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Socio-economic Impacts of Nuclear Power Plant Closure: Lessons Learnt from Different EU Member States

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ABSTRACT

Independently of the national nuclear energy plans, any nuclear power plant in operation will eventually close and enter the decommissioning phase. From a local perspective, the closure of such an important industrial facility can pose economic and human capital challenges. In this context, we review three case studies of host communities that have already experienced the closure of a nuclear power plant. We analyse different lessons learned and show good practices which, if considered in the coping strategy may reduce the risks of job losses and corresponding reductions in tax revenues in the potentially affected regions in the future.

1 INTRODUCTION

Nuclear energy accounts for a substantial share of electricity production in the European Union (EU). In 2019, it was 26.4 % [1]. It should be noted that that the mix included electricity production in the UK. Regardless, there are 106 nuclear power reactors generating nuclear electricity in 13 of 27 EU Member States (MS) today [2]. While some countries continue to build new units, others, such as Germany, Spain and Belgium plan to phase out nuclear power in the relatively near future [3]. In such case, national policies tend to focus on public health and safety, environmental impacts and security of energy supply. The closure of the nuclear power plant (NPP) is not limited to technical solutions, it has also a major social and economic dimension, as the operating NPP provides a significant economic stimulus for the host region.

From the prospective of each EU MS we analysed that a total of 33 regions – at NUTS3 (Nomenclature of Territorial Units for Statistics) classification level – host an operational NPP with closure scheduled before 2050 and without new proposals for nuclear power at this moment [3,4]. It could be expected that with the increasing rate of NPP closures across the EU, local socio-economic impacts will become more important in the future. In this context, this study focuses on the first step towards sharing experience on this topic and provides an insight into socio-economic aspects by exploring the ways in which host communities have responded in the past to the closure of the NPP.

2 REVIEW OF CASE STUDIES

The study is conducted through a review of publicly available information on three cases: Fessenheim in France, Philippsburg in Germany and Ignalina in Lithuania. Figure 1 shows their location as well as NUTS3 regions hosting operational and permanently closed

NPPs. In the following, we extract the most relevant information of each historical case study, along with lesson learned from the ongoing regional transition.

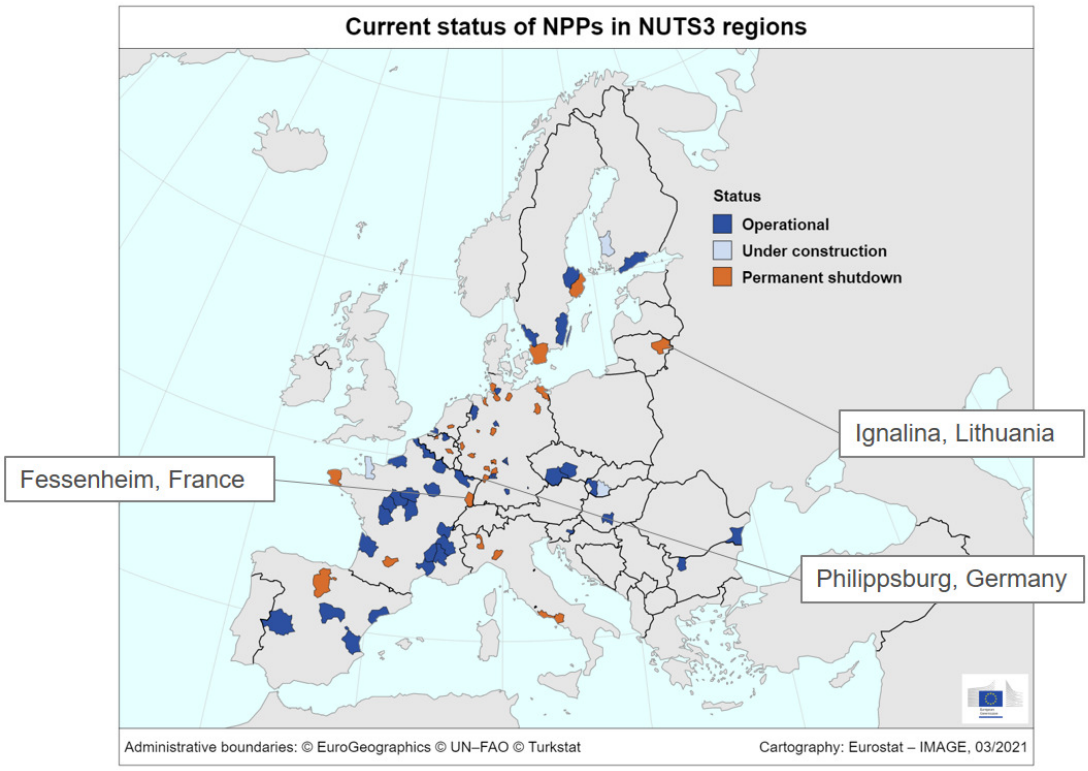

Figure 1: Location of the case studies and the current status of NPPs in NUT3 regions.

2.1 Fessenheim, France

Nuclear energy makes a predominant part of the French energy mix providing 70% share of the electricity production [5]. However, by 2035, the national energy plan foresees a reduction to 50% [6]. To begin with, the Fessenheim NPP (FNPP) closed its first unit by the end of February 2020 and the second by the end of June 2020 [7]. France has another 56 reactors of the same type, of which 12 is reaching 50 years of operation by 2035 [3]. This raises a great opportunity for FNPP to be a pioneer in the prospect of decommission in France. In the coming years it will allow for the pooling of engineering, operating and maintenance resources and sharing important lessons applicable to all sites.

The FNPP is located in the Haut-Rhin of the Grand Est region, eastern France. Since the start of its operation in 1977, the territory around Fessenheim has remained dependent on the socio-economic activities associated to the NPP. Its operation provided a financial privilege to the area for many years without the need of exploring diversified solutions. In addition, the FNPP has made a significant contribution to the local taxes. In 2016, the region received a total of 47.1 million euros, including 2.1 million from property tax. The Fessenheim town alone, with a population of 2389 inhabitants, receives around 6.6 million euros per year [8]. Therefore, as in any other region where a NPP is shut down, the area around Fessenheim now raises questions about the local economy and jobs.

The French company EDF (Electricité de France) assumes full technical and financial responsibility for the decommissioning of all its nuclear power plants. Under EU State aid rules, EDF received compensation in 2020 as a result of the early closure of the FNPP of almost 400 million euros [9]. In addition, up to 2041 there will be subsequent payments to compensate for any loss of earnings [7]. The amount allocated will be used for dismantling

operations of the FNPP and to support projects for the green growth of the region [10]. The decommissioning of the power plant will start by 2025. Until then, EDF will prepare the facilities for dismantling and strengthen support for its employees.

In 2020, the FNPP employed 760 EDF employees and approximately 300 employees in service companies [11]. In 2025, the number should be reduced to 60 employees in charge of dismantling activities and around 100 service providers [12]. EDF has therefore put in place a system allowing each employee a personalized care in preparation for the professional transition [13]. In one year, they found a solution for 80% of employees. However, most of them opted for relocation to other EDF production centres and only a quarter of the employees plan to join EDF's local projects [14].

To continue benefitting from the local employment and supporting the economic development of the territory, the region presents a number of projects that allows for creation of new jobs. The first forward-looking plans focus on the prosperity of the industrial site around the NPP and the nearby river port. The proposal also includes site reconversion into a techno-centre for the dismantling of nuclear reactors and recycling low-level radioactive metal [15]. Such a project would use the existing technical skills and alleviate the saturation of waste storages implied by the closure of many reactors in France in future. The location of the NPP close to the border with Germany also allows for Franco-German cooperation, such as a planned photovoltaic project in Réguishem, which is expected to be operational in 2022 [16].

The region is committed fully substituting energy production from FNPP with renewable energy production and energy savings. In this context, the State will mobilize 250 million euros in aid over 20 years [17]. This is the first time in France, when the call for tenders for renewable energies was limited to a specific territory. Potential energy transition projects take into account renewable electricity production (solar, wind, small and large hydro) and heating alternatives such as geothermal network or biofuel plant [18]. This plant is expected to start operating in 2024 and to create 350-700 full-time positions [19]. The ongoing energy transition also strengthens the tradition of the local chemical industry, as the development plan presents a semi-industrial pilot of the methane cracking for hydrogen production. Finally, the planned program for the future of the Rhine territory also takes into account sustainable mobility, agriculture and investments in the required infrastructure [18].

While all the above-mentioned projects seem promising, their implementation will take several years. An overall transition plan will still to be defined in a coherent manner, including its coordination and funding. The local government criticizes the lack of anticipation of closure, as the first initiatives were launched only in 2018, and fears the consequences for local jobs when EDF staff leave and until new opportunities emerge [20].

2.2 Philippsburgh, Germany

As part of its energy transition, known as "Energiewende", Germany targets to reduce its greenhouse gas emissions by 80 to 95% in 2050 compare to 1990 levels [21]. To achieve this, priorities lies in the coal phase out, large-scale expansion of electricity generation from renewable sources, upgrades in transmission grid infrastructure and energy efficiency. At the same time, German policymakers decided to phase out all nuclear power following the Fukushima accident in 2011. Eight reactors were immediately shut down and the remaining reactors are being phased out by 2022. Replacing fossil fuels and nuclear power with renewables has transformed many sectors affecting number of businesses and employees in the country with the largest energy market in the EU.

Overall, "Energiewende" can bring many socio-economic benefits. The renewable energy sector has become a major growing industry and has created more jobs than was lost in the traditional energy industry [22]. However, there have been particular challenges that

may be important to raise within the context of this study. For example, the "Energiewende" framework strongly supports energy community projects across the country. However, their presentation to local communities requires careful planning. There were examples of intensive opposition that managed stopping a wind farm project [23]. This shows how sensitive the topic is and that a relatively small community can influence the feasibility of the project.

The anticipated transition planning is a key instrument supporting regional policy in its structural changes. Unexpected measures can have negative socio-economic impacts of a larger magnitude. This can be seen from the example of German NPPs, which closed immediately after the Fukushima accident in 2011. Local employment has decreased significantly and house prices fallen largely compared to regions maintaining operational NPPs [24].

The last shut down reactor in Germany was the Unit 2 in Philippsburg in the end of 2019 [25]. The Philippsburg NPP (PNNP) is located in the southern federal state Baden-Württemberg, which has an important history in the nuclear sector. There are three NPPs with altogether five units, two interim storage facilities, the former reprocessing plant in Karlsruhe, the European Joint Research Centre in Karlsruhe, facilities of the Karlsruhe Institute of Technology and the Siemens educational reactor [26].

Out of the five nuclear power units, only Neckarwestheim II continues to operate, others are decommissioned. The permanent closure strategy for Philippsburg 2 therefore benefited from the experience gained in the closure of all surrounding sites. For example, the local energy company responsible for the operation, decommissioning and dismantling of the PNPP, Energie Baden-Württemberg (EnBW) Kernkraft GmbH, launched an early public communication in Philippsburg and neighbouring municipalities in 2014 [27]. The evolving discussion, including the main public dialogue event in 2016, concerned not only the plans for dismantling existing infrastructure, but also the re-use of the site and the construction of new facilities. This concerns in particular (i) the temporary on-site storage of waste; (ii) the residual material processing centre; and (iii) a converter to be built at the site of the recently demolished PNPP cooling towers, which will serve as a substation in the south of the next 340 km long direct current line bringing electricity from northern Germany [28].

These projects ensure that the location maintains its economic development without interruption. According to the EnBW Kernkraft GmbH, all employees, accounting for around 700 people, continue at PNPP for the dismantling process. In addition, the Philippsburg area requires additional qualified workers through recruitment channels such as decontamination specialists, equipment mechanics or radiation protection specialists [29].

2.3 Ignalina, Lithuania

The Lithuanian Ignalina Nuclear Power Plant (INPP) closed its two units in 2004 and 2009. The closure of the RBMK-1500 nuclear power plant was a condition to join the EU. Due the premature closure of the only NPP, which supplied 80-85% of the energy needs, it has significant national and local impacts [30].

Both the plant – starting its operation in 1983 and 1987, units 1 and 2 respectively – and the town (former Sniečkus, now Visaginas) were established to integrate Lithuania into the All-Soviet Union economic structures via the energy supply system. The specific characteristics of the town were specific mono-industry, high living standards and ethnic composition (mostly Russian-speaking migrants, Lithuanians as a minority). Over the years, it was a story of success and the forerunner of socialism. Following the declaration of Lithuanian independence in 1990, the town became a place of tension and uncertainty [31]. The impact of INPP extends beyond Visaginas, in 2002 the government officially established INPP region, with a total of 2839 km^2 consisting of municipalities Visaginas, Ignalina and Zarasai [32].

The shutdown and subsequent decommissioning of the INPP were of unprecedented nature and represented for Lithuania an exceptional financial burden disproportionate to the size and economic power of the country. The EU financially assists Lithuania in decommissioning and in addressing the consequences of the closure of the INPP [33]. In addition, the region has its responsible authorities: Ignalinos NPP Regional Development Council (Regiono plėtros taryba), decision taking body and INPP Regional Development Agency (Regiono Pletros agentura), decision implementing body, responsible for implementing socio-economic projects in order to minimise the consequences of the closure of the INPP.

The site of the plant should be adapted for economic activity, re-use of buildings and infrastructure. The plan is to achieve the "green field" by 2038. For this purpose, 1800 employees still worked at INPP on 1 January 2021 [34]. However, the European Court of Auditors doubt that this number is adequate, and there is still no detailed staff plan covering the entire decommissioning process, which has been significantly delayed [35].

Despite all efforts to soften the sub-sequences of decommissioning of the INPP, the aftershock increased the energy prices, unemployment increased, trades were disappearing, and the emigration level increased [36]. Over the past 20 years, the INPP region has lost around 1/3 of its population and has a higher unemployment rate and lower entrepreneurship rate compared to the country's average [37,38]. However, it is possible that the immediate negative impact on the region has been caused by more factors than the mere closure of the INPP, such as the global economic crisis. Some mitigating measures against poverty and social exclusion have certainly been implemented before joining the EU. However, access to the European Structural and Investment Funds has increased the capacities of the region [39]. The recovery task has additional challenges due to the multinational composition of the regional community (i.e. 43 nationalities in Visaginas) and the social exclusion of target communities. The municipalities of the region openly refer to these challenges and seek to address them through formal planning [40].

Although there are still socio-economic challenges in the region, progress has been made and efforts are slowly showing trends of recovery. For example, the number of small and medium-sized enterprises increased to 2156 in 2021 compared to 1930 in 2011 [41]. At national level, Lithuania's energy transition policy is on track with visible success [42]. After the closure INPP the energy had to be imported. Currently, Lithuania imports 70% of its electricity, while bioenergy is taking the lead in domestic energy supply. Most Lithuanian co-generation (combined production of heat and power), district heating and residential heat switched from natural gas to biomass. The Lithuanian liquefied natural gas terminal in Klaipėda has significantly reduced the country's dependence on direct gas imports from the Russian Federation, which is a declared political priority for the government. The terminal also improved gas market integration and lowered gas prices in the region.

3 DISCUSSION AND CONCLUSIONS

Our review shows that each host community has its own experience and challenges. Nevertheless, we have been able to identify best practices related to the transition that, if considered in the coping strategy developed well before the closure of a NPP, can reduce the negative socio-economic impacts.

Commonly for all case studies, the operator of the NPP was a major employer contributing to the economic prosperity of the region. It brought highly qualified and highly paid workers and their families to relatively small towns, often located in rural areas. In addition, NPPs provided jobs, not only in connection with their operation, but also as sub-contractors and indirectly associated activities induced by the consumption of the employees and their families. This has created a sense of community pride and provided a substantial

income to the region from property taxes and other revenues that kept the local economy alive.

It is therefore important to identify the potential impacts and estimate the changes in the number and structure of the jobs concerned once the closure has been announced. Personalized care for each employee appears to be an excellent practice in preparation for the professional transition. A sufficient number of employees is required to ensure safe plant operation through the processes of decommissioning and dismantling. The age structure of the staff is also important. More aged employees may opt for early retirement. In general, younger generations have greater potential for retraining. Workers with transferrable skills can look for a local re-employment. Regions should review the potential for economic growth covering different opportunities and attract new investors to match the wishes and skills of the affected employees.

We also observed a significant interest for repurposing of the NPP site. A specific factor is the presence of nuclear waste at decommissioned sites, which may represent an obstacle to the site redevelopment. At the same time, the proposed projects are related directly to the NPP dismantling or nuclear waste recovery process, which ensures the continuation of specific local businesses activities in the region and can partially compensate for the socio-economic impacts. However, it is important to identify further opportunities in the surrounding and to provide targeted support for the structural change. The transition process takes several years and lack of a solid recovery plan can reduce the prosperity of the region and consequently increase the costs.

Most importantly, the coping strategy needs to be anticipated and involve all relevant stakeholders. The NPP closure is announced by the national policies, whereas the socio-economic impacts are strongest at the regional level. Cooperation across different levels of government is therefore crucial. In addition, local authorities have knowledge of local conditions and expertise, which can facilitate the establishment and monitoring of the local network. However, the decision must be cooperative and inclusive. The proposal for a coherent revitalisation plan provides incentives for the establishment of new industries and services, as well as the identification of specialised vocational retraining to facilitate the future of affected workers. Certainly, the most important aspect from the local perspective is that skilled workers remain and continue to provide income for the region.

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DISCLAIMER

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