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Greening the energy sector-Does Macedonia need nuclear energy?

Introduction

The construction of viable energy options for the next decades is at the centre of significant period in the national discussions in Macedonia. This was triggered in part by the adoption of the Energy Strategy for the period of 2008-2020 with a vision up until 2030. One of the options mentioned is nuclear energy and the possibility of building a nuclear power plant in the country. This option deserves to be adequately and properly analyzed and researched in the following years, as do other alternatives, RES, gas, coal.

However, unlike the other energy options, nuclear energy causes lot of stir in the public and expert circles. Whether it is potentially hazardous or is a great investment option is still a big issue that necessitates closer inspection. This brief therefore tries to look at both sides of the discussion while also recommending several future steps regarding the exploration of nuclear energy in Macedonia to the relevant stakeholders.

The brief represents a starting point in what should follow a comprehensive research on the benefits and risks that the nuclear option has, not only for Macedonia but for the wider region in general. The research methodology is qualitative, using primary sources, such as interviews and legal documents, as well as secondary sources, such as analysis of documents of the contemporary energy discourse.

1. Recent global developments in the nuclear energy sector

Nuclear energy is making a major comeback in the energy systems worldwide. In an era where energy security is a key subject in international relations, and in search of reliable and clean energy sources, governments are re-thinking nuclear energy. From the USA to Italy, the UAE and Vietnam, building new generation of safe, clean nuclear power plants is becoming a reality and new energy policy.

Since a couple of years, the "green" energy policy of the European Union has tentatively included nuclear fission as a low-carbon alternative.[1] Although some of the EU member states have very active anti-nuclear movements, the rise of the nuclear agenda in the last couple of years at the EU level is not an empty postulate. In the search for economic growth and sustainable development nuclear energy as a low-carbon emission technology is being seriously reconsidered in the energy mix of the EU.[2]

In the region of Southeast Europe, nuclear energy has a tradition in energy supply dating back to the communist era. Bulgaria and Slovenia are the only countries that used to have nuclear power plants on their territory. However, since the 1990s the nuclear option has been the least prioritized energy policy in the region due to the restructuring of economic systems and the fear of possible environmental consequences. It was not until recently that most governments of the region expressed a strong interest in investing in nuclear energy, as the Chernobyl accident and its consequences were strongly felt in SE Europe. Therefore the governments were quite reluctant for some time to open up the discussion about the possible use of nuclear power. Today however, Bulgaria, Albania, Croatia and Macedonia are countries that want to invest in their own nuclear power plants, while recently Serbia has expressed readiness to join in co-investing in the Belene nuclear power plant in Bulgaria.

[1] *Investing in the development of Low Carbon Technologies (SET-Plan),* COM(2009)519 final.
[2] Council of the European Union, Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations", *Official Journal of the European Union,* L172, 2 July 2009.

The Macedonian government has prepared a Strategy for the development of the energy sector until 2030[3], in which it proposes a nuclear option for the country among others. A subject of expert and public discussion, so far there has been no analysis of nuclear energy policy that objectively discusses the benefits and the weaknesses of having a nuclear power plant in Macedonia. The lack of research on nuclear energy in the country and the negative climate that prevails in the experts' and public sector against opening discussions on 'hot topics' can be pointed out as reasons why a vigorous debate is lacking. Demystifying the idea of a nuclear power plant in Macedonia is important as a ground for an unbiased and open energy debate in the country.

2. Green vs. Nuclear - A never-ending debate

The new activities regarding nuclear energy have raised numerous debates among scientists, economists and environmentalists. The hottest debate is between proponents of the renewable energy as clean and non-polluting technology and proponents of the nuclear power option, over different aspects like emission of CO_2, the cost of the electricity, the capacity of the plants, the risk factor, other environmental and political concerns, etc. (*See Table 1*)

Proponents of the renewable energy option base their arguments on the specific characteristics of renewable energy technologies, GHG emissions, investment costs, the utilization level of renewable energy, etc[4]. According to them operating emissions and other environmental damage of RE range from zero to sustainable; operating costs are in the range from zero to low; electrical energy costs range from cheaper than the true cost of grid electricity to slightly more expensive; REs face challenges with energy storage; and the scale of RE utilization is wide ranging from house-sized to utility sized. They argue that in addition to being energy efficient, RE is the second easiest, fastest and cheapest option for reducing GHG emissions. It is an option that can be easily multiplied, and is broadly available to people, communities and industry.

Environmentalists are also very vocal when it comes to protesting against the use of nuclear power plants because, according to them, nuclear energy never was nor will ever be 'clean'. They argue that the degradation of the environment and human lives in the life-cycle of nuclear power plant (beginning with uranium excavation through constructing the power plant to storing the nuclear waste) is too great for this option to even be considered. For them investing into 'green' technologies as well as in energy efficiency is a much better option than investing billions in a facility that will bring more harm than good to the human race.[5]

Table 1: The different aspects of nuclear vis-à-vis renewable energy

	Nuclear Energy	Renewable Energy

[3] *Strategija za Razvoj na Energetikata vo Republika Makedonija za Period 2008-2020, so vizija do 2030,* Makedonskata Akademija na Naukite i Umetnostite MANU, January 2009.

[4] Gordon Howell, electrical engineer, PV expert, in "Green (renewable) Energy Versus Nuclear Energy", as part of an eight part written debate regarding nuclear power generation, Published in the January 20, 2010 edition of the *Mile Zero News and Banner Post*, March 17, 2010, available at: http://www.computare.org/Support%20documents/Guests/MZN%20Nuclear%20Debate/5%20of%208%20Green%20Energy%20Howell-Keyes.pdf

[5] Interview with the NGO Macedonian Green Center conducted on 2nd of September 2010.

Political aspect	• Requires politically stable and economically developed countries • Issues of proliferation of nuclear fuel and use of uranium for military purposes	• Can be exploited in remote areas and conflict zones • Safe and low-risk technology
Economic aspect	• Large public subsidies/Price distortion • Large companies and massive government subsidies • Higher life-cycle costs	• Feed-in tariffs • Available to industry, SMEs and households • Lower life-cycle costs
Environmental aspect	• Low GHG emission • Less GHG emissions on a life cycle basis (except wind) • Nuclear waste storage	• Low GHG emission • Wind energy produces least GHG emissions
Health and safety aspect	• Risks of illnesses in humans and animals due to radiation • Potential target for attacks (the country and the power plant)	• No registered harm for the health of humans and animals • Considered a friendly and relatively safe way to produce energy

On the other side of the debate, the *proponents of the nuclear option* defend their calls for a resurgence of nuclear energy based on the premises of a carbon-free world, energy security and clean energy economy. They argue that nuclear energy is the less polluting energy source, which will considerably add to reducing the GHG emissions. Compared to the capacity of RES, the capacity of nuclear energy outnumbers that of all renewable energy sources together more than tenfold.[6] Regarding the safety of the nuclear plants the pro-nuclear lobby in USA and EU rebut criticism by promoting the development of new technologies for electricity production that will maximize safety, increase efficiency, produce less radioactive waste and minimize proliferation risks.

Last but not least, supporters of the nuclear option argue that in times of declining of fossil fuels, high costs of upstream investments, and non-commercial availability of renewable energy technologies, nuclear plants are the least costly option that can satisfy the growing energy demand in the world and satisfy pledges for a low-carbon economy. (*Table 2*)

Table 2: Positive and Negative sides of the nuclear energy and its exploitation

	Nuclear Energy

[6] For example in USA, for the last 20 years its 104 nuclear plants have produced nearly 20% of the nation's electricity, contrasted to the wind and solar energy producing only 5% together. "Is nuclear power the future? Obama calls for more plants", in *USA Today*, 28.01.2010, available at: http://content.usatoday.com/communities/greenhouse/post/2010/01/is-nuclear-power-the-future-obama-backs-gop-call-for-more-plants/1

PROS	• Large amount of electricity produced by nuclear reactor • Long life time of a reactor (40-60 years) • Immune to volatility of fossil fuels
CONS	• Long period of construction of the plant (over 10 years) • High investment costs/high reactor costs • High amortization costs • Hidden state subsidies • not carbon free • Health risks are big • major security issue

3. Macedonia's nuclear strategy - necessity or empty idea?

3.1 Positive and negative aspects of the plan

The idea of building a nuclear power plant in Macedonia is not a new one. During the Yugoslav era, there were big plans to build nuclear power plants in each of the republics. However, these were only realized in Krshko in Slovenia.

The nuclear option is listed under the vision section of The National Strategy for the development of the energy sector until 2020, as a possible alternative for energy production in Macedonia. The Strategy sets out the following objectives[7]:

- Maintenance, revitalization and modernization of existing and construction of new, modern infrastructures for the purposes of energy generation and utilization;
- Improvement of energy efficiency in the generation, transmission, and utilization of energy;
- Utilization of domestic resources (reserves of lignite, hydropower potential, wind and solar energy) for electricity generation;
- Increase of natural gas utilization;
- Increase of utilization of renewable energy sources;
- Environmental protection;
- Economic energy prices;
- Elimination of the monopoly position of any entity;
- Integration of the energy sector of the Republic of Macedonia with the regional and European electricity and natural gas market.

Based on research that has been conducted to date, the following sections will discuss the positive aspects of this alternative and the possible challenges Macedonia will face if it opts to build a nuclear power plant.

Reasons for building a nuclear power plant

[7] William Boyd, "Meeting Macedonia's Energy Needs", *Analytica's Interns' Yearbook 2009*, page 167. , http://www.analyticamk.org/index.php?option=com_content&view=article&id=146&Itemid=177

According to energy experts, there are many reasons why the nuclear option is worth considering as part of the energy supply of the country.

1) The most pressing issue is the security of energy supply. The backbone of the Macedonian energy system, the thermal power plant REK Bitola, which supplies over 50% of the total electricity production in the country, is close to the end of its lifecycle. Therefore the main issue for the country is to find the most suitable energy source to replace it. The energy strategy offers several scenarios for energy production in Macedonia that will guarantee security of energy supply until 2030. The nuclear option is one alternative. Thus, the construction of a nuclear power plant with a capacity of 1 GW on the territory of Macedonia would allow stability of basic energy supply replacing Bitola 1, 2 and 3 after 2020[8].

2) Another reason is the investment instability of the large hydro power plants. The large hydro power plants have been the government's marketing trump over the years. However, proponents of hydro energy as a clean and renewable energy source have failed to mention that the amount of electricity produced by the HPP Chebren and Galishte, and eventually Lukovo Pole, will not be sufficient to meet the basic electricity needs of the country once REK Bitola goes off power. The hydro power plants can only be an additional source of energy, and certainly not the basis of the Macedonian energy system.

3) The Energy Strategy foresees significant investments in the installation of a gas network in the country in forthcoming years. This has been a cornerstone policy of all consecutive governments in Macedonia. However, the state has not invested anything except one gas pipeline running from the Bulgarian border to Skopje. The installation of a gas network is an expensive project that requires political consent, government endorsement and economic stability. Gas import and long-term supply contracts also raise another issue of energy security, given the recent cases of the EU countries and Russia fighting over the abundant gas sources of Caspian region. On the other hand, gas-fired power plants like TE-TO do not have a major share in the overall electricity generation. They only cover the amount of the electricity imports, and economically they are an expensive investment, since the price of the electricity produced in gas-fired power plants will be the market-price and more expensive than the current state regulated electricity prices.

Challenges for the nuclear option in Macedonia

First and foremost, when discussing whether Macedonia should build a nuclear power plant or not, it should not be disregarded that *a nuclear power plant will not completely satisfy the energy needs of the country, and even with a nuclear option the country will need to import energy to meet the additional demand for electricity. Nuclear energy is only one of the possible sources for securing long-term energy supply.*

[8] Interview with PhD Anton Chausevski – Faculty of Electrical Engineering and Information Technologies conducted on 25th of August 2010.

Bearing in mind the past and present risks arising from the use of nuclear power it would only be fair to open the discussion to the *potential challenges* the country could face in the process of building a nuclear power plant. Usually experts identify the following as possible hurdles on the way:

a) The economic cost-effectiveness of a nuclear plant and its sustainability. Without an accurate assessment of the latter, it is impossible to even begin thinking about building a nuclear power plant, let alone to look for investors;
b) Establishing a link between the human capacity, education and development of academic curriculum. At least 100 to 200 people will need training to work in a nuclear reactor;
c) Providing safety requirements. These are related to political and security criteria (NATO/EU integration), as well as to the legal capacities of Macedonia to transpose the international legislation on nuclear power, and to the level of technological development and R&D promotion;
d) Fear among the population. The lack of awareness among citizens , deriving from a lack of nationwide awareness raising campaigns about nuclear energy could prove a considerable obstacle at all stages of the construction of the plant;
e) Political Consensus. It is highly important to reach a political consensus among the political parties, different interest groups, CSOs, and support from the general public in order to reach a socially acceptable agreement on the construction of a nuclear power plant on Macedonian territory;
f) There is always the risk that the *nuclear research program* could prove that a nuclear power plant is not feasible for Macedonia. In this case, not having invested in Belene or other energy sources will lead to big electricity shortages, economic repercussions and social unrest.

3.2 Current state of affairs

In Macedonia, findings about the potential for constructing a nuclear plant date from partial research conducting in the 1970s. These findings show that Mariovo is the best location for the construction of a nuclear plant. Geographically, the Mariovo area is the most seismically stable in Macedonia, and it is rich in water resources. Water from the river Crna Reka could be used for the cooling of the nuclear reactor, together with the hydro system that is planned to be built on the river and includes the HPPs Chebren and Galishte. Concerning safety, Mariovo is the least populated area in Macedonia, which decreases the immediate consequences of eventual nuclear disaster and radiation to people's health. Economically, the construction of a nuclear plant will provide thousands of new jobs and offer a development perspective not only to the underdeveloped region of Mariovo, but also to the country's overall economy.

One of the first steps taken after the adoption of the Energy Strategy was the initiative, i.e. the proposal by the Ministry of Economy to the Government, to form a Commission for Nuclear Energy. This Commission would have between 7 and 11 members selected from the areas of energy, engineering, economics, law, public policy, etc. The Commission would undertake the following obligation and assess the following activities:

- The position of nuclear energy in the energy sector compared to the other energy sources;
- Its profitability;
- Regulation and legal aspects of nuclear energy;
- The Environmental impact on the wider and closer area of a nuclear power plant;
- Nuclear energy technologies;

- The nuclear life-cycle including waste management and decommission of the nuclear power plant;
- The government and private sector's role in the nuclear programme;
- The available potential of the industry and the human capital needed for the nuclear programme;
- The sources and amount of uranium in the country and the impact on procuring the power plant with fuel;
- Public opinion and the public's acceptance of the nuclear programme.[9]

Over the next 3 years the Commission should prepare serious studies about the nuclear energy option in Macedonia, identify the basic infrastructural elements and plan the implementation of the nuclear programme. However, the Commission has not been established yet. The general sentiment among experts is that there is no willingness to speed up this process for the time being. These issues arise from the expert community's unwillingness and accordingly of the political elites in Macedonia to open up the public debate not only about nuclear energy but also about the energy situation as a whole in the country. The climate in Macedonia for discussing sensitive issues has never been more problematic, and subsequently many important issues are left outside of the public domain. No one can predict when things will get into motion.

Another initiative was proposed by the Ministry of Science and encompasses forming an Agency for Nuclear Technologies that will conduct in-depth scientific research on this topic. Although the Ministry of Economy was asked and provided its opinion on this matter in April 2010, there is still no information on the stage at which this project is.

The third alternative is the possibility of participating in a regional project – the Belene power plant in Bulgaria. The benefits of Macedonia having a share in the plant are: increased safety, considering that the plant will not be on Macedonian territory; Belene should start operating 5-10 years earlier than a nuclear plant in Macedonia; it does not stop Macedonia from building its own nuclear power plant in the future. However no new developments have been registered regarding this possible cooperation[10].

Nonetheless, because of the limited scope of data on nuclear energy in Macedonia, proceeding with the construction of a nuclear plant requires groundbreaking research that can be expected to take up to 5-6 years.

Recommendations

The risks exist, but so does the potential of nuclear energy. There are many future steps for the development of a nuclear program and it will take years before they are conducted. Some recommendations regarding this are:

Conduct an accurate, transparent, accountable and comprehensive study on the nuclear possibilities of the country in the following five years. Develop a nuclear program which usually lasts 5-6 years, as the optimum period for research and to arrive at new findings.

[9] Internal memo of the Ministry of Economy for the Government of the Republic of Macedonia, *"Information for the preparation activities for the realization of the nuclear programme in Macedonia"*, 2009.
[10] Interview with PhD Anton Chausevski – Faculty of Electrical Engineering and Information Technologies conducted on the 25th of August 2010.

Complete the immense paperwork – prepare agreements and other legal documents that need to be signed with the IAEA (permission from the IAEA is needed) as well as with other international agencies. (By now 10-15 agreements have been signed).

Undergo a complex approval procedure involving all actors of the Macedonian political system – the Parliament, the Government, and the public, through public debates and informational campaigns.

Open the discussion to the public as this topic has been highly stigmatized by all parties involved (political, media, professional).

Find the appropriate and most suitable way of financing a nuclear power plant, through PPP. A 1000MW nuclear plant is worth 2-2.5 billon of investments. However, the exploitation of the plant and amortization costs are lower than for coal power plants.

In the short term the Government has to seriously analyze the benefits of participation in the construction of the nuclear plant Belene in Bulgaria. Schedule several meetings with political figures and experts from both countries in which the possibilities for cooperation are thoroughly analyzed and discussed.

Continue the project of installing a gas network in the country. This priority must not be sidestepped!

Energy mix! It must not be forgotten that retrieving energy from combined energy sources (gas power plant; windmills, hydro, nuclear) is the best option for a country poor in energy sources and dependent on energy import.

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