REGIONAL CONSIDERATIONS IN THE NATIONAL ENERGY-MIX TRANSFORMATION

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Abstract

The article is a concise overview of the national transformation of the energy-mix, with a focus on of the Pomeranian region in Poland (the main location of the energy sources discussed), on the basis of economics and social aspects. For the first time, Polish society, especially the inhabitants of Pomerania, are encountering a situation in which many investments in the power industry utilizing new energy technologies, unfamiliar to the general public, are being publicly considered. Among them, there are technologies that evoke fear and arouse controversies, notably; nuclear energy and offshore wind farms. These two future options for the desired Polish energy-mix are discussed as an alternative to the one described in the national energy policy document PEP 2040 (Monitor Polski, PEP 2040). These alternatives are compared with the regional and national challenges of the UE legislation and their highly ambitions targets. First, a concise overview of the literature on energy-mix transformation and the social aspects of the energy transition is presented. Second, it attempts to show the economics of the choices presented last year by two important institutions: the PSEW, concerning the development of new possible sites for offshore wind farms in the Baltic Sea, and the nuclear experts of the Ministry of Climate and Environment, regarding a potential increase in nuclear energy as planned according to PEP 2040. The analysis is based on cost calculations, including both LCOE (levelized cost of energy) as well as the external costs analysis – predefined in the previous work published by the Institute of Environmental Protection [Mitroczuk ed. 2022]. Lastly, the article discusses multiple social considerations relevant to a successful energy transition.

Key words: *Energy-Mix Transformation, Climate Change, Renewable Energy Sources, External Costs of Energy Production, Social Cost*

1. LITERATURE REVIEW

Energy-mix transformation, as a research subject is broadly described in scientific literature. The fundamental consideration is that climate change is caused by anthropogenic sources and that is compelling the world to pursue decarbonisation. Decarbonisation is not only possible but also highly needed, especially in the way we produce energy. There is substantial evidence to support those efforts globally [Fisher 2013; UNGA Paris Agreement 2015] and on the regional level [Hansen et al. 2013; Fisher 2013; Wewerinke-Singh 2021; Popkiewicz 2022, Tatarewicz 2022]. A way forward in this process is the need to decarbonise the energy-mix [IRENA 2016; Fofrich et al. 2020; Wimbadi et al. 2020; Darby, Gerretsen 2020]. Climate change is the backbone of the United Nations documents [IPCC 2018; UNFCCC 2020; UNFCCC 2021] and underpins the efforts of the European Union to decarbonise [EC 2014; EU 2019; Minas 2020; EU 2022a; EU 2022b]. Moreover, advice from the International Energy Agency is evident and presented in the World Energy Outlook report [IEA 2020]. There is growing body of literature that emphasizes that human rights, as well as the social dimensions of the energy-mix transformation, are essential [Center for Global Development 2016; Olsson et al. 2020; Wewerinke-Singh 2021].

Fossil fuels powered sources are the most evident adversary in the way the energy-mix transformation is designed. The speed and the level of penetration of the energy-mix with low-carbon energy technologies, including those of renewable energy sources (RES) are discussed in numerous publications worldwide [Valentine et al. 2019; Lederer et al. 2019; PIE 2019; Deloitte 2020; Keles, Yilmaz 2020; Blondeel et al. 2021; MacKinsey & Company 2021; Jonek-Kowalska 2022; Torres, Petrakopoulou 2022; Chorowski 2022]. The most paramount consideration in discussions concerning the economics of the energy-mix transformation is the efficiency of RES (renewable energy sources). There is extensive evidence suggests that it did increase over the last decades, and that the LCOE is declining, sometimes at a rapid rate [Lazard 2020; Infield, Freris 2020; Christophers 2022; Banks 2022].

Specific energy-mix models that can be highly effective in facilitating climate transformation and decarbonisation of the energy-mix are elaborated upon. One example could be the simultaneous use of natural gas and RES, as proposed in the Polish Energy Programme [Monitor Polski 2020]. These solutions are described as having substantial potential in some parts of the world including the United States and China [Pless et al. 2016; Xu et al. 2017; EIA 2020a; EIA 2020b; EIA 2020c]. Additionally, there is extensive literature on the role of distributed or decentralised energy production. That is viewed as a possible solution to the grid investment problems and challenges outlined in PEP 2040. [Lund et al. 2019; Burger et al. 2019a; Burger et al., 2019b; Nyangon, Byrne 2022; Banks 2022].

Negative externalities accompanying energy production are vital in the important discussion on the energy-mix composition. A significant proportion of fossil fuels in the Polish energy-mix is considered a primary problem for society both now and in the near future. However, this discussion is of utmost importance not only for Poland but also to the future of the planet and is also covered by the growing body of literature. Many economists have advocated environmental Pigouvian taxes as a means to rectify the situation, analysed from the perspective of the common good for society. Pigouvian taxes are intended to serve as the the primary environmental policy instrument, forcing power generation units to internalise the high social costs of using fossil fuels, that cause both GHG emissions and the release of many harmful substances, including PM2,5 and PM10 [Pearce 1991; Goulder 1995; Koeppl et al. 1996; Speck 2006; Anderson 2019]. According to numerous researchers, the challenge of precisely measuring the total social cost of using fossil fuels makes the Pigou tax, a policy instrument, based on the best available estimates, a crucial signal for the need to internalise the social costs of the climate change processes. Energy companies pay taxes, levied upon them to raise their private costs up to the level necessary to internalise the negative externality. This phenomenon is one of the most important pillars of modern environmental economics [Preiss et al. 2008; Pindyck 2013; Pindyck 2019; Andersson 2019]. Although this subject is not covered in this article, there is extensive literature that proves that Pigou taxes, when used with care, do not have a detrimental influence on employment or GDP growth – a subject of utmost importance to our regional and national discussion on the energy-mix solutions to be adopted in Poland in the near future [Metcalf, Stock 2020a; Metcalf, Stock 2020b]. It is also essential to address the issue of the high cost associated with the energy-mix transformation away from fossil fuels to RES. It does not mean only investment expenses necessary to change the base of the energy system. Significant costs are also associated with the so-called network cost of RES. If not accounted for, these costs would put RES in an even more favourable position to fossil fuels, solely based on the declining LCOE. Those costs are also identified in a considerable number of publications [Mai et al. 2013; D'haeseleer 2013; Fraunhofer 2015; ARE 2016; Al Matin et al. 2019; Burger et al. 2019b; Karkour et al. 2020; Pillai et al. 2021; Falvo et al. 2021; Veronese et al. 2021; Yang et al. 2022].

The review of literature on social and energy issues encompasses several aspects such as 1) just transition, understood as access to safe (renewable, zero-emission) and affordable power while eliminating energy poverty, and which also results in compensation for communities affected by restructuring [Biernat-Jarka, Trębska, Jarka 2021] [Karpinska, Śmiech 202], 2) social acceptance for energy investments [Mrozowska 2016] and 3) health issues [Vasev 2017].

2. PURPOSE AND METHODOLOGY

According to economics theory, the energy-mix transformation, as outlined in the Polish Energy Policy 2040 [Monitor Polski 2020], entails a change away from fossil fuels to RES and gas sources as a temporary solution – a vital base of the whole energy-mix. This shift will lead to improved air and environmental quality, as well as the potential creation of many new businesses in the energy and industry sectors, providing services to the power industry, including the creation of millions of new jobs [Europe 2017]. Today coal serves as the base of the energy system, yet it is not socially desirable because it causes emissions harmful to the environment as well as air pollution that leads to many lethal diseases. The social marginal cost of using solar energy is lower than the private cost, while the social marginal cost of using coal surpasses the private cost. As such, there is a capacity for a net gain in the energy-mix transformation process [Anderson 2019].

Economics theory plays a vital role in shaping the desired direction for the transformation of the energy-mix. That transformation aims to eliminate expensive energy sources, assessed from a social perspective and develop effective and cheap renewable sources, measured through a comparison of social costs. Another the evolution of energy prices from various sources as measured over time should be a key aspect of the discussion [Lazard 2020]. The evaluation of energy recourses in terms of technology and economics is based on the LCOE analysis. The LCOE equates to the cost of producing a kilowatt hour (KWh) using a given source of energy. In general, LCOE is calculated as the summation of the total costs incurred by the company divided by the total energy produced during the lifetime of its operations. The costs include: (1) the initial investment, (2) operation and maintenance (O&M) costs, (3) the fuel and consumable costs. The total MWh (megawatt hours) of energy produced in that plant can be adjusted by taking into account the proper degradation rate of the power plant [Papapetrou 2022]. Considering this data, the PV energy prices in the United States have decreased by approximately 15% since a decade ago [Lazard 2020]. It can be assumed that the process of falling RES prices could continue in the future. Therefore the decisions made today to shape the energy-mix of a country in the medium and long term should take this into account.

Let us also consider the results of the comprehensive renewables-oriented energy transformation. A report on the economic benefits generated by the use of renewable energy was prepared by IRENA. This study establishes that the benefits of doubling the share of RES in the global energy-mix would increase global GDP by 0.6 and 1.1% by 2030. Morover, this doubling of the renewables' share in the global energy-mix would world result in a 24.4 m increase in employment in that sector [IRENA 2016]. This article analyses, two alternative options for the development of the future energy-mix in Poland from 2020–2050. Both are juxtaposed to the one outlined in governmental documents [Monitor Polski 2020]. It is evident that some new directions shown in last year's government plan [KPRM 2022] are not sufficient enough to achieve the goals set by the EU's Fit For 55 package. Furthermore, it appears that social expectations regarding the future of the country and the quality of life, to which quality of air is vital, are changing rapidly. Heating and cooking in residential buildings constitute an important source of emissions of greenhouse gases and air pollutants, accounting for 84% of total household energy consumption. Air pollution is one of the greatest threats to health, it can lead to strokes, heart diseases, lung cancer, as well as chronic and acute respiratory diseases, including asthma. A recent report of the European Public Health Alliance [Korteland et al. 2022] states that Poland has the highest coal consumption in comparison to other the countries in the region. Coal boilers account for 30% of total household energy consumption and constitute 64% of all social health costs in the country.

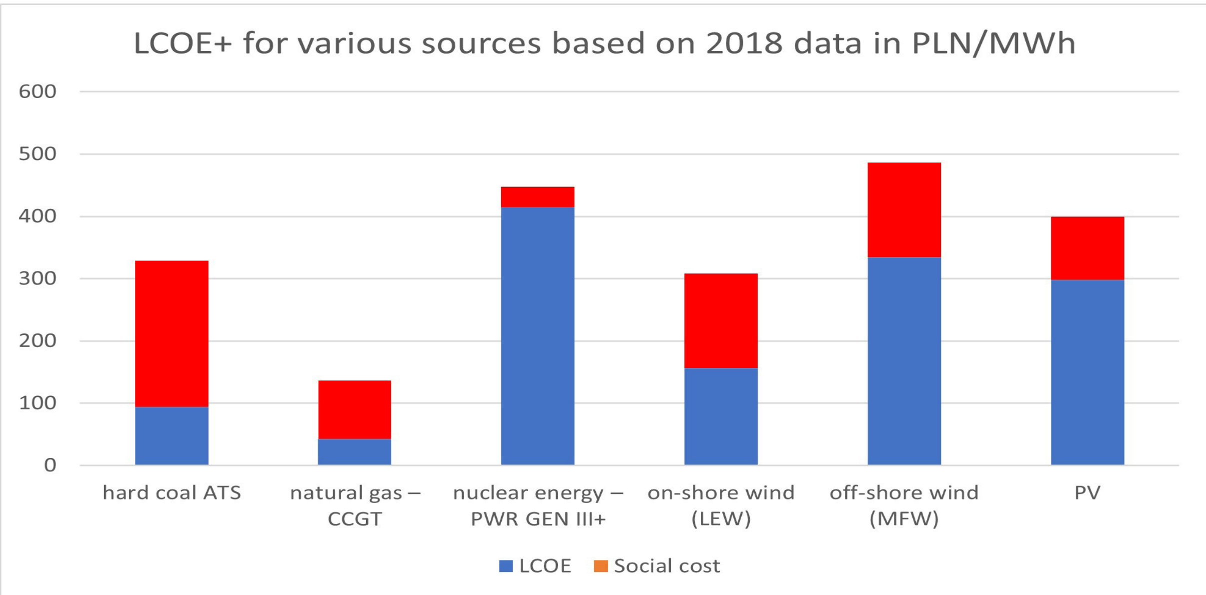
That is why the status quo –represented by the governmental plan for 2040, is compared to an alternative view described as a methodology in the previous publication [Mitroczuk, ed. 2022]. This methodology is used to evaluate two alternative scenarios presented recently by the PSEW [PSEW 2022], as well as by nuclear experts of the Ministry of Climate and Environment [PAP 2022], which are not mutually exclusive. The first scenario presents new possibilities and areas of the Baltic Sea for wind farms. These surpass what was planned on the basis of PEP2040: proposing not 11 but 33 GW of offshore wind farms, which could be built on the Baltic Sea, providing a substantial proportion of the energy-mix. The other scenario envisions a significantly bigger ratio of nuclear energy in the total energy-mix for the year 2040, exceeding the 6-7 GW proposed in PEP 2040. The total costs (private and social) associated withpursuing such energy-mix models are calculated assuming that the cost relations are as they were when PEP 2040 was prepared (2018). The second analysis, expecting the possible further decline of the RES sources LCOE over the next decade to come, is based on LAZARD calculations of the previous ten years. A conservative position is taken that there could be only half of the changes, already observed in the previous decennium [Lazard 2020].

The whole exercise consists of simple cost calculations combining the LCOE as well as the estimations of external costs (based on the cited literature). The details of simplifying assumptions can be found in the earlier publication by the Institute of Environmental Protection [Mitroczuk, ed. 2022]. The estimates of social costs were calculated by adding external expenses of emissions that are borne by society as a whole. Those costs are associated with the negative effects of fossil fuels on health, the environment, and the climate. They are at the level of 35 EUR/MWh (2008) and 55 EUR/MWh (2030) for hard coal CHP and 15 EUR/MWh (2008) to 22 EUR/MWh (2030) for a gas turbine [Preiss et al. 2008]. Other research puts them at comparable levels of 40 EUR/MWh (2012) for coal and 20 EUR/MWh (2012) for gas [D'haeseleer 2013]. The simple excel model that we use puts them at a moderate level of 50 EUR/MWh for hard coal and 20 EUR/MWh for gas-powered sources.

In the analysis of the nuclear-intensive solution for the future energy-mix of Poland, the issue of nuclear security is also important. Even though Polish society approves of governmental plans to incorporate nuclear energy in the mix, the possible costs of nuclear disasters belong to social expenses – they are included here as proposed by D'haeseleer in his report to the EC, where the environmental costs for nuclear energy

are put at the level of EUR 7/MWh, including possible accidents [D'haeseleer 2013], adjusted by data from OECD countries [Karkour et al. 2020].
The same is true for the RES network costs. A full catalogue of costs for the grid resulting from the extensive (high penetration ratio of RES in the energy-mix) is taken into account, that is the balancing, network, and profile costs of RES. Those values are added to the LCOE as presented in Figure 1. This analysis is limited to six main energy sources that together constitute 95% of the 2040 energy mix, according to the national strategy PEP 2040. It follows the cost of (1) hard coal power plants – ASC PC. It then tracks (2) natural gas power generation or CCGT, described in the policy as an intermediary and medium-term substitute for coal, indispensable to guarantee the stability of the system, coupled with a growing share of renewable sources and (3) nuclear energy as the necessary base of the future energy mix. The analysis is limited to the three most important renewable sources: (1) on-shore wind (LEW), (2) off-shore wind (MFW), and (3) photovoltaics (PV), the last source being successfully developed by individual prosumers at a record speed, an 1100% increase in the number of Polish prosumers from just 4,000 in 2015 to 0.5 million in 2021 and 1 million expected by 2030 [Kurtyka 2021]. The process was enabled by initially generous financial support from the government and a growing social consciousness of environmental and energy issues.

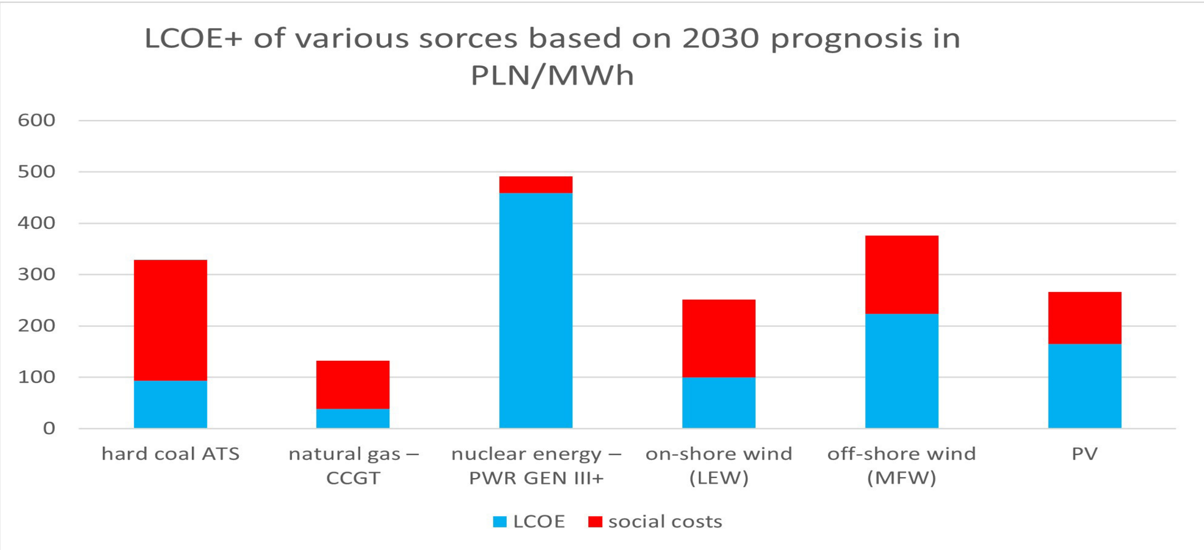
Figure 1. LCOE and the social costs (LCOE+) for various sources in PLN for MWh for 2018



Source: own calculations on the basis of PEP 2040 (LCOE) and the cited literature (social costs)

Further, the assumption is that the LCOE of producing energy from sources will evolve in the direction proved over the previous decade, but at a smaller pace (1/2 of the change observed during the period 2009 – 2019) [Lazard 2020]. Therefore, it is assumed that solar energy will be 44.5% cheaper in 2030 and wind energy 35% less expensive, gas use in CCGT will be 13% less costly, followed by only a small decline in coal costs (due to better technologies that will allow for better efficiency of the source and excluding ETS costs) – 1.5% cheaper than now. The prediction is that the only source that will increase in the LCOE is nuclear energy due to even stricter security considerations and regulations as well as new and more expensive technologies being utilised. The results are shown in Figure 2 below. The social costs are the same as in Figure 1, as they are already put on the levels cited in the available literature, based on 2008 – 2030 estimates. The competitive advantage of RES sources is further built up in relation to fossil fuels, which comes as no surprise. Those figures could be used to prepare an analysis for the future energy-mix instead of using historical data for 2018.

Figure 2. LCOE and the social costs (LCOE+) for various sources in PLN for MWh for 2030



Source: own calculations on the basis of Lazard 2020 (LCOE) and the cited literature (social costs)

Having analysed the cost side of the economics of producing energy from various energy sources in social terms (LCOE+), attention can be paid to the issue of a possible new shape of the future energy-mix of Poland. It is done on the basis of the 2018 cost data only to show the potential of the transformation as compared with the PEP 2040 scenario. Further decreases in RES costs for 2030 would only make that comparison more evident. Two scenarios mentioned previously are looked into – the first – a strong Baltic Sea offshore wind energy cluster and the second – a solid base of nuclear energy, according to the vision of nuclear department experts of the Ministry of Climate and Environment. The two alternative scenarios of the future energy-mix are put together and the total costs of creating and running such an energy-mix are compared with the one presented in PEP 2040.

3. RESULTS AND DISCUSSION

Poland's Energy Policy until 2040 presents a vision of the transformation of the energy sector on the path to climate neutrality, in line with the European Union recommendations, while respecting national circumstances. Those are mostly connected with the use of coal as an energy source. It is related to the fact that Poland has the largest hard coal deposits in the European Union. Poles like to call coal "black gold" and treat it as a national energy security guarantee. According to the plan, coal use will be reduced considerably but not to nil. The scale of the reduction is from 95% in the early nineties, 74% in 2019, to mere 56% in the electricity generation energy-mix in 2030. That means that by the year 2040, 16 GWh of coal-fired capacity will be withdrawn and substituted with gas and RES.

There are two major challenges for the economy and society. The first one is the need to stop the energy poverty growth rate in Poland, which is already one of the highest rates in the EU. According to the data provided by the Structural Research Institute on the basis of Main Statistical Office 2021 data, 11% of households in Poland are regarded as affected by energy poverty [IBS 2023]. The analysis of renewable energy policy and the EU ETS shows that the policy of providing numerous industries with exemptions leads to a situation in which individual households bear most of the costs associated with those policies. The analysis also shows that low-income households are the most affected by energy price increases because they spend a large share of their income on electricity [Cludius 2015]. In Poland, households spend a larger proportion of the budget on energy. Another analysis shows that introducing changes of EU Fit-for-55 package would increase spending on energy by 50% and on transport by 44% for one-fifth of the poorest households in the EU. In the case of Poland, that increase would be at the level of 108% [PIE 2021]. Regular public opinion polls show that support for nuclear energy in Polish society is highly dependent on international events. The Fukushima disaster in March 2011 and Germany's decision to close down nuclear power plants resulted in a decline in support – until 2014 opponents predominated [CBOS 2016]. However, currently during the war in Ukraine, with the increasing importance of energy independence from the Russian aggressor, as many as 86% of Poles support the construction of nuclear power plants in Poland, moreover, over 70% of respondents would give their consent to building such a power plant near their place of residence [MKiŚ 2022]. Support for the construction of new wind farms has also increased. More than two-thirds of the respondents (69%) would back the construction of an onshore wind farm in their area [PWEA 2021].

Research revealed [Mrozowska, Kijewska 2016] that attitudes towards nuclear power are complex and do not relate merely to the question of technology acceptance, which does not usually raise major controversies. The factors that determine the perception of nuclear power as important include: (1) the level of trust, (2) the political-economic context, and (3) the location, national and destination target dimensions of the investment; in particular, the level of trust in state institutions, government and politicians (the Minister responsible for the programme), the law regulating and inspection institutions (PAA, the Ministry of Economy, scientists) and market institutions (investors: PGE EJ1, technology providers: AREVA, Candu, and others). Studies [Mrozowska, Kijewska 2014] conducted in the community residing in the municipality of the potential location indicate that the inhabitants need to define their position on this investment, but they do not express the need to participate in strategic decisions. Opponents are largely not against the "technology" but the methods of implementing it: protracted decision-making; the lack of clear, immediate and direct information from the top (government) to the bottom (municipality) increases distrust towards the investment. There is noticeable solidarity with the local government that feels disregarded in many decisions and has no possibility to take pre-emptive action. As a consequence, local authorities feel overlooked at many stages of the decision-making process. This intensifies the distrust of the local community towards the central authority. At the same time, the inhabitants are subject to pressure from external pro- or anti-nuclear interest groups (environmental organisations, lobbying organisations).

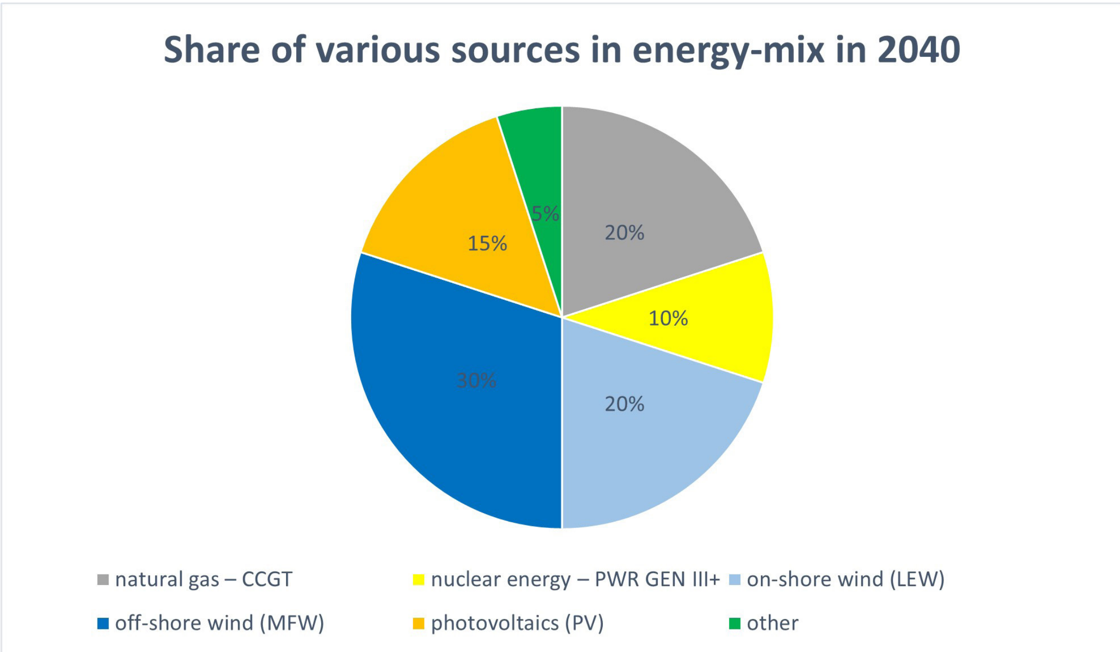
The other challenge is to limit social unrest during the process of restructuring the coal mining sector in Poland, which plays an extensive social role, providing employment to nearly 80,000 people, concentrated in mining regions of the country. Additionally, many coal-powered plants will have to be closed as they are already old, fully utilised in technical terms, and highly inefficient [Gawlikowska-Fyk 2021]. Almost ¾ of the coal-burning potential is more than 30 years old and approaching the limit of technical viability – the average age of power plants in Poland is 47 years [Kurtyka 2021] and URE is planning the retirement of 11 GW of coal facilities by 2034 [Wysokie Napięcie 2022]. Also when considering companies that supply the coal industry in Poland 7/10 of jobs are located in Upper Silesia and some 17 thousand employees would be redundant when coal mines in the region are closed down [IBS 2023].

The majority of Polish citizens (over 90%) agree that we should limit greenhouse gas (GHG) emissions, and 60% agree that we should act today, rather than in some undefined future [MKiŚ 2020].

The closure of coal units will be accompanied by massive investments in both on-shore and off-shore wind farms, PV – small and large units, as well as a new source – nuclear energy. Effective and fully disposable gas power generation is planned to supplement and provide a reserve for RES, as a transitional source of energy. That would be scaled down with the increased use of large-scale energy storage and a better grid management system. The total installed capacity of RES will amount to approximately 23–25 GW in 2030, providing up to 32% of electricity in 2030. Investments in the development of offshore wind farms – a 5.9 GW wind farm will be installed in 2030 and an 8–11 GW wind farm in 2040. The first nuclear unit with a capacity of 1–1.6 GW is scheduled for 2033 in the Pomeranian region, and the whole Polish nuclear programme means the construction of between 6 and 9 GW units by

2043. The PEP 2040 programme assumes that – with the growing demand and major electrification of the power system – as much as 200 TWh of electro-energy will be needed in 2040 [Monitor Polski 2020].
The aim of the analysis is to show two things. First is a demonstration that the alternative energy-mix based on LCOE+ modelling would be cheaper for society than the one described in PEP 2040. Indeed both scenarios presented in Figure 3 and Figure 4 below yield a total cost for society that is about 20% lower than the one in PEP 2040. Second, two alternatives are evinced: one assuming the enlarged proportion of wind energy both on-shore as well as off-shore, as suggested by PSEW. The other one is based on the broad use of nuclear energy – with a 30% share of it in the total energy-mix. In both cases, disposable gas units are built into the model as a base. All that could be complemented by PVs and biomass, hydro/geothermal energy, which is well described in the CAKE analysis [Tatarewicz et al. 2022]. Both energy-mixes are more or less at the same level of total LCOE+ for society to build. Which one is better is a separate discussion beyond the scope of that article. The discussion would require further analysis of models utilised in Europe and their consequences in terms of economic and social costs.

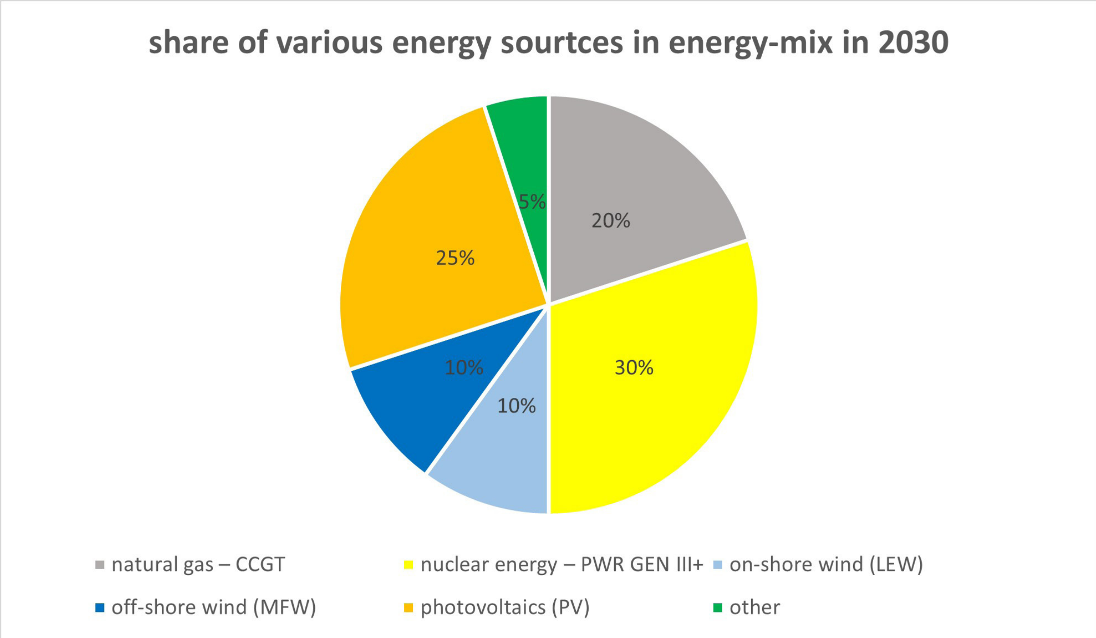
Figure 3. Share of various sources in energy-mix in 2040 with high penetration of wind power



Source: own calculations on the basis of PSEW and model of [Mitroczuk ed. 2022]

Another important element of the energy puzzle to be analysed is the one about the use of a distributed rather than centralised energy system. Both scenarios presented below are based on petrification of the model that Poland has been following for decades – of centralised large power units producing energy and the necessary grid development to distribute electro-energy produced in them to the places where it is needed. Some research may prove that could be replaced by the distributed energy system [Nyangon, Byrne 2022; Banks 2022]. That view is also presented in Poland by the influential Institute of Eco-Development and its head – Andrzej Kassenberg, which provides an alternative model to the traditional development path of the Polish energy-mix [Kassenberg 2020].

Figure 4. Share of various sources in energy-mix in 2040 with high penetration of nuclear power



Source: own calculations on the basis of PSEW and model of [Mitroczuk ed. 2022]

CONCLUSIONS

Considering the total costs of a given energy-mix for society as a whole, one has to include both the LCOE as well as social costs. The abbreviation LCOE+ should be used as it suggests going beyond the standard cost calculations, to include costs associated with the negative externalities of energy production. They are the costs borne by society and not always internalised by entrepreneurs as should be with the EU ETS scheme in place. The first result demonstrates that the alternatives of the future energy-mix discussed above are cheaper than the PEP 2040 scenario. Both have 20% lower overall costs for society.

The second result is that the inclusion of even a moderate rate of the falling RES LCOE over the next decade can only improve the competitive advantage of RES in the future in relation to fossil fuels. The long-term decisions that need to be taken now should include those considerations as well. They will have a long-lasting, over a couple of decades into the future, important influence on national energy security as well as the competitiveness of the national economy. Another important dimension is the social one. Only those solutions that are desired by the public as well as the public is willing to pay for, could be implemented successfully. The increase in awareness of climate threats, and the presence of climate and energy issues in the public debate (e.g. Paris Agreement, European Green Deal, Polish Offshore Wind Sector Deal etc.) in recent years has led to the change in public opinion. Poles understand and accept the need for energy transformation – moving away from coal in favour of more ecological methods of energy production. The gradual abandonment of coal-based energy is supported by nearly three-quarters of the respondents (74%) [CBOS 2021].

This analysis shows that negative externalities like deterioration of human health due to worsening air quality associated with burning fossil fuels should be taken into account in energy-mix decisions. One of the reasons is that the full economic cost reasoning should not avoid including social costs. The second is the growing pressure from the EU and society as a whole that will inevitably force that change. Moreover, what is stressed here is that both scenarios presented above are in line with the goals of the Fit-for-55 package of the EU, including the revision of the RES directive [Chojnacki 2021].

What shape will the Polish energy-mix decisions take is to be seen. It is not only influenced by the decisions made in the EU but also strongly depends on political processes in the country. The war in Ukraine and its consequences for the world energy market have added a new perspective to energy security, and when energy security is so important, it would be hard to imagine the future Polish energy-mix without nuclear energy. The study has also shown that such inclusion could be limited to composing a mix relatively cheap in the LCOE+ sense.

Further analysis is needed to examine the distributed energy generation model. That would entail more bottom-up prosumer initiatives, not only limited to the individual households that will try to avoid the trap of energy poverty. That would also mean that the industry will look for new opportunities to lower the carbon footprint, in line with the new non-financial reporting directive [EU 2022c]. Rapidly growing electro-energy and heat-energy prices, accompanied by possible blackouts, can only support that option. Moreover, energy efficiency, which is not discussed above, will grow in importance – the cheapest energy is the energy you don't utilise. The EU energy transformation strategy assumes a compromise between environmental, economic and social goals. Therefore, building a sustainable economy is to be accompanied by counteracting energy poverty so that the poorest do not bear the costs of the transformation. Apart from the price, social calculations include health and political issues, taking into account the type and origin of energy sources. There is no doubt that social support for the success of the transformation will depend on good communica tion and financial support for the transition.

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