EuVI ANALYSIS

15 November 2013.

The best way to predict the future is to create it.

(Peter Drucker)

V., Nr. 3.

15. November 2013.

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The European Union`s nuclear energy policy

The Game of « Rock-Paper-Scissor »

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I. Facts and figures : how nuclear energy shapes our world

The EU climate policy is connected to its energy policy. Reducing greenhouse gas emissions is one of the main aims and the use of nuclear power is really important to achieve it. We are going to see how it is possible and why atomic energy is good for our society.

In the focus of this paper are the following lines: the European Union, the European Atomic Energy Community, future expectations and 'what is going on after Fukushima?'.

This paper does not have the frame to concentrate on all of the EU Member States. In one or two paragraphs I mention different countries and different situations to see to this topic as whole.

Nuclear energy is one of the preferred energy sources next to the fossil fuels around the world, it is competitive but socially and politically sensitive. Many more reactors are going to be built around the world, even in the European Union.

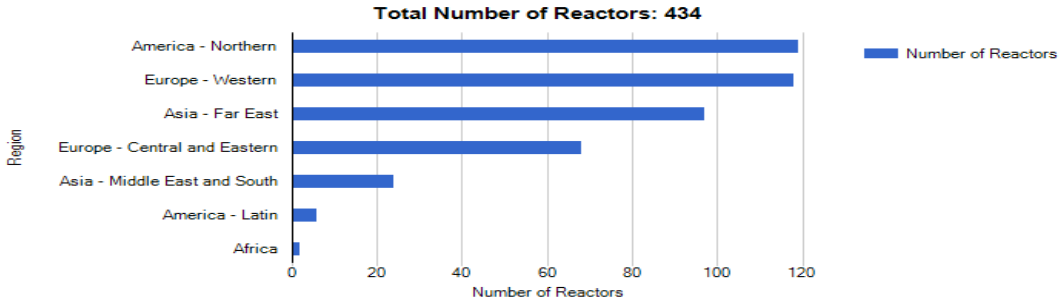
Mostly, the people are not aware of its benefits, they tend to see the disadvantages of it since nuclear accidents have happened in the last decades as in Fukushima and Chernobyl, and we still have to face their consequences. By this point two effects must be mentioned. First of all, we can talk about their harmful impacts on nature, atmosphere and people.

On the second hand, societies are mostly against nuclear energy since 1986 because people are afraid that the past will repeat itself and cause bigger catastrophes than ever before. People and even governments do not see or do not want to see why nuclear energy is the most effective alternative to produce energy on earth.

Among the outputs, carbon dioxide emissions cannot be found which actually increases global warming and greenhouse effect. In 2007 151 nuclear reactors were located in the EU and they provided over 30 (%?) of the electricity needs, thus annually the emission of 700 million tonnes of CO_2 is avoided[1].

[1] European Commission (2013): *Research & Innovation: Why nuclear research*. Available: http://ec.europa.eu/research/energy/euratom/index_en.cfm?pg=why Downloaded: 20.10.2013

According to the International Atomic Energy Agency, there are 434 nuclear power reactors in operation in 2013. Of these reactors, 132 are in 14 Member States of the European Union. We can see the reduction since 2007. France with its 58 reactors (19 Nuclear Power Plants) leads the group. The United Kingdom (16 reactors, 10 NPPs), Sweden (10 reactors, 3 NPPs), Germany (17 reactors, 12 NNPs) follows it with the highest number of operating reactors.



The next EU Member States also own NPPs as Belgium, Bulgaria, Czech Republic, Finland, Hungary, the Netherlands, Romania, Slovakia, Slovenia and Spain. In Lithuania 2 reactors are under decommissioning, and in the EU 4 reactors are under construction: 1-1 in Finland and France, 2 in Slovakia.

About 16 reactors are planned to be built in the future[2]. Reactors are categorized among their types. The most common one is the Pressurized Light-Water-Moderated and Cooled Reactor type. 270 have been built worldwide from 434[3,4].

Where the uranium comes from in case of the EU Member States? On the top of our list Russia is the country where 5102 metric tonnes of natural uranium (MTU) are imported from. Canada (3212 MTU), Niger (2376 MTU) Australia (2280 MTU), Kazakhstan (2255 MTU) and Namibia (1342 MTU) follow it in the queue. The less comes from Uzbekistan with 168 MTU. The EU itself produces 421 MTU, which value is not even close to satisfy its own market. Total number of imported natural uranium was 18639 MTU in 2012[5].

Figure 1: Operational Reactors
Source: IAEA[6]

Support of nuclear energy in the European Parliament has become more accepting in the past years, but still it is not in the appropriate level. As long as nuclear safety is maintained, human life and health are not in danger. One point that can be made against reactors is the negative effects on nature.

The Fukushima case showed us that even if the countries make safety regulations, these norms are not compared with reality. Fortunately, Europe has never experienced such tragedies, but of course, the effects of the previously mentioned accidents still exists in the form of radiation in the air, thus increasing the number of cancer patients.

The European Union has adopted and implemented a series of Community documents to strengthen nuclear safety.

[2] Ec.europa.eu: http://ec.europa.eu/energy/nuclear/doc/nuclear_power_plants.pdf
[3] IAEA (2013): http://www.iaea.org/PRIS/WorldStatistics/OperationalReactorsByType.aspx
[4] "The light water reactor produces heat by controlled nuclear fission. The reactor core consisting of fuel and control elements is enclosed by a water-filled steel pressure vessel. The water required to cool the condenser is taken from a river and refed into the river in warmed condition or the heat is dissipated via a cooling tower into the atmosphere." /European Nuclear Society: http://www.euronuclear.org/info/encyclopedia/l/lightwaterreactor.htm /
[5] World Information Service on Energy Uranium Project (2013): Uranium Market. Available: http://www.wise-uranium.org/umkt.html#STATEUIMP Downloaded: 26.12.2013
[6] IAEA (2013): http://www.iaea.org/PRIS/WorldStatistics/OperationalReactorsByRegion.aspx

We will talk later in this paper about safety regulations.

Economic side of the EU's energy policy also can be seen. Steps towards new energy strategies have been quite important in our decade inside the European Union because of its huge dependence on imports of primary energy (coal, oil, natural gas).

It is essential to reduce dependence on the transit and source countries with increasing utilization of one of the most important technological tool, which is nuclear energy. Importation of natural gas means the biggest intake to the European Union which means dependence on Russia, Norway and Algeria[7].

Contribution of nuclear energy may mean a tool to win the war against climate change and on the second hand, it helps to strengthen energy supply of the EU-28 to live by their own. We must not forget that it also increases the competitiveness of the EU's economic because of its cheapness.

II. Euratom and its safety issues

In regards to the European Union and nuclear energy, we have to talk about the most important organisation established: Euratom. What is it, what is that for, what is its future, is its operation effective? - we can ask line of questions. I believe that many issues are not clear and known about it.

It is important to get a comprehensive overview since we live in the EU. Shortly after the establishment of European Coal and Steel Community (1951) the next turn was in 1957 when the Treaty of Rome was signed founding the European Economic Community (EEC) on 1 January 1958.

In parallel, the European Atomic Energy Community (EAEC or Euratom) was also established in Rome. The source of this decision is the Suez Crisis in 1956. This crisis made it clear to the six European countries how vulnerable they are regarding external supplies of oil[8].

The structure of the Treaty stands from six titles and comprises 234 articles, which number was reduced to 177 in December 2007[9].

Unlike this year, Euratom Treaty has never been changed significantly. The aim of the institution was a continuously developing European nuclear industry and for that it undertakes to following points. In the interest of achieving this plan Euratom promotes research and dissemination of technical knowledge and they provide ores and nuclear fuels for Member States.

For the six founding States (the Netherlands, Belgium, Luxemburg, France, Italy, and Germany) this Treaty meant the

[7] Nemzeti energiastratégia 2030. p.18. Available: http://www.kormany.hu/download/5/39/40000/Energiastrategia.pdf Downloaded: 26. 12. 2013

[8] Burlacu, Florentina (2012): *Nuclear Safety in the European Union*. Available: http://cogito.ucdc.ro/2012/vol4n2/en/7_nuclear-safety-in-the-european-union.pdf Downloaded: 17. 10. 2013

[9] Europa.eu (2007): *Treaty establishing the European Atomic Energy Community (Euratom)*. Available: http://europa.eu/legislation_summaries/institutional_affairs/treaties/treaties_euratom_en.htm Downloaded: 20.10.2013

way to achieve energy independence. Common safety standards were necessary to build out a well-working system with the aim of increasing health protection of workers in the field.

Stimulating capital investment in the nuclear industry was also a very important factor, moreover, the institution ensures that necessary facilities are constructed to further develop the industry.

The last factor is about to ensure free movement of equipment, materials and the money issue is also an important pillar, thus Euratom ensure capital for the controlled investments. The aim of this entire frame is to secure the peaceful civil uses of nuclear materials in the Member States.

In June 2013 the Commission has proposed new safety standards as establishing 'a mechanism for developing EU-wide harmonised nuclear safety guidelines', strengthening 'the role and independence of national regulators'[10].

In the institutional structure we can find European Parliament, the Council, the Commission, the Court of Justice and the Court of Auditors. They can act within the limits the Treaty gave them. The right of option is a basic and important right of the organisation what is connected to raw materials, minerals and special fusionable materials produced by the Member States on their own territory.

The security control over the final destination of the previously mentioned groups of materials is also controlled by the Euratom. The importance is absolutely clear. Just think of the situation of the World War II, and what after happened: the Cold War. In these decades it was important to implement such a regulation and give this exercise to the hand of this organisation. The fear of a nuclear war was in the air every single day. It has changed in the last twenty years, but we still have to worry about using nuclear energy in the military field, the Middle East being the highlight of this serious issue.

The EAEC's aim was to unite countries in order to have joint nuclear research. After more than thirty years some people gave their opinion about Euratom: 'Treaty itself is usually a regarded as something of a still-born child: its original goals have been at best only partly realised, and at worst totally ignored.'[11]

Disappointment ruled around the Treaty in the 80s. The basic of their problem was that the Euratom itself has limited movement on the field of the nuclear cycle. The Community does not have exclusive competence in many issue, I mainly think here about to fulfil the allocated tasks.

The Community's role in this topic is a promoter, what is limited to the early stages of processes as by the nuclear researches and developments. In the phase of production and commercialisation the Community does not involved, just a little bit. Their exercise is supervisory and supplementary.

Another problem the organisation has had to deal with since the beginning of its existence is the sovereignty. It has always been a burning issue in history, nobody wants to lose it in any fields. It is also the situation in the case of nuclear matters. Since the Member States were not reluctant to cede it, the Community powers are reduced.

[10] European Commission: Nuclear Energy. Nuclear Safety. Available: http://ec.europa.eu/energy/nuclear/safety/safety_en.htm Downloaded: 21.10.2013

[11] Schermers Henry G., Heukels Ton, Mead Philip, „Non-Contractual Liability of the European Communities", Kluwer Law International 1988, p.53.

The Euratom Treaty does not include joint liability, but it does not mean it does not exist. Because of the case of sovereignty, the Community cannot be liable in case of a nuclear accident. Naturally, the Community has obligations, one of them is to guarantee equal access to raw materials, moreover, free movement of them in the nuclear common market. The EAEC Treaty was amended by the Maastricht and the Lisbon Treaty.

After the Euratom Treaty one terrible event opened the eye of the EU and made the solution of nuclear safety issues more urgent. The Chernobyl nuclear disaster in 1986 made this happen. Many of the new European reactors were Soviet designed first generation reactors with graphite moderators. New candidate states had to upgrade or close their reactors in order to prevent a nuclear catastrophe.

Negotiations started in this issue. First one was the 1992 G-7 summit. Agenda 2000 and the Laeken Council in 2001 brought the solution. The Commitment included the high level of nuclear safety and the goal became the part of the accession process. In relation to the use of nuclear energy the EU definitely wants to build a closer cooperation among the Member States in term of nuclear waste management, safety of nuclear facilities.

The development of legislation in regards to safety for nuclear power plants in the EU is an interesting aspect. Safety issues are sensitive parts of the Treaties of the EU because in many cases it has no legislation in them. The European Commission has been trying to implement uniformity into the Community-wide safety standards in past years, moreover, it has made proposal for new directives.

They have met obstacles by the Member States when they proposed harmonizing safety standards in the European Union. As I mentioned before sovereignty has a strong role, and the states protected their right for their own national regulatory regimes. The reason is that some of the countries are experienced in case of nuclear energy, they have got their own regulations, and they do not need the European Union to tell them how to make the system safe.

However, working together inside Euratom is stronger than in the 80s. Seemingly, they have found an appropriate way of not cutting the interests of Member States. Turning back to the common safety standards, we are going to see the present status. The EU has the highest safety standards to promote safe power generation and waste storage, medical uses and research.

Primary responsibility belongs to the operators. Fukushima accident forced the Commission to create more stringent EU-wide safety rules. Energy 2020 is *A strategy for competitive, sustainable and secure energy* which includes that one of the EU's priorities requires the promotion of legally binding nuclear-safety, security and non-proliferation standards[12]. Moreover, the EU has to strengthen its cooperation with the IAEA.

The Commission also works together with the EU's immediate neighbours and with the International Atomic Energy Agency (IAEA)[13]. On 17 September 2013 the Commission and the IAEA signed a memorandum on the understanding of

[12] Europa.eu (2010*): A strategy for competitive, sustainable and secure energy*. Available: http://europa.eu/legislation_summaries/energy/european_energy_policy/en0024_en.htm Downloaded: 26.12.2013

[13] The IAEA is the world's center of cooperation in the nuclear field. It was set up in 1957 as the world's "Atoms for Peace" organization within the United Nations family. The Agency works with its Member States and multiple partners worldwide to promote safe, secure and peaceful nuclear technologies. /Source: http://www.iaea.org/About/)

nuclear safety. Its aim is to improve nuclear safety in Europe and also worldwide. To cite form the objectives, the Partnership is 'to enhance knowledge sharing with a view to fostering co-ordination and synergies in the areas of cooperation, and to support best practises in IAEA Member States'.[14] They want to achieve a greater harmonization, coordination and a structured framework for cooperation with sharing analysis and exchanging information.

III. Radioactive waste management - The issue

High level radioactive waste means a special problem for the Commission. Its management is multidirectional. First of all, the storage of radioactive waste requires long term, but it also has to be transported. For this operation, special infrastructure and machines are needed.

We can see that working with radioactive waste means danger and regulations are important. With the enlargement in the 1990s this issue became more urgent, discussions and negotiations started in this topic. New members had serious problems to store radioactive waste, because until the early 1990s it did not happen on their site.

It is mainly the Central and Eastern European states I am talking about. They used to ship the radioactive waste to the Soviet Union, but Russia did not accept it any more. To help improve safety in the Russian designed reactors in this area the European Union provided resources. The well-known programmes PHARE (Poland Hungary Aid for Economic Reconstruction) and TACIS (Technical Aid for the Commonwealth of Independent States) gave support to the accessing countries in the past, as Bulgaria and Lithuania also received technical help.

Romania was in the same situation. Its heritage was the same as the other East-Central European countries problems. Help was needed to overcome the existing environmental problems, which were poor building standards and equipment performance in 1990. It is also not surprising that reactors failed stress tests. They got international help to improve the old systems and build new reactor. The first help came from Canada

[14] Memorandum of Understanding (2013): http://ec.europa.eu/energy/nuclear/safety/doc/20130917_ec_iaea_mou_nuclear.pdf

and later from the EU. Waste management meant a big concern after the Soviet era since Moscow passed a law in 1992. This law was against 'disposing of nuclear waste from foreign countries on its territory'.[15] There would be a lot more to talk about the process of improving the nuclear safety standards in the post-soviet countries, but it could form an other paper.

The enlargement of the EU resulted in the development of a nuclear energy policy. Before the accession, the Council established a Working Party on Nuclear Safety in 2000 which was just temporary but got enough time to evaluate the status of nuclear power. They gave recommendations and wrote country reports. As former Communist countries there were fear against their nuclear policy because of Chernobyl.

IV. Dependences, reactors and energy hunger

Having new nuclear plants has become important to reduce dependence on Russian sources as oil and natural gas. Russia has never been reliable, Europe has always been in danger in case when Russia stops the flow of these resources for political reasons. Slovakia, Estonia, Finland, Lithuania, Latvia, Poland, Czech Republic and Hungary are the Member States using big amount of imported gas to prove electricity. With expanding their nuclear sectors the reliance could be reduced. In case of Hungary it is already planned to build new reactors in Paks (Hungary).

Even if the oil prices are high Europe's energy needs could be covered with the help of nuclear reactors. It is necessary to separate the role of the EU and the Member States. The EU has been focused primarily on the economical aspect of nuclear energy, thus the security of energy supply and the electricity market. Their job is to accomplish a liberalized market.

The Member States has had the responsibility for safety. The Community is allowed by the Euratom Treaty to set standards for exposure to ionizing radiation in order to make a safe environment for the public and the workers, moreover, to protect the transport of nuclear material.[16]

The 1990s has enhanced the demand for energy and the Commission has the job to take care of energy policy more seriously from a security perspective. As I mentioned before, nuclear energy is the cheapest and environmental friendly source can produce electricity. In this case it remained a solution against the global

[15] Carter, F.W., Turnock, David: Environmental Problems of East Central Europe. Second edition. London, Routledge, 2002. p. 102.

[16] Axelrod, S. Regina (2006): The European Commission and Member States: Conflict Over Nuclear Safety. Perspectives. Available: http://www.isn.ethz.ch/Digital-Library/Publications/Detail/?ots591=0c54e3b3-1e9c-be1e-2c24-a6a8c7060233&lng=en&id=138739 Downloaded: 18.10.2013

warming because it helps to reduce carbon dioxide levels, it could not be achieved without it.

The Member States has been thinking in different ways. Sweden, Belgium, the Netherlands, Germany and Italy announced to gradually remove their nuclear power plants. The opposite site as France has pledged to build the new plants, obviously it is committed to nuclear energy. France gives almost half of the nuclear energy production in the EU-27.[17]

There are Member States where we cannot find any nuclear reactor. In the first group there are Austria and Italy, they used to have nuclear constructions, but they already closed all of their power plants. In the second group we can find Ireland, Greece, Denmark, Cyprus, Luxemburg, Malta and Portugal have never operated nuclear power plants and it is not even planned in the near future. News created a major political uproar in Germany in 2013.

The European Union wants to change its energy policy and it would allow to nuclear power plant constructions to get direct state subsidy. A nuclear industry may get similar subsidies as renewable energy does. It is mentioned as the industry promotes the reduction of carbon dioxide emissions.

Especially France and Great-Britain urges to reach this by the EU, because they are preparing for nuclear investments. Chancellor Angela Merkel opposites these plans. Germany has decided to support renewable energy instead of nuclear energy and they will phase out all of their power plants until 2022.

This decision has become stronger after the Fukushima power plant accident. She said if the EU introduces these subsidies their efforts to enhance the use of renewable energy will be broken down.

I have already mentioned the Fukushima accident, but I did not talk about its effects on the EU Member States, especially on Germany and the UK. This disaster was caused by earthquake and tsunami in 2011 and it was followed by political debate on nuclear energy.

The EU Member States gave different responses. In this global panic most countries with nuclear plants started to look for new ways to make their reactors more safety.

In case of Germany we meet a strong resistance against nuclear power, the federal government has decided to shut down older nuclear reactors and supervise the safety of all nuclear power plants in the country.

The shutdowns were at least temporarily. Just three days after the catastrophe Germany's two oldest nuclear power plants were announced to be shut down by Angela Merkel.

The UK has not done same steps. Even in the media we can see differences in these two countries in the way they handled this accident. In the UK, media reports about Fukushima also was frequent and after a while the Libyan conflict was on the front pages. Contrary to the UK, the German headlines were dominated by nuclear energy news for weeks.

One year after Fukushima Germany had new energy policy. But what did Germany use to be and what will happen to this country after a full 180-degree new governmental decision turn?

[17] EUvonal (2008): *A Bizottság kiáll az atomenergia felhasználása mellett.* Available: http://www.euvonal.hu/index.php?op=hirek&id=4944

Great-Britain shows energy-hunger. They already have 18 operating reactors (10 gigawatt) but these only cover 16 percent of their electricity needs.[18] After twenty years they have decided to build new nuclear power plants. It is important for two reasons.

At first, the electric power of the two new reactors will be 326 megawatts and will promote a big role in the island's supply. On the second hand, the nuclear power plants are located in Great-Britain are generally old, thus they are approaching that time when they have to be stopped. It means that until 2025 40 percent of them will be shut down. In this case it is needed to build new and stronger ones.[19]

The entry of a new reactor is always a complicated process and takes years, in general 10-12 years. The country still plans to entry more six reactors, so we are talking about a big expansion here.

Russians who are the master of nuclear technology with one of their companies, Rosatom, presents in Great-Britain. In this year they start the authorization of Russian reactors by the Brits. They will partner with Britain's Roll Royce and also with Finnish utility Fortum.

We all know that public opinion still has concerns over Russian technology since the nuclear disaster in 1986, but Rosatom tries to entry to major tenders and seemingly they got the chance to work together. British Energy Minister Michael Fallon already signed a memorandum of understanding with Russia's state nuclear energy monopoly.

Rosatom considers the UK as an attractive opportunity to present in their market, as most of their operating nuclear power plants are planned to be stopped in the medium term. We talked about the Russian-British relations, but what can be seen in case of the other European countries-Russia cooperation? The European market is hiding untapped possibilities for Russia with their nuclear technology.

Günther Oettinger, the European Union Commissioner for Energy said that the EU won't follow Germany's notion, nuclear power won't be completely abandoned by the Union, what shows interest in the Russian technologies. Russia cannot plan for years ahead because of the changings in the European market. What I mean here is that due to lack of founds, states can delete their constructions.[20]

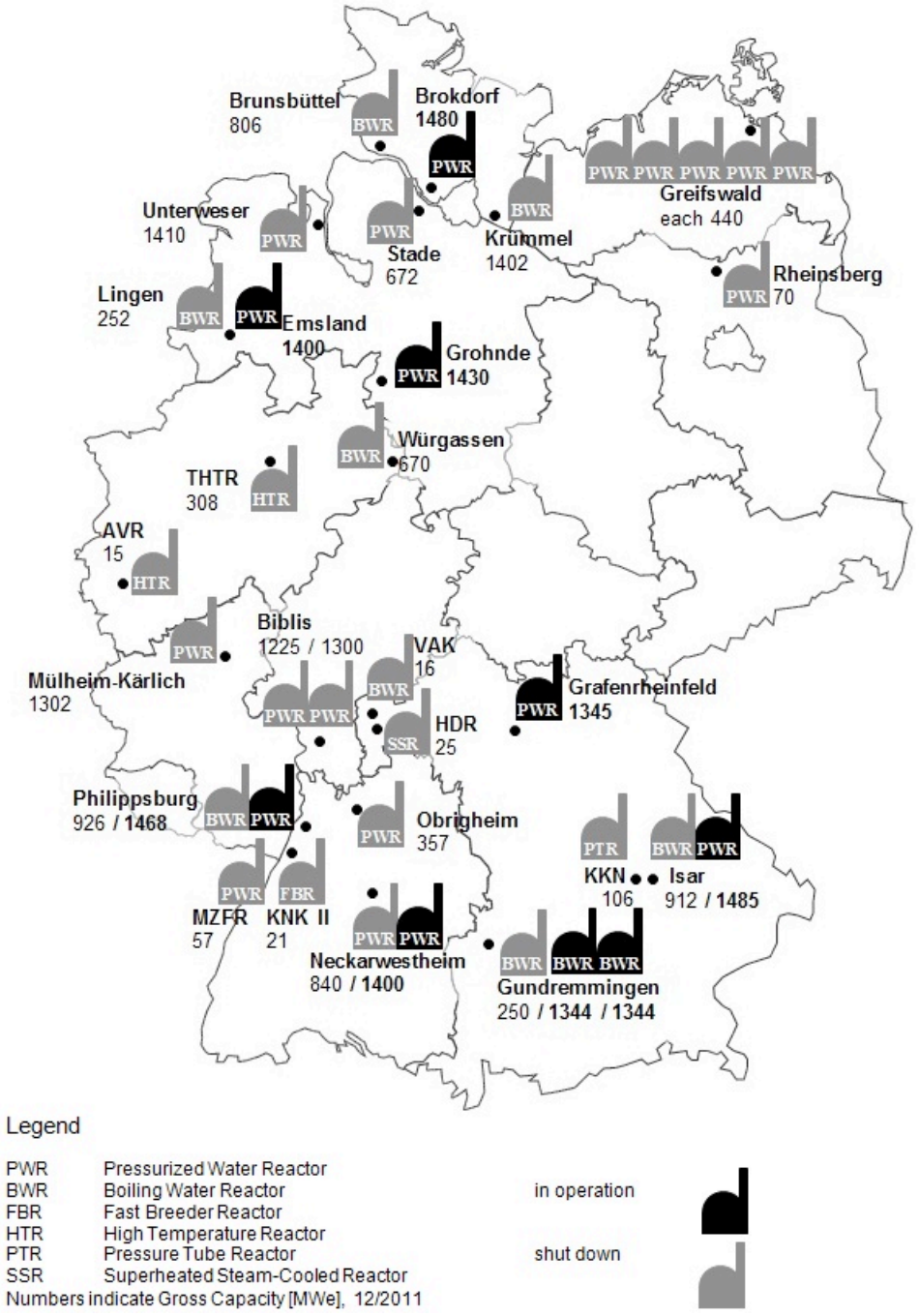
The same happened in case of Bulgaria in 2012, when they told the nuclear power plant "Belene" won't be built. Lithuania's plans are also unsure to build a new plant in Visagians. The state-owned corporation, Rosatom, is also planning additional low and medium power plants in Baltic countries.

The EU and Baltic countries have decided to disconnect the power supply system of Lithuania, Latvia and Estonia from Russia, because there are on a common energy network. To get this goal

[18] Atomenergiainfo (2013): *A britek bővülni akarnak*. Source: http://atomenergiainfo.hu/blog/a-britek-bovulni-akarnak Downloaded: 17. 10. 2013
[19] Atomenergiainfo (2013): A britek bővülni akarnak. Source: http://atomenergiainfo.hu/blog/a-britek-bovulni-akarnak Downloaded: 17. 10. 2013
[20] Daly, John (2011): *France and Russia Deepen Nuclear Cooperation*. Available: http://oilprice.com/Alternative-Energy/Nuclear-Power/France-And-Russia-Deepen-Nuclear-Cooperation.html Downloaded: 26.12.2013

it is planned to install low and medium capacity reactors.[21]

France is the next EU member state that cooperated with Russia. At prime ministerial level, they made their cooperation official when a declaration was signed in the field of nuclear power. French companies got involved in construction of the 2300 megawatt Kaliningrad Nuclear Power Plant (Baltic Nuclear Power Plant). Its goal was to utilize 'French companies' technologically advanced energy equipment'.[22] This power plant will be special because of the foreign participation what has never happened before by Russian nuclear power plants.



[21] Miranovsky, Anatoly (2013): *Europe pins great hopes on Russian nuclear energy*. Pravda.ru Available: http://english.pravda.ru/business/companies/04-07-2013/125022-europe_russia_nuclear-0/ Downloaded: 20.10.2013

[22] Daly, John (2011): *France and Russia Deepen Nuclear Coopeation.* Available: http://oilprice.com/Alternative-Energy/Nuclear-Power/France-And-Russia-Deepen-Nuclear-Cooperation.html Downloaded: 18.10.2013

V. German nuclear policy

I am going to introduce Germany's nuclear history with main data. Development of nuclear power plants started in West Germany with the help of US manufactures. Pressurized water reactors (PWRs) and boiling water reactors (BWRs) were built. Biblis A's construction in West Germany started in 1972 and that time it was the world largest reactor with its 1200 MWe.

In 1988 three "Konvoi" units started to operate and they were the last nuclear power plants built in West Germany. The German Democratic Republic with Soviet assistance also started to develop its nuclear programme in 1955. After the reunification safety assessments of GDR's Soviet type NPPs were carried out and they were shut down due to technical and economic reasons.[23]

Nuclear power has been unpopular since Chernobyl, but this disaster did not hinder its energy policy to become the fourth largest producer of nuclear power in the world by 2000.[24] But the lack of social acceptance of this energy source was also big in this decade.

German Chancellor, Gerhard Schröder made a decision in 1998 to phase out nuclear power by 2021. He considered the disposal of nuclear waste as a great concern and nuclear energy as a senseless source in national-economy terms.

The aim was to reduce the proportion of nuclear energy and replace it with new energy supplies. By this point we cannot see any difference between 1998 and today's German policy. But before Fukushima, in September 2010, Angela Merkel reversed Schröder's decision with spending significant political capital to reach this goal. Under the terms of deal, the lifespan of all seventeen reactors were extended by an average of twelve years.[25] And some months after this decision Germany has decided to shut down all nuclear plants in the country by 2022. Its process is planned in the following order:

1. 6 August 2011 for Biblis A, Neckarwestheim 1, Biblis B, Brunsbüttel, Isar 1, Unterweser, Philippsburg 1 and Krümmel NPPs,
2. 31 December 2015 for Grafenrheinfeld NPP,
3. 31 December 2017 for Gundremmingen B NPP,
4. 31 December 2019 for Philippsburg 2 NPP,
5. 31 December 2021 for Grohnde, Gundremmingen C and Brokdorf NPPs,
6. 31 December 2022 for Isar 2, Emsland and Neckarwestheim 2 NPPs.[26]

Figure 2: Nuclear power plants in Germany as of 31 December 2011 (Source: IAEA)

The question is how to solve the missing electricity in the future, because almost one-third of Germany's electricity generation is given by nuclear power. One of the solutions may be to buy imported power as Austria does from its neighbours.

But I have got a problem with this: they are against nuclear power, they do not produce it, but buying it from other countries as Czech Republic and France, who export their power mostly from their nuclear plants. The European Union's aim

[23] World Nuclear Association (2013): *Nuclear Power in Germany*. Avaiable: http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/Germany/ Downloaded: 26.12.2013

[24] Moore, John (2012): *How much precaution is too much? Evaluating Germany's nuclear phaseout decision in light of the events at Fukushima*. Available: http://publicspherejournal.files.wordpress.com/2012/11/germany-nuclear-phaseout-2012.pdf Downloaded: 20.10.2013

[25] Mauldin, Paul (2011): *Germany's Nuclear Decisions – Maybe Not the Optimal Timing??* Smart Energy Portal.net Available: http://smartenergyportal.net/article/germany%E2%80%99s-nuclear-decisions-%E2%80%93-maybe-not-optimal-timing Downloaded: 18.10.2013

[26] IAEA (2013): Country Statistics. Available: http://www-pub.iaea.org/MTCD/Publications/PDF/CNPP2013_CD/countryprofiles/Germany/Germany.htm Downloaded: 21.10.2013

as it was mentioned before to reduce dependent on Russian fossil fuels.

But in case of Germany it is going to be hard to accomplish, because they are getting even more dependent on them. And it does not even help to reduce polluting. Windmills and solar energy are not able to produce as much electricity as it was necessary to the whole country.

We will see how Germany can afford this policy in the near future, we do not need to wait long years until 2022. The European Union meets with an enhancing energy needs and it is still dependent on imported energy sources. In 2007 it meant 53 percent and there are concerns that it will have grown to 67 percent by 2030, mainly if Germany and other Member States continues their energy policy.[27]

In case of Germany I would like to cite from the Treaty. As we all know Germany was one of the founding States and also described itself as: 'RECOGNISING that nuclear energy represents an essential resource for the development and invigoration of industry'; 'RESOLVED to create the conditions necessary for the development of a powerful nuclear industry which will provide extensive energy resources, lead to the modernization of technical processes'.[28]

What about these principles now? Germany seemingly has fed up with them. Nuclear energy does not mean an essential resource in their energy policy anymore. The closure of reactors in less than one decade will continue to such a Member State who does not agree with the Treaty he established. What a paradox we see here. Germany do not provide nuclear industry anymore, does not want to be the part of the whole process. With *Figure 1* my aim is to make visible in what extent Fukushima has changed the nuclear energy production in Germany.

The results of the shutdown of 7 reactors can be seen on the diagram. Within one year almost with 10 percent the capacity of nuclear plants was reduced. Thermal energy using hard coal, lignite, gas and oil had the biggest capacity and electricity production with 85,4 GWe and 351,8 TWh in 2011. In electricity production hydro, wind, photovoltaic are not even close to nuclear energy. To compare it with windmills which produced 48,9 TWh, reactors made 108 TWh and by this number many of the reactor were closed.

[27] European Commission (2013): *Research & Innovation: Why nuclear research*. Availabe: http://ec.europa.eu/research/energy/euratom/index_en.cfm?pg=why Downloaded: 20.10.2013

[28] Treaty establising the Euratom Atomic Energy (EURATOM) (1957). II/E. Available: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:11957A/TXT:EN:PDF Downloaded: 20.10.2013

VI. New regulations and fusion energy

Number 139/2012 Council Regulation was signed in December 2011 which lays down different rules in the Framework Programme of the European Atomic Energy Community.[29] This Framework Programme was created for nuclear research and training activities in period of 2012-2013. The Commission is responsible for its implementation and the related financial aspects. The newly created rules have the function to ensure an efficient implementation. For research centres, universities and undertakings a coherent, transparent and comprehensive framework should be provided to get the previously mentioned goal.

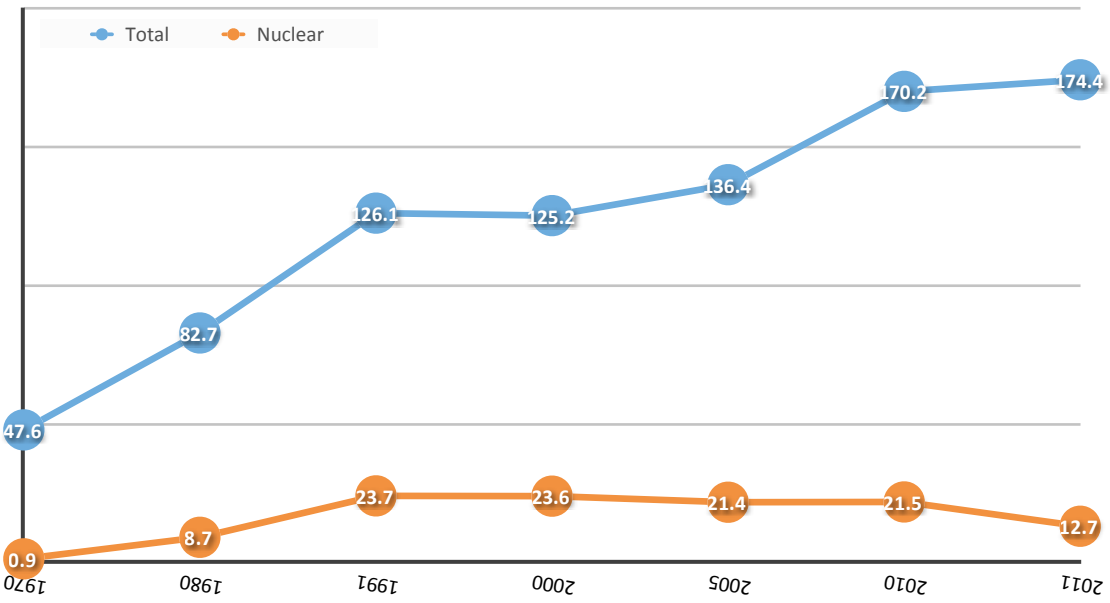
This regulations takes care of the outermost regions of the Union in term of promoting their participation. It is also wanted to involve their research centres, universities and undertakings in a wide range. Encouraging the participation of international organisations whose field is nuclear research would be also important.

Participation of international organisations established in third countries should also be envisaged. This regulation includes rules for fusion energy research. Minimum conditions are defined to participate in indirect actions: at least three legal entities are needed, established in a Member State or associated country; they have to be independent of each other. There are coordination and support actions, and training and career development of researchers.

Euratom was created to coordinate research programmes of Member States in order of peaceful use of nuclear energy. This role has changed, in three main areas helps the Euratom Treaty to make the common work more effective: pooling knowledge, funding and infrastructure of nuclear energy. A centralised monitoring system ensures the security of atomic energy supply in the EU.

The Multiannual Research Framework Programmes are founded from the EU budget. The EU is continuously doing researches to find solutions for a better energy supply. And here we have to talk

Figure 3: Capacity of electrical plants (GWe)
Source: IAEA[30]



[29] Official Journal of the European Union (2012): *REGULATIONS: Council Regulation (EURATOM) No 139/2012 of 19 December 2011*. Available: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:047:0001:0017:EN:PDF Downloaded: 20.10.2013

[30] IAEA (2013): Country Statistics. Available: http://www-pub.iaea.org/MTCD/Publications/PDF/CNPP2013_CD/countryprofiles/Germany/Germany.htm Downloaded: 21.10.2013

about the Euratom fusion R&D programme which has 7 global partners 'representing more than half the planet's population and 80% of the world's GDP'.[31]

It owns the world's largest energy research project. The use of fusion energy could mean the revolution of energy sources in the future.[32] This energy powers the sun and the stars and we want to use this clean energy.

Fusion energy is important because it means limitless fuel; inherent safety (runaway situation cannot happen as at Chernobyl); no greenhouse gases, harmful pollutants or long-lasting radioactive waste; extremely low fuel consumption; no radiation!

Bilateral contracts have been signed between the European Community and fusion research organisations in Member States. The European fusion laboratories jointly undertake the activities in the work programmes for Euratom FP7.

International cooperation has a key role in the fusion research programme. The ITER Agreement is now the most important international fusion cooperation framework. Seven parties take part in it: the EU, India, China, Japan, Russia, South Korea and the US. There is a parallel agreement next to the previous one:

The Broader Approach Agreement negotiated between the EU and Japan and its role to support the ITER project with preparing materials for the construction. Moreover, they are testing facility for the fusion reactor. ITER (International Fusion Energy Organization) has the purpose to promote cooperation among the Member States on the ITER Project.[33]

The Agreement was signed in Paris in 2006 for 35 years. ITER is a tokamak fusion experimental reactor, it will be able to generate 500 megawatts of fusion power continuously and its expected cost will be more than 10bn€.[34] It is being built in South of France, in Cadarache.[35]

The realisation of fusion energy is supported and coordinated by the EU and its Fusion Energy Programme has several parts. Fusion For Energy is an autonomous agency of Euratom and it was created under the Euratom Treaty and it helps the work of ITER.

The laboratories of the EU Member States and Switzerland (European Fusion Associations) carry out the fusion research. Trans-national research units are Estonia, Malta and Cyprus. Luxemburg takes part in the Belgian Association because it does not have a stand-alone.

This internationally collaborative project is one of the world's most important and ambitious researches which results could dramatically change our world's operation, it could create a new energy landscape because we are talking about a CO_2-free, safe and affordable energy source. To stop global warming, the Earth need this change as soon as it possible.

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[31] European Commission (2013): *Research & Innvvation. Energy: Half-century old Euratom research at a turning point today*. Available: http://ec.europa.eu/research/energy/euratom/index_en.cfm?pg=intro Downloaded: 20.10.2013

[32] ' Fusion at a glance: clean, sustainable energy: Fusion is the process that powers the Sun. It is the energy that makes life on Earth possible. Unlike nuclear fission, which releases energy when a heavy atom splits into two lighter elements, fusion releases energy when the nuclei of two light atoms combine, such as when two hydrogen nuclei fuse to form a helium atomic nucleus.' / European Commission: http://ec.europa.eu/research/energy/euratom/index_en.cfm?pg=fusion&section=at-a-glance/

[33] 'ITER Project which is an international project that aims to demonstrate the scientific and technological feasibility of fusion energy for peaceful purposes, an essential feature of which would be achieving sustained fusion power generation.' Source: http://ec.europa.eu/world/agreements/prepareCreateTreatiesWorkspace/treatiesGeneralData.do?step=0&redirect=true&treatyId=4041/

[34] European Commission (2013): *Research & Innovation. Energy: ITER: international research to tackle a global issue*. Available: http://ec.europa.eu/research/energy/euratom/index_en.cfm?pg=fusion&section=iter Downloaded: 20.10.2013

[35] The construction process is available at the official homepage: http://www.iter.org/construction

Until the realization of it, Euratom works on a safer and more effective reactor generation, called the Generation-IV. Comparing with the planned Hungarian reactors which ones will belong to Generation 3+. We still have to wait for the implementation of the new generation.

Conclusion

Euratom, international organizations, regulations and even country profiles were adopted to my paper. I wanted to make it clear how the system work inside the European Union and Europe. We could see the parts are important for both sides as safety management and their realisation.

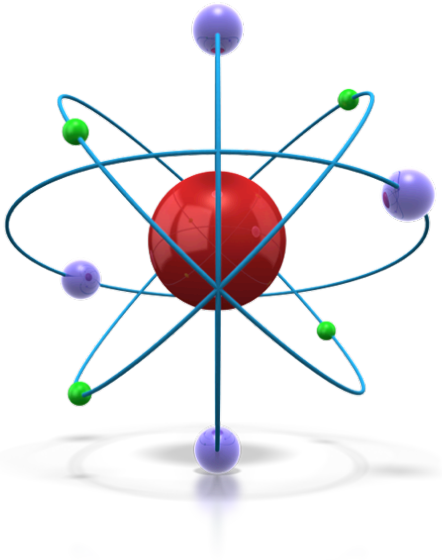
We saw the past and the present, now we are able to compare them and make conclusions. Unlike the importance of sovereignty, Euratom is a good-working framework and developing network. It is not all about regulations, serious technical knowledge is under the system that is going to form our future.

Great partnerships have been established, Euratom is able to work together outside the EU with third countries. This organisation is not a closed system, it also shares knowledge and technics internationally.

I don't believe that the accident happened at Fukushima is a milestone. Germany was already on its way to shut down its reactors, Fukushima just strengthened in this decision. It is their own problem to produce enough power for the country.

Germany is against nuclear power because it is harmful for mankind and nature, but still closing the nuclear plants means a bad solution. Not using nuclear energy means more carbon dioxide emission, what concludes in stronger greenhouse effect, because Germany will have to use more thermal energy as hard coal, lignite, gas and oil which are not so environmentally friendly. Fusion energy could mean the solution for this problem. There would be no more need to build nuclear power plants and having issues around their existence. But still it is the best way to protect our environment and

produce the cheapest energy for our growing population. The reactors is getting more safety with time to time. We cannot forget that in case of Chernobyl human omission caused the tragedy and at Fukushima natural disaster. We all have to take into consideration that nuclear energy is still our future until the realisation of a better construction.



Opinions or points of view expressed are those of the author and do not necessarily reflect the official position of the Europa Varietas Institute.

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