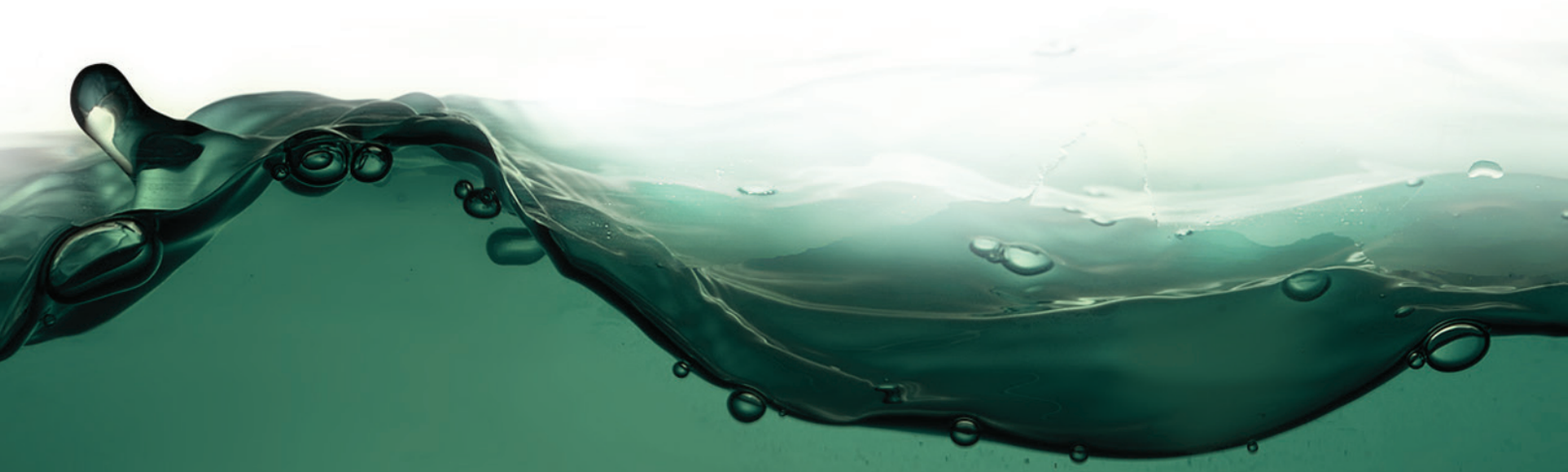
CENTRUM BALTICUM

BALTIC SEA POLICY BRIEFING



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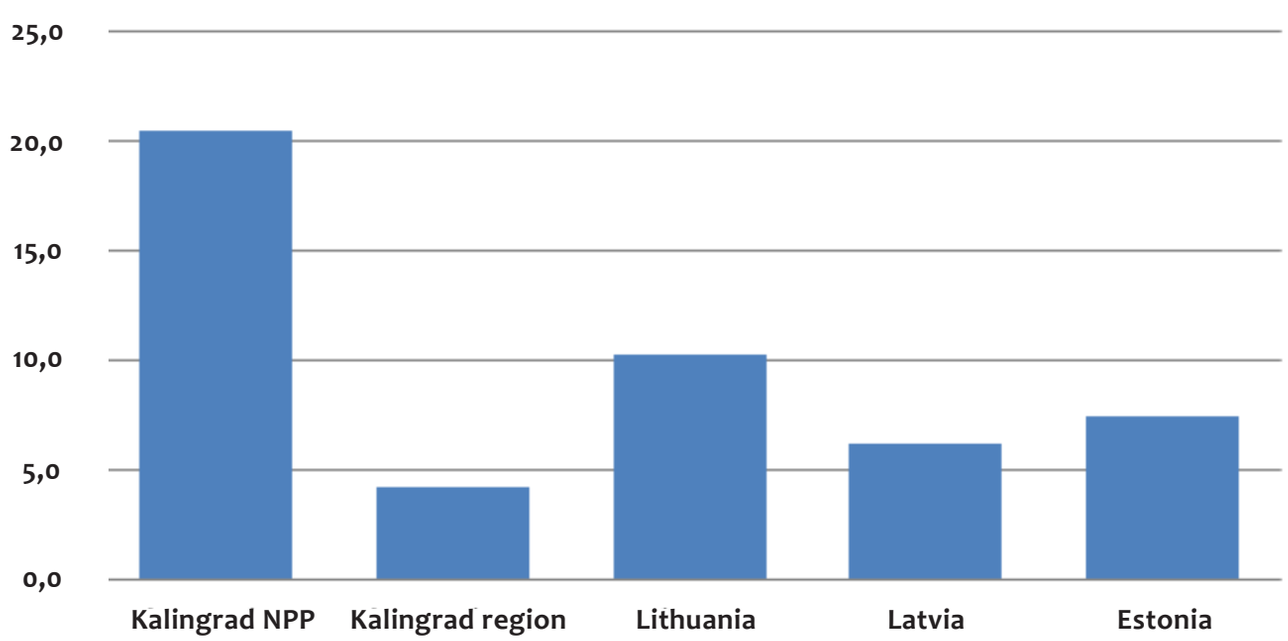
The project of Kaliningrad nuclear power plant, if of much greater capacity than conceivable needs of the oblast, will necessarily influence plans and feasibility of the nuclear power plants intended and/or planned in the Baltic Sea region. Complexity of the nuclear situation in the region is greatly enhanced by diverging concepts and imaginations about the nuclear-for-electricity as energy generation technology. In the region, there are countries that do not intend to have nuclear electricity capacity (Denmark), or that want to get rid of it (Germany). But there are also those that firmly rely on nuclear electricity generation (Finland), or those that seem to agree to it because of its climate action preferences (Sweden). At the same time, there are those that signal their intention of building one or two nuclear power plants (Poland), or those that want to return to their nuclear generation past (Lithuania).

The situation is complex also because the former Soviet electricity system that used to embrace all the former Soviet Union countries (including now firmly again independent Baltic states of Lithuania, Latvia and Estonia), as well as Poland as a part of former communist bloc, still operate in the Baltic states. That makes for a awkward situation when an important part of the European Union (the Baltic states), potentially an indispensible connection north-south from Scandinavia to the European mainland in Poland, cannot contribute to making of the common electricity system of the EU. Conversely, if they finally switch over to the European electricity standard, they will make the Kaliningrad oblast an electricity island within the EU, much as it stands in all other areas. A possibility of the Kaliningrad region switching to the EU's electricity standard together with other three Baltic states would naturally reverse the logic and would separate – in electricity terms – the Kaliningrad oblast from the Russia mainland.

Fig 1. Planned Kaliningrad NPP capacity versus total electricity consumption of the Kaliningrad oblast and the Baltic states (TWh/year)



Source: Own calculations, data on total electricity consumption from the World Factbook, 2013-14.

Here is where the local nuclear power plant plays a huge role. Its capacity greater than the needs of the local Kaliningrad market means that the Russian authorities play on the logical assumption of either the Baltic states remaining firmly in the post-Soviet electricity system, or the Kaliningrad oblast joining the EU standard. If the capacity is to be greater than the needs of Kaliningrad and Lithuania combined, as intended in the first project, than its feasibility may rely on export opportunities to the EU standard neighbours, mainly Poland, perhaps Sweden, or even Germany. This seems possible only if Kaliningrad oblast switches to EU electricity standard.

The Kaliningrad nuclear power plant project

The Russian Federation is planning a significant strengthening of their nuclear sector as a way to increase its share in electricity production. According to the adopted plans, by 2030 the nuclear share will grow to about 25-30% of the global electricity production and then to 45-50% after the next two decades[1]. The aim is to achieve three objectives that seem crucial for the Russian economy. The first is to make available a significant amount of gas for exports. Approximately 70% of Russian annual gas production is consumed by the domestic market[2]. The second reason, most obvious, is to secure increasing energy needs in next two or three decades. Last but not least is to make Russian nuclear technology more competitive on the international market. In order to meet the above tasks, the process of lifetime extension of existing reactors is in progress. More than 35 new reactors are under construction, or planned[3]. With exception of the most advanced investments, the future of the suggested, new nuclear power plants is uncertain.

In the context of ambitious Moscow plans, the Baltic Nuclear Power Plant (NPP) (Kaliningrad) has got a very special status. The first proposal to erect a new nuclear power plant in the Kaliningrad province has been announced by InterRAO UES in 2008. The construction agreement with the Kaliningrad authority was signed in April 2008 and the future installation located in the town of Neman near the Lithuanian border[4]. The initial plans assumed building a twin AES-92 plant with two VVER-1000 reactors[5]. It was supposed to be the first nuclear installation in Russian Federation with its output destined for export. Energy needs of Kaliningrad were of secondary importance. The energy security of the town is currently guaranteed by its thermal power plant (Kaliningradskaya Thermal Power Plant 2 - 875MWe)[6].

The nuclear power plant is expected to be the first case in the history of nuclear industry of Russian Federation to have the anticipated foreign equity share (albeit no more than 49%)[7]. Part of the main plant modules is to be developed in cooperation with foreign industry. The contract signed in February 2012 by the Alstom-Atomenergomash (AAEM) company provides, among the other things, that Alstom would deliver steam turbines ARABELLE and moisture separator re-heaters, power generators and other auxiliary equipment. The contract is estimated at 875 million euro[8].

According to a more recent project, the new nuclear power plant would be based on the larger and more modern AES-2006 design with two pressurized water reactors (PWR) VVER-1200[9]. Each VVER-1200(V491) reactor has the thermal capacity of 3200MWth and electrical capacity of 1170MWe gross. The design is the common project of OKB "Gidropress" and "Atomenergoproekt" with the scientific supervision of Kurchatov Institute from Moscow[10]. The Russian VVER-1000/1200 family are equivalent of the Western PWR reactors (generation III and III+). VVER-1200(V-491) based on AES-2006 design, are classified as generation III+ with an expected service life of 60 years. It would probably be the most modern project of the Russian nuclear industry until the beginning of the next decade. As many as 17 of similar VVER-1200 reactors are expected to be commissioned in other locations in the

Russian Federation by 2020[11]. It's also an export success. The identical project is planned in Turkey (Akkuyu nuclear power plant). The Turkey-Russia agreement of May 2010 provides for the construction of four VVER-1200 reactors around 2020-23. The total electrical capacity of the Akkuyu will be about 4800MWe[12]. The contract value is about 20 billion dollars.

The doubts about nuclear safety raised in connection with the Kaliningrad nuclear power plant investment, can be referred to all the latest-generation reactors. There might be problems, as in case of all III/III+ generation projects, with the reliability of the most important modules in assumed long-standing service life[13]. The VVER-1200 reactors are based on many-year-experience with operating of earlier generations of VVER family. There are about 50 VVER-440 and VVER-1000 operating units in Russian Federation and abroad. They are more reliable in comparison to other Soviet designs (RBMK reactors in particular). According to the official information, the VVER-1200 reactors that are currently under construction contain extensive passive and active safety systems with the increased share of the passive one. It comprises, inter alia, a passive heat removal system and a passive reactor scram system, as well as a passive hydrogen removal system and a secondary system of passive heat removal via steam generators[14]. In the opinion of the Russian specialists, the concept of the safety system is comparable to the western designs of PWR reactors of the III and III+ generation.

The preparatory work of the project in Kaliningrad has begun in February 2010[15]. The first elements of concrete were poured two years later. According to the plan, the first reactor should be in commercial service by 2017. The cost of the project is estimated at 6-8 billion euro.

Due to the electricity exports objectives of the project, there are several conditions to be fulfilled, before it gets operational. The first one was to attract foreign investors and loans to finance the project. The second one was to attract the real interest for future foreign customers. Only a small part of planned output (2300MWe) may be consumed by energy needs of Kaliningrad. The long-term contracts from foreign partners are necessary to ensure the economic side of the investment. Last but not least, there are grid connection requirements. The Russian enclave has got a limited capacity transmission line with Lithuania and no connection to Poland. This situation makes a future export of electricity impossible, unless fundamentally changed. Project of such a big nuclear power plant in the Kaliningrad Province, if not fully connected of to the EU grid system, is not really arguable in economic terms.

In the course of last five years none of the conditions mentioned above was fulfilled. There is no long-term contract for future supplies of electricity, although the proposal has aroused some interest. The project seems to be in direct contradiction with energy strategies of neighbouring countries, all of which are very much interested in raising their energy independence ratio.

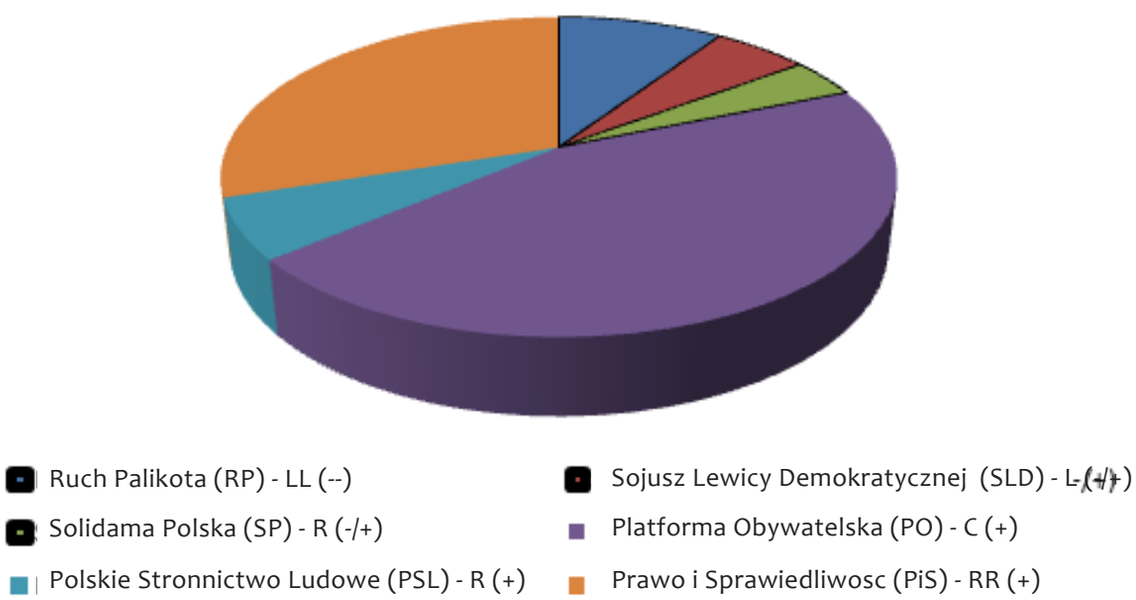
The latest news from Kaliningrad indicate a possible change in the schedule of the project's implementation. This could mean, at least, a significant delay of the works, if not abandoning of the project altogether. A possible scenarios assumes that the VVER-1200 reactors could be replaced by a smaller design, thus better corresponding to the real energy needs of the region itself, and less relying on the external markets.[16]

Poland still uncertain

In Poland, until now with no nuclear generated electricity, in November 2008 the government took decision to explore possibilities for building two nuclear power plants that should be operational by 2023-24. It therefore created a special purpose company, that is a consortium of mostly state owned electricity utility companies PGE, Tauron and Enea, together with the KGHM, a copper mining conglomerate. So far, the three possible

locations were all considered at the Baltic Sea shore in either Gąski, Choczewo, and/or Żarnowiec, as seen from the West to the East. However, the Polish public opinion remains divided on the issue. On one side, the nuclear generated electricity could enhance the country energy security, so far – for electricity generation – largely (by 90%) based on coal and lignite. It would also significantly contribute to lowering the country's CO_2 emissions, thus contributing to the EU's driven climate change action. Yet, when things got to local, things turned bad. In a local referendum in Gąski (February 2012), an overwhelming majority of 95% of 50% turnout voted against any new nuclear power plant built in vicinity. Although, there was no public awareness campaign before, and the local population was not familiarized with the benefits of such an option, still the results were considered straightforward in saying 'no'. In politics, two parliamentary left wing parties, Ruch Palikota and SLD, with one fringe right wing party Solidarity Poland, are all against, while all major mainstream parties of both the government and the opposition are favourable for building a nuclear electricity generating capacity in Poland. In short, over three quarters of the current parliament is in favour of the nuclear power plants in the country.

Fig 2. Polish parliament split on nuclear electricity generation, 2013



Source: own analysis of party platforms. Those bolded are against, or rather against nuclear power plants; L = left; R = right; C = centre; (-) and (--) = against nuclear; (+) and (++) = for nuclear; (-/+) = split.

It plays a role, that Poland is in fact currently surrounded by the nuclear producing countries: Germany, Czech Republic, Ukraine, Belarus, and Sweden with Finland across the Baltics. There are several well known exceptions to that picture that do and will play a role. Germany has announced its Energiewende, the energy transition that presupposes also closing their nuclear power plants by 2022. Lithuania used to be a strong player on the local market thanks to its Ignalina nuclear power plant, but this was closed at the end of 2009 as a part of their accession deal with the EU, the installations there considered not secure enough. The Kaliningrad oblast, although Russian territory, does not produce nuclear based electricity for now. And Denmark, again across the Baltics, has decided already in 1985 not to produce nuclear energy at all. Even if it imports electricity from Sweden and Germany, thus partially imports the nuclear derived electricity, it was able to successfully exert pressure on the Swedish public opinion. Consequently, the Swedes closed two Barsebäck units, what ultimately happened in 1999 and 2005 respectively.[17] Finns apparently managed to solve the nuclear waste problem, and seem to proceed to the final stage with their European Pressurized Reactor (EPR) at Olkiluoto 3. The EPR there, although much delayed now (from 2008), is expected to go operational in 2016, with almost tripled costs of now estimated 8.5 bn EUR[18]. This, along with the French Flamanville project and the British one, could contribute to the possible implementation of the European nuclear energy design EPR.

Lithuania going for and hesitating

An interesting project, from the point of view of the Baltic Sea nuclear situation is the Lithuanian concept of Visaginas, the new nuclear power plant. It has been construed as one not only to replace the closed Ignalina, but also to provide a backbone to the long needed and awaited north-south connection from the Scandinavian Finland and Sweden, via the three Baltic States of Estonia, Latvia and Lithuania, to Poland in the south. The region suffered long from incompatible inheritance of the Soviet times when it was largely connected east-west, to the USSR as a pole and source of energy and dependence. The Visaginas project started in 2007 with participation of companies from Lithuania, Estonia, Latvia and Poland, which subsequently withdrew in 2011. The main technology provider, and strategic investor would be Hitachi GE, which should start to build a single 1350 MWe Advanced Boiling Water Reactor in 2015, intended to be operational as of 2021. It is estimated to cost almost 5 bn EUR. Still, the project has been overshadowed by the national referendum in Lithuania, which in October 2012 proved negative sentiment by a large margin of almost 65%. Although non-binding, the referendum might indicate problems with the project at a later stage.[19]

The Visaginas has been planned to be the cornerstone of the new Baltic Energy Market Interconnector Plan (BEMIP), which is intended to link Poland with Finland and Sweden, via the three Baltic States. It gets support of the European Union which funds several of its parts: LitPolLink (Lithuania-Poland), Estlink-1 and Estlink-2 (Estonia-Finland), NordBalt (Lithuania-Sweden). The links as the interconnectors should effectively reverse the situation when, now, Lithuania, Latvia and Estonia are still parts of the Russian controlled IPS/UPS electricity system. With the three Baltics states connected to the European Network of Transmission System Operators (ENTSO), the Kaliningrad oblast would get isolated from the mainland Russia. Apparently, the Russians recognize this situation and Rosatom proposed to build a link between Poland and Kaliningrad that would effectively forge the Kaliningrad electricity system with that of the EU. This prospect would eventually facilitate greatly any Kaliningrad nuclear generated electricity exports to the EU, either Poland, or Lithuania, or even all the eastern and southern Baltic states.[20]

Eventually, Poland would add one or two of its own nuclear power plants, if the government's plans are going to materialize. The decision

on the technology, the reactors and design, has not been taken, however. With the Swedish 10 nuclear reactors, and their public opinion strongly backing them as a viable strategy for climate action, the Baltic Sea nuclear prospects seem a bit diversified. But there are interesting patterns emerging where the Kaliningrad nuclear power stations or the Polish nuclear power plants may play important roles. Particularly, if we take into account the Germans going the Danish road to abandoning the nuclear electricity generation, with their Energiewende. This way, the west of the Baltics would be free from nuclear energy capacity, while there would be strong production sites in the north, south and east of it.

The situation in the north and east of the Baltic Sea seems clear: both the Swedes and especially the Finns are seemed prone to rely heavily on nuclear for their electricity generation. Their capacities are construed. Specifically, the Finnish seem to generate electricity from nuclear fission - based their cooperative concept of ownership of the nuclear capacities - for domestic purposes, and not really intended for serious exportation.

Sweden nuclear, but...

The current status of Sweden's nuclear industry is a result of the decades of development, beginning with the top secret nuclear weapon program for advanced nuclear industry. As far as today more than 40 percent of Swedish electric power comes from ten nuclear reactors at three nuclear power plants. Four of them entered commercial service in the 1970s (Oskarshamn 1,2 and Ringhals 1,2) and six began to operate in 1980's. As mentioned, the Barsebäck nuclear power plants were ultimately closed in 2005.

Interestingly, for more than 30 recent years, the Swedish nuclear power plants have undergone consistent process of expanding nuclear capacity as well as their operational lifetimes. In case of the Ringhals nuclear power plant it has meant an increase of about 337 MWe[21] to 450 MWe by 2012.[22] This action, despite the closure of the Barsebäck has allowed to maintain the strong position of nuclear energy in the Swedish electricity mix and to add about 1050MWe to the ten working reactors by the end of 2008.[23] Further investments of this kind are planned.

Sweden has one of the most advanced programs of nuclear waste management. The Swedish Nuclear Waste Fund is administrated by the Swedish Radiation Safety Authority and will cover costs associated with the decommissioning of nuclear reactors and waste storage. The fund is financed from the fees of nuclear power operators.

According to the plans of the Swedish Nuclear Fuel and Waste Management Company, SKB, the ultimate repository for used fuel from Swedish NPP will be located in Söderviken, close to the Forsmark Nuclear Power Plant. The repository will be placed at the depth of approximately 500 m in geologically stable granite bedrock. The beginning of the construction is planned for 2019 and the investment will be completed about 2025. The repository will be in use until about 2070 and at that time it will have 60 km of tunnels and about 4 square kilometers of underground storage surface. Its total capacity is expected at 12000 tons and it will be able to store as many as 6000 iron, copper-cast canisters containing used fuel.[24] The canisters will be stored in the holes bored in the tunnel floor. Each canister will be surrounded by bentonite clay to isolate it form the bedrock and to absorb water. That is to help to stop a corrosion process of the copper canister. In case of leakage or other damage of a canister the clay insulators of the granite bedrock would delay radioactive materials from reaching the surface.[25]

This kind of storage is known as the KBS method. The technology should isolate radioactive material from people and living nature for at least 100 thousand years. Given the time-span of the storage project, the speed of corrosion of the copper containers seems to be a crucial safety problem. The bentonite clay as well as the repository environment are both

intended to help to stop the corrosion process of copper, but there are still controversies over the safety issues of the technology. The newest report of the Swedish Radiation Safety Authority indicated that the corrosion had occurred on the surface of the copper elements during the last tests. The issue would require further research to solve the controversy.[26]

In the last three decades Sweden went through ambivalent nuclear "phase out" policy. The US Three Mile Island catastrophe of 1979 was the reason for the Swedes to organize a referendum about future of the Swedish nuclear energy. In 1980 a majority of Swedes voted for not developing the next generation of nuclear power plants after having ended lives of those plants already operational or under-construction. Consequently, the Swedish parliament took a decision to close all twelve nuclear power plant by 2010. For economical reasons and under a strong pressure from industry and labor unions, the Swedish political elite has not made a serious attempt to implement this decision and the 2010 target was subsequently abandoned.[27] In 2010, in spite of resistance from the political opposition and ecological movements, the Swedish government adopted a new plan of replacement of all ten nuclear reactors by new ones, and passed it through the parliament. The plan is strictly limited and assumes replacements only. The number of reactors is not allowed to exceed ten, and all of them must be built at the same site of as currently existing nuclear plants.[28] According to the plan, the first new nuclear reactor would be required after 2025.

Today, it is difficult to foresee future of nuclear energy in Sweden. Still, taking into account the public opinion shift in favor of continuing of the nuclear power program and ambitious government's plans, atom seems to be an important part of the Swedish climate policy. Together with renewable energy sources, nuclear plants will contribute towards environmental goals and will help to impose further limits on the fossils fuel share in the Swedish energy mix.

Finland firmly nuclear

The nuclear industry in Finland is providing nearly 30% of the electricity. The first generations of nuclear power plants, like in Sweden, were completed from 1977 to 1980. All four nuclear power reactors built at the time, are currently in use. Unlike Sweden, Finland has not developed its own nuclear technology capacity. Olkiluoto 1 and 2 are based on the Swedish technology, and Loviisa 1 and 2 on the Russian one. In spite of this, an average lifetime capacity factor is one of the highest in the world - over 85%. Moreover, as in the case of the Swedish nuclear power plants, the nominal capacity of the Finnish reactors have been uprated ever since they were built. In case of the Olkiluoto, the nominal capacity of each reactor has increased from 658 MWe to 880 MWe.[29]

The decision about the future of the nuclear industry in Finland has been taken in 2002. For economical reasons, in May 2002 the Finnish parliament approved a proposition to build fifth nuclear reactor.[30] According to the initial investment plan, developed together with French Areva (EPR reactor EPR reactor, 1600 MWe), it should have been in commercial service in 2013. Unfortunately, due to the sophistication of the project, serious technical problems and delays have been encountered. The budget exceeded more than twice by now, and today its commercial operation is planned for 2016.[31]

All these problems have not stopped the Finnish intentions to further expand its nuclear power industry. Of two new projects, the first one – Olkiluoto 4 – is intended to be one of the modern western designs, while the other one - Hanhikivi 1 NPP, led by the new consortium in the nuclear power industry: Fennovoima Oy – would most likely get partnered with the Rusatom Overseas to develop the AES-2006 design based on the VVER-1200 reactor.[32] In July 2010 the Finnish parliament approved construction of the new reactors.

Finland's nuclear waste management program was initiated in 1983, and is in general similar to the Swedish one. The key player is Posiva Oi, company responsible for the final disposal of spent nuclear fuel. The company is owned by two Finnish nuclear power plants operators: TVO – 60% and Fortum – 40%.[33] The final repository and waste encapsulation plant will be placed at Olkiluoto up to 450 meters underground in the stable bedrock. Disposal will be based on the Swedish SKB-3 concept with the copper canister and bentonite clay as the second barrier.[34] The planned capacity of the deposit is 9000 tons and will allow to dispose of all spent fuel from the four existing reactors as well as the new Olkiluoto 3 and 4 units. The future of the spent fuel from Hanhikivi 1 nuclear power plant is still unclear.[35]

The cost connected with the final disposal and decommissioning of nuclear power plants will be covered by the state owned Nuclear Waste Management Fund. The fund is financed from the charges on the generated electricity which amounts to about 10% of the total electricity production cost. According the Ministry of Employment and Economy, at the end of 2012 the Fund has amassed about 2.16 billion Euro.[36] This amount of money seems sufficient to cover all the costs of management of current nuclear waste stockpile as well as decommissioning of the existing power plants.

In Finland the nuclear energy is perceived as a reliable and safe source of electric power. The Finnish public is among the strongest supporters of the nuclear energy in Europe. Successful finishing of Olkiluoto3 and the two planned projects will extend a nuclear horizon far beyond 2050 and will root nuclear power deeply in the Finnish climate and energy strategy. The future of nuclear energy in Finland seems to be stable and certain.

Conclusion

To sum up, the nuclear electricity generation on the south and east side of the Baltic Sea remains mixed. There are several reasons for that, with perhaps the most important one being social and political uncertainty about the projects and their public perceptions among nations and locally. External developments, with Fukushima disaster, German Energiewende, and pressures from the non governmental organizations, which in many cases do not recognize nuclear electricity generation as beneficial for climate action and they still press for the development of renewable resources.

The other very important reason is an apparent competition between three major concepts: Kaliningrad power station, Visaginas project in Lithuania and Poland's plan for two major power plants, all of them intended to be nuclear and located in the north of the country. It seems either – or. With serious inroads of the renewable resources into the electricity mixes and consumption needs, there seem not to be place for more than one project regionally.

Moreover, their business chances are interlinked – any increased possibility of advancing and implementing of one of them does and will indeed influence chances of financing and building the others. Clearly, capacity of the projects to raise money and loans are interlinked as all investors and banks would naturally look into the externalities of each project.

Finally, neither of them have yet crossed their respective points of no return. While the Kaliningrad project seemed most advanced, it got stilled. The Visaginas has been clouded by the Lithuanian public opinion referendum. And the Polish plans are still far from being stable.

Interestingly, the European Union does not play any important role in these cases. As only natural with energy projects, especially of this magnitude of investment needs, the national authorities are the key players. Even if the case of local cooperation across and along the Baltics would normally call for somewhat closer cooperation on the issue, this is not the case. The European Commission might get interested in the issues, especially with its interest for the single energy market, but it has not been noted as an important player among the parties here. Its role is marked in pressing for

making of the north-south energy and transportation connectivity, but not on the choice of ways of electricity production. While this being national prerogative, Brussels would still seem only a natural point of meeting and coordinating of regional plans, a helping hand to be.

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