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The energy security of Finland after joining NATO

Abstract: The aim of the article is to present Finland's energy situation after Russia's aggression against Ukraine and the related fact of this country's accession to NATO structures. This situation is taking place for the first time in history and the analysis of this phenomenon is an important element of energy policy planning for other countries. The article shows how decisions that affect the country's energy security can be made quickly and effectively.

Finland, due to its geographical location and historical circumstances, was closely economically linked with the Soviet Union and then with Russia. However, this situation changed dramatically after Russia's invasion of Ukraine. This has resulted in a change in the thinking of politicians responsible for security, including energy security.

Finland is gradually increasing the share of RES in its energy mix due to the lack of energy resources and also to achieve climate neutrality. Nuclear energy, one of the most important domestic sources of electricity production, is also being developed. In 2021, it accounted for 33% of the total generation of electricity, and Finland's two nuclear power plants have a combined installed capacity of 4.39 GW. Domestic production and imports from "safe" sources are the basis of Finland's energy security, especially after the suspension of electricity and gas supplies from Russia in May 2022. Currently, electricity is mainly imported from Sweden and gas is imported by pipeline from Estonia and via three small LNG terminals. According to the Finnish government's plans, Finland is expected to become an electricity exporter by 2030 due to increasing

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nuclear and renewable electricity production. It is also planned to use heat pumps and waste heat in heating to a greater extent.

Keywords: energy security, energy policy, NATO

Introduction

Finland, officially known as the Republic of Finland, is a Nordic and Baltic country in Northern Europe. Its capital and largest city is Helsinki; the country is bordered by three other countries: Sweden to the west, Norway to the north, and Russia to the east. The population of Finland is currently 5.6 million and has been gradually increasing for many years from 4.5 million in 1960, through 4.8 million in 1980, 5.2 million in 2000, to the current 5.6 million in 2023 (Population of 2023). Finland's GDP in 2021 was around USD 252.9 billion, which per capita amounted to USD 41.9 thousand (Stat.fi 2023). The Finnish economy is mainly based on the services sector (69% of GDP in 2021), followed by industry (28%), agriculture, forestry, and fisheries (3%) (OECD 2023).

Finland has historically depended on energy supplies from Russia. Finland spent 10.1 billion euros on energy imports in 2021, of which 5.3 billion euros were spent on imports from Russia. Russia accounted for 81% of Finland's net oil imports, 75% of its natural gas, 52% of coal, and 51% of its net electricity imports. Russia accounted for 25% of wood chip for energy purposes. Finland also imported nuclear fuel from Russia in 2021, accounting for 35% of the country's total monetary value of nuclear fuel imports (Finland 2023). Currently, Finland is trying to find different suppliers and rely on its own energy sources such as nuclear power and renewable energy. There is also a campaign to raise public awareness of the need to save energy, which is already starting to bring tangible benefits.

1. Energy needs of the country

One of the reasons for Finland's high energy demand is its geographical location. The country is located in the northern part of Europe, where winters can be long and cold. This applies especially to the northern regions of the country. The cold climate makes it necessary to use large amounts of energy for heating. The second reason for the high energy demand is the well -developed industrial sector. The timber industry is one of the leading industries in Finland. The industry currently accounts for about one-fifth of Finland's exports. In the nineteen-seventies, the pulp and paper industry accounted for about 50% of all exports from Finland. Despite the

reduction in forest product exports, the pulp and paper industry remains a key industry with more than fifty plants across the country. The chemical industry is also well-developed, especially the manufacturing plastics and paints, pharmaceuticals, petrochemicals, petroleum products, chemicals, and biotechnology products. The Finnish chemical industry supplies about 25% of the country's industrial production and exports. The chemical industry alone provides about 34,000 direct jobs. Finland is also one of the main exporters of copper, nickel, zinc, chromium, and steel. There is also an export of finished products, including steel pipes, roofing materials, and cladding (Worldatlas 2023).

Figure 1 shows the primary energy consumption in the years 2012–2022.

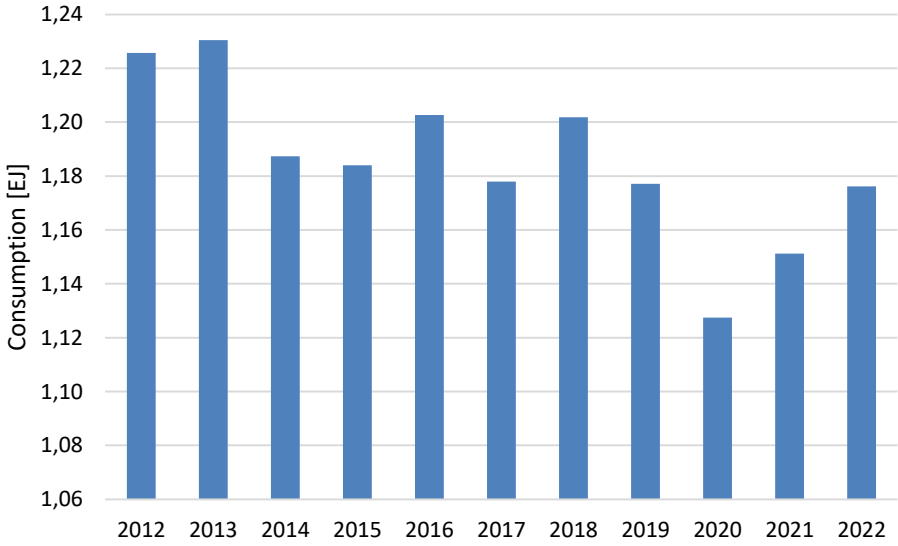


Fig. 1. Primary energy consumption
Source: own work based on (BP 2023)

Rys. 1. Zużycie energii pierwotnej

During the period shown in the figure, the highest consumption was in 2013 and amounted to 1.23 EJ, then decreased to 1.18 EJ in 2018, only to increase twice more to 1.20 EJ in 2016 and 2018. Over the next two years, energy consumption decreased significantly, which was related to the COVID-19 pandemic, and then increased in subsequent years to 1.15 EJ in 2021 and 1.18 EJ in 2022. It is difficult to predict energy consumption in 2023, but the Finnish government is trying to convince the public to save energy, which is beneficial not only for the environment but is also economically favorable for everyone.

2. Natural gas

Finland has no natural gas reserves. The gas is imported from Estonia via the Balticconnector gas pipeline. Finland also uses a large gas storage facility in Inčukalns, Latvia, and imports liquefied gas from Klaipeda (Energiavirasto 2023a). The bi-directional Balticconnector gas pipeline was commissioned in early 2020. Prior to it being put into operation, the vast majority of gas was imported through a 1,310-kilometer pipeline from Russia through the Imatra interconnection point. The 77 km Balticconnector offshore pipeline runs between Inkoo in southern Finland and Paldiski in northwestern Estonia and is co-owned by the Finnish TSO, Gasgrid Finland, and the Estonian TSO, Elering. The nominal transmission capacity between Estonia and Finland is about 8 million m^3/d. In 2021, gas imported via the Balticconnector met 23% of the country's needs (Finland 2023).

Natural gas plays a relatively minor role in the Finnish energy mix, accounting for about 3% of TFC. By 2022, Finland was sourcing the vast majority of its natural gas from Russia via a pipeline connection. After the Russian invasion of Ukraine, Finland stopped importing gas from Russia when the Finnish state gas supplier Gasum rejected Gazprom's demand for payment in Russian rubles, which prompted the main gas recipients to use alternative fuels (primarily coal, biomass, and propane) and implement efficiency measures. As a result, Finland's natural gas consumption fell by more than 50% in 2022.

In addition to the Balticconnector gas pipeline, three small LNG terminals are used in Finland, none of which is connected to the gas network. These enable gas to be delivered to places where the Finnish gas network does not reach. The first LNG terminal was commissioned in Tahkoluoto in September 2016. From Tahkluoto, LNG is transported to customers by tanker trucks or by sea tankers or, after regasification, by a local gas pipeline with a length of 12 km. The LNG storage capacity of the terminal is approximately 30,000 m^3. A second LNG terminal was opened inTornion's Röyttä in June 2019. The terminal has a storage tank with a capacity of 50,000 m^3. In addition to the refueling of LNG ships and the transport of LNG, gas, after regasification, can be transported to customers by pipeline (KAASUN 2021). Since the gas pipeline and three small gas terminals were unable to secure gas supplies at the appropriate level in May 2022, TSO Gasgrid Finland signed a ten-year contract with the American company Excelerate Energy for the supply of FSRU (*Floating Storage Regasification Unit*). The FSRU terminal is located at the port of Inkoo. FSRU Exemplar ensures greater availability of gas in Finland, as its regasification capacity is at the level of 5 billion m^3 per year. This terminal will also enable gas supplies to the Baltic countries – Estonia, Latvia, and Lithuania – and perhaps also to Poland via the Balticconnector offshore gas pipeline running near Inkoo between Finland and Estonia (Euronews 2022).

The security of the natural gas supply is supervised by the Energy Agency (fin. *Energiavirasto*), which publishes annual reports outlining the results of security of supply monitoring and the actions that have been taken or are planned to address the problems. In addition, in accordance with the regulations, the role of the Energy Agency in cooperation with other bodies is to monitor

the development of the supply and demand balance for electricity and natural gas and to act to cover peaks in demand for these energy carriers.

Figure 2 shows the consumption of natural gas in the years 1974–2022.

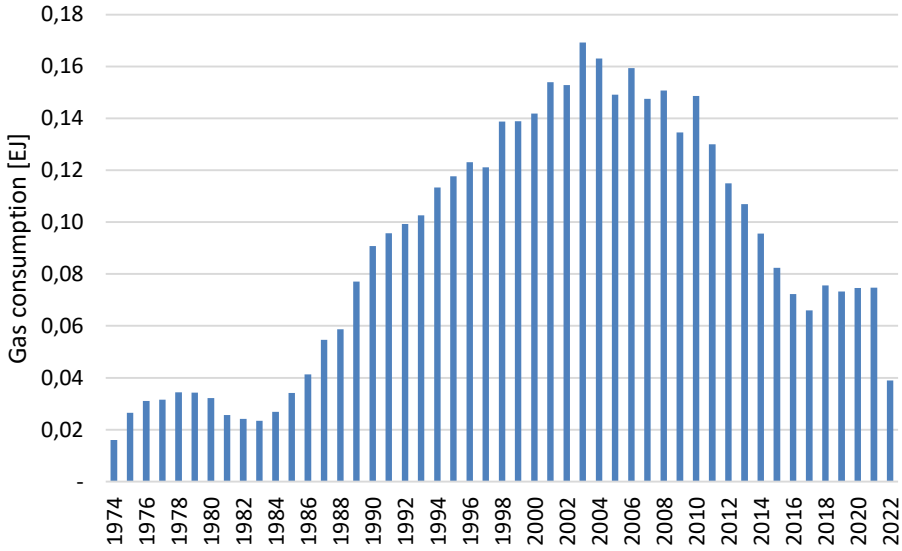


Fig. 2. Consumption of natural gas
Source: own work based on (BP 2023)

Rys. 2. Zużycie gazu ziemnego

As can be seen from the figure, natural gas consumption has been steadily decreasing since 2003, when it reached its peak. The largest decrease was recorded in 2022 after the suspension of imports from Russia. This consumption, despite the change of supply sources, is not expected to increase, as the country is trying to move away from fossil fuels and focus on renewable energy sources, low-carbon nuclear power and low-carbon hydrogen.

The vast majority of gas demand comes from industry (52% of total demand in 2021) and electricity and heat generation (45%). Consumption in residential and commercial buildings is negligible; in 2021, less than 700 residential buildings and only 1,100 commercial buildings used natural gas for heating (Finland 2023).

3. Crude oil

When discussing the country's energy security, special attention should be paid to the key energy companies. The largest and only oil company in Finland is Neste. It does not own shares in any company that extracts oil or conducts exploration, it only buys oil and processes it. Looking ahead, Neste is preparing to convert the refinery in Porvoo into a closed-loop refinery based on renewable sources with an annual production capacity of 2–4 million tons and complete oil refining by the mid-twenty-thirties. The Porvoo refinery is already introducing renewable and recycled raw materials, such as liquefied plastic waste (Neste 2022).

Oil consumption in the years 1965–2022 is presented in Figure 3.

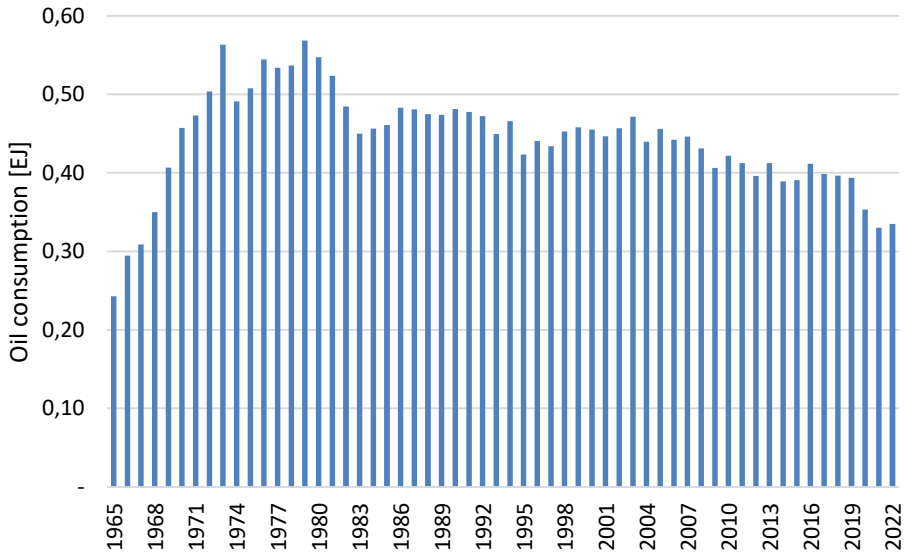


Fig. 3. Crude oil consumption
Source: own work based on (BP 2023)

Rys. 3. Zużycie ropy naftowej

In the case of crude oil, as in the case of natural gas, consumption decreases year by year. The downward trend has been going on for almost forty years. Despite a minimal increase in consumption in 2022 compared to the previous year, a change in the trend should not be expected as the Finnish government plans to increase the electrification of transport and the use of hydrogen fuel.

Oil is mainly used in transport, but it is refined in Finland into diesel and gas for both domestic consumption and export.

Finland, due to its geographical location and historical conditions, imported most of its crude oil from Russia. After the Russian invasion of Ukraine, Finland decided to change the supplier of this raw material. As recently as 2021, the share of Russian Urals oil in Finnish supplies was 84%, by 2022 it was already only 17% (Reuters 2023). On December 5, 2022, the European Union and the UK banned Russian oil imports by sea to cut off Russia's fossil fuel revenues (Myllyvirta 2022). However, the Finnish company Neste stopped importing Russian oil in July 2022, ending the long-term contract. Contracts for the supply of other fossil resources from Russia have also expired (Neste 2022). Before Russia's invasion of Ukraine, Finland's annual imports of crude oil and petroleum products from Russia were worth about 3.5 billion euros. The share of crude oil was about 2.7 billion euros, 91% of which came from Russia (Euractiv 2023).

Figure 4 shows the percentage share of oil suppliers to Finland in 2021, and Figure 5 shows the percentage share of oil suppliers in 2022.

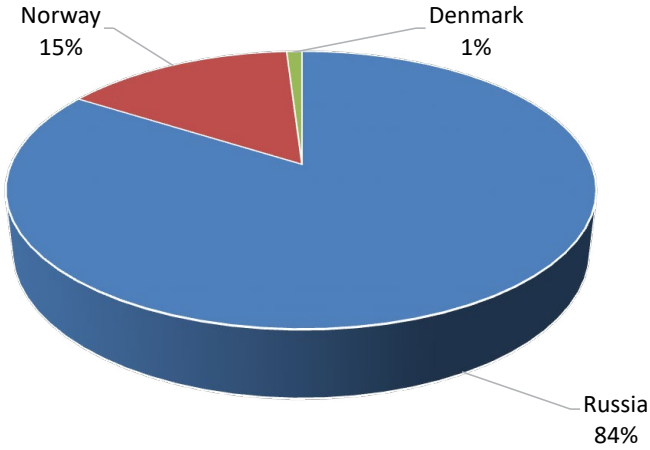


Fig. 4. Imports of crude oil in 2021
Source: own work based on (Reuters 2023)

Rys. 4. Import ropy naftowej w 2021 roku

Using oil as an example, it is best seen how import sources have changed between 2021 and 2022. In 2021, as many as 84% of supplies came from Russia. The rest included 15% from Norway and 1% from Denmark. In 2022, the situation changed dramatically, and the majority of supplies came from Norway – 65%, the United Kingdom – 8%, the United States – 7%, and Denmark – 3%. Russia imported only 17% of its crude oil in the first half of the year. Later, oil from Russia was no longer imported.

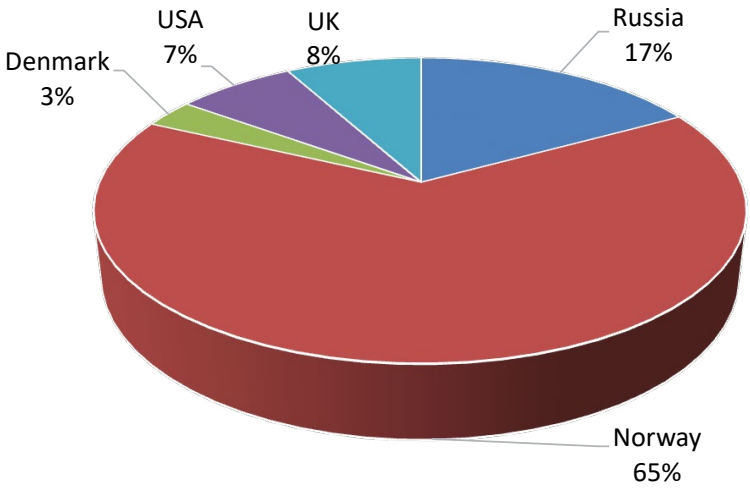


Fig. 5. Imports of crude oil in 2022
Source: own work based on (Reuters 2023)

Rys. 5. Import ropy naftowej w 2022 roku

4. Electricity

Finland has 475 power plants and combined heat and power plants. This is a large number for a country so sparsely populated. However, these are usually small units with only a few megawatts of power. Large power plants include nuclear power plants, primarily Olkiluoto 3 with a pressurized water reactor (EPR – *European Pressurized Water Reactor*) with an installed capacity of 1600 MW (Fig. 6), and Olkiluoto 2 and Olkiluoto 1, with capacities of 890 MW each (Energiavirasto 2023b). Olkiluoto 3 started operating on April 16, 2023 and currently covers about 30% of the country's electricity needs (TVO 2023a).

As a result of Olkiluoto 3, the share of zero-emission electricity production will increase from 89 to 93%. There will also be a 60% reduction in electricity imports, and production from this reactor will cover 14% of Finland's electricity needs. The electricity produced by the power plant per year will yield 12 TWh, which is enough to heat 5.2 million apartments or charge, for example, 3.6 million electric cars (TVO 2023b).

The oldest nuclear power plant in Finland is the Loviisa power plant. The first unit of the Loviisa power plant was commissioned in 1977, and the second in 1980. Each of them has a capacity of 507 MW. In 2022, the power plant produced 7.9 TWh of electricity, which covered 10% of the domestic demand. Currently, the Finnish government has granted a new operating license to the Loviisa nuclear power plant, which will allow energy production until the end of 2050. The power plant units are pressurized water reactors of the VVER-440 type. In 2018, the power

Fig. 6. Olkiluoto 3 Power Plant
Source: (TVO 2023a)

Rys. 6. Elektrownia Olkiluoto 3

plant was thoroughly modernized (Fortum 2023). The two Finnish nuclear power plants (Olkiluoto with three reactors and Loviisa with two reactors) have a total installed capacity of 4.39 GW.

The total installed capacity in Finland's power system amounted to 18.7 GW in 2021 (in April 2023, it increased by 1.6 GW as a result of the commissioning of Olkiluoto 3). However, the level of electricity production was too low to meet the country's total energy needs, so Finland had to import electricity. Between 2010 and 2021, net electricity imports ranged from 11–20 TWh, corresponding to 14–31% of Finland's electricity supply. In the past, electricity was imported mainly from Russia, which in the years 2005–2011 accounted for an average of 88% of net imports. Since 2012, imports have come mainly from Sweden, which accounted for 87% of net imports in 2012–2021 (Finland 2023). Finland has cross-border interconnections with Estonia, Norway, Sweden and Russia, and, through Nord Pool, with Denmark, Germany, Lithuania, the Netherlands and Poland. In 2022, these connections had a total import capacity of 5.38 GW and a total export capacity of 3.98 GW. Finland's transmission system operator Fingrid, together with its Swedish counterpart Svenska kraftnät, plans to extend the existing Aurora connection with another 400 kV line by 2025 to increase import and export capacity (Fingrid 2022). It is also planned to add DC power to the existing submarine cable connection between Finland and Estonia. If these plans were to be implemented, the additional capacity would more than compensate for the loss of connections with Russia.

Figure 7 shows the production of electricity in the years 1986–2022.

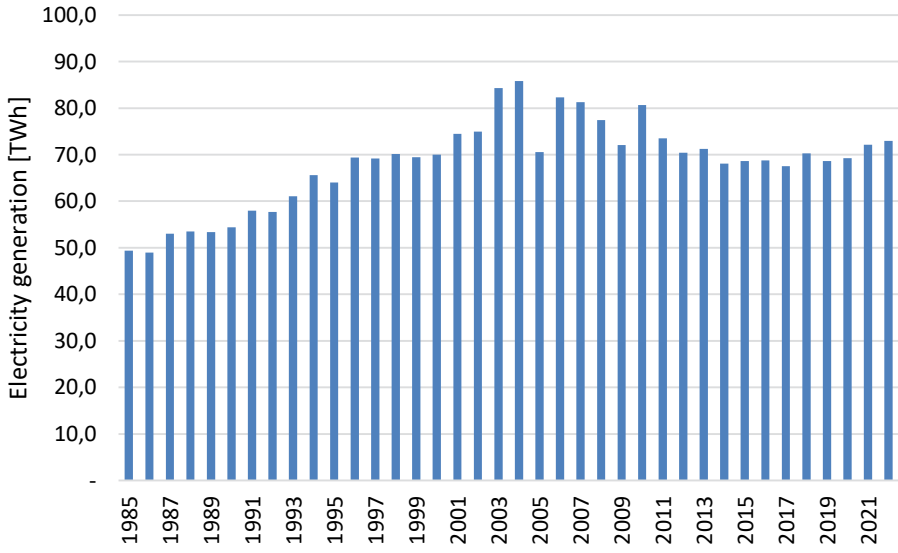


Fig. 7. Electricity production
Source: own work based on (BP 2023)

Rys. 7. Produkcja energii elektrycznej

The energy mix of Finland in 2022 deserves special attention (Fig. 8).

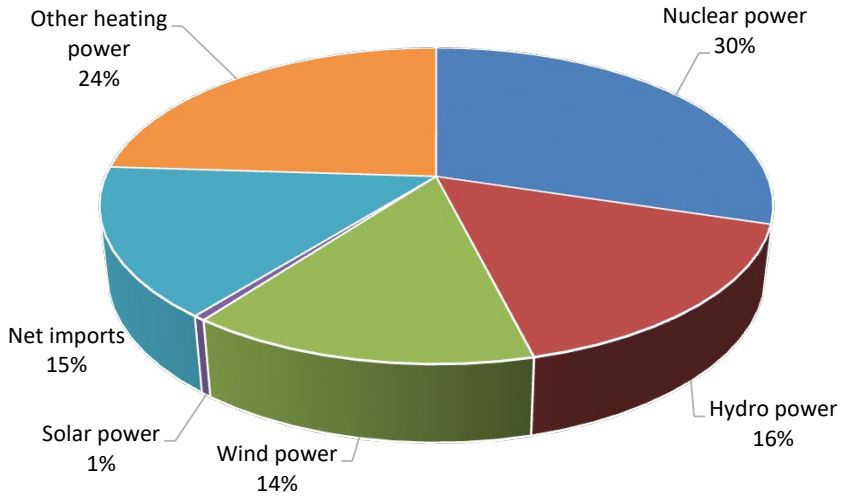


Fig. 8. Finland's energy mix in 2022
Source: own work based on (Finland in figures 2023)

Rys. 8. Miks energetyczny Finlandii w 2022 roku

This mix is very diverse. About 30% of electricity production comes from nuclear power plants, 16% from hydroelectric power plants, 14% from wind power plants, and 24% from other heat sources, which include peat, coal, natural gas, and light and heavy fuel oil. Such diverse sources of electricity generation confirm the validity of Finland's energy policy.

5. Renewable energy sources

In order to become independent from Russia, as well as to meet the requirements of the European Union, Finland has recently made significant progress in the implementation of renewable energy sources. Figure 9 shows the production of electricity from renewable energy sources (RES).

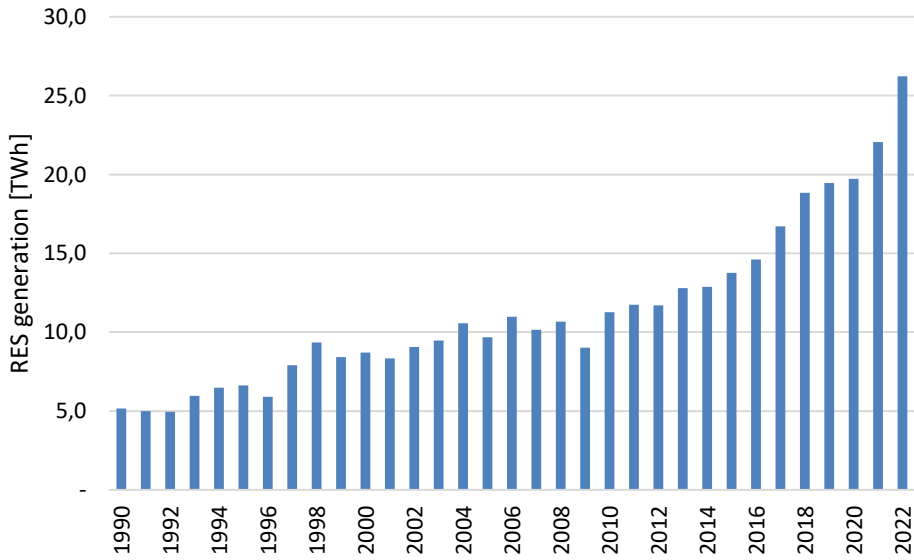
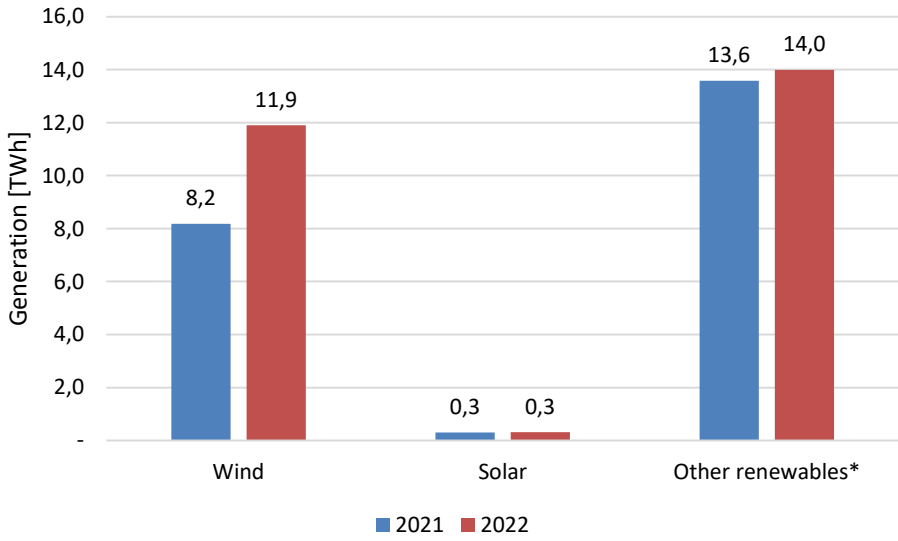


Fig. 9. Electricity production from renewable energy sources
Source: own work based on (BP 2023)

Rys. 9. Produkcja energii elektrycznej z odnawialnych źródeł energii

As can be seen, this production is increasing all the time, but a rapid increase occurred after 2020. Figure 10 clearly shows that wind energy developed best in the last year; the generation has increased from 8.2 TWh to 11.9 TWh. The generation from other sources, which include biomass, hydropower, geothermal, etc., has also increased slightly.



* biomass, hydropower, geothermal, etc.

Fig. 10. Production of electricity from RES by source
Source: own work based on (BP 2023)

Fig. 10. Produkcja energii elektrycznej z OZE z podziałem na źródła

The largest increase in electricity production was from wind power, up by 3.7 TWh, photovoltaics remained unchanged and other renewables only slightly increased production, by just 0.4 TWh.

Wind power in Finland initially developed quite slowly, as can be seen in Figure 11.

From 2000, when generation was 0.1 TWh, until 2021 when there was an increase to 0.5 TWh, there was virtually little investment in the industry. After 2012, and especially after 2014, wind energy began to develop rapidly. At the end of 2022, 1,393 wind turbines with a total capacity of 5,677 MW were installed. These generated 14.1% of Finland's electricity consumption in 2022 (Tuulivoimayhdistys 2023). According to the latest report, Wind power statistics, first half of 2023 (Wind power 2023), there were 1,468 wind turbines in Finland in the first half of 2023, with a total installed capacity of 6,116 MW. The following companies have the largest shares in the installed capacity in wind energy: Taaleri Energia (11%), Neoen (8%), EPV Tuulivoima Oy (8%), Exilion Tuuli Ky (7%), and Gigawatti Oy (5%). The share of other companies does not exceed 5% (Wind power 2023). The Finnish Wind Power Association (FWPA) predicts that in 2040, Finland will generate about 100 TWh per year from onshore wind power and 100 TWh per year from offshore wind power. There will also be a growing demand for renewable energy in Finland. According to Fingrid System Vision (Fingrid 2023), under all four electricity system development scenarios, Finland's electricity consumption will increase from 86 TWh to 128 188 TWh by 2035.

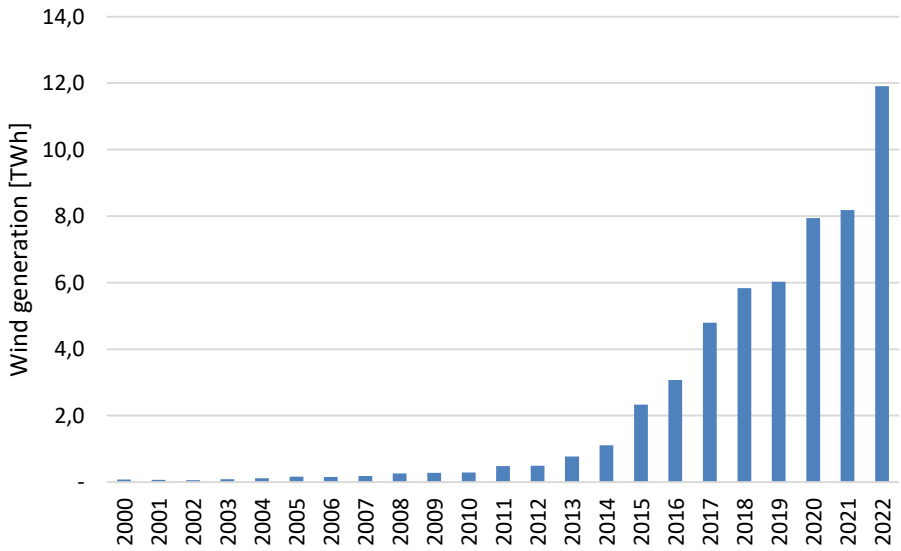


Fig. 11. Electricity production from wind
Source: own work based on (BP 2023)

Rys. 11. Produkcja energii elektrycznej z wiatru

6. Directions for the coming years

After the Russian invasion of Ukraine, in practice, a lot of emphasis was put on reducing dependence on energy imports and raw materials from uncertain suppliers such as Russia. On the other hand, the Member States began to import goods from partners whose actions and reactions, especially in crisis situations, can be easily predicted. As a result, since May 2022, electricity trade with Russia has been suspended due to sanctions (National Report 2022). It is indisputable that Finland should have become independent of such an unpredictable supplier as Russia many years earlier. However, the issue of energy efficiency, i.e. reducing the energy demand, was of great importance in this case. Business partners – suppliers of energy or raw materials – are now chosen more carefully, while imports have been reduced in favor of internal energy production from local sources, with a clear emphasis on the use of renewable energy sources on a larger scale.

Reducing dependence on energy imports and ensuring energy security are one of the most important areas of Finland's energy policy next to climate neutrality, which is to be achieved by 2035. Under Finland's Climate Change Act (SUOMEN SÄÄDÖSKOKOELMA 2022), updated on July 1, 2022, it has become a legal obligation to promote a sustainable economy and protect

biodiversity. The above aspects are included in one of the most important documents of Finnish energy and climate policy at the moment "Carbon neutral Finland 2035 – national climate and energy strategy" (Carbon neutral Finland 2022). This is a national strategy that sets out measures to ensure that Finland will be in a position to meet the European Union's climate commitments for 2030, as well as to meet the targets set out in the Climate Act (SUOMEN SÄÄDÖSKOELMA 2022). The Climate Act itself provides for medium- and long-term plans and aims to create and monitor the implementation of a coherent state climate policy, while coordinating and supporting the activities of state bodies that aim to mitigate climate change. It is also linked to EU targets (particularly on the subject of greenhouse gases). The Act is aimed at reducing greenhouse gas emissions to the atmosphere by at least 60% by 2030, 80% by 2040, and 90% by 2050 (aiming for 95%) compared to 1990 levels. However, when making decisions, the Finnish authorities need to comply with the EU targets in this sector. These, on the other hand, assume a total reduction in greenhouse gas emissions by 2050 (Commission 2023). However, looking at the current situation regarding greenhouse gas emissions in Finland, and more specifically its reduction, it is clear that the situation has undoubtedly been improving in recent years. Over the last twenty years, there has been a significant decrease in CO_2 emissions by more than 40 million tons. Interestingly, more than 50% of Finland's emissions are due to the production of electricity from coal, which accounts for only 5% of total electricity production (Electricitymaps 2023). It can, therefore be seen that the Finns, undeniably, are managing this objective very well, for example, by reducing the role of the aforementioned raw material in their energy mix. The Climate Act additionally stipulates that governing bodies must approve a long-term climate change policy plan, i.e. a national climate change adaptation plan, once every ten years. It should include a scenario for greenhouse gas emissions in the perspective of 2050. Moreover, the government approves a medium-term climate change policy plan once per term. The above plans are always reviewed by the public. On the other hand, an annual climate report is issued every year, which contains, among others, information on emissions and their reduction. In addition, an independent expert body, the Finnish Climate Change Panel, has been appointed by the government for a four-year term to support climate policy planning (Finnish Suomen ilmastopaneeli) (SUOMEN SÄÄDÖSKOKOELMA 2022). The data contained in the Climate Act and the framework set by the European Union were therefore the basis for the creation of the document "Carbon neutral Finland 2035 – national climate and energy strategy" (Carbon neutral Finland 2022) with a particular emphasis on carbon neutrality, which was also one of the main assumptions of the program of the government of the former (until this year) Prime Minister Sanna Marin. Currently, this role is played by Petteri Orpo. Carbon neutral Finland 2035 – national climate and energy strategy, Publications of the Ministry of Economic Affairs and Employment Energy 2022 therefore presents a specific framework, comparing it with the framework set by the European Union. One of these is the reduction of greenhouse gas emissions in Finland by a minimum of 60% by 2030, compared to 2005, while the European Union's target is a 40% reduction compared to 1990. The share of renewable energy in the gross final energy consumption is equally important. Looking at the current trend, Finland will soon have a chance to meet the target set for 2030 at a minimum of 51%. For the same year, the target for the European Union is 32% (Carbon neutral Finland

2022). In the long-term context, the share of renewable energy is projected to increase above Finland's indicative minimum target in the EU's Fit for 55 package by 2030 (Fit 2022).

Finland is also strongly involved in energy efficiency issues, and the target level included in the Carbon neutral Finland 2035 – national climate and energy strategy, Publications of the Ministry of Economic Affairs and Employment Energy 2022 for 2030 is the final energy consumption of no more than 290 TWh by 2030, which results in a reduction in consumption by a minimum of 32.5% compared to 2007. There are many programs that favor and promote energy saving or the modernization or thermo modernization of buildings. Particular attention is paid to the role of energy audits as effective tools for achieving energy savings, especially in small and medium -sized enterprises.

Several measures are currently being taken to gradually achieve carbon neutrality in Finland. These include measures such as the widespread use of renewable energy sources and the large -scale development of nuclear power, improved energy efficiency, electrification, the development and commercialization of new energy technologies, and the use of biomass and biofuels. The further development of projects related to renewable energy sources is also planned. One of these is to emphasize the role of energy communities in the context of encouraging communities to produce energy in specific areas, on a small scale, which also promotes energy security. It is planned to accelerate the procedures for issuing permits for investments related to the green transition, e.g. wind farms. Equally interesting projects – as Finland has access to the Baltic Sea – are an offshore wind energy project (possibly supported by EU funds) and the development of offshore energy, including the development of offshore power grids. The implementation of the national hydrogen strategy is also envisaged.

In Finland, there are plans for the commercial implementation of hydrogen solutions, i.e. the use of clean hydrogen and electro-fuels for industry (in the context of low-carbon industry), as well as transport and the energy system. This is related to the development of hydrogen networks, i.e. investments in hydrogen transmission and distribution. The target set for electro fuels is to account for 3 percent of all transport fuels used. The development of hydrogen networks is an important issue for Finnish energy policy. Therefore, the government's objectives include investments in distribution networks, increasing the security of supplies, and, in the event of electricity shortages, providing peak power reserves. Currently, Finland is one of the pioneers in the development of smart grids and, looking forward, is likely to remain so.

With regard to Finland's energy policy, it is also important to consider the role of gas in the context of the diversification of supply routes due to Finland's geographical location and the existing connection of the Finnish gas system with the Russian gas network. Furthermore, gas storage (in liquefied form), transmission between other Baltic countries, and the expansion of LNG infrastructure are the key issues. The use of the Balticconnector gas pipeline and the LNG terminal in Klaipeda, Lithuania, as well as the GIPL pipeline from Poland and other European countries, will play an important role in the coming years. The new gas supply routes will undoubtedly contribute to ensuring Finland's energy security. As in Poland, the launching of new nuclear technologies with a special focus on small and modular examples – SMRs (*Small Modular Reactors*) is also planned in Finland. This is a very interesting technology because it does

not require large areas, so the Finns will have more flexibility in considering possible reactor sites. In addition, SMR technology can be integrated with renewable energy sources, such as wind and photovoltaic power plants, and as a complementary energy source, e.g. in the case of energy communities. The potential of waste heat, estimated to be 35 TWh, can help to eliminate the use of coal in power generation (Carbon neutral Finland 2022). This entails several energy, economic and environmental benefits with a particular emphasis on energy efficiency, reduced fuel consumption, sustainability in the broader sense, as well as cost savings or the availability of heat locally without the need to transport it and without the associated losses. The above information shows that Finland's energy and climate strategy for the coming years is therefore focused on the green transformation.

Conclusions

Finland has been dependent for decades on energy supplies from the Soviet Union and then Russia. After the Russian invasion of Ukraine, Finland decided to become independent from its neighbor and took decisive steps to move away from fossil fuels which were imported from the East. Such measures have made it possible not only to increase one's energy security but, through the development of renewable energy sources, to reduce greenhouse gas emissions into the atmosphere. Finland is one of the leading countries striving for carbon neutrality, as it declared in its energy policy. Finland aims to achieve climate neutrality by 2035, which puts the country at the forefront of the world in this area. Also noteworthy is the country's strong commitment to technological innovation and an increasing commitment of funding to research and development initiatives. Due to the development of renewable and nuclear energy, Finland will soon become an exporter of electricity. Of the various forms of renewable electricity generation, onshore wind power is the most promising, although the development of large offshore wind farms is also planned. The development of photovoltaics is also planned, although so far it is of marginal importance in the country's energy mix. In the field of heating, it is planned to move away from combustion sources in favor of heat pumps, waste heat recovery, and the use of geothermal energy.

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Bezpieczeństwo energetyczne Finlandii po przystąpieniu do NATO

Streszczenie

Celem artykułu jest pokazanie sytuacji energetycznej Finlandii po agresji Rosji na Ukrainę oraz związanym z tym faktem wstąpieniem tego kraju do struktur NATO. Sytuacja taka ma miejsce po raz pierwszy w historii i analiza tego zjawiska jest ważnym elementem planowania polityki energetycznej dla innych państw. W artykule pokazano, jak można szybko i skutecznie podejmować decyzje mające wpływ na bezpieczeństwo energetyczne kraju.

Finlandia ze względu na swoje położenie geograficzne oraz uwarunkowania historyczne do niedawna była ściśle powiązana gospodarczo ze Związkiem Radzieckim, a następnie z Rosją. Sytuacja ta zmieniła się jednak diametralnie po napaści Rosji na Ukrainę. Spowodowało to zmianę myślenia polityków odpowiedzialnych za bezpieczeństwo, w tym bezpieczeństwo energetyczne.

Ze względu na brak zasobów surowców energetycznych oraz w celu dążenia do osiągnięcia neutralności klimatycznej, Finlandia sukcesywnie zwiększa udział OZE w swoim miksie energetycznym. Rozwijana jest również energetyka jądrowa stanowiąca jedno z najważniejszych źródeł produkcji energii elektrycznej w tym kraju. W 2021 roku miała 33% udział w całkowitej produkcji energii elektrycznej, a dwie fińskie elektrownie jądrowe mają łączną moc zainstalowaną wynoszącą 4,39 GW. Własna produkcja oraz import z bezpiecznych kierunków to podstawa bezpieczeństwa energetycznego Finlandii, zwłaszcza po wstrzymaniu dostaw energii elektrycznej i gazu z Rosji w maju 2022 roku. Obecnie energia elektryczna importowana jest głównie ze Szwecji, a gaz gazociągiem z Estonii oraz przez trzy małe terminale LNG. Zgodnie z planami rządu fińskiego od 2030 roku Finlandia ma się stać eksporterem energii elektrycznej dzięki zwiększaniu produkcji energii elektrycznej z elektrowni jądrowych oraz ze źródeł odnawialnych. Planowane jest też wykorzystywanie w większym zakresie pomp ciepła oraz ciepła odpadowego w ogrzewnictwie.

Słowa kluczowe: bezpieczeństwo energetyczne, polityka energetyczna, NATO