

# ENERGY TRANSITION IN WEST MACEDONIA. WHAT IS THE PUBLIC ATTITUDE OF THE LOCAL SOCIETY?

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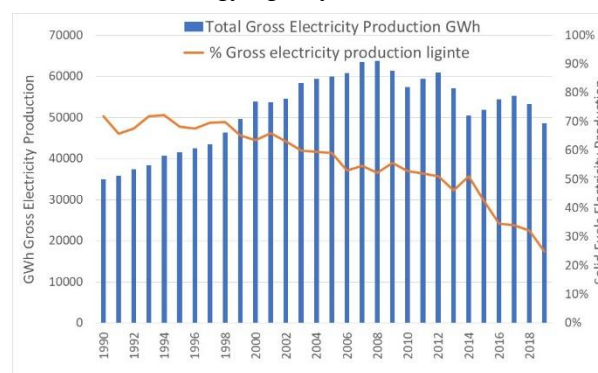
**Abstract.** In view of the EU decarbonization policy implementation, the Greek government has recently decided the permanent retirement of lignite based thermal power stations (TPS) of West Macedonia, being in operation since the 70's. For the last fifty years, the Public Power Corporation has undertaken the responsibility to run the quarries and the thermal power stations offering almost 15000 direct and indirect job positions. In this context and despite the significant environmental impacts in the wider area, the lignite extraction and the operation of the TPS of Ptolemaida, Amintao, Kardias and Agios Dimitrios have been the major economic activity of the entire prefecture for the last five decades. Although the Greek government has prepared quite ambitious plans to financially support the local communities and to encourage public and private investments, local societies are quite anxious about their future. To this end, the present work not only investigates the energy transition of the West Macedonia but also analyzes the attitude of the local people towards the radical changes anticipated in the near future. Emphasis is put on examining the answers of young scientists, most of them expecting to work in the energy supply chain of the under retirement TPS. The results of this analysis are quite interesting and underline the danger of significant immigration and brain drain for the area, while the involvement in planned energy installations may also be a serious alternative solution.

**Keywords:** Lignite, Natural Gas, Job Creation, Air pollution, Energy supply security.

## 1. Introduction

Electricity generation is a fundamental element of all modern economies, supporting a range of critical services from healthcare to banking and transportation. Secure supply of electricity is therefore critical. The structural change from an electricity system based on conventional fossil fuel power plants to a system based on decentralized variable or even stochastic renewable energy continues apace at various stages around the

world. As a result, governments, industries and other stakeholders will need to ensure electricity security through updated market policies, regulations and plans (International Energy Agency (IEA), 2021).



**Figure 1.** Electricity Production: 1990-2019, Greece

Lignite is abundantly available in the underground of Greece; it is estimated that the existing resources can suffice to provide primary fuel for electricity production for the next 30-50 years. In particular, almost 4.7 billion tons of lignite have been discovered in the Greek territory, while only during 2018 lignite production reached 36.5 million tons (Karasmanaki et al., 2020). During the previous decade, the lignite power stations of Table 1 were in operation, with a total nominal power of 4GW. These TPS produced almost 35% to 50% of the total national electricity production (see Figure 1), however their contribution was gradually declining. Actually, in 2018 the lignite contribution represented only 20.5% of the country's primary energy supply of 32.3 Mtoe. On the other hand, lignite is Greece's most important indigenous energy resource excluding renewable energy sources (RES). In this context, for more than fifty years, Greek lignite is deemed to be a fuel of strategic importance, because it involves low mining cost, stable and easily controlled price, the ability to ensure stability and security in fuel supply, while it has been providing thousands of jobs in rural regions with particularly high rates of unemployment (EUROCOAL, n.d.) (Activity sectors, n.d.).

**Table 1. PPC Lignite Power Stations 2021**

LIGNITE POWER STATION	NOMINAL (MW) CAPACITY	WITHDRAWN UNITS (MW)	TOTAL (MW)
TPP LIPTOL	43	43	
TPP PTOLEMAIDA	620	620	
TPP KARDIA	1250	Under Retirement	<b>1250</b>
TPP AG.DIMITRIOS	1595		<b>1595</b>
TPP AMYNTAIO	600	Under Retirement	<b>600</b>
TPP MELITI	330		<b>330</b>
TPP MEGALOPOLI 3	250	250	
TPP MEGALOPOLI 4	300	Under Retirement	<b>300</b>
<b>TOTAL MW</b>	<b>4988</b>	<b>913</b>	<b>4075</b>

## 2. Greek government decarbonization policy

According to the updated (December 2019) National Energy and Climate Plan (NECP), all Greek lignite thermal power plants (TPP), of total installed capacity of about 4GW<sub>e</sub>, are expected to be retired by the end of 2023. Accordingly, all lignite mines should be also abandoned in the areas of West Macedonia and Megalopolis, Peloponnese (Just Transition Development Plan, 2020). The only exception concerns the new under construction Ptolemaida-5 power plant, which is planned to operate initially with lignite and accordingly with natural gas.

In this context, the lignite-fired power stations of Kardia III and IV are at the final stage of retirement, as these two facilities will complete their life cycle extension of 32,000 hours in April 2021. The two-forthcoming power-station withdrawals, equivalent to a 540MW capacity loss, follow a first stage of lignite-fired TPS retirement carried out last year by PPC, including the withdrawal of Amynteo I and II (Table 1). Besides producing electricity, the two Kardia units, located in north Greece, also serve district heating needs to the nearby city of Kozani. PPC's prospective Ptolemaida V unit will cover the district heating services after the adoption of intermediate solutions.

Due to the forced decarbonization of the area, under the new European funding program for the period 2021-2027, an effort is made to claim increased funds from the Union's Just Transition Fund. Moreover, funds from such programs as Horizon, Connecting Europe Facility and Invest EU will support this effort.

An integrated, multi-faceted and front-loaded plan (Just Development Transition Master Plan) was presented in mid-2020, to serve as a roadmap towards the post-lignite era (National Energy and Climate Plan, 2019).

## 3. Energy transition of West Macedonia area

West Macedonia extends to 9,451 km<sup>2</sup> and the local population amounts to almost 270,000 people. As already mentioned, until recently the electricity market has been based on lignite mining. More specifically, the regions of West Macedonia and Central Peloponnese support a large part of business activities in the electricity generation

sector (Figure (1)), since almost 50% of the national electricity production results from the major lignite TPSs of Table I (Just Transition Development Plan, 2020). Moreover, much of West Macedonia's employment is concentrated in sectors directly or indirectly linked to the use of its natural resources, i.e. land and mining (Luc Christiaensen, Céline Ferré, 2020).

Additionally, the prefecture of Western Macedonia is the first region in Greece where district heating systems have been designed and installed for the needs of citizens in three cities. Regional and municipal councils should play a decisive role in the electricity generation sector so that they can contribute to the creation of green jobs and support environmental protection, while ensuring the priority for local investors in the segment of renewable energy.

On the basis of existing extensive energy and building infrastructure, the large land occupied by former lignite mines, the strategic location of these areas, the utilization of human resources and the region's vast experience in operating energy systems should offer an advantage on preparing strategic plans for the region's post-lignite development. For example, the abandonment of lignite exploitation in the area will save large quantities of water in the catchment area for other applications, while the energy-intensive pumping station at Polyphyto Lake may cease to operate due to absence of electricity surplus by the W. Macedonia TPSs.

Tax reduction and other incentives are offered by the Greek government to attract local region investments and industries creation, focusing on the production of new products that meet environmental objectives. Actually, investments concerning the construction of photovoltaic panels with new and efficient technologies, manufacturing of batteries and electric chargers, electric vehicles, etc. are planned. Moreover, construction and operation of a Carbon Capture Utilization and Storage pilot unit in one of the existing lignite units of PPC in the Region of Western Macedonia or in connection with the new Ptolemaida-5 unit are now under investigation.

Subsequently, initiatives can be prepared by the University of Western Macedonia for the development of educational and research activities for innovative ideas in energy and in general. In addition, initiatives from the Prefecture, in collaboration with the University, for fast training in new and efficient technologies, with new knowledge and skills may be considered (Just Transition Development Plan, 2020).

#### 4. The attitude of the local community towards expected radical changes

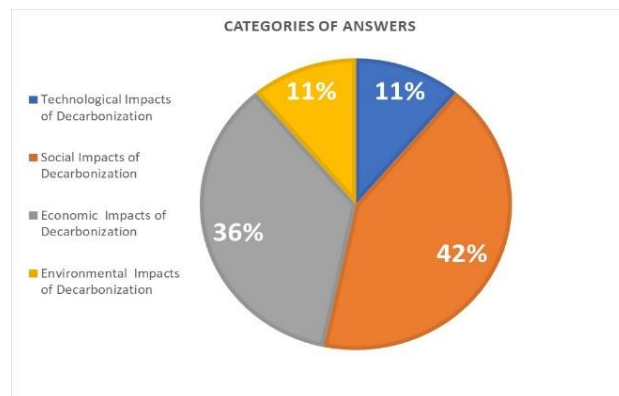
The above-described changes in the Region of Western Macedonia are planned to occur in a short period of time and will crucially affect the economic life of the area, since they concern the key productive sector of the region. The opinion of 100 young scientists living in the area, about these impending changes has been surveyed and the main conclusions are as follows. First, they have been asked to report on the main effects of the planned decarbonization strategy and then to propose solutions for the "Just Energy Transition" of the area. The main concern of the respondents is for the proximity and the rapidity of the announced changes and for the accuracy of the entire plan. More specifically, four categories of decarbonization effects have been recorded. These concern the technological, social, economic and environmental impact. Categorizing the effects of decarbonization, one may realize how closely interconnected all the issues are and how much they affect all sectors without facilitating the distinction between categories in most cases (see Table 2).

**Table 2.** Decarbonization Effects in West Macedonia

Decarbonization Effects			
Technological	Social	Economic	Environmental
The utilization of natural gas for electricity production does not use its energy content efficiently, resulting in energy waste.	The district heating program continuation.	Employment & households' total income decrease.	Immediate and efficient soil remediation.
Behavior changes and technology use in daily lives in order to achieve energy saving, energy efficiency, energy storage and hydrogen use.	Negative impact on the living standards of residents and increase the risk of leaving the area.	The energy market privatization is intensifying due to the new energy mix that leads to increase in energy prices and negative effects on energy security.	Sedimentation and deposition of new materials.

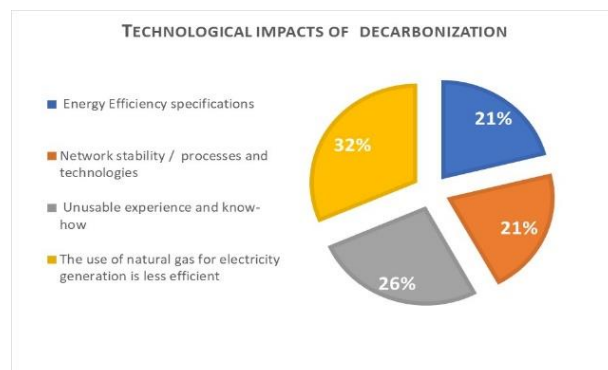
It becomes more apparent when we observe that the answers gathered deal more with the social and economic dimension of decarbonization, see also Figure 2.

In terms of the technological approach, the need for the CO<sub>2</sub> capture technologies adoption or other new technologies to reduce the environmental footprint of electricity generation has been reported but it wasn't in the four (4) most popular answers. The biggest concern of respondents (see Figure 3) is that the use of natural gas (NG) for electricity generation is less efficient than other uses of NG. This option holds the highest percentage, i.e. 32% of the answers.



**Figure 2.** Categories of answers

People also reported the most likely changes in the daily lives of residents and behavior change using new technologies to achieve energy saving, energy efficiency, energy storage and hydrogen use. Technologically the vast majority report that lignite cannot be abandoned in such a short time and that the cold backup of these units is at least necessary. Everyone also agrees on the necessary upgrade of the electricity network in order to become a smart grid and to host decentralized electricity production. They consider that lignite should preserve a percentage of 10-15% in the national fuel mix as a base load so that the



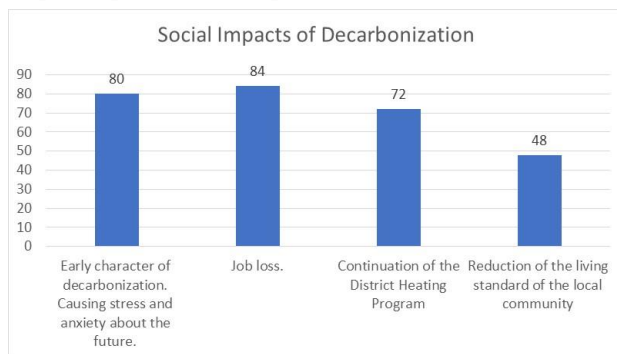
country can meet all its needs whether it is sunny, snowy or the price of oil has skyrocketed.

**Figure 3.** Technological Impacts of Decarbonization

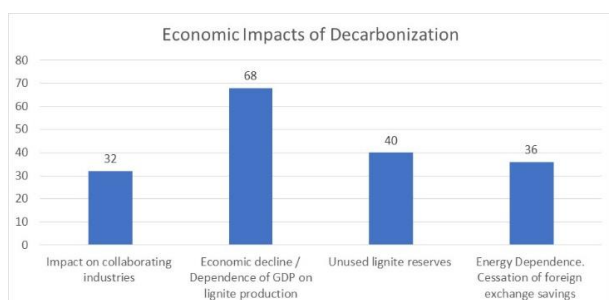
Based on the material gathered, the problems with the greatest concern are those of social and economic impact. These problems concern all respondents. The impact on the total employment and the total income of the households that depend directly or indirectly on the activity of PPC is the main issue. As predicted, the retirement of the local TPSs will have a negative impact on the living standards of residents and will increase the risk of leaving the area. These issues have been highlighted by all respondents, also focusing on the risk of rising unemployment and economic decline, due to the

strong dependence of the region's gross domestic product on lignite production. There has been a high percentage of respondents who believe that the privatization of the energy market is intensifying due to fuel change from lignite to NG, although this answer is not in the four (4) more popular answers.

Local people are particularly concerned about the district heating program continuation and this has been mentioned in almost  $\frac{3}{4}$  of the answers, concerning the social impacts of decarbonization, Figure 4. The continuation of district heating is assumed crucial due to the cold climate of the area. They also consider that the participation of the inhabitants of the area and the local government in social entrepreneurship schemes is necessary. Concerns have been raised about rising energy prices due to changes in the local energy mix and increase of energy dependence, while the lignite reserves will be left untapped (36% and 40% responses respectively, Figure 5). The main economic impact reported is the expected economic downturn.

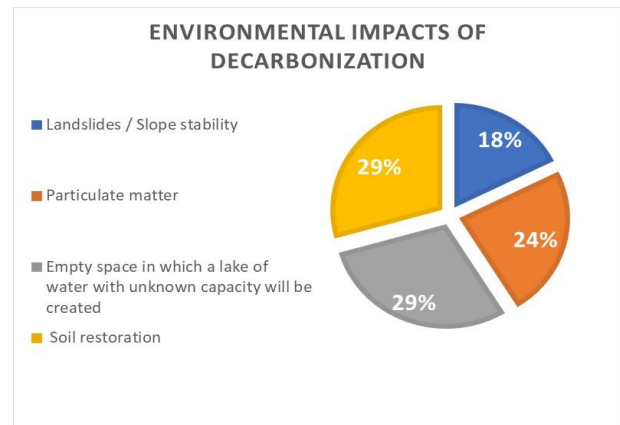


**Figure 4.** Social Impacts of Decarbonization



**Figure 5.** Economic Impacts of Decarbonisation

Moreover, all of them express the need for funding and operation of the Research Centers of the local University in order to assist in the energy transition of the region through research programs. At the environmental level, they all agree on the return of land to society for environmental and social reasons. There is great concern from all respondents (Figure 6) about the duration of soil remediation and the effects of these delays, such as self-ignition of lignite, carbon monoxide emissions from open pit mines, particulate matter and slope stability. Even in the case of early restoration, responders have concerns about the rate of sedimentation and deposition of new materials. A percentage of 29% has reported as a serious environmental issue (to be addressed immediately) the empty space that becomes a lake with unknown capacity.



**Figure 6.** Environmental Impacts of Decarbonization

## 5. Discussion and Future work

The role of local authorities and local society in the modern energy transition is expanding and becoming critical. Technology has always played a key role in the economy. Its integration to the economy with the main concern of improving the living standards of citizens and protecting the environment should be the main priority.

Knowledge and its transfer from the Universities to society is definitely a good practice. The case of West Macedonia fast decarbonization is a study field for testing political decisions. One of the goals of the current study is to present and analyze the opinion of local young people in order to underline their agonies and inform the politicians about possible negative results of their decisions in an attempt to maximize the social benefit of all citizens.

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