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ROADMAP FOR THE TRANSITION OF THE WESTERN MACEDONIA REGION TO A POST-LIGNITE ERA

ROADMAP FOR THE TRANSITION OF THE WESTERN MACEDONIA REGION TO A POST-LIGNITE ERA

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SUMMARY

For more than two decades, the net annual increase rate of the installed coal and lignite power worldwide ranged between 20-25GW. However, since 2010, the fuel that has supported the growth of the global economy for decades fell out of favour. This trend is expected to accelerate in the years to come, particularly following the historic agreement of the 2015 United Nations Climate Change Conference in Paris (COP21).

The future of lignite in Greece appears to be even more ominous, given its particularly low quality, the turn of big international finance institutions away from coal, the recent changes in the EU ETS, the tightening up of the European environmental legislation regarding the rest of the air pollutants, as well as the competition with renewables. In the Western Macedonia Region (WMR) in particular, where almost all of the country's lignite units are located, lignite capacity is expected to decrease by 3,495MW between 2014 and 2030. It's obvious that the impacts of such developments on the economy of Western Macedonia, which for decades has been relying almost exclusively on lignite, will be dire.

In the midst of these developments, the government and the Public Power Corporation (PPC) seem dedicated to the prolongation of Greece's lignite-based model for electricity production. They are moving forward with the construction of the new, lignite unit "Ptolemaida V" and also planning to construct a second lignite unit, "Meliti II" in Florina, while PPC has revealed publicly its plans to extensively upgrade the Amyntaio TPS (Thermal Power Station) in order to extend its operation beyond 2023.

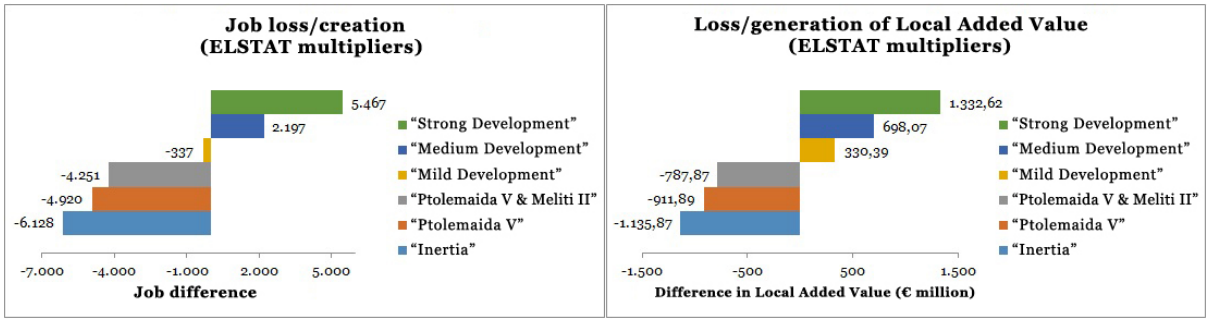
The lack of institutional initiatives aimed at preparing the transition to a post-lignite era, indicates that the aforementioned actions are considered as the only solution to tackle unemployment in W. Macedonia. This is also illustrated by the fact that a recent request by the five "energy municipalities" of the country, which called for a share of the revenue generated by auctioning of CO_2 allowances to be used to create jobs in the three "lignite Regional Units" of Greece, was rejected.

At a first stage, the present study examined the local added value and the jobs that will be lost as a result of the expected shut-down of lignite units in W. Macedonia over the next 15 years (*"Inaction Scenario"*). It then examined the extent at which constructing new lignite units can make up for this loss. The results of the economic assessment were negative: Ptolemaida V and Meliti II can reinstate only 30% of the jobs and the local income that inevitably will be lost, despite the fact that their construction will require investments in the order of €2.5 billion. It is therefore necessary to investigate the potential that alternative sectors of the economy have in tackling this issue.

For this purpose, a preliminary plan for WMR's transition to a post-lignite era was developed and the corresponding investment cost was estimated, elaborating on past proposals by stakeholders in Western Macedonia. In this context, three scenarios were formulated, assuming a “mild”, “medium” and “strong” development respectively, each focusing on economic activities that are not related to lignite extraction and burning and whose implementation can be carried out over a 15-year period. More specifically, emphasis in the primary sector was placed on the cultivation of Kozani saffron and aromatic and energy plants, along with the further development of the forestry sector. In the secondary sector, the

fundamental pillar was the development of Renewable Energy Sources, energy savings, waste management, the operation of a fly ash processing facility, and the processing of aromatic plants. Finally, the tertiary sector relies on the development of tourism, with an emphasis on industrial tourism and ecotourism, as well as on carrying out research in academic institutions and research centres in Western Macedonia.

In order to estimate the multifold effects that the implementation of these scenarios will have on Western Macedonia's economy as a whole, input-output analysis at a regional level was used, regarding both job opportunities and local added value (LAV). For comparison purposes two different groups of regional multipliers were used: those based on Hellenic Statistical Authority (ELSTAT) data for 2011, and those based on a study by the Academy of Athens/Technical Chamber of Greece-Western Macedonia department (TCG-WM) which, however, uses older data (dating back to 2001 and 2005 for employment and added value respectively) and different economic sectors compared with ELSTAT's. The results of the analysis using the newer multipliers - based on ELSTAT's figures - are summarised in the following graph.



Comparison of 6 scenarios regarding the job opportunities and the Local Added Value they create compared with the "Inaction" scenario (ELSTAT multipliers).

Even in the "mild" development scenario, which was based on particularly modest assumptions, almost the same number of jobs and a higher LAV as those that will be lost from shutting down the lignite Thermal Power Stations ("*Inaction scenario*") can be created.

Significant improvement can be achieved in the "medium" development scenario, as based on ELSTAT's multipliers, there will be 2,197 more jobs created compared with those that will be lost by shutting down the lignite stations by 2030, while LAV is estimated at €1.834 billion, approximately €0.7 billion higher than that of the "inaction" scenario.

The "strong" development scenario presents the greater benefits to the economy of WMR. Using ELSTAT's multipliers, almost twice the number of jobs and more than twice the LAV can be created compared with those lost ("Inaction scenario").

It should be noted that, in all three scenarios, the RES sector contributes significantly to the total direct employment opportunities (49%, 38.7% and 36.9% in the "mild", "medium" and "strong" development scenarios, respectively) and to the direct Local Added Value (67.3%, 61.1% and 60.9% in the "mild", "medium" and "strong" development scenarios, respectively). This is due to the fact that, apart from the secondary sector, the development of RES has a positive effect on the primary sector, too, brought about by the cultivation of energy plants required for the operation of PPC Renewable's biomass unit. Hence, by making a decisive

turn to RES, the current character of WMR as an energy centre can be retained even once the existing lignite units have been shut down and without the need to construct new ones.

Finally, it's interesting to note that in the “strong” development scenario, the required investments (€2,35 billion) are of a similar scale to the construction cost of PPC's two new lignite units Ptolemaida V and Meliti II.

The actual implementation of the proposed scenarios of “mild”, “medium” or “strong” development for revitalising WMR's economy require political will, a timetable and more detailed scenarios, that will be formulated with the involvement of the central and local administration as well as that of the local communities. It also requires significant capital. The report concludes with the designation of possible national or European funding resources, in order to achieve the transition to a post-lignite era within a 15-year time frame.

1. AIM OF THE REPORT

The transition to a new national energy model and the need to transform the model of development of Western Macedonia have been acknowledged and anticipated for years. However, the reluctance of the state, local authorities, local stakeholders and PPC has prevented the Western Macedonia Region from planning and adapting to a new era in a timely and smooth manner. The present study aims to contribute to the public debate, present the issue to a Greek and international audience and designate different alternatives that can ensure social and economic prosperity in the region.

This report follows on from two older studies by WWF Greece that highlighted the dead-end situation brought on at a national level through the prolongation of the lignite-based model for electricity production, as well as the existence of economically competitive alternatives to lignite. The first of those, *"Ptolemaida 5 and Meliti 2, Economic viability report of the new lignite units" (2013)*, examined the operation of Ptolemaida V and Meliti II over a 30-year time frame, and their operating hours and economic efficiency in particular. Based on the results of the analysis, these two new PPC units were found to be disadvantageous and, under certain circumstances, even harmful investments. The second study, *"Clean Alternatives to Ptolemaida V" (2015)*, demonstrated that there are hybrid combinations of RES units and pumped hydro energy storage stations that can sufficiently cover the same base load for which Ptolemaida V has been designed. These solutions are proven to be advantageous, not only from an environmental and social standpoint, but in purely economic terms, too.

However, while the investment in new lignite power generation units will lead to a dead-end, at a national level, the reduced lignite activity will have dramatic economic and social impacts on the Western Macedonia Region. The rest of the report describes alternative growth scenarios that are compatible with an environmentally and economically sustainable production model and, at the same time, can meet the needs of the local community and local economy.

There is no doubt that the transition will be painful and long. Nevertheless, the prompt mobilisation of competent bodies, the timely development of an integrated, long-term transition plan for Western Macedonia and the raising of sufficient funds can help the local economy and community make a radical turn towards sustainability.

The report is structured as follows:

Chapter 2 offers a historical overview of the role of lignite, the exploitation of which has been the cornerstone of Greece's electricity generation and industrial development, followed by a description of the main reasons why lignite-based power production is approaching an end.

Chapter 3 outlines the region's current economic and development profile, in order to assess the losses expected to be brought about by the end of the lignite era. The next part presents guidance documents prepared by international bodies on planning this transition, case studies of regions that managed to successfully respond to the needs of such a transition (Chap. 4), as well as recommendations made by various local stakeholders in particular (Chap. 5). Chapter 6 describes the main economic activities that can be developed in order to

offset the decline in PPC's activities. In addition, there are 6 scenarios developed, based on assumptions regarding the development of distinct sectors of the economy and the multifold impacts they would have on the job sector and the GDP of the region under study. Finally, chapter 7 sets out the prerequisites for a transition to a post-lignite era, along with the economic tools, both at national and international level, that can and need to be used in order to successfully implement the growth scenarios proposed.

2. LIGNITE IN THE PAST, PRESENT AND FUTURE

2.1. What is lignite?

Coal is a solid, combustible sedimentary fossil fuel. It was formed by herbal remains of aquatic plants in lacustrine environments, which were buried and decomposed under high temperatures and geological pressures, a process which led to their enrichment with coal, described by the special term "*carbonation*"[1]. The course of carbonation leads to various types of coal, such as turf (considered as the first stage of coal formation), lignite, coal, anthracite and graphite. Lignite is a fuel of low calorific content, as it is 3 to 7 times lower than that of hard coal and 5 to 10 times lower than that of oil[2]. Lignite is still been used worldwide, mainly as a fuel in electricity production.

2.2. Lignite in Greece

2.2.1. A short historical overview of lignite production in Greece [2,3,4]

The first significant attempt to exploit lignite reserves in Greece took place in Aliveri, Euboea, in 1873, while electricity was first introduced in the country in 1889. According to PPC's historical data, the "Contractors' General Company" built the first power production unit on Aristeidou st., in Athens.

Until 1938, lignite in Western Macedonia was used only by the inhabitants of the wider region as a substitute for wood, to cover mostly domestic heating needs. The first serious attempt to exploit lignite at an industrial scale was in 1939, following the publication of a study by German professor F. Kegel[5], who estimated the country's lignite reserves at approximately 6 billion tonnes. At that time Greece covered 95% of its energy needs through fuel imports, as its approximately 400 private power generation companies used oil and coal as raw materials, which were both imported from abroad. The Public Power Corporation (PPC) was established in August 1950, and constituted the first public utility ever to offer generation, transportation and distribution services.

During the 1950s, an extensive search was carried out aiming at locating and assessing lignite reserves. In September 1956, LIPTOL SA (Ptolemaida Lignite Mines) signed an agreement with German company KHD regarding the construction of the first thermal power station operating on lignite, rated at 10 MW. The lignite reserves in Megalopolis were scientifically examined for the first time in 1957 and their exploitation began in 1969. This was the first time worldwide that a lignite reserve of such a poor calorific value was excavated and exploited for electricity production.

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[1] E. Samiotis Thesis Technical University of Crete, School of Mineral Resources Engineering. 2012. "Modelling and estimation of the reserves in the Komninon lignite deposit in Western Macedonia". http://goo.gl/LTQCmN
[2] PPC. 2010. "Excavating light... memories and images of lignite". http://goo.gl/ts5bs5
[3] PPC. Historical Overview. https://goo.gl/IAuKQ2
[4] RAE. The history of power production in Greece. http://goo.gl/w5tXUW
[5] D. Zarafidis, Assistant Director of the Lignite Centre of Western Macedonia and F. Palioudakis, Section Manager for Environmental Protection and Soil Restoration. "History, Current State, Potential: The lignite of Ptolemaida". http://goo.gl/9NALNK

2.2.2. Greece's lignite reserves[6]

According to IGME's (Institute of Geology & Mineral Exploration) geologic map of Greece, the lignite reserves on the Florina - Ptolemaida - Kozani axis were formed during the tertiary geologic period, and are between one to five million years old. It was estimated that it took 1,000 to 4,000 years for one cubic meter of lignite to be formed.

The total sum of confirmed geologic lignite reserves in Greece is approximately 5 billion tonnes and is - to a significant extent - spread across the country's territory. According to PPC, the reserves that can be exploited for energy purposes, based on the most recent techno-economic data available, reach approximately 3.2 billion tonnes, their energy being equivalent to 450 million tonnes of oil. The most important lignite reserves are located on the Kozani - Ptolemaida - Amyntaio - Florina axis - where the most significant mining activity in Greece takes place - with an estimated deposit of 1.8 billion tonnes. The second most important area of lignite mining is in the Megalopolis region, in the Peloponnese, with a reserve of approximately 223 million tonnes. There are also two important, charted yet unexploited, lignite deposits in the Drama region, whose reserves amount to 900 million tonnes, and in the Elassona area, reaching 169 million tonnes.

Based on Greece's total exploitable lignite reserves and the projected future consumption rate, it is estimated that the former can suffice for more than 45 years. To date, the quantity of lignite excavated amounts to approximately 29% of the total reserves.

According to the World Coal Association[7], Greece ranks 7th amongst the 10 greatest brown coal producers worldwide (2014), as can be seen in the following table.

Table 2.1: Lignite production worldwide in 2014

Country	Production (Mt)
Germany	178.2
USA	72.1
Russia	69.6
Poland	63.9
Turkey	61.5
Australia	60.7
Greece	48.0
India	47.2
Czech Republic	38.2
Bulgaria	31.2

2.2.3. The quality of Greek lignite

Lignite in Greece is located in 68 lignite basins of varying sizes across the country, and is generally considered of low calorific value and relatively high ash content[8]. Its calorific value

[6] PPC. Reserves and quality. https://googlxAqT
[7] World Coal Association coal facts 2015 https://goo.gl/a0JmX5

ranges between 975 - 1,380 kcal/kg in the Megalopolis, Amyntaio and Drama regions, between 1,261 - 1,615 kcal/kg in Ptolemaida and between 1,927 - 2,257 kcal/kg in Florina and Elassona[6].

According to a study by Booz&Co[9] on behalf of PPC, out of 8 countries examined - 7 European (Germany, Poland, Greece, Czech Republic, Romania, Bulgaria and Serbia) and Turkey - the calorific value of lignite in Greece is, by far, the lowest. More specifically, its calorific value was estimated at 1,200 kcal/kg on average in 2012, whereas the weighted average of lignite in other countries ranged between 1,605 kcal/kg (Bulgaria) and 2,915 kcal/kg (Czech Republic). This inevitably leads to lower productivity and, as a result, higher production costs.

2.3. The role of lignite in today's energy model

For more than two decades, the net annual increase rate of the installed coal and lignite power worldwide ranged between 20-25GW, and had actually tripled from 2005 onwards. However, since 2010, the fuel that has supported the growth of the global economy for decades fell out of favour. Out of all the coal stations that were under plan in 2010, only 1 out of 3 managed to reach the construction stage. This is due to a number of reasons: The competition with cheaper energy sources, the difficulty in securing funding as a result of the change of policy of the funding institutions, the rising of carbon prices, the increasing concerns regarding lignite's impacts on health and the environment, the economic crisis, the improvement in energy efficiency, have all contributed to the pressure exerted on coal.

Some of the factors that have led to the fall-off of lignite as the main electricity generating fuel in Europe and particularly in Greece are presented below.

2.3.1. European Union Emissions Trading System (EU ETS)

Since 2013, the auctioning of CO_2 emission allowances as part of the European Union Emissions Trading System (EU ETS) also includes the power production sector, with a fee in place for every ton of CO_2 emitted. The expenses of the PPC between 2013, 2014 and 2015 increased despite the drop in emissions (€187.5 million, €216.9 million and €251 million for annual emissions of 41.3 million, 39.2 million and 34.3 million tonnes of CO_2 respectively)[10], as a result of the increase of carbon prices.

In 2015, as part of revising the EU ETS, a Market Stability Reserve (MSR)[11], where the emission allowances surplus of the market will be temporarily 'stored', was established. The mechanism, which will come into force in 2019, is expected - along with other anticipated changes to the EU ETS - to drive carbon prices up to approximately €30/ton in 2030, from

[8] K. Papanikolaou and Th. Kotis. 2005. "Lignite in Greece: Properties, Uses and Perspectives". http://goo.gl/yp9Rdj

[9] Booz & Co. 2014. "Understanding Lignite Generation Costs in Europe". https://goo.gl/3i3uCR

[10] PPC SA, annual economic report. https://goo.gl/G32VmB

[11] European Parliament. 06/05/2015 "ETS market stability reserve: MEPs strike deal with Council" http://goo.gl/ovzX5n

€7.5/ton in 2015[12]. The low quality of Greek lignite and the associated high emissions per kWh generated, further increase the vulnerability of lignite units, which has been acknowledged even by PPC itself[13]. In fact, this is the reason behind PPC's board formal request calling for Greece to become eligible for an Article 10c derogation, thus avoiding CO2 costs[14], which was nevertheless rejected by EU's Energy Commissioner Arias Cañete.

At the same time, increasing allowances costs will lead to an increase in public revenue, through the auction of the allowances allocated to Greece. It is estimated that this revenue will exceed €6 billion between 2015-2025[15]. Clearly, free allowances for the electricity sector will decrease public revenue that can be used for other purposes according to 2003/87/EC.

2.3.2. European environmental legislation

While Greece is planning to build two new lignite units (Ptolemaida V and Meliti II), which are neither economically sustainable[16] nor their need has been justified yet, the developments in European legislation create an increasingly unfriendly environment for investments in coal/lignite units. More specifically, the ongoing tightening of the emission limit values, also known as 'the Seville process', is expected to establish stricter limits than those in Ptolemaida V's environmental permit. Since the new unit will need to comply with these specifications from its first year of operation, PPC will be forced to install emission control technology that will affect both the unit's construction and operational costs.

The obligation to comply with EU emission limit values (see Directive 2010/75/EU) also applies to existing PPC units. For this reason, eight lignite units have been placed under the so-called Transitional National Plan (TNP), in order to receive a compliance deadline extension until 2020. As the TNP calls for a costly plan of retrofits, NO_X emissions reductions and desulphurisation measures, and in order to avoid the additional costs related to retrofitting, PPC chose to include 6 more units in the "limited life time derogation" (Article 33 of the same Directive). According to the latter, the operation of the units can be prolonged until 2023 at the latest, with an obligation to reduce their operating hours to approximately one-third of the current[17].

2.3.3. Developments in the international financial sector

Indicative of the change of scenery in the energy sector worldwide are the changes in the lending policy of many financial institutions. One of the first banks that took coal/lignite projects out of their investment agenda was the European Investment Bank (EIB), which announced in July 2013 a new set of terms for its loans, based on an Emission Performance

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[12] Thompson Reuters. 15/07/2015 "Reviewing Europe's carbon market: fight for free allocation, slightly higher prices - Carbon prices are estimated to reach €30/t in 2030, according to Point Carbon analysts". http://goo.gl/EUoZxw

[13] Energypress.gr. 11/10/2015. "Panagiotakis: Granting free CO_2 emission allowances will encourage investments". http://goo.gl/HqwUR2

[14] It should be noted that Greece doesn't meet the typical requirements in order to be placed under the particular exception (article 10c of the 2003/87/EC Directive), according to which free allowances can be provided to countries whose per capita GNP indicator was below 60% of the European average in 2013. Greece's was at 62%.

[15] Point Carbon. 27/04/2015. "Future of EU carbon market still at stake as governments remain at odds: analysis from Point Carbon at Thomson Reuters." http://goo.gl/zRH7z1

[16] http://goo.gl/QXxz6C WWF Greece. 2013. "Ptolemaida 5 and Meliti 2: Economic viability assessment of the new lignite units". http://goo.gl/j5G8jl

[17] WWF Greece. Lignite nowadays. http://goo.gl/rGhHY4

Standard (550gCO_2/kWh) for new power plants. Almost simultaneously, the World Bank announced its intention to significantly cut down the funding of new coal plants[18]. Similar policies for restricting their exposure to polluting coal plants are currently also being implemented by the Export–Import Bank of the United States[19], the German bank KfW - one of the sponsors of Ptolemaida V,[20] and the European Bank for Reconstruction and Development (EBRD)[21]. The example of these banking groups is followed by other financing institutions, such as the Norwegian Sovereign Wealth Fund, one of the biggest worldwide[22], 17 USA institutions managing a total of $1.8 billion[23], the Rockefeller Brothers Fund[24] etc.

2.3.4. The development of RES Technology

One of the main factors pushing forward the transformation of the energy model is the major improvement in the competitiveness of RES technologies, both regarding their efficiency and the reduction in equipment and construction costs.

According to data provided by the International Renewable Energy Agency (IRENA)[25], biomass, geothermal energy and onshore wind farms are nowadays directly competitive with fossil fuels with regards to electricity generation. At the same time, the levelized cost of energy for PVs has been halved between 2010-2014, which renders large-scale PV projects increasingly more competitive, while the cost of PV panels in 2014 had dropped by 75% compared with 2009 figures. It's important to note that the larger the RES investments, the faster and greater the drop in technology costs will be - for example, doubling the installed capacity of PVs is estimated to lead to a reduction in costs of approximately 18-22%.

Similar are the estimates of the International Energy Agency[26]. The energy cost of onshore wind farms worldwide has dropped by approximately 30% between 2010-2015, while that of large-scale PVs has dropped by an equivalent 66%. This pattern will continue, to a smaller extent, until 2020; for example, onshore wind farm and PV costs are expected to drop by an additional 10% and 25% respectively, making the subsidies of such projects essentially redundant. The total investments in RES are expected to reach $230 billion annually by 2020, with the share of new investments in wind and PV technologies accounting for 2/3 of the total sum.

It is evident that, in any case, the payback of RES investments largely depends on the potential of each technology as well as on national and local particularities, such as the abundance of natural resoures, the access to funds, the capacity of the installed unit etc. A study by WWF Greece regarding Greece in particular found that, apart from offshore wind farms and solar thermal, all other RES technologies can be directly competitive with natural gas, from a levelized cost of energy perspective[27].

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[18] Reuters. 17/07/2013. "World Bank to limit financing of coal-fired plants". http://goo.gl/Lgdt8D
[19] Bloomberg. 18/07/2013. "Ex-Im Bank Halts Funding Review for Vietnam Coal Plant". http://goo.gl/hoU6uS
[20] Bundesministerium fur Witschaft und Energie. 2014. "Bericht der Bundesregierung zur internationalen Kohlefinanzierung für den Wirtschaftsausschuss des Deutschen Bundestages". http://goo.gl/9kwgBE
[21] EBRD. "The shift from coal". http://goo.gl/efn1gh
[22] WWF EU. 05/06/2015. "Climate expectations raised after Norwegian coal divestment". http://goo.gl/Oskhba
[23] Dealbook. 29/01/2014. "Foundations Band Together to Get Rid of Fossil-Fuel Investments". http://goo.gl/bKSbEF
[24] Rockefeller Brothers Fund. 9.2014. "Divestment Statement" http://goo.gl/jF6y84
[25] IRENA. 2015. "IRENA, Renewable Power Generation Costs in 2014". http://goo.gl/jzWCao
[26] IEA. 2015. "Medium-Term Renewable Energy Market Report 2015". https://goo.gl/gvhsAv
[27] WWF Greece. 02/2015. "Clean Alternatives to Ptolemaida V" http://goo.gl/PCG8JP

In addition to RES electricity production, one should also examine the means for providing energy storage as ways to deal with RES' variable nature in energy production. Specifically, small capacity storage units, are appropriate for individual buildings in remote areas where connecting to the network is costly, or in cases where full autonomy from the grid is sought. According to estimates by UBS, the payback of a domestic PV system, a battery and an electric vehicle is expected to drop from 12 years (as of today) to 6-8 years by 2020, and 3 years by 2030. The cost of batteries in particular is expected to drop by 50% by 2020[28].

2.3.5. The share of lignite in the Greek Electric Power System

From 2002 onwards, there has been a gradual reduction noted in the share of lignite in covering Greece's electricity demand. For example, the share of lignite in the electricity distributed to the interconnected system dropped from 69.8% in 2002[29] to 38% in 2015[30]. Between 2014-2015, lignite power production dropped by 14.5%, which was offset by an increase in the share of RES (12.8%), natural gas (14.6%), hydro power (38%) and energy imports.

Figure 2.1 offers a brief summary of electricity production and the balance of interconnections (electricity imports - exports), between January and December 2015. The plus sign of the interconnections balance translates to 19% electricity imports in 2015. The installed capacity of electricity producing units in Greece's interconnected system is the following[31] (January 2016):

- 3,913 MW of lignite units[32]
- 5,170 MW of natural gas units
- 698 MW of oil stations in the interconnected system
- 3,173 MW of hydro power units[33]
- 1,857 MW of wind
- 2,093 MW of PV
- 351 MW of roof-mounted PVs (≤10kW)
- 223.5 MW of small hydro power units
- 52 MW of biogas - biomass
- 100 MW of high-efficiency combined heat and power

[28] UBS. (2014, August). "Will solar, batteries and electric cars re-shape the electricity system?". http://goo.gl/9HH0nN

[29] PPC. "Annual Bulletin and Review of 1stFinancial Year 01/01/2001-31/12/2002". https://goo.gl/7OTZKI
[30] IPTO. Monthly Energy Bulletin. December 2015. http://goo.gl/2GSblk
[31] LAGIE. DAS Settlement System Monthly Bulletin. January 2016. http://goo.gl/T6xK2y
[32] Excluding cold start-up units or those out of operation.
[33] Including the Ilarionas Hydroelectric Power Plant which is in trial operation since 15/02/2014.

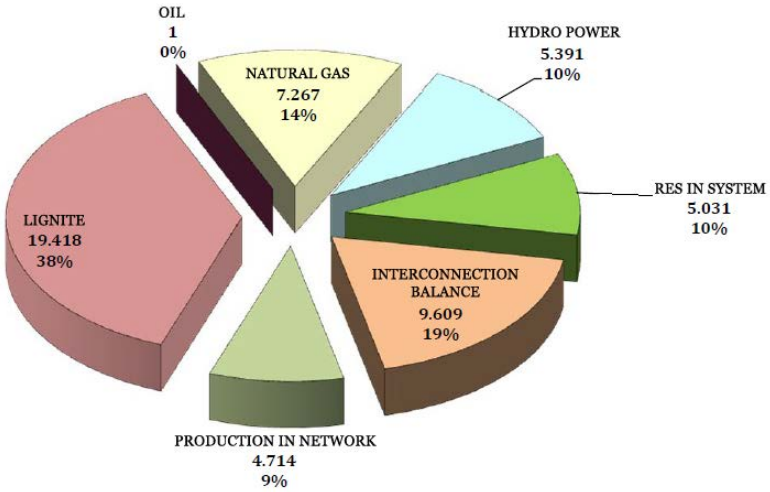


Figure 2.1: Power Production estimate and Balance of Interconnections for 2015[34]

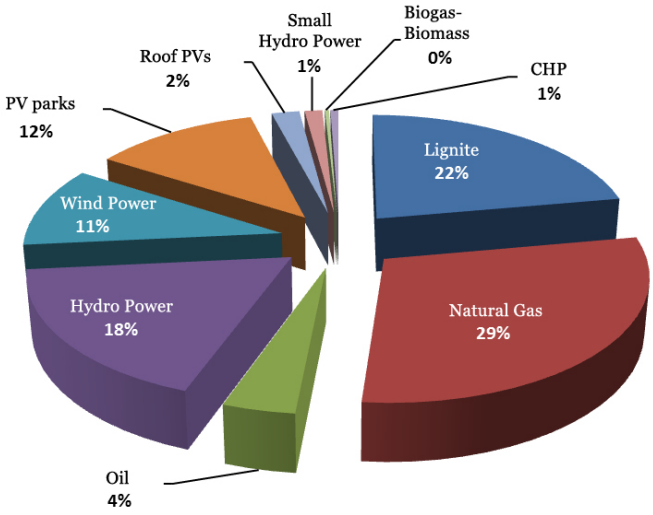


Figure 2.2: Total installed capacity (January 2016)

PPC is expected to withdraw a significant share of its lignite power capacity in the years to come. The associated timetable, published by the Ministry of Environment, Energy and Climate Change (MEECC) 20-20-20 Committee (2010), and the respective timetable that former European Commissioner for Competition Joaquin Almunia had included as part of a letter addressed to the former W. Macedonia Governor (2012) are presented below.

Table 2.1: Lignite units closure timetable, Sources: a[35] and b[36]

[34] Power production in the Network is calculated using validated records regarding Medium Voltage and estimates regarding Low Voltage.

Unit	Net Power [MW]	Start of operation	Scrapping (a)	Scrapping (b)	Note
Agios Dimitrios 1	274	1984	2020	2022	Obligatory retrofits (Directive 2010/75/EU, TNP)
Agios Dimitrios 2	274	1984	2020	2022	
Agios Dimitrios 3	283	1985	2020	2022	
Agios Dimitrios 4	283	1986	2020	2022	
Agios Dimitrios 5	342	1997	Beyond 2040	-	
Amyntaio 1	273	1987	2020	2019	Limited Lifetime Derogation (2010/75/EU)
Amyntaio 2	273	1987	2020	2019	
Meliti	289	2003	Beyond 2040	-	Retrofits (Directive 2010/75/EU. TNP)
Kardia 1	275	1975	2019	2019	Limited Lifetime Derogation (Directive 2010/75/EU)
Kardia 2	275	1975	2020	2019	
Kardia 3	280	1980	2020	2019	
Kardia 4	280	1981	2020	2019	
Ptolemaida 1	64	1959	2010	2011	Retired on 18.06.2010
Ptolemaida 2	116	1962	2012	2012	Cold reserve since 03/10/2013
Ptolemaida 3	116	1965	2014	2014	Fire on 09/11/2014
Ptolemaida 4	274	1973	2015	2014	Fire on 09/11/2014
Liptol 1	30	1959	2012	2012	Retired on 28/06/2013
Liptol 2	8	1965	2012	2012	Retired on 28/06/2013
Megalopolis 1	113	1970	2010	2011	Retired on 30/09/2011
Megalopolis 2	113	1970	2010	2011	Retired on 30/09/2011
Megalopolis 3	255	1975	2025	2024	Obligatory retrofit (Directive 2010/75/EU, TNP)
Megalopolis 4	256	1991	Beyond 2030	2024	

The increasing costs for maintaining and operating lignite units, the oversupply in the electricity production system, the drop in consumption and the increased competition from other energy sources (RES, natural gas, imports) have already limited the operating hours of

[35] Kozan.gr. 23/04/2012. "Reply of the Vice-President of the European Commission Joaquin Almunia to the letter of the Western Macedonia Governor Giorgos Dakis regarding selling lignite units". http://goo.gl/VThP4b
[36] MEECC. Committee 20-20-20. July 2010. "Analysis of Energy Scenarios regarding the share of RES technologies in the Energy System and Meeting 2020 National Targets using MARKAL, ENPEP, WASP, COST models". http://goo.gl/778C6U

lignite plants. For example, in the spring of 2016, all 4 units of Kardia's TPS were out of operation and expected to turn back on in the summer, when the demand loads increase[37].

The region of Western Macedonia is already being affected by the upcoming transformation of the energy model and the reduction of lignite activity. According to the local press, since the beginning of 2016 the contractor companies, which carry out 60% of the total mining works, have fired 70 workers[38], while according to Ptolemaida's Labour Centre another 1,000 jobs are under threat[39,40]. The limited operation of PPC units is also the reason why companies such as LARCO and METE SA, employing approximately 350-400 workers, are expected to cut down significantly the operation hours of the lignite mines they control[41].

[37] e-ptolemeos.gr. 18/05/2016. "The PPC units in the Lignite Centre of Western Macedonia (LCWM) are put on standby - Another two units of the Kardia TPS are turned off - Lignite production is further reduced due to costs". http://goo.gl/jx2W9l

[38] ert.gr. 27/04/2016. "Eordaia: Contractor lay-offs in PPC Mines carry on". http://goo.gl/sCy0if

[39] kozan.gr. 05/05/2016. "Ptolemaida: 1000 without pay and laid off in the Mines". http://goo.gl/iG8hKj

[40] Energypress.gr. 02/02/2016. "The contractors are 'freezing' their activity in PPC's mines". http://goo.gl/q2qgR8

[41] Kozanews.gr. 06/06/2016. "Insecurity and fear of new lay offs - Activities are reduced dramatically in two mines - The case of LARCO". http://goo.gl/f31MvB

3. THE WESTERN MACEDONIA REGION

3.1. Geographical characteristics

The Western Macedonia Region (WMR) is located in the Northwest part of Greece, bordering Albania to the west and F.Y.R.O.M. to the north. WMR is the only region in Greece not bordering the sea and one of the less populated regions in the country. It consists of the Regional Units (RU) of Kozani, Grevena, Kastoria and Florina.

It covers an area of 9,451 km^2, which accounts for 7.16% of the country's total area, and comprises mostly mountainous and semi-mountainous land (82%). WMR is well-known for its rich natural resources, such as fossil fuels (lignite), ores (asbestos, chromite, marble etc.), forests (50% of its total land) that form ecosystems defined by rich biodiversity, as well as pastures, while it also has the greatest surface water potential in Greece (approximately 65% of the country)[42].

At Regional Unit level, the RU of Kozani, on the eastern side of WMAR, is the largest in size (3,516 km^2), and is covered mainly by mountainous and semi-mountainous land (77%). The RU of Grevena, covering a total of 2,291 km^2, is the most mountainous region in WMAR (93% of its land is considered mountainous and semi-mountainous), while the Florina RU is the third largest (1,925 km^2) and has the highest share of lowlands (26%). The smallest region of WMR, the RU of Kastoria (1,720 km^2), is covered almost entirely by mountainous and semi-mountainous areas (90%)[43].

3.2. Population composition

The population of WMR has been significantly reduced over the past 50 years, as, according to the official census, it has dropped by 9.7% between 1961-2011 (Table 3.1). According to the latest Eurostat figures[44], the population of the area was estimated at 278,706 in 2014, i.e. there is an additional 1.8% drop between 2011 and2014.

The most significant population reduction trend is noted in the RU of Grevena (27% between 1961 and2011) - which also has the highest ageing rates - followed by the RU of Florina (23.7%) and Kozani (1.7%), which is the most populated, too. The RU of Kastoria is the only one where the population shows an increasing trend (6%).

The population density in 2013 was 42.8 people/km^2 in the RU of Kozani, 29.2 people/km^2 in the RU of Kastoria, 28.1 people/km^2 in the RU of Florina and 13.7 people/km^2 in the RU of Grevena, making the latter the least populated Regional Unit in the whole of Greece.

The composition of WMR's population, per age group and sex, is presented in Figure 3.1. The age 65+ category is the largest population group.

[42] Regional Operational Programme of Western Macedonia 2000-2006
[43] Operational Programme "Environment and Sustainable Development" Part A' - 2009: http://goo.gl/D240hZ
[44] Eurostat. http://goo.gl/DJCRxe

Table 3.1: Western Macedonia Region population (1961-2011)

	Regional Unit Kozani Regional Unit	Regional Unit Florina	Regional Unit Grevena	Regional Unit Kastoria	W. Macedonia total
1961	152,809	67,356	43,484	47,487	311,136
1981	147,051	52,430	36,421	53,169	289,071
1991	150,386	53,147	36,797	52,685	293,015
2001	155,324	54,768	37,947	53,483	301,522
2011	150,196	51,414	31,757	50,322	283,689

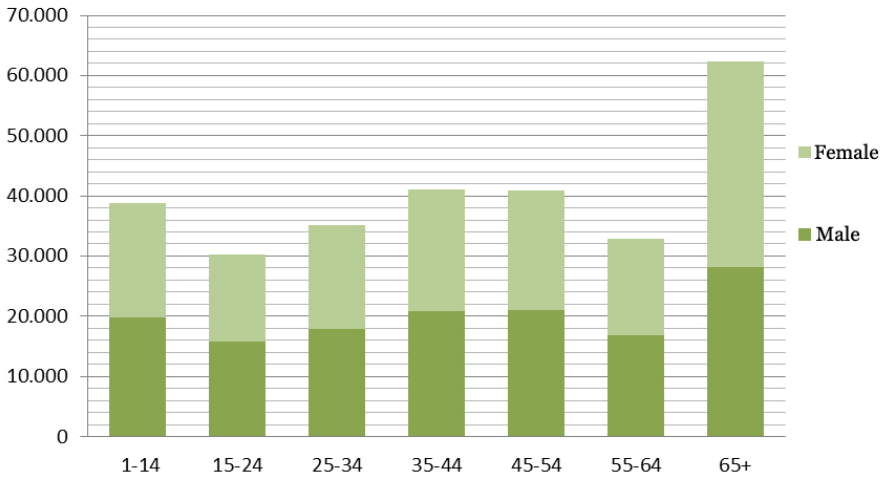


Figure 3.1: WMR population composition (2011 census)

3.3. Economic activities

The Western Macedonia Region (WMR) produced 2.43% of Greece's Gross Domestic Product (GDP) in 2013. According to Eurostat[45], WMR's GDP in 2013 is estimated at €3.97 billion (current rates), and its distribution per sector is presented in Figure 3.2. Similarly, Figure 3.3 shows the gross added value per production sector, with the mining, industry, power production etc. sector contributing the largest share, €1.45 billion at current rates (2013). The energy production sector (electricity production through lignite combustion and hydroelectric energy) is the main economic activity of the regional economy, rendering Western Macedonia Greece's "energy centre".

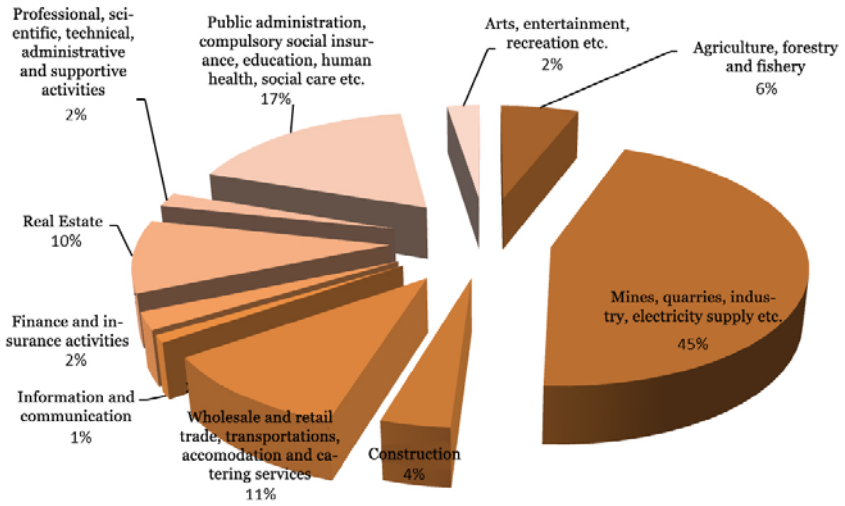


Figure 3.2: Contribution of each sector to the GDP of WMR in 2013 (ELSTAT)

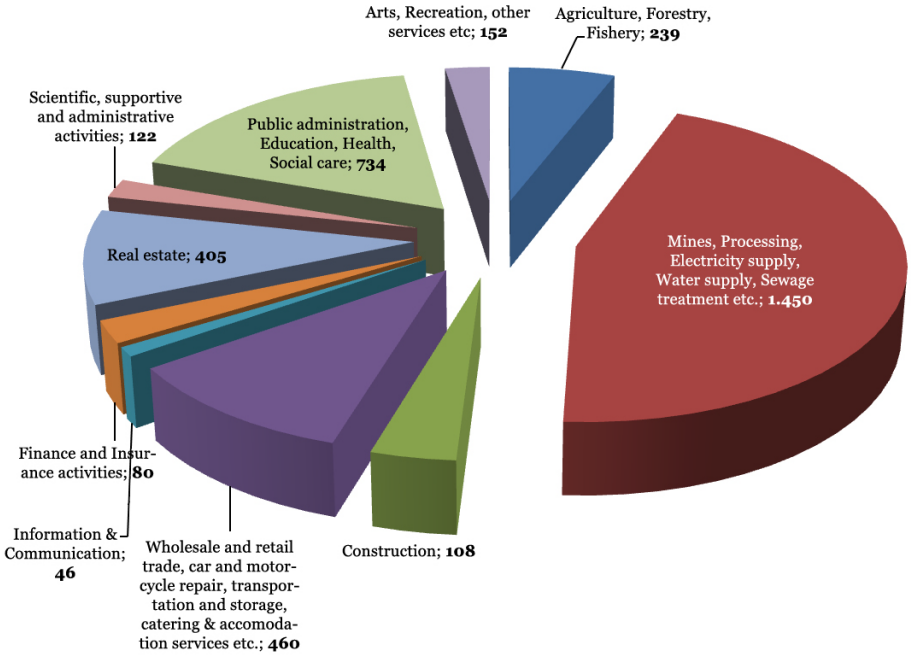


Figure 3.3: Gross added value per production sector in WMR in 2013 (current rates, € million) (ELSTAT)

As 49% of the production occurs in the secondary sector (2013), and the primary sector is limited to very low production rates, it is accurate to describe WMR as an industrial region of limited job sectors. This structure, which reveals the region's huge dependence on PPC's activities, is unique throughout Greece. The main characteristics of each economic activity sector in WMR, as described in detail in the RIS3 plan[46], are the following[47,48]:

[46] Smart Specialisation Strategies in Greece – expert team review for DG REGIO. "RIS3 Regional Assessment: Dytiki Makedonia". http://goo.gl/7r12Ov
[47] European Commission, DG REGIO. http://goo.gl/p13XWk
[48] NSRF 2014-2020. "Operational Programme based on the "Investments for Development and Employment" target". https://goo.gl/q0YHsE

- The **primary sector** has been gradually shrinking over the past years. However, according to the RIS3 plan, WMR has the ability and potential to increase the contribution of the primary sector to the regional GDP (through restructuring, increasing production and improving vertical integration and standardisation of agricultural and livestock products) and to job creation.

- The **secondary** sector is dominated by lignite mining - electricity production activities (in the Kozani and Florina Regional Units), which share all the characteristics of a "monoculture". The fur processing and fur-bearing animal breeding sector (Kozani and Kastoria Regional Units) constitutes the second most important activity in the secondary sector of WMR.

- The **tertiary** sector is defined by an important reduction in trade, since 2009, as a result of the economic crisis. Moreover, the insufficient exploitation of the natural capital and the cultural assets keeps the contribution of the tourism sector at particularly low levels. Despite its notable natural resources and the potential they offer in developing mild and alternative forms of tourism, the Region constitutes, by far, the less attractive tourist destination in the country, as it accounts for only 0.17 of tourist overnight stays per capita.

As a result of the current economic circumstances, WMR's per capita GDP has dropped significantly since 2009. The greatest reduction is noted in the Kozani and Florina Regional Units, followed by relatively smaller drops in the Kastoria and Grevena Regional Units (Figure 3.4). A similar drop, according to Eurostat, is also noted in the purchasing power per capita, based on the final consumption of goods and services (Figure 3.5).

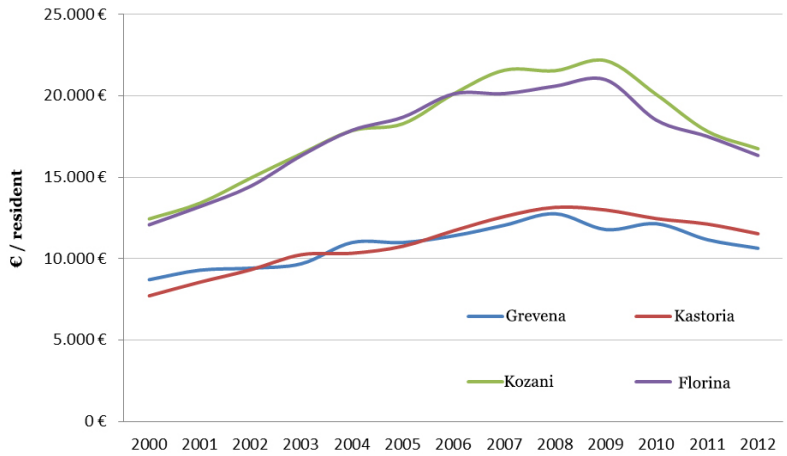


Figure 3.4: Per capita GDP in WMR per Regional Unit between 2000-2012, at current rates (ELSTAT)

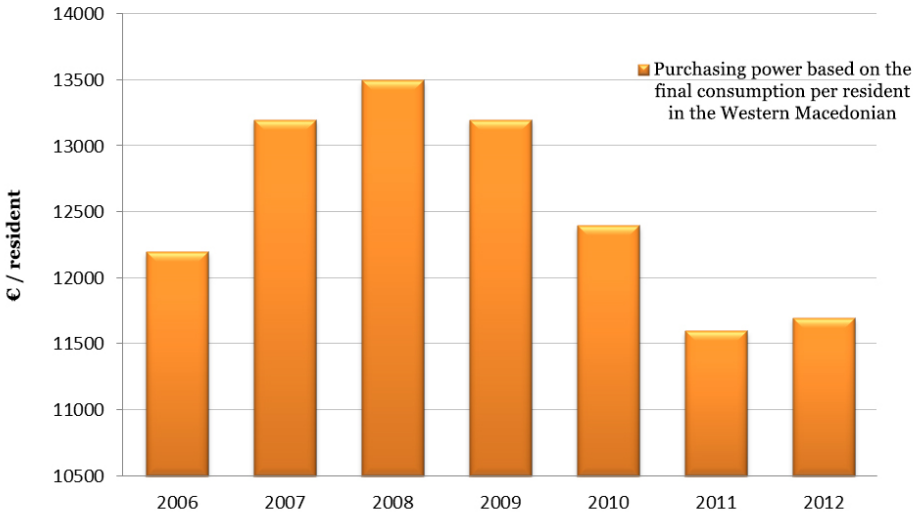


Figure 3.5: Purchasing power based on the final consumption per capita in WMR (Eurostat)

3.4. Employment

3.4.1. Sectoral distribution of WMR's workforce

Based on the distribution of employment per sector within the Region, 16.53% of the active population is employed in the primary sector, 23.85% in the secondary sector and 59.61% in the tertiary sector. In absolute figures, employment per sector of productive activity in 2013 consisted of 14,579 employed in the primary sector, 12,033 employed in the secondary sector and 52,560 employed in the tertiary sector[49].

The distribution of employment of WMR's active population over time is presented in Figure 3.6 for the period 2000-2013. By examining the percentage change in the distribution of the active population per sector since 2008, the year of reference, until 2013, the largest drop is noted in the construction sector (-50.22%), followed by the Real Estate sector (-24.29%). An increase is noted only in the "Professional, scientific and technical, administrative and supportive activities" (+22.73%) and the "Arts, entertainment, recreation, other service-based activities, household activities as employees" (+20.4%) sectors.

[49] ELSTAT figures for 2013

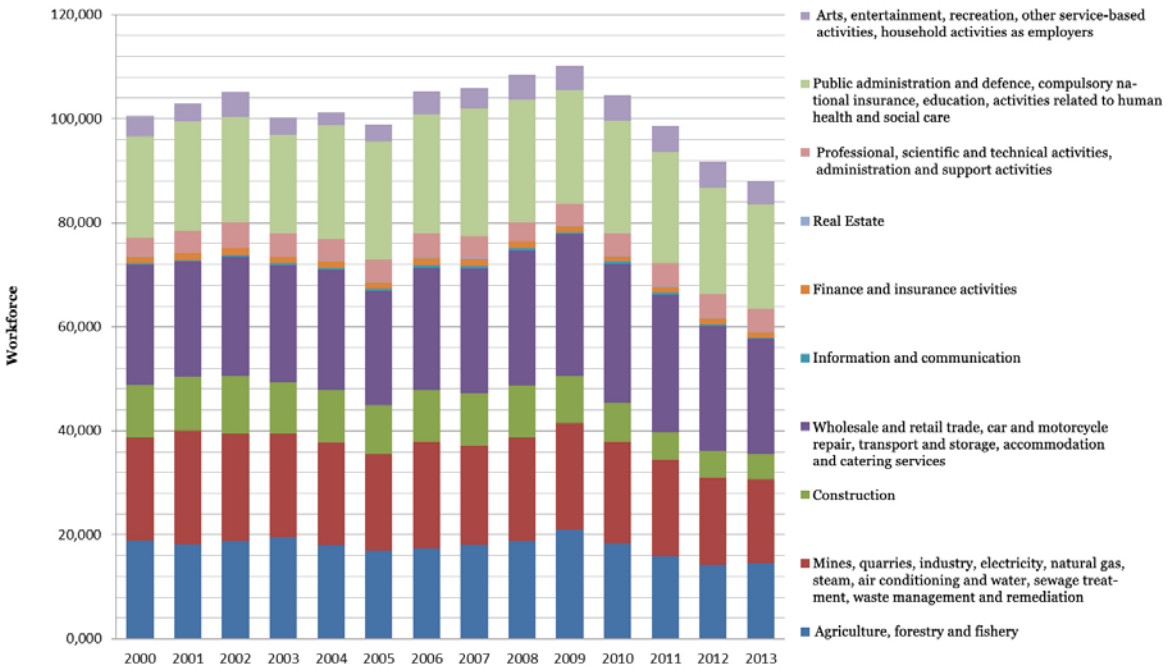


Figure 3.6: Sectoral distribution of WMR's workforce in WMR between 2000-2013.

3.4.2. Jobs created by PPC

The jobs created by PPC in WMR are examined separately, given the fact that the company is the largest employer in the area. Employment data was kindly provided by PPC's Human Resources Department to the Panteion University of Athens and refers to the 2008-2014 period[50]. The personnel are divided into permanent and temporary, per TPS and mine (Figure 3.7). Specifically, in 2014, the permanent personnel in all TPS reached 1,628 employees and the temporary 346. Similarly, the permanent workforce in the mines accounted for 2,571 employees and the temporary 977. Therefore, the total permanent and temporary personnel employed by the PPC in WMR were 5,522 employees (2014), 4,199 out of which were permanently employed. Based on the data presented in paragraph 3.4.1, it is estimated that PPC creates approximately 45.9% of the direct job opportunities in the secondary sector. PPC provides 6.3% of all the jobs in WMR, without taking into account the indirect employment created.

[50] According to the Human Resources Department, since 2010 the company's permanent and temporary personnel is not enough to meet its actual needs, as any additional recruitment has been put on hold due to Greece's economic status.

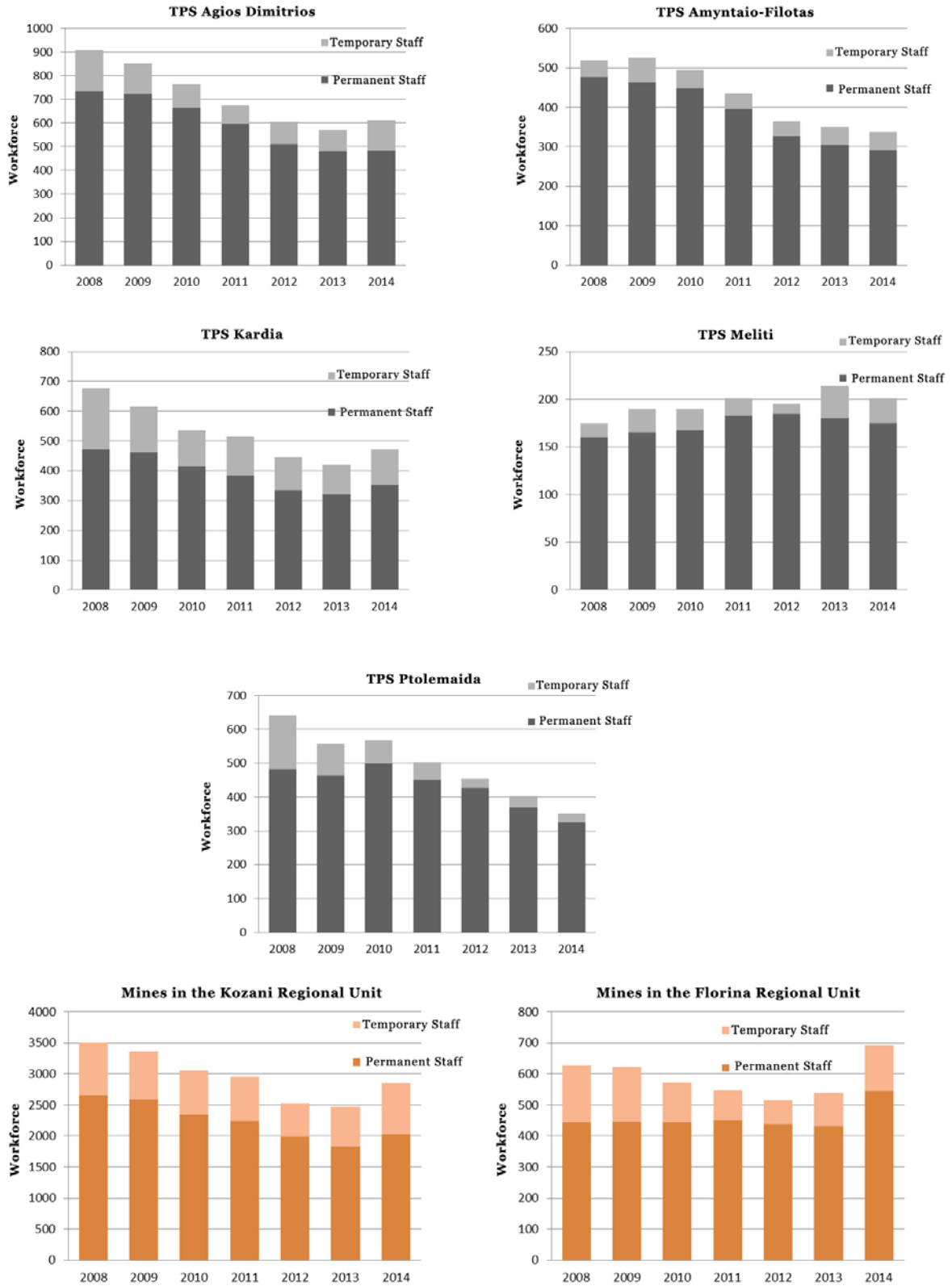


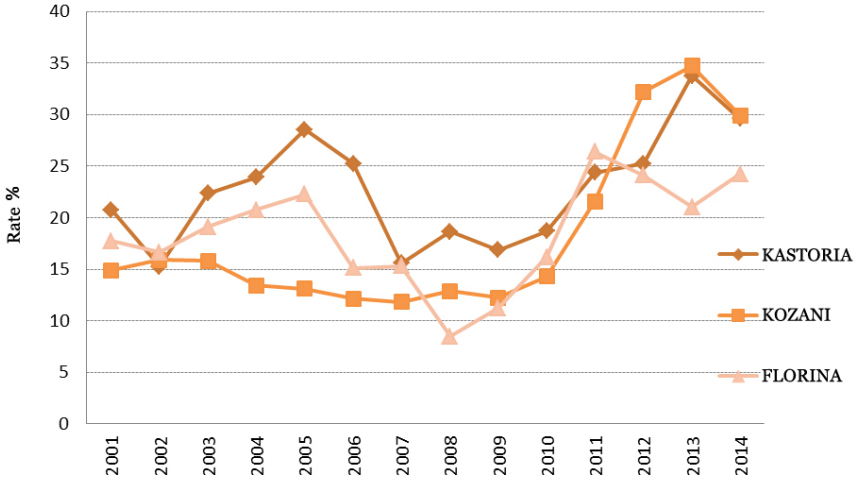
Figure 3.7: PPC S.A. employees in TPS and mines 2008-2014

3.4.3. Unemployment in WMR

According to Eurostat (2014), WMR ranks 9th in unemployment amongst all European Regions, with a 27.6% unemployment rate (22.4% for men and 34.6% for women,

respectively). More specifically, long-term unemployment (≥12 months) reaches 16.5% amongst the Region's active population (2014)[51]. Unemployment amongst young people up to 24 years was 70.4% in 2013, while in 2014 it appeared to drop significantly to 49.6%, an estimate which is nevertheless considered unreliable by Eurostat.

The average annual unemployment rate per Regional Unit between 2001 and 2014 is presented in Figure 3.8. From 2009 onwards, there is a swift increase in unemployment in all Regional Units where data is available. Since 2011, there is a gradual decrease in the average annual total unemployment rate in the Florina Regional Unit. In the Kozani and Kastoria Regional Units there is a drop of approximately four per cent between 2013 and 2014. There is no data available for the Grevena Regional Unit[52].



* For Regional Units with an estimated population below 50,000, such as the Grevena Regional Unit, ELSTAT provides no estimates due to large sampling errors.

Figure 3.8: Average annual unemployment rate per Regional Unit between 2001-2014

[51] Eurostat. http://goo.gl/oVJtuE

[52] No estimates are provided for Regional Units of an estimated population below 50,000, due to large sampling errors. However, according to the Operational Programme of the Grevena Municipality, the unemployment rate in the Grevena Regional Unit in 2014 was approximately 32% (1,671 people in absolute numbers).

4. BEST PRACTICES - INTERNATIONAL EXPERIENCE

4.1. Introduction

Best practice is defined as the technical procedure, or that motive, that aims at identifying practices that succeeded in solving problems under certain circumstances. In other words, best practice constitutes the most efficient and effective way to accomplish a task or solve a problem, and is based on successful procedures followed in the past that, under certain circumstances, can be repeated in the present/future in similar cases/problems.[53]

The majority of international literature agrees that - with regards to a transition to a post-mining, post-carbon/lignite era - there is no universal recipe for best practices and appropriate transition policies that could be applied ex-ante or/and ex-post in a region where mining activity is declining. In the absence of a general transition methodology, each case should be examined separately, by taking into account best practices across the globe and by preparing a distinct transition plan designed for the particularities and special characteristics of the region under study.

The international literature classifies the issues resulting from excavating activities into **environmental** (landscape degradation, land degradation and pollution, desertification, groundwater pollution, deforestation, overall degradation of ecosystem services and more) **socio-economic** (unemployment, population decline due to internal and external migration, training in order for professionals to re-enter the labour market, reduction of overall and per capita Gross Domestic Product, deterioration of health and more) and **cultural degradation** issues (extinction of traditional activities, aesthetic degradation of areas, ruining the potential for developing alternative activities, one-sided development etc.)[54,55].

In this context, the present literature review of the best practices that have been used to help the transition to a post-mining era examines and describes the international experience in three different sections: The first presents the *theoretical framework* of post-mining transition procedures, the second, *general category*, examines wider examples of post-mining transition best practices, regardless of the mineral resource that is being mined, while the third section examines best practices in post-coal transitions (*special category*). The ultimate goal is to identify the best practices that can be used to rationally plan a post-lignite transition for the Western Macedonia Region (WMR). Finally, the report offers a short description of the recommendations of local and national stakeholders and organisations regarding the transition of WMR to a post-lignite era.

[53] Peter Wirth, Barbara Černič Mali, Wolfgang Fischer (Editors). 2012. "Post-Mining Regions in Central Europe Problems, Potentials, Possibilities". http://goo.gl/88bH9T
[54] Greenpeace. 2008. "The true cost of coal". http://goo.gl/Xjjxky
[55] P. Wirth and J. Harfst. 2012. "Challenges of Post-Mining Regions in Central Europe" https://goo.gl/425r1K

4.2. Theoretical approaches and guidance documents

4.2.1. World Bank[56]

The World Bank has carried out a number of studies regarding the procedures that should be followed during the shut down/restoration of mining activities, as well as for the smooth transition of local communities to a post-mining era. The table below briefly summarises the important steps, the bodies involved and the necessary restoration and transition steps that should be followed as part of exemplary and rational planning.

Table 4.1: *Who does what when a mine closes*

ULTIMATE MONITORING SUPPORT/COLLABORATION

BODY	*Framework*	*Initial reserve auditing*	*Construction Operation Shut-down*	*Post-mining period*
Government	*Sets out the rules and assigns responsibilities*	*Monitoring, implementation, information*		*Monitoring and information activities*
MINING COMPANY	*Support*	*Design of the mine with provisions for its shut-down - Collaborations*		*Monitoring during the first stages, support later on*
Local Communities	*Support*	*Incorporating mine closure plans into business activities, establishing synergies with the mining company*		
LOCAL ADMINISTRATION	*Support*	*Timely initiation of planning the regional transition plan, establishing collaborations, planning and promoting sustainable economic activities*		
NGO	*Support*	*Link with international organisations and NGOs, development of skills of local communities, monitoring and information activities.*		
INTERNATIONAL ORGANISATIONS	*Support*	*Dissemination of international best practices, setting out standards and regulations, collaboration with the government, local communities and the mining company*		

It should be pointed out that the World Bank played a key role particularly in mine closures in the former USSR and in Central and Eastern European countries. This role involved both terminating the mining activities in an environmentally acceptable way, as well as mitigating the associated social impacts. It is interesting to note that the International Finance Corporation, member of the World Bank Group, supports only the mining projects that have prepared in advance a plan for closure. More recently, the Bank led a related initiative ("*Towards Sustainable Decommissioning of Oil Fields and Mines Initiative*") that aimed at providing support to the governments of development countries rich in mineral deposits.

[56] World Bank and International Finance Corporation. 2002. "It's not over when it's over: Mine Closure around the world" http://goo.gl/5sgfbu

One of the deliverables of the initiative was the release of a guide of general recommendations[57] on the topic.

4.2.2. The guidelines of the International Council on Mining and Metals[58]

The International Council on Mining and Metals (ICMM) has published a thorough toolkit on mine closures, which contains recommended methodologies related to a wide spectrum of activities, from the involvement of stakeholders and local communities, to the evaluation of the economic risk and the likely opportunities, environmental management, best practices regarding biodiversity etc.

The toolkit concludes that the complexity of mine closures is such that most of the challenges are of a managerial rather than technical nature. The associated planning needs to take into account the likely economic, social and environmental implications for the decades to follow and to ensure sufficient monitoring of the goals set, even after the mining company has withdrawn. The role of local communities is, therefore, elevated.

4.2.3. United Nations recommended policies

As part of the Environment and Security (EnvSec) initiative, the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), and the Organization for Security and Co-operation in Europe (OSCE) released a study that contains a list of recommended actions and a best practice guide regarding mine closures[59]. Apart from the mining industry, the report is addressed to governments, NGOs, international organisations and the wider public, while from a geographic point of view it focuses on countries in South-Eastern Europe, Central Asia and Caucasus.

Central to the report is the issue of assigning economic responsibility, which becomes a complicated issue due to the frequent changes in the ownership of the mines throughout their lifespan, the high restoration costs, the lack of government personnel and know-how that can manage abandoned mines and, finally, by the magnitude of the problem, which goes beyond the power of one and only body, whether local or national.

The recommended policies include means for providing financial guarantees for restoring the mines, supporting the collaboration between stakeholders, promoting and communicating the likely benefits rather than simply assigning responsibilities and legal sanctions, means to overcome regulatory and institutional obstacles etc.

Particular attention is also given to the presentation of innovative proposals for the alternative use of mines and pieces of land, some of which have been partially realised: making bricks out of metal remains rather than conventional aggregates, cultivating mushrooms in the favourable conditions of underground diamond mine tunnels, fish farming in metallurgical plants and open mines etc.

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[57] World Bank Multi Stakeholder Initiative. 2010. "Towards Sustainable Decommissioning and Closure of Oil Fields and Mines: A Toolkit to Assist Government Agencies" http://goo.gl/mpqpjK
[58] International Council on Mining and Metals (ICMM). "Planning for Integrated Mine Closure: Toolkit". https://goo.gl/gBUOcC
[59] UNEP, UNDP, NATO, OSCE. 2005. "Mining for closure". http://goo.gl/dVQhOH

Another intergovernmental organisation of the United Nations, the United Nations Conference on Trade and Development (UNCTAD), has also demonstrated significant activity around post-mining related matters. An example is the Mining Policy Framework, which makes special reference to the obligations of national governments, from establishing an appropriate regulatory framework to ensuring economic sustainability in mine closures and abandoned land management[60].

4.2.4. Management standards of the International Organization for Standardization[61]

The absence of international management standards for abandoned mines led the International Organization for Standardization to establish a committee with the aim of setting out guidelines that can approach the issue from an international, rather than local, perspective. These guidelines - still under preparation - are general in nature and aim at bridging the gap between the clashing interests of mining companies and local communities.

The axes on which the associated standards will be based are the following:

- The management of the restoration should be supported both by the government and by the companies, and should take into account the inhabitants' opinions.
- The companies and the governments need to be adequately prepared in order to monitor the state of the environment, the likely reuse of closed mines, the economic rejuvenation of the local community and the expenses that all the above require.
- Guaranteeing transparent procedures and the participation of all stakeholders involved, through official channels of communication. Public hearings are a recommended tool for this purpose.

It's important to note that Greece takes part in the committee that prepares the aforementioned standards as a member-observer, having the right to comment but not to vote.

4.2.5. The ReSource project

The ReSource project[62] was carried out between 2009 and 2012 with the participation of 9 research bodies and coal producing regions in Germany, Austria, Czech Republic, Slovenia and Hungary. According to the deliverables of the analysis of best practices in post-mining/post-lignite activities in central Europe, the developmental potentials can be grouped into three categories:

- Natural Potential: Examining and developing innovative approaches such as biomass production, installing RES units or producing geothermal energy using minewater.
- Cultural Potential: The term refers to utilising industrial heritage, infrastructure, production facilities, and equipment - in other words any human-induced leftovers of the mining activity. "Cultural potential" refers to the more developed resources, in the areas of central Europe under study, as approximately 1/3 of the cases examined as part of the ReSource project concern cultural infrastructure (e.g. museums) and tourist routes.

[60] Intergovernmental Forum. 2015. "Mining Policy Framework" http://goo.gl/x7pTN6
[61] ISO. 2015. "Safe and sustainable mining with ISO standards". http://goo.gl/gdz4Kl
[62] http://goo.gl/QsmWTT

- Integrative Approaches: The outcomes of the project pointed out that the most important factor in the successful development of integrated approaches is the constant and seamless collaboration between the stakeholders involved, by laying out alternative scenarios of economic development, exchanging knowledge and opinions, involving the academic community and citizens' associations and the overall smooth collaboration between the mining company, the local administration and the community.

4.2.6. The contribution of Non Governmental Organisations

The key role of citizen organisations and bodies is underlined in almost all the guidelines for planning the transition to a post-mining future. In fact, there are many cases where environmental organisations have taken initiatives ahead of local bodies or central administrations.

Such examples can be found in many regions across the globe that boast rich fossil reserves. In 2015, Greenpeace Germany released a study aimed at setting out, for the first time, a roadmap for the gradual transition to a post-lignite future for the region of Lusatia in Eastern Germany, by 2030[63]. More specifically, according to the study, the gradual end of lignite power production activities will lead to the loss of approximately 4,100 jobs. On the other hand, the external cost of lignite exploitation - estimated at €82.7 billion - will be significantly reduced, while the full exploitation of RES technologies, particularly wind and solar energy, will create 3,900 full-time jobs in the regions examined. More jobs can be created by making use of the added value brought about by taxing the profits of RES companies, salary increases, municipalities and state resources etc.

In Australia, a country with a long tradition in coal mining, the Queensland Conservation Council and 350.org released a study[64] with policy recommendations for the transition of the Queensland state. These recommendations are centred around a *just* transition, in other words, around protecting ordinary workers and their families from the painful process of a change in the economic model - crucial in this respect is the role of trade unions and cooperatives.

WWF led a similar initiative in New Zealand, in 2012. The respective study[65] describes the sustainable development alternatives for the (rich in lignite) regions of south New Zealand. The scenarios presented in the study examine the reciprocity of likely investments in the forestry, engineering and construction, occupational training and agricultural sectors. The simulation of the scenarios showed that, for example, harnessing forestry products can create up to 1,180 jobs, while within a 15-year time frame there could be an additional 820, 755 and 540 jobs in the engineering, education and agricultural sectors, respectively.

There have been quite a few efforts to lay out alternative options for states that excavate and burn coal in the USA, too. Some examples include the report[66] of the "BlueGreen Alliance" -

[63] Greenpeace. 2015. "A future for Lusatia without lignite". http://goo.gl/2B3fwm
[64] Queensland Conservation Council. 2015. "Jobs After Coal: a Just Transition for Queensland". https://goo.gl/9W5m0V.
[65] WWF New Zealand. 2012. "A view to the South". http://goo.gl/2j0tzs
[66] BlueGreen Alliance.2015. "Managing the Employment Impact of Energy Transition in Pennsylvania Coal Country". http://goo.gl/SNf7dd

a collaboration between trade unions and environmental organisations - for the State of Pennsylvania, and a study by the Headwaters Economics research group, which focused on the State of Montana and its provincial areas that have high dependency on the coal industry[67].

4.3. International best practices in mine restoration and post-lignite transitions

The next section of the report presents a brief summary of some of the notable practices of a coordinated transition from a state of mining activities to a post-mining era, regardless of the product of mining, followed by a focus on regions rich in coal or lignite.

4.3.1. The Eden Project in Cornwall, United Kingdom

The Cornwall County was a region of intense mining activity during the industrial revolution of the 18thand 19thcenturies. Over a period of more than 150 years, there were over 4 million cubic meters of kaolin excavated, creating a mining area of 22 hectares wide and 30-70 meters deep. For decades the county constituted a relatively isolated region defined by low tourist interest and a degraded environment.

The Eden restoration and promotion project[68] began in 1995, with the initial aim of undertaking large-scale works of ecological restoration. Following over two years of works related to slope stabilisation, installing advanced irrigation systems, producing over 80,000 tonnes of artificial soil through recycled material and landscape transformations, the biggest greenhouse in the world was constructed, featuring more than 1,000 different plant species.

Today the region features exemplar structures and facilities, of a research and educational nature, which at the same time contribute to the creation of a new tourist product. In its first two years of operation, the greenhouse attracted more than 4 million visitors, while it generated revenue of approximately £150 million (€190 million) in its first year of operation alone, and created over 400 new jobs.

4.3.2. The Wieliczka salt mine in Poland

The Wieliczka salt mine in south Poland was in operation from the 13thcentury until the end of the 20th century. In its 327 km of underground tunnels, one can find religious statues and places of worship created by self-taught mine workers, and various other works by contemporary artists. The underground chambers of the mines today host cultural events such as concerts and art exhibitions, and they feature modern dining facilities, an underground museum, thermal springs and health services such as treatment for illnesses of the respiratory system, physiotherapy etc.[69].

In 1978, the salt mine was declared a World Heritage Site by UNESCO and every year it welcomes more than one million visitors from around the world. It is managed by the Wieliczka Salt Mine Capital group, which falls under the Polish Ministry of State Treasury

[67] NRDC. 2016. "Planning for Montana's Energy Transition". https://goo.gl/4VYaQu
[68] Eden project. https://goo.gl/bfl2eq
[69] Wieliczka Salt Mine. http://goo.gl/3UkFzk

and collaborates with local Municipalities and private businesses on shaping and preserving the cultural heritage of the region[70].

4.3.3. The Britannia[71] coastal copper mine in Canada

Britannia was a copper mine with a network of tunnels spanning 210 kilometres that operated in the south west coast of the Canada's British Columbia province between 1902 and 1974. Since 1929, it was the biggest copper producer in the Commonwealth and employed over 60,000 people. When the mine closed, in 1974, the excavations became one of the most important areas of acid rock disposal in North America, the irrigation of which in the adjacent coastal zone led to environmental degradation and to the destruction of important fishing reserves in the region. In 1975, a section of the mine was converted to a Mine Museum, while in 1988, one of the treatment plants was designated as a National Historic Monument and was restored using mining industry funds and donations by the federal and regional government[72].

For more than two decades, the runoff of the acid soil remained an unresolved issue. However, when the land was sold to a new company, the latter agreed to help construct a facility for treating acid runoffs before they reach the shore. In 2001, the Province filed for compensation for the environmental degradation caused by the given surrogate companies exploiting the mines, which was set at 30 million dollars. Using this money, the local government, in collaboration with the University of British Columbia, prepared a long-term plan for the permanent closure of the mine, the environmental restoration of the area and the creation of a mining history and research centre, located in the restored mine.

4.3.4. The Sullivan mine in Canada

The Sullivan mine in Kimberley, northwest Canada, is an interesting example of a successful transition of a region to a post-mining era. Before closing at the end of 2001, the mine had operated for more than 90 years, generating over 20 billion dollars and employing up to 3,500 workers.

Towards the end of the 1960's the owning company, in collaboration with the local administration, started preparing a plan for the transition of the region from a mining to a tourism model of development. These plans were realised through the construction of a ski resort, golf courses and housing facilities for visitors, while the mining company is also investing in building development in order to attract new residents to the region, particularly pensioners.

Apart from the above, the Kimberley region also features one of the biggest photovoltaic parks in Canada, of 1,05 MW of capacity and a total value of $5,3 million, which was funded by the Municipality, the mining company and charities of the wider region. In order to obtain the consent of the local community, the local authorities held a referendum in which 76% of

[70] UNESCO. "Wieliczka and Bochnia Royal Salt Mines". http://goo.gl/PlKUGh

[71] Britannia Mine. http://goo.gl/aMfglC

[72] Canadia Institute of Mining, Metallurgy and Petroleum. 2010. "Restoring the past - Britannia Mine Museum receives makeover" .http://goo.gl/XqiHZ4

the citizens voted in favour of constructing the park, the operation of which generates an annual revenue of approximately $224,000[73].

With regards to the major environmental issues in the region, a public committee was set up to ensure that all the related matters will be dealt with transparency and in cooperation with the local administration, the community and local NGOs.

4.3.5. Innovative mine reuses

Mining areas usually revert to their former uses, i.e. those prior to the excavations, which in most cases are wild life habitats or forest lands. Over the past few years, however, the rise in the importance of economic pay-offs led companies and local authorities to come up with innovative reuse plans that make use of the existing infrastructure. Some of these new uses are the following:

- Mountain biking park in the coal mines of the Afan Valley[74] in South Wales.
- Underground science laboratory in the Vale Creighton[75] nickel mines in Canada. Located 2 km below the ground, SNOLAB scientists investigate the properties of dark matter particles.
- Racetrack in the limestone mines of the Gotland island[76] in Sweden.
- Diving centre in the flooded limestone mine of Kőbánya[77] in Hungary.
- Winter sport and tourism resort in the gold and silver mines of Park City[78], in Utah, USA.
- Underground sports track for the simulation of training in high altitudes, in the Yanahara iron mines[79] in Japan.
- Specialised services for the underground storage of valuable assets, from pieces of art to files containing earthquake data, in the former salt mines of Hutchinson[80] in Kansas, USA.
- Opera House that takes advantage of the acoustics of the limestone mine in the city of Dalarna[81] in central Sweden.
- Particle physics underground lab located 750 m. beneath the ground, in the former iron mine of Minnesota[82] in the USA.

4.4. International best practices in mine restoration and post-lignite transitions

[73] Sunmine, Kimberly, British Columbia. http://goo.gl/iW1Tc3
[74] BBC News. 2010. "Afan Valley moves from mining to mountain biking". http://goo.gl/T2wJd0
[75] SNOLAB. https://goo.gl/qs0hXf
[76] Gotland Ring. https://goo.gl/mQRvZS
[77] Kőbánya. http://goo.gl/Y0OCYz
[78] Park City. http://goo.gl/IN41FK
[79] Gilles A. Tremblay and Charlene M. Hogan. 2009. "Approaches for the Remediation of Abandoned Mines and NOAMI". http://goo.gl/U0k0zJ
[80] Hutchinson. http://goo.gl/YXcywa
[81] Dalarna. http://goo.gl/ihl0o8
[82] University of Minnesota. Soudan Underground Lab. http://goo.gl/i623rj

This section presents the best restoration and economic restructuring practices that were carried out in regions where *coal/lignite* was the primary mining material.

4.4.1. Loos-en-Gohelle (France, Pas-de-Calais)[83,84]

The Loos-en-Gohelle region, in Nord-Pas-de-Calais in Northern France, of a 7,000 population, had hosted coal mines since 1850. The gradual end of mining activities appeared to be creating an ominous future ahead: likely collapse of the local economy, devastation of the social fabric, widespread uncertainty and severe environmental issues. In 1997, the municipal council decided to implement sustainable development policies, revolving around the active participation of citizens. The initiative was met with success and today the Loos-en-Gohelle municipality is one of the main supporters of environmental innovation in France and is considered a role model in the energy transition of cities.

The main milestones of Loos-en-Gohelle municipality policies were the following:

- Extensive energy saving measures on the existing municipal building stock and the former residencies of miners.
- Exploiting clean forms of energy by installing PV stations in the restored mining and deposit areas, and planning the future exploitation of wind energy through the construction of 6 wind turbines.
- The creation of a research centre for testing 24 solar technologies in collaboration with engineering research faculties of the region.
- Creating a support and development centre for over 600 "green businesses", 150 of which are involved in renewable energy resources.

Finally, in 2012, the Nord-Pas-de-Calais mining area, along with the associated facilities (the older of which dates back to 1850), were designated as an Unesco World Heritage site. The site was chosen due to the extent of the activities, which were spread out over an area of more than 1,200km^2, the testimonials regarding the development of mining technologies used which is of important historic value, the regional planning for housing the employees, and the fact that it brought together an impressive mixture of workers from across the world[85].

4.4.2. The case of the Zeitz municipality in Germany

The Zeitz municipality is part of the Saxony-Anhalt region in Eastern Germany, south of Leipzig. In the past, the region was defined by significant mining activity, with over 20 mines and many lignite power production units. Today there are only a few mines left, used to supply the two remaining units. Following the German reunification, the new Federal Republic of Germany decided to restore all the closed mines. An extensive programme of restorations was carried out in the region. There were 21 artificial lakes created and extensive areas were restored, such as for example the Geiseltalsee lake[86], whose creation required

[83] Loos-en-Gohelle: 20 years of sustainable development policy, heading towards transition. http://goo.gl/1uM0Rn
[84] Loos-en-Gohelle, ville pilote du Développement Durable http://goo.gl/yPS7gg
[85] Nord-Pas de Calais Mining Basin. http://goo.gl/yWsxfU
[86] Geiseltalsee. http://goo.gl/mzmeXH

€350 million. The implementation of the restoration programme was carried out by LMBV[87] which was established following the dissolution of the MIBRAG extraction company.

The state municipalities have approved a special plan regarding land restoration. A special fund was set up especially for this purpose, using mining revenues. The fund is managed by local authorities, while companies are required to commit to restoration works in order to obtain permission for mining activities in new areas. The company bears the full cost of settlement relocations, which take place in areas handed over by local authorities, within an implementation time frame that does not exceed 5 years. Finally, big investments in the waste management sector are also taking place in the region.

4.4.3. The transition of the Ruhr region in Germany[88]

From the late 1950s, the Ruhr region started to gradually move towards deindustrialisation, as a result of the increased mining costs and the progressive substitution of coal with oil, natural gas, nuclear energy and cheaper, imported coal.

This required a long and progressive restructuring of the local economy, which gradually moved from the dominating secondary sector to the tertiary one.

As the governments of the regional state grasped the magnitude and the difficulties of this transition, they took important initiatives already from the '60s, to face the likely impacts on the local economy, by implementing development programmes that aimed at dealing with the structural weaknesses of the labour market, retraining and diversifying the workforce towards new activities, promoting technological innovation and redesigning residential areas. The interventions were planned at a local scale and required the collaboration of local authorities with chambers, local businesses, banks and trade unions of the coal industry. There were also networks created between the communities and regional authorities of mining areas, with the aim of protecting and designating their common industrial and cultural heritage as part of promoting tourism development.

The Ruhr region has nowadays managed to develop new sectors of economic activity, mostly orientated towards information technology, biomedicine, environmental protection technologies and more. In this context, the region has created one of the denser networks of academic institutions in Germany (5 universities and 8 technical schools) and technological centres, and is the home of over 600 businesses.

4.4.4. The Northumberlandia restoration project[89] in Newcastle, England

The Northumberlandia restoration project constitutes a typical example of the potential of combining mining activities and public use of land. It was completed in 2012 in the Cramlington, Northumberland region in Northern England and is considered as the first example of a restoration that was carried out while mining activities were still in progress. A piece of land adjacent to the mine was converted into a large public park, using, among others, the material excavated from it. The cost of the project reached £3 million (which is

[87] LMBV. https://goo.gl/c05G08
[88] ANKO 2015. "Operational Development Plan for the Post-Lignite Era (Phase A')" pp.81-84.
[89] Northumberlandia http://goo.gl/XN5DF1

approximately twice the average cost of a restoration project). Both the creation and the maintenance of the park are privately funded by the Mining Group and Blagdon Estates banks. The park is open to the public and comprises of four miles of footpaths in a 4.7-hectare area.

4.4.5. Management of the transition and support bodies

The successful transition of regions rich in coal requires central governments to make special planning and management provisions in that direction. Examples of such bodies - all different in terms of structure and goals – are presented in the section below.

The POWER initiative in the USA[90], with the participation, as of 2015, of 11 different services under the US Economic Development Administration (EDA), managed development funds with the aim of supporting communities affected by the decline in the use of coal. The funds allocated by the programme reached $35 million (€31 million) in 2015 alone, for supporting new economic activities, attracting new investments, preserving and promoting cultural heritage, retraining and diversifying the workforce towards new activities.

The LMBV company in Germany has a different structure. It is owned by the German government and, since its establishment in 1994, it focuses on the closure and restoration of mines in Lusatia and Central Germany. LMBV is involved in the safe management of mining facilities, water management, promoting and exploiting abandoned lands, environmentally reclaiming lignite mining areas, the professional development of the local workforce etc. It is estimated that as a result of the activities of LMBV there have been over 12,000 jobs created in the area.

The NOAMI initiative,[91] (National Orphaned/Abandoned Mines Initiative) in Canada constitutes a special case, supported by both the government (federal, regional and local administrations) and the mining industry. Funded by state and private funds and under the management of the Canadian Ministry of Natural Resources, the initiative aims at restoring and managing orphaned/abandoned mines or mines that belong to owners that are unable to meet their obligations. The conglomerate is in charge of creating an associated national registry, taking initiatives for overcoming institutional obstacles, mobilising local communities, attracting funding mechanisms etc.

Finally, there are several charities in the United Kingdom that have been established exclusively for providing support services to local communities adapting to new economic circumstances. Two such examples are the Eden Trust and The Coalfields Regeneration Trust. The Eden Trust has received funds of approximately £140 million (€180 million) since 1995, mainly through the National Lottery, private funders and local development businesses, while the Coalfields Regeneration Trust has invested over £260 million since 1999 (€330 million) creating 5,375 new jobs, retraining 1.3 million workers and providing consultation on the funding of new, innovative activities and the support of businesses[92].

[90] US Economic Development Administration. https://goo.gl/yjR9rn
[91] National Orphaned Abandoned Mines (NOAMI). http://goo.gl/xxsKXO
[92] The Coalfields Regeneration Trust. http://goo.gl/72WvcB

5. RECOMMENDATIONS OF STAKEHOLDERS FOR THE TRANSITION OF THE WESTERN MACEDONIA REGION TO A POST-LIGNITE ERA

The aim of this section is to examine, document and review initiatives, proposals and recommendations made by local stakeholders, citizen organisations, chambers, the academic community, and local and national NGOs that are investigating the potential of the transition of the Western Macedonia Region (WMR) to a post-lignite era.

5.1. Regional economic-development planning of W. Macedonia - Regional Operation Programme 2014-2010

The Strategic Planning of the Operational Programme (Phase A' 2015-2019)[93] of the Western Macedonia Administrative Region (WMAR), coincides with the general development framework that has been set out for the 5th programming period (2014-2020) by the National Priorities and the national co-funded programmes.

The new Regional Operational Programme 2014-2020 (ROP) makes no direct reference to the need for devising an operational plan for the transition of WMR to a post-lignite future. However, the current status and the sectors of priority of the new ROP-WM indirectly acknowledges the need for economic restructuring in WMR - which is necessary for a successful transition. The Energy/RES-District Heating sector is pivotal in ROP-WM's strategy, while the Integrated Waste Management sector, research and innovation, the development of traditional sectors of Rural Development and Production, and the development of the Tourism sector (ecotourism - industrial tourism) constitute important strategic targets that are compatible and fundamental in the operational planning of the transition to a post-lignite era.

5.2. PPC's lack of long-term planning for WMR

Apart from the plan to restore the mines of the Lignite Centre of Western Macedonia (LCWM), the realised and scheduled relocations of the afflicted settlements and the cooperation agreement signed with the Kozani Regional Authority, PPC has made no other long-term plan for WMR regarding the post-lignite era.

5.2.1. Cooperation Agreement

In 2007, PPC signed a Cooperation Agreement with the then Kozani Regional Authority which, without challenging the energy model pushed forward by PPC[94], officially acknowledging the environmental burden caused by the company's facilities, through both pollution and the consumption of vital natural resources. With regards to jobs creation, on the one hand it highlights the quantitative and qualitative degradation of the jobs provided and on the other hand the conflict between the company's and other economic activities.

[93] WMR. "Western Macedonia Region Operational Programme (2015-19). Part A': Strategic Planning". http://goo.gl/GjRp1U

[94] Kathimerini. 27/10/2007. "They want both the PPC and their lives", http://goo.gl/fFQU2D

In order to efficiently design and implement an operational plan for a post-lignite transition, the cooperation agreement needs to be reviewed and re-orientated towards that direction, with specific commitments and timetables.

5.2.2. Relocation of Settlements

The relocation of the settlements afflicted by the extraction activities is carried out through expropriations, as there is no institutional framework in place. It's interesting to note that in the case of the Pontokomi settlement, the relocation procedures and the obligations of PPC were dictated by a bilateral agreement between the corporation and the local community[95].

In cases of more recent relocation agreements, the economic burden is shared between PPC and the state budget (within the context of the Special Development Programme - SDP)[96] and is estimated based on the expropriations act. However, this method leads to an underestimation of the real cost of the expropriated settlement - a difference covered either by PPC or through local funds, depending on each case.

5.2.3. Land restoration[97]

Based on the Environmental Impact Assessment (EIA) of the mines in the Kozani Regional Unit, the restoration works are expected to be completed by 2053. More specifically, the mining works are scheduled to be completed in the South Field, the Main Field and the Kardia Field by 2039, 2044 and 2050, respectively. The budgeted cost of closing down and environmentally remediating the sites of the Ptolemaida Mines for the period between 2009-2020 is estimated at €13,2 million.

Once the exploitation works have been completed and the restoration programme has been implemented (2053), it is estimated that there will be 5,015 hectares of cultivable areas and 5,374 hectares of forests created, while 1,167 hectares of lakes will be covering the excavations of the mines. The final uses of the restored lands include agricultural, forest, recreational and more (Waste Treatment Plant, RES etc.).

Taking into account that soil restoration is expected to have reached only 33% of the total mining area by 2020[98], a detailed study should be carried out on the likely decrease in WMR's economic prosperity as a result of the delay in handing over the restored lands for cultivation purposes. Finally, it is necessary to sort out the legal status of the lands covering the mines (lack of institutional framework for restorations, ownership) that belong to PPC.

5.2.4. The future of district heating

Pivotal to the post-lignite transition is to timely provide alternative sources of thermal energy to fuel the existing district heating systems, once the TPS that are currently feeding

[95] PPC. 11/03/2010. "Memorandum of Agreement". https://goo.gl/u1p4lM
[96] L. 3937/2011, article 28: http://goo.gl/Pyn08c
[97] PPC S.A.. 2009. "Environmental Impact Assessment of Ptolemaida mines, Regional Unit of Kozani" http://goo.gl/86BO5J
[98] Kalaitzidou I. 2009. "Restoration of Excavation Areas. European experiences and the Ptolemaida basin in the Kozani Regional Unit" http://goo.gl/FrgTm8

them have started to close down. PPC has signed an agreement for the provision of thermal energy (district heating) with the municipalities of Kozani, Ptolemaida, Amyntaio and Florina, securing in this way thermal energy for the region at significantly lower costs compared with those when using heating oil. According to the corresponding agreement, heat is to be provided either by using the existing facilities or/and by constructing new, the cost of which should be covered by the respective municipalities. However, there is no comprehensive plan to date to deal with the expected decline in the thermal energy fed into the district heating systems as a result of the gradual retirement of old TPS.

5.3. ANKO: Operational Development Plan for the Post-Lignite Era

Recognizing the need for long-term operational planning for the transition of WMR to a post-lignite era, the Regional Development Agency of Western Macedonia - Kozani S.A. - (ANKO)[99] has been developing since 2010 a relevant plan for the Kozani-Ptolemaida-Amyntaio-Florina axis.

In its first part, the operational plan makes a comparative analysis of the Kozani and Florina RU with the RU of Trikala - which serves as a reference RU - and the Drama RU, where rich lignite reserves can be found. The analysis clearly shows that the Kozani RU outmatches that of Drama in terms of prosperity per capita (per capita GDP almost twice compared with that of Drama in 2009). Moreover, according to the study, lignite mining and electricity production in the Kozani and Florina RUs have contributed significantly to a higher GDP compared with the remaining Western Macedonia RUs (Kastoria, Grevena) and the reference RUs (Trikala and Drama). Interestingly enough, the comparative analysis shows that unemployment is particularly high in the Kozani, Florina and Drama RUs, while it remains lower in the Trikala RU, where economic development has been based on a balanced exploitation of its inherent potential.

ANKO also prepared a roadmap of best practices for dealing with the impacts of a WMR transition to a post-lignite era, based on international best practices - case studies that were presented in one of its older studies in 2007[100]. These practices refer to:

- The economic obligations of companies (e.g. mining duties) and the population (e.g. municipal income tax) that fund activities in the interests of the local community, administration etc.
- Policies to promote the new district heating units / combined production units.
- Provisions by electricity production companies towards local societies (e.g. urban regeneration projects, recycling etc.)
- Use of modern technologies to reduce the environmental footprint of electricity production units (emission reduction, use of sewage sludge, treatment of industrial waste etc.)
- Environmental protection measures in the wider area of activities of the companies (air pollution monitoring systems, measures to protect fish populations in hydro power projects, soil restorations etc.)

[99] ANKO. 2105 - Phase A': Operational Development Plan for the Post-Lignite Era.
[100] ANKO 2007. "European Experiences in the relationship between power production Organisations and local societies and their applicability in Western Macedonia - Final Report - Volume A' ". http://goo.gl/HJOVUj

- Funding of development programmes and local businesses by energy production companies (research centres, ecotourism projects, lower electricity bills for local businesses etc.)

Finally, the operational plan focuses on specific axes of intervention for the post-lignite period, which are briefly the following:

- Axis 1: "*Supporting business activities and providing innovative and profitable activities to the region's labour force*".
- Axis 2: "*Developing the abilities and skills of the workforce in sectors directly related to the production potential of the region*".
- Axis 3: "*Protecting, designating and exploiting the natural and man-made capital and creating favourable living conditions*".
- Axis 4: "*Technical support for the realisation of the Operational Programme*".

The results of the open consultation[101] on the post-lignite period, which began in 2015 on the initiative of Western Macedonia's Administrative Region, will be used to improve the operational development plan for the post-lignite period, which is currently prepared by ANKO.

5.4. The contribution of TCG, Department of Western Macedonia

The Technical Chamber of Greece, Department of Westerm Macedonia (TCG-WM) is constantly contributing to the dialogue regarding the challenges anticipated in the lignite electricity production sector in Greece and the Western Macedonia Region. Below is a brief summary of two studies related to the post-lignite transition of WMR.

5.4.1. Estimation of the cost of the transition of Western Macedonia to a lower lignite production model (TCG-WM)[102]

This study by TCG-WM constitutes the first attempt to systematically estimate the likely cost of WMR's transition to a post-lignite era. At first, it presents an analysis of the socio-economic impacts likely to occur if the 2020 targets the Greek government has committed to are met, in the context of a non-systematic de-industrialisation of WMR. The study criticizes Greece's national energy plan, pointing out the gradual rise in the country's dependence on imported fuels, while it also presents relevant international case studies (United Kingdom, Germany).

According to the analysis, the synergies between the lignite industry and the regional economy can be divided into direct, indirect and derivative. The TCG-WM study uses Input-Output Analysis (I-O) to estimate the aftermaths of a post-lignite transition; the I-O analysis methodology is presented in Annex I, since it was also used in the present study.

Based on the analysis and the estimated technology multipliers for WMR, the TCG-WM estimates that for 1 permanent job position in mines or in TPSs, there are 3.28 positions created and maintained in the local economy. Similarly, every €1 spent by the PPC in salaries

[101] http://goo.gl/7ERy7d
[102] TCG-WM. 2012. "Estimation of the cost of the transition of Western Macedonia to a lower lignite production model"http://goo.gl/bqRCh7

and other employer obligations provides €3.09 to the local economy. The study concludes that the withdrawal of 2,400MW of power from WMR would lead to 12,468 jobs and a local income of approximately €670 million to be lost as a result of the multiplying effects.

It should be noted that the study "*doesn't examine the truly important issues of environmental pressure and degradation*", hence it fails to estimate the negative impacts of lignite monoculture both on the local GDP and on the job sector, caused by the degradation of the region's resources, the exclusion of other economic activities and the degradation of the public health system.

5.4.2. Assessment and designation of the Post-Lignite Era for the Energy Centre of Western Macedonia[103]

In this report the TCG-WM attempts to define the post-lignite era following a systematic approach. By examining international experiences, the report acknowledges that prompt and long-term policy planning is necessary in order to ensure a smooth transition to a state of low dependence on the mining and exploitation of fossil fuels.

The beginning of the post-lignite era, according to Hubbert's "Peak Theory", is 2002, when lignite production reached a peak of 55.8 million tonnes. The analysis estimates that the post-lignite era will end in 2021, when a "*steep decline in production, with heavy impacts on jobs and income*" is expected.

Despite this conclusion, the report rounds off by making recommendations that include the construction of new lignite units using modern pollution abatement technology, the combined use of natural gas and lignite during the start-up of the units, CO_2 transport and storage, carbon capture and use, and using lignite in the production of high-added value products. In other words, to counterbalance the impacts of the expected end of lignite activities, the report recommends policies that will further preserve them. Even in the case of running out of lignite, the report recommends importing it "*from neighbouring countries (FYROM, Albania, Serbia) and definitely from Elassona and Drama*". At the same time, no mention is made of the need to put forward a model of alternative development.

5.5. The report by Greenpeace Greece[104]

Released in 2006, Greenpeace Greece's report is one of the first attempts to articulate the need for a gradual post-lignite transition of Greece. It makes a detailed account of the international pressure on lignite and it presents case studies in countries such as Germany and the United Kingdom, where a gradual decline in coal-based electricity production has already taken place. The report also makes a thorough investigation on the external cost of lignite mining and combustion, focusing on its impacts on the health of the local population. It rounds off with an attempt to portray an alternative energy model for Greece and it examines the potential of job creation through investments in clean energy. According to the results of the comparative analysis, RES create more jobs than lignite, both per unit of installed capacity and per unit of energy.

[103] TCG-WM. 2012. "Assessment and Delimitation of the Post-Lignite Era for the Energy Centre of Western Macedonia". http://goo.gl/1bCdpv
[104] Greenepace. 2006. "The end of lignite and the transition to a new energy era". http://goo.gl/CttEBm

The report concludes by acknowledging that the coherent planning of the post-lignite transition should, first of all, ensure that new lignite stations will not be constructed and that the older PPC units can be gradually withdrawn, as they reach the end of their useful lifetime.

5.6. The proposal of Kozani's Ecological Group

According to the proposal of Kozani's Ecological Group (KEG)[105], a large share of the jobs expected to be lost by closing down the lignite units could be recovered by turning WMR into a centre for manufacturing green energy equipment. More specifically, RES equipment could be manufactured in units allocated in the RU of Kozani and Florina, with large-scale and craft industries manufacturing wind turbines, PV equipment and solar-thermal systems. In order for this to materialize, WMR would need to be designated as a special incentive and financial assistance zone, retaining its energy centre profile and being environmentally sustainable at the same time, accumulating one third of the units manufacturing RES equipment in the country. Under these assumptions, KEG estimates that there could be 1,730, 630 and 560 jobs created between 2009-2020 in the wind turbine, PV and solar sectors, respectively. KEG's proposal certainly needs to be updated since, as its members point out, seven years after its "first edition" many facts related to the RES market and to manufacturing costs have now changed.

5.7. European experiences and the Ptolemaida energy basin in the Kozani Regional Unit98

This interesting private initiative focuses on the systematic monitoring of the status of soil restoration in the Lignite Centre of Western Macedonia (LCWM) and the promotion of international best practices in soil and landscape restoration and soil re-use. At the same time, it aims at designating and recommending measures and practices that should be part of an operational plan for a smooth transition to a post-lignite era, by establishing a new energy culture in WMR and, sequentially, the entire country.

The study focuses on Greece and WMR in particular. It includes an extensive assessment of the local developmental potential of the Ptolemaida municipality, the creation, in the former AEVAL facilities (Industrial complex for the production of nitrogen fertilizers), of a Business - Innovation - Culture - Education hub for energy and environmental issues, the designation of a greenhouse zone with district heating, setting up a network of lake ecosystems (related to Natura 2000), and more.

Despite the fact that the study approves of the construction of new lignite units, it constitutes an early attempt to describe the general directions of a likely operational plan for the post-lignite transition of WMR:

A. National Energy Strategy - PPC Operational Plan.
    - Construction of new lignite units using Pollution Abatement Technology.

[105] Ecological Movement of Kozani. 2009. "Call for a green equipment manufacturing industry in Kozani with PPC as the main stakeholder". http://goo.gl/qnCBCy

- Interconnection of WMR with the existing and planned natural gas network (simultaneous burning of lignite and natural gas).
- Extensive contribution of RES to the national energy mix.

B. Regional Planning and actions

- Handing over restored areas to the relevant municipal authorities and setting out a plan for their use based on the needs of the region.
- Relocation of all afflicted settlements.
- Re-defining the boundaries of the land area of the mine.
- Construction of greenhouses and other heat-intensive facilities, using the existing district heating networks.
- Partnership with PPC to exploit the by-products of its activities (exploitation of ash, exhaust gases heat recovery, using minewater for irrigation and more).
- Energy crops.

C. Research - Education - Innovation - Business

- Making use of the ISFTA-CERTH recommendations.
- Designation of the facilities in the Ptolemaida Industrial Park - Kozani Industrial Region, creating business hubs.
- Upgrade of the Western Macedonia Exhibition Centre in Koila.
- Using the former AEVAL facilities.
- Preservation and promotion of the region's industrial heritage.
- Using the existing educational-academic facilities of WMR and introducing new fields of study.
- Development of industrial tourism.

5.8. Workshops on the transition to a post-lignite era

Over the past few years, the rising interest with regards to planning the transition to a post-lignite era has led to a series of associated workshops for exchanging ideas and information.

In December 2014, the European Green Institute and the Greek Green Institute organised a workshop entitled "Transition of Greece and Western Macedonia in particular to a post-lignite era - challenges and opportunities"[106]. The event aimed at collecting information and best practices from European regions that face the challenge of a transition to a post-lignite era, to investigate if and to what extent lignite will be required in the electricity production system in the decades to come and to outline alternative options for the associated areas. The workshop featured presentations by PPC, the Kozani municipality, ANKO, the Ecological Group of Kozani, WWF Greece, Greenpeace, representatives of cooperatives and more. The main issues highlighted in the course of the workshop were the following:

- The current developments and the challenges resulting from the unanimous consensus of the scientific community on climate change, the new EU targets for the climate and the steep decline in RES costs make the transition to a post-lignite era both feasible and necessary.

[106] European Green Institute and Green Institute. Athens. 06/12/2014. "Transition of Greece and Western Macedonia in particular to a post-lignite era: challenges and opportunities", http://goo.gl/CKCPsl

- Greek lignite is significantly more expensive in terms of thermal content compared with other reserves in Europe and the USA.
- PPC's new unit Ptolemaida V will be displaced by natural gas units in the electricity market for CO_2 costs of 30€/ton.
- The second lignite unit included in PPC's investment programme, Meliti II, is faced with issues related to the provision of lignite for its operation from the adjacent mine.
- The new RES and natural gas units have already taken away an important share of the market from lignite, while lignite electricity generation is expected to drop from 25TWh in 2014 to approximately 13TWh by 2030.
- The need to comply with the European directives for CO_2 and other air pollutant emissions, in combination with the low quality of Greek lignite, will force the lignite units to close down within the next 15 years.
- Over the past years, the production cost of RES technologies has dropped significantly, which makes them directly competitive with lignite.
- Despite the recent developments and the formation of energy cooperatives across Europe, similar attempts in Greece are facing great difficulties.

In February 2016, Kozani hosted a two-day conference entitled "Business Reboot of Western Macedonia"[107]. The conference was co-organised by the Commercial and Industrial Chamber of Kozani (EVEK), Kozani's RU Civil Partnership for the Promotion of Entrepreneurship (AEPE), the Regional Development Agency of West Macedonia (ANKO), Western Macedonia Prefecture (WMR) and the Central Union of Greek Chambers, which was represented by over 45 chambers. The ultimate aim of the Conference was to designate the "New Business Standard and Development Model" that will "reboot" the local economy and mobilise all the creative voices and forces that share an interest in the region's future.

The conference included specific proposals by several authorities of the local administration, governmental representatives, PPC, the academic community, citizen organisations, WMR's business community and many private undertakings.

Of particular interest was the talk by PPC's president and managing director, who presented the company's plan for the next decades. He referred to the escalating economic danger that lignite production is facing as a result of Greece's participation in the European Union Emissions Trading System, but at the same time he announced the construction of a second lignite unit in the region (Meliti II), as well as the efforts made to extend the operation of the Amyntaio TPS beyond 2023.

In April 2016 the Kozani municipality in collaboration with the Western Macedonia Region, ANKO, TCG-WM, the energy municipalities network, the Centre for Research & Technology Hellas (CERTH) and the University of Western Macedonia organised a workshop entitled "Post-lignite era - The Challenge for Western Macedonia" with the participation of representatives of PPC, trade unions, the government, MPs, local businesses and academic bodies, Kozani's Ecological Group and WWF Greece[108]. The mayor of Loos-en-Gohelle (France), Francois Caron presented the model that the town followed in order to restore the

[107] Business Reboot of Western Macedonia Conference. 13/02/2016. http://goo.gl/MTWjqM

[108] Contributions of the workshop "Post-lignite era - The Challenge for Western Macedonia" Kozani. 08.04.2016. http://goo.gl/Kl7Zkz

mines and put the region on a new development path. The workshop also featured presentations of proposals and strategies for an alternative model of development for WMR.

5.9. Conclusions

The empirical study of international best practices has shown that coherent regional development strategies for a region under transition should meet the following three basic criteria[109]:

- Reflect a wide consensus, achieved through transparent processes between the various stakeholders, with regards to the object and the aims of the transition.
- State in a clear and well-documented way what should or should not be done.
- Classify the projects to be carried out. The coordination, management and monitoring should be carried out by the bodies involved and the competent authorities.

The review of best practices presented in this chapter has highlighted the following fundamental issues:

Legal framework: There is a need for a rigorously defined and binding legal framework regarding the restoration of mining areas, once mining has been completed, as well as the likely re-location of settlements afflicted by mining activities. Without a detailed legal framework for closing down mines, restoring lands and re-locating afflicted settlements, the mining companies are not aware of their present and future obligations and local communities ignore their rights or/and obligations. This is likely to lead to inefficiency and confusion between the various ministries and the public bodies at a local, regional and central government level.

Long-term planning: A common element of the best transition practices at international level is the need for long-term planning. The timely identification of the problem and the long-term planning of the transition, following democratic consultation procedures and by ensuring the active participation of the local community, are essential for the successful transition of a region to a post-mining future.

Funding framework: A prerequisite for the long-term planning of the transition of a region to a post-mining era is to persistently pursue and secure the funds required. The funding procedures should be transparent and in line with the legal framework of the mining activities and the post-mining era.

Jobs: International experiences suggest that some of the greatest impacts of post-mining transitions include very high unemployment rates and workforce migration. Measures to support employment, the development and retraining of the workforce and its diversification towards new productive activities are some of the most crucial and hard to achieve goals during a transition and should be key elements of its long-term planning.

Mine restoration: According to international literature, the average cost of restoring a mine is estimated at $1.5 million[110]. The main land restoration works include landscape

[109] Peter Wirth, Barbara Černič Mali, Wolfgang Fischer (Editors). 2012. "Post-Mining Regions in Central Europe Problems, Potentials, Possibilities" http://goo.gl/88bH9T
[110] L. Sloss. 2013. "Coal Mine Site Restoration CCC/216". https://goo.gl/WVo5h5

preservation and design (e.g. projected topography maps), managing and restructuring the underlying layers of the ground (e.g. to ensure slope stabilisation), refilling deep mines to avoid collapses and surface mines to create a smooth landscape, managing cultivable lands and managing and reusing waste.

Land uses: Once the restoration has been completed, the ecosystem can be reconstructed, either actively or passively. Determining and choosing the final land uses of a restored area depends on a number of parameters such as: geographical characteristics, existing land uses, economic factors, social needs, and the characteristics of the local ecosystem. The land can be used for economic (e.g. industrial or residential) or productive purposes (agriculture, pasture, fishing, tourism etc.). In any case, the restored mining areas should be used in a way that best serves the needs of the local community.

6. ALTERNATIVE ECONOMIC ACTIVITIES - SCENARIOS

Despite the interesting proposals that were briefly presented in the previous section, there still hasn't been a budgeted plan prepared for WMR's transition to a post-lignite era. There is also confusion regarding the general direction that needs to be followed and particularly the future role of lignite in the local economy.

For these reasons, this chapter presents six (6) scenarios of economic development for the Western Macedonia Region (WMR), followed by an economic and comparative assessment. Starting off from a timetable for closing down the lignite units, the first scenario ("Inaction") assumes that there will be no action taken in order to compensate for the jobs and the corresponding local added value expected to be lost by shutting down the lignite units. The second scenario ("Ptolemaida V") assumes that PPC's new, massive Ptolemaida V unit, of 660 MW gross nominal capacity and a €1.4 billion initial budget is constructed and set to operation. In the third scenario ("Ptolemaida V and Meliti II"), we assume that the second unit in Meliti, Florina, of 450 MW gross nominal capacity, is also constructed and operated according to the plans of PPC's current administration[111] and in line with the plan to create the "small PPC", which was submitted by the previous government and was approved by the Parliament in July 2014[112]. Finally, there are three scenarios presented, each assuming a "mild", "medium" and "strong" development of the primary, secondary and tertiary economic sectors of WMR, which are based on alternative economic activities that do not involve lignite mining and combustion.

It should be noted that the estimates of the impacts of each scenario do not take into account specific development parameters for each sector, such as the evolution of market values, the existing and future state of the market of each product, payback estimates for each investment etc. These are beyond the scope of the current study.

Shut-down timetable

The timetable for closing down the lignite units that was used in the analysis that follows is in line with the commitments made by the Greek government and PPC as part of demonstrating compliance with European legislation. It is also *much more moderate* compared with that presented in Chapter 2 as well as with other timetables that have been published at times.

Specifically, as part of implementing the Industrial Emissions Directive 2010/75/EU which came into force on 01/01/2016, PPC placed under the "limited life time derogation" regime the TPS of Kardia and Amyntaio[113]. According to PPC's initial announcement, the company bears the responsibility for operating both these stations, of a total 1,850 MW gross nominal capacity, for at least 17,500 hours by 2023 at the latest (approximately 1/3 of their operation hours to date) before they close down. In addition, given the fact that units I-IV of the Ag. Dimitrios TPS, of a total 1,220 MW gross nominal capacity, were constructed between 1984 and 1986, they are expected to shut down around 2030, following 45 years of operation. Finally, since November 2014, units III and IV of the Ptolemaida TPS, of a total 425 MW of

[111] News247.gr. February 2016. "Panagiotakis announces a new PPC unit in Florina". http://goo.gl/6X1IUZ
[112] L. 4273/2014
[113] PPC. SA. BD 23/10/2013. https://goo.gl/O4dI6X

power, have been closed down. It's interesting to note that the request made by the Greek government in 2015 for prolonging the operation of Ptolemaida's III unit, was turned down by the European Commission[114]. Therefore, it is expected that lignite power in WMR will drop by 3,495MW between 2014-2030.

6.1. "Inaction" Scenario

This scenario assumes that there will be no action taken in order to compensate for the jobs and the corresponding local added value expected to be lost as a result of closing down the aforementioned lignite TPSs by 2030.

The number of job losses was estimated using the latest figures available (2014) for all of WMR's TPSs and mines, which were kindly provided to Panteion University of Athens by PPC's Human Resources Department. For TPS Kardia, Amyntaio and Ptolemaida, PPC data was used as provided, while for the 4 units of Ag. Dimitrios TPS it was assumed that 80% of the jobs will be lost, taking into account that the station comprises of 5 units. With regards to job losses in the Kozani and Florina mines, a job indicator was initially calculated for each Regional Unit (RU) per unit of capacity, based on PPC figures and on the gross nominal power of the TPS operating in the given RU in 2014 (approximately 1 job/MW in the RU of Kozani and 0.75 jobs/MW in the RU of Florina). This indicator was then multiplied by the capacity of the units scheduled to shut down. The total job losses in mines and TPSs between 2014 and 2030 were estimated, as can be seen in Table 6.1, at 4,625. The corresponding loss in local added value is estimated by converting ELSTAT figures for 2011, regarding the "Mines, quarries, industry, electricity, natural gas, steam, air conditioning and water, sewage treatment, waste management and remediation" sector. The analysis of the data shows that the workers in the sector are estimated at 8,091 and the corresponding local added value is approximately €1.5 billion.

Table 6.1: Estimation of jobs expected to be lost between 2014 and 2030 in WMR

TPS/Mines	Gross Nominal Capacity (MW)	Permanent jobs	Temporary jobs	Total
TPS Ag. Dimitrios I-IV	1220	387	103	490
TPS Kardia (I-IV)	1250	352	120	472
TPS Ptolemaida (III-IV)	425	325	27	352
TPS Amyntaio (I-II)	600	292	45	337
Kozani Mines		1,794	734	2528
Florina Mines		352	95	447
Total		3,501	1,124	**4,625**

6.2. "Ptolemaida V" Scenario

This scenario assumes the construction and operation of PPC's new "Ptolemaida V" unit, accounting for a total 660 MW of power and an initial budget of €1.4 billion. According to the Environmental Impact Assessment of the unit, Ptolemaida V will create 250 permanent jobs. To estimate the number of jobs that will be created in the mines, the job indicator per

[114] WWF Greece. 27/01/2016. "The EU turns down Ptolemaida III". http://goo.gl/HyVUmv

unit of power in the Kozani RU was used, leading to 662 direct employment opportunities. The corresponding economic value that will be directly created in WMR is estimated once again using ELSTAT figures for 2011, for the "Mines, quarries, industry, electricity, natural gas, steam, air conditioning and water, sewage treatment, waste management and remediation" sector.

6.3. "Ptolemaida V and Meliti II" Scenario

This scenario assumes that apart from Ptolemaida V, the funds required to construct a second unit in Meliti (Florina RU), of a total 450 MW of nominal capacity will be secured. The permanent jobs in the TPS are estimated in a similar way to those of Ptolemaida V, taking into account the smaller capacity of Meliti II (170 jobs), while the respective number of jobs in the mines is calculated using the pre-calculated indicator of the RU of Florina and the power of the new unit under plan (335 jobs). Finally, the local added value is estimated using ELSTAT figures, similarly to the previous two cases.

6.4. Alternative Activities Scenarios

The following section presents three scenarios (mild, medium and strong) for the development of the primary, secondary and tertiary economic sectors of WMR, which are based on alternative economic activities. More specifically, there were three scenarios devised, each assuming a “mild”, “medium” and “strong” development respectively, which focus on the development of economic activities in WMR that are not related to lignite extraction and combustion, are of a sustainable nature, while many of them have already been proposed by local stakeholders in the past. Emphasis in the primary sector was put on the cultivation of Kozani saffron and aromatic and energy plants. In the secondary sector, the fundamental pillar was the development of Renewable Energy Sources in WMR – construction and operation, as well as manufacturing of green energy equipment -, energy savings projects that will create jobs in the construction sector, waste management, fly ash processing, and the processing of aromatic plants. Finally, the tertiary sector relies on the development of tourism, with an emphasis on industrial tourism and ecotourism, as well as on research in academic institutions and research centres in Western Macedonia.

6.4.1. Primary sector

According to a study by McKinsey[115], the primary sector has significant potential for further development in Greece and will need to play a key role in the economic resurgence of the country in the future. The analysis estimates that the primary sector can contribute to the creation of up to 140,000 new jobs by 2021. A broader scenario regarding the potential contribution of the primary sector to job creation in WMR could be developed based on the cultivated areas that have been registered by ELSTAT and the distribution of these job positions per region. Given that the cultivated areas in Greece and in WMR amount to 3,892,348 and 210,400 hectares respectively, it is estimated that there can be up to 7,574 jobs created in WMR. For WMR in particular, the study makes special mention to Kozani saffron and the need to systematically develop the scale of cultivation of this unique agricultural product.

[115] McKinsey & Company. 2011. "Greece 10 Years Ahead. Determining Greece's new development model" http://goo.gl/qg6BVQ

According to the Regional Framework for Planning and Sustainable Development (RFPSD) of WMR for the primary production sector, the WMR products that have the greatest potential are[116]:

- Saffron (Kozani RU)
- Legumes, particularly beans (Florina, Kozani and Kastoria RU)
- Vineyards, primarily for wine production (Florina and Kozani RU)
- Apples and peaches (Kozani and Kastoria RU)
- Aromatic plants (Kozani RU)

The WMR is also the home of many certified products. More specifically[117]:

- Feta Cheese (Protected Designation of Origin - European Union)
- Kozani saffron (PDO - European Union)
- Amyntaio Wines (VQPRD - European Union)
- Siatista Wines (Local Wine - Ministry of Rural Development and Food)
- Velventos Wines (Local Wine - Ministry of Rural Development and Food)
- Beans of Prespes, Florina (Protected Geographical Indications - European Union) - (Flat "megalosperma" and giant Elephant)
- Apples of Vermio, Kozani (Integrated Crop Management - Ministry of Rural Development and Food)
- Fruit of Velventos, Kozani (Integrated Crop Management - Ministry of Rural Development and Food)
- Giant - elephant beans of Kastoria (PGI - European Union)
- Kastoria Apples (PGI - European Union)
- Anevato Cheese (PDO - European Union)
- Mpatzos Cheese (PDO - European Union)
- Kefalograviera (PDO - European Union)
- Manouri (PDO - European Union)

Moreover, the olive oil produced by the Imera Agricultural Cooperative is a relatively new, high-quality agricultural product of the region, as it has received several international quality awards[118]. Finally, the livestock sectors with the greatest potential are those of bovine and caprine animals, located primarily in the regions of Livadero (Kozani RU), Deskati (Grevena RU), Lehovou and Varikou (Florina RU) and in the mountainous and semi-mountainous areas of Grevena and Kastoria RU in general[116].

It's also important to note that WMR land uses have been surveyed in detail using Geographical Information Systems (GIS)[119]. The use and constant update of this digital database can turn it into a valuable tool for the restructuring and strategic planning of WMR's primary sector. Generally speaking, the primary sector will need to create and maintain a significant share of jobs in the post-lignite era. As a result of its climate (cold

[116] MEECC. 2013. "Evaluation, Review and Designation of the Regional Framework for the Planning and Sustainable Development of the Western Macedonia Region", http://goo.gl/XOrp0L
[117] WMR. 2012. "Operational Plan 'Western Macedonia Market Basket' ". http://goo.gl/0AN2Kw
[118] Imera Agricultural Cooperative. 2015. "More awards for the oil of the Agricultural Cooperative of Imera" http://goo.gl/ddFDDj
[119] Western Macedonia Geographical Information System http://goo.gl/9thsIe

prolonged winters) and geomorphological (mountainous, semi-mountainous regions and plateaus) characteristics, WMR has no competitive advantage in *quantitative agricultural production* (large scale)[120] but, on the contrary, has the potential required to produce quality livestock and agricultural products, as well as special agricultural products such as saffron, aromatic plants and more. At the same time, the processing potential of many of WMR's agricultural products can contribute significantly to job creation in the secondary sector, too. Efforts regarding agricultural and livestock production in Western Macedonia should focus on the production of quality organic products, with specific characteristics and specifications, targeting the Greek and, most importantly, international markets. In addition, there should be thorough investigation into the role that circular economy schemes between energy plant cooperatives and the PPC can play.

More specifically, in order to estimate the number of jobs that can be created in WMR's primary sector, the current study examined three different scenarios of a mild, medium and strong development, based on the production of saffron and the cultivation of aromatic plants and energy crops. Finally, job creation in the remaining sectors of agriculture-livestock is estimated based on different scenarios of employment growth, using ELSTAT data.

6.4.1.1. Cultivation of saffron

The Kozani Saffron Cooperative employs 6 permanent workers, while it also creates 15 temporary full-time jobs annually (staff that takes turns for given periods of time). There are approximately 5,000 people employed in the cultivation of saffron over a two-month period (October-November) and there are 400 hectares cultivated altogether, split into conventional (200) and organic (200) crops[121].

In the mild development scenario we assume that by 2030 there will be an additional 400 hectares of saffron crops, that will be added gradually, in equal shares spread out over the next 15 years. The required investment is in the region of €10,000/hectare[122]. In a similar way, the medium development scenario assumes an increase in the areas of saffron cultivation of approximately 800 hectares, which reaches 1,200 hectares in the strong development scenario. The corresponding job opportunities are calculated by converting the data related to the existing crops, while the seasonal two-month jobs are converted to permanent. In order to estimate the local added value for the period until 2030, it is assumed that saffron cultivation will generate revenue in the region of €15.000/hectare, most of which will be attributed to salaries and to producers as profit[121], while the required investment is of the order of €10,000/hectare[122].

[120] DEVELOPMENT AGENCY OF KOZANI MUNICIPALITY S.A. (D.A.K.M. S.A.) 2013. "Local Integrated Action Plan for the Development of the Countryside, the restructuring of the primary sector and the designation, reinforcement and promotion of Agricultural Entrepreneurship in the Kozani Municipality - Roadmap for the 5th Programming Period 2014 - 2020"http://goo.gl/SE1oYQ

[121] The figures refer to 2015 and have been obtained through personal communication with the cooperative's Managing Director, Ms. E. Kaliva.

[122] K. Anastopoulos. "Cultivation, production and trade of aromatic and pharmaceutical plants. Potential for financial aid". "Existing and new crops in the Attica Region" Workshop. http://goo.gl/joZklg

6.4.1.2. Cultivation of aromatic plants

Based on current data (2016), the Agricultural Cooperative of Aromatic-Pharmaceutical Plants and Fruit-Vegetables of Voio Kozani estimates that 5 hectares of aromatic plant crops correspond to 1 full time and 1.25 seasonal jobs[123]. The conversion of seasonal to full time jobs is made assuming 2-month full-time employment during harvesting, as was the case with saffron. The mild development scenario estimates that the cultivation of aromatic plants will reach approximately 500 hectares, which is also the cooperative's goal for the following years. As in the case of saffron, this increase will be carried out in equal shares spread out annually over the next 15 years. In the mild and strong development scenarios the spread of aromatic plant crops is estimated at 700 and 1,000 hectares, respectively. Cultivating aromatic plants in a 1 hectare area can generate a net annual revenue in the range of €6,500[123]-€8,000[124], an estimate used to calculate the direct local added value in the three scenarios examined for the 2016-2030 period. It should be noted that the local added value can increase significantly if along with the cultivation of herbs, an integrated unit is constructed to produce essential oils from the plants. Such a unit requires a minimum of 9 hectares, and will generate a revenue of approximately €100,000 over three years[124]. This option was not explored in the present study.

6.4.1.3. Energy crops

There can be additional jobs created in the agricultural sector by using locally produced biomass as fuel for the 25 MW planned unit of PPC Renewables (see 6.4.2.1). It is assumed that all the fuel needs of the unit will be met using cardoon, whose cultivation can generate €2,400/hectare[125], which corresponds to a crop yield of approximately 33 tn/hectare. This cost of cardoon is in agreement with estimates by PPC (€73/tn)[126]. It is also assumed that a full time job corresponds to an annual net salary of €24,000. Considering the area of land that will be required for the production of the fuel (10,000 hectares) and the financial yield per hectare of cultivated land of cardoon, it is estimated that the operation of the biomass unit can create up to 1,000 jobs in W. Macedonia's agricultural sector. To calculate the overall local added value in the primary sector, it is assumed that the unit will start operating in 2018.

6.4.1.4. Forestry

Greece's forests and forest lands cover approximately 49% of its total area, while 77% of them belong to the state. The forestry sector[127,128] has an important added value and a multifold contribution with regards to both the secondary (trade of forestry products, and wood industry) and the tertiary (tourism) sectors. It also provides a series of ecosystem services such as soil generation and protection, water resources protection, carbon storage

[123] The figures used refer to 2015 and have been obtained through personal communication with Ms. Tsaggadoura.
[124] Ethnos. 2014. "Two aid programmes for aromatic plants" http://goo.gl/GrVbxI
[125] Manelis G. 2012. "Techno-economic Assessment of energy crops for the production and exploitation of biomass" https://goo.gl/uuCoLj
[126] Econews. 28/07/2011. "Energy plants: cultivation policies promoted by the Western Macedonia Administrative Region", http://goo.gl/31kqQs
[127] Forestry is the primary sector that includes the production of all forestry products.
[128] WWF Greece. 2013. "A Living Greek Economy for the people and the environment". http://goo.gl/Xbul0D

etc., which - even though they can't be easily classified into one of the production sectors - are nowadays becoming more and more important in terms of market value.

In order to examine the developmental potential of forestry in WMR, data from forest directorates, forestry commissions and certain forestry cooperatives in the four Regional Units was collected, regarding the share of managed forest lands in the total potentially manageable wooded area of each Regional Unit, as well as employment rates and corresponding salaries.

There are 30 managed forests (out of a total 83) in the Grevena RU, covering approximately 55% of the total potentially manageable wooded area. The 250 active members of the 38 cooperatives that operate within the RU of Grevena log approximately 40,000 cubic metres of wood annually, with a total gross revenue in the range of €1,5 million.

In the Kastoria RU there are 15 managed forests covering approximately 55% of the total wooded area. The 280 active members of the 35 forest cooperatives log approximately 85,000 cubic metres of wood annually, with an annual gross revenue in the range of €2,5 million.

Similarly, there are 11,741 hectares of managed forest lands in Kozani RU out of a 23,200 total, where 70 loggers from 7 forest cooperatives are employed, with an annual gross revenue of approximately €430,000.

Finally, in the Florina RU almost all of its 55,000 hectares of wooded area are managed, hence the sector's potential for further development is limited. There are 55,000 cubic meters of firewood logged by 250 active loggers from 44 forest cooperatives with an annual gross revenue in the range of €2 million.

Using the aforementioned data and assuming that in the sector's mild, medium and strong development scenarios the share of the managed land will rise from today's 55% to 75%, 90% and 100% respectively, we can calculate the additional jobs created in the logging sector alone, in line with sustainable profitability. It is also assumed that the investments needed to carry out 10-year management studies are negligible compared to those of the other sectors included in the study. The corresponding local added value is calculated using the data from the gross annual revenue of logging, taking into account that - according to the forest cooperatives - the annual salaries are approximately 40% of the gross revenue. Table 6.2 presents the 3 scenarios of “mild”, “medium” and “strong” development for the sector, at a Western Macedonia Region level.

Table 6.2: Jobs and direct local added value of the forestry sector in WMR for the “mild”, “medium” and “strong” development scenarios.

	"Mild Development"	**"Medium Development"**	**"Strong Development"**
New Jobs	218	382	491
Local Added Value (million €)	0.644	1.128	1.450

Exploiting crop and forest lands following sustainability standards

The expected increase in the use of agricultural, energy and forest products in the years to come creates conflicts between the different land uses and also raises concerns regarding the exploitation of lands in an environmentally sound manner.

For example, one of the main issues related to the expansion of energy crops is the area of the land required, as its size can lead to habitat losses, it can hamper the safe movement of species, and degrade aquatic and ground formations.

Apart from plant species and the methods of exploitation, the impacts of crop cultivation also depend on the land use they replace. For example, cultivating energy plants in degraded or highly exploited agricultural areas will have neutral or even positive results, but that would not be the case in areas of natural ecosystems. The latter can also be harmed by the occupation of forest lands by agricultural activities, as an indirect result of the expansion of energy crops. Finally, the globally expected rise in the demand of forest products will also increase the pressure on ecologically sensitive regions.

At the same time, land ownership issues might come to surface, particularly in the case of developing energy crops at an 'industrial' scale, where big landowners and businesses are likely to dominate. Such a development would limit the potential of land exploitation for family businesses, small cooperatives etc.

The extensive use of wood in particular, can have negative environmental, economic and social impacts. Specifically, forest diversity can be affected by the use of fertilisers and by importing species incompatible with the existing ones, while the use of forest-sourced biomass in the energy sector is not always environmentally neutral.

In order to deal with the above, it is recommended to:

1. Develop mechanisms that will ensure the access of economically vulnerable members of society to land use and will regulate the cost of land.
2. Give priority to the exploitation of polluted and degraded areas.
3. Protect food crops, particularly the organic ones.
4. Encourage the diversification of cultivation methods and crop types.
5. Make provisions for passages for the movement of local fauna in cultivatable areas.
6. Explicitly forbid the combined burning of biomass and lignite.
7. Give priority to the use of wood as a building material, as its direct burning doesn't make best use of its embodied energy.

6.4.2. Secondary sector

According to WMR's Regional Framework for Planning and Sustainable Development (RFPSD)[116], the Region's secondary sector is still dominated by the mining/combustion of lignite and the fur industry. This section presents the potential that sustainable economic activities in the secondary sector can offer to WMR's economy. Specifically, it examines the development of Renewable Energy Sources (RES), energy savings, waste management, the processing of fly ash, and the processing of aromatic and pharmaceutical plants.

6.4.2.1. Renewable Energy Sources

In order to estimate both the economic benefit for the local community and the jobs that the development of RES can create in WMR, three scenarios were examined, based on the increase in the use of RES in Greece by 2030; the scenarios were then applied to WMR. With regards to wind energy, the scenarios proposed by the European Wind Energy Association (EWEA)[129] were adopted. The mild development scenario assumes that the total installed wind power capacity will reach 8,000 MW by 2030, while the medium and strong scenarios assume 9,000 and 12,500 MW respectively. Regarding PVs, the strong development scenario assumes that their capacity will have reached 6,500 MW by 2030, based on a study by the Aristotle University of Thessaloniki (AUTh) which was recently carried out on behalf of the Hellenic Association of Photovoltaic Companies (HELAPCO)[130]. According to the study, installing this capacity by 2030 will not burden consumers, as it won't result to an increase in the RES levy. On the contrary, under certain circumstances, it can lead to a drop in electricity production costs, since the System Marginal Price (SMP) will decrease, too. The mild development scenario for PVs was based on the assumptions of the European Commission's reference scenario[131] according to which PV capacity in Greece will only reach 3,640 MW by 2030, while the medium development scenario assumed an installed capacity of 5,000 MW by 2030.

In each scenario, the existing installed wind and PV capacity - according to LAGIE's[132] and HEDNO's bulletins[133] for the interconnected system and the non-interconnected islands, respectively - were deducted and only the one expected to be installed was taken into account. It was assumed that 5% of that wind and PV capacity will be installed in WMR, a share that is very close to the current contribution of W. Macedonia to the total installed PV power of Greece's interconnected system[134]. With regards to wind energy, WMR's current share in the country's total installed power is 2.46%[135]. However, according to a study by the Centre for Renewable Energy Sources (CRES)[136], the region's contribution can reach 500MW and a 4.67% share by 2020. This assumption is made based on the existing dense power

[129] European Wind Energy Association. 2015. "Wind energy scenarios for 2030". http://goo.gl/GQ1Qz8
[130] http://energypress.gr/sites/default/files/media/HELAPCO_MES_16July2014.pdf
[131] European Commission. 2013. "EU Energy, Transport and GHG Emissions. Trends to 2050. Reference Scenario 2013", https://goo.gl/xeBVvY
[132] LAGIE. February 2016. "RES & CHP Special Account Monthly Bulletin. February 2016" http://goo.gl/sGzlql
[133] HEDNO. March 2016. Information Bulletin for the production in non-interconnected islands in January 2016", http://goo.gl/mfwkfc
[134] LAGIE. February 2016. "Renewable Energy Sources and CHP. Brief Information Bulletin. February 2016", http://goo.gl/dSlis2
[135] ELETAEN. 2015. "HWEA. Wind Energy Statistics, 2015", http://goo.gl/I8pzzd
[136] ANKO. 2012. "Implementation of the legislative framework for wind parks in the Western Macedonia Administrative Region", http://goo.gl/S8tox0 and http://www.cres.gr/kape/datainfo/maps.htm

transportation network in WMR. In addition, based on the region's carrying capacity, it is estimated that there can be approximately 6,246 wind turbines installed.

Apart from the installation and operation of RES, jobs can also be created by the manufacturing of energy equipment in WMR. According to a study by the Athens University of Economics and Business and WWF Greece, the development of a national RES manufacturing industry could contribute significantly to the creation of employment opportunities, the generation of income and to the recovery of the Greek economy[137]. In W. Macedonia in particular, the recent proposal by PPC for the construction of a 200 MW PV park in the areas of the closed mines also included plans for an industrial unit dedicated to the manufacturing of equipment for PV systems. As the potential for job creation in the energy equipment manufacturing sector is considered important, it is assumed that 40% of the required wind and PV energy equipment will be constructed in Greece, 1/3 of which in W. Macedonia[138]. In this way, WMR will manage to retain its key role as Greece's energy centre in the future.

Using the aforementioned assumptions, the following were calculated for each of the 3 scenarios: a) the wind and PV capacity to be installed and operated in W. Macedonia and b) the wind and PV capacity for which part of the equipment will be manufactured in the region.

The three scenarios examined (see Table 6.3) assume, apart from wind and PV units, the construction of a 25 MW biomass unit in Kozani, which is already under design by PPC Renewables. The unit, whose licence for power production was approved by RAE at the end of 2015[139], will cost €80 million and produce 186,150 MWh per year, while approximately 10,000 hectares of land will be required for the cultivation of the required energy plants[140].

Table 6.3: Scenarios examined for the development of RES

Scenario	RES Technology	2030 National Target (MW)	Capacity in Greece (MW)	Capacity in WMR (MW)	Construction in WMR (MW)
Mild Development	Wind	8,000	5,820	291	776
	Photovoltaics	3,640	1,034	52	138
	Biomass	-	-	25	-
Medium Development	Wind	9,000	6,820	341	909
	Photovoltaics	5,000	2,394	120	319
	Biomass	-	-	25	-
Strong Developm	Wind	12,500	10,320	516	1,376
	Photovoltaics	6,500	3,894	195	519

[137] WWF Greece - Athens University of Economics and Business, 2010 "Green measures in Greece: benefit/cost assessment for carrying out of specific actions to promote renewable energy sources and energy saving", http://goo.gl/af3F43

[138] Ecological Movement of Kozani. 2009. "Call for a green equipment manufacturing industry in Kozani with PPC as the main stakeholder". http://goo.gl/qnCBCy

[139] RAE. 26/10/2015. "Grant of licence for power production using a 25 MW biomass unit in the "LKM" region in the Kozani Municipal Unit, Kozani Municipality, Kozani Regional Unit, to the companies "Limited Company for the Management of Renewable Energy Sources" and "PPC Renewables SA"." https://goo.gl/ZRYSgK

[140] Energypress. 9/1/2012 €80 million biomass investment by PPC Renewables in Ptolemaida http://goo.gl/az25fj

ent	Biomass	-	-	25	-

The jobs expected to be created by the construction, operation and maintenance of the wind, PV and biomass units in the W. Macedonia region, as well as those related to the manufacturing of green energy equipment, are calculated based on the aforementioned assumptions and using employment data for 2015 (see Table 6.4). These coefficients were estimated by the International Trade Union Confederation (ITUC) by combining two different methodologies [141] and have already been used in a various studies.

Table 6.4: RES technologies employment coefficients (source: ITUC)

RES Technology	Construction &Installation (job-years/MW)	Operations and Management (job-years/MW)	Manufacturing (job-years/MW)
Wind	2.7026	0.2501	11.6492
Photovoltaics	20.5155	0.3308	6.3717
Biomass	3.7089	1.9559	0.3804

Based on data provided by companies involved in the wind energy sector in Greece, approximately 12% of the construction cost of a land wind park (€1.3 million/MW[142]) is returned to the local economy. This doesn't include the cost of purchasing the land, which, according to EWEA[143], amounts to at least 5% of the total cost. The larger part of the annual operation cost also stays within the local economy, reaching 3.9% of the construction cost[142]. The local economy also benefits from the special duty of law 3468/2006, which based on law 3851/2010 is 2.7% of the gross electric energy sales. These are in turn calculated using the annual power production of the unit and the corresponding Feed in Tariff for selling electricity, as set by law 4254/2014. The annual electricity production is estimated using the country's average capacity factor[144]. The size of the required investment for each of the three scenarios is calculated using the wind power expected to be installed in WMR and the unitary construction cost (€1.3 million/MW).

The local added value of PV is estimated at 58.5% of the total installation and operation cost[145]. The former reaches 1.1 million €/MW while the annual operation cost is estimated at 2.5% of the construction cost[142]. It should be noted that photovoltaics are exempt from special duty obligations, based on law 3468/2006. For both wind energy and PV, it is assumed that the total RES capacity will be installed annually in equal parts spread out over the next 15 years. Similarly to wind energy, the size of the required investment for each of the three scenarios is calculated using the PV capacity expected to be installed in WMR and the unitary construction cost (1.1 million €/MW).

It also assumed that the local added value related to the operation of the green equipment manufacturing units (wind and PV), is generated only from the salaries of the unit's

[141] Millennium Institute, 2012. "ITUC green jobs assessments research project– Methodology Overview", http://goo.gl/BdWYM8
[142] WWF Greece. 2015. "Clean Alternatives to Ptolemaida V" http://goo.gl/zqEoyf
[143] European Wind Energy Association (EWEA). 2009. "The Economics of Wind Energy", http://goo.gl/TVYFUP
[144] Dialinas E. 2011. "Assessment of impacts on the operation of the Greek system by the installation of 5 to 8 GW by 2025" Prerequisites and cost of smooth incorporation.", http://goo.gl/Es9KrO
[145] Psomas. 2016. "The national added value of PV" http://goo.gl/Thi5jS

employees that reside in WMR. It is assumed that 80% of the workforce will be living in W. Macedonia and that their average monthly net income will be €1,700, which is half the average PPC salary, according to the utility's annual economic report for 2015[146]. It should also be noted that this average salary is significantly lower compared with that of the "Facilities in industrial areas" category (annual salary €27,170), used by the Ministry of Finance to estimate the employment created by the realisation of National Strategic Reference Framework (NSRF) projects[147]. Finally, it is assumed that these units will become operational halfway through the 2016-2030 period, and will therefore contribute to the local economy for 8 years within the time frame examined in this study. The required investment for the wind turbine equipment manufacturing units was estimated using: a) the capacity projected to be manufactured in WMR in each scenario and b) the average construction cost per unit of power, based on similar units operating abroad[148,149]. A similar approach was followed for the PV equipment manufacturing units[150,145,151,152].

The local added value generated by the installation and operation of the 25MW biomass unit was estimated making the conservative assumption that 10% of the construction cost will be attributed to the local economy. Regarding biomass units, it is assumed that the system's operation and maintenance costs, excluding fuel costs, constitute approximately 4% of the construction cost[153] and that 75% of that will be used to pay salaries, hence will also be returned to the local economy. In addition, WMR will also benefit from the special levy of l. 3851/2010. On the basis of the aforementioned assumptions and assuming that the unit will be operational in 2018, the revenue for the local economy is estimated at approximately €42 million by 2030.

6.4.2.2. Energy saving projects

According to official data released by the Ministry of Environment and Energy (MEE), as part of the first phase of the "Energy Saving at Home" programme, there were 49,514 projects submitted with a total budget of €515.62 million, €37.9 of which (7.35%) were in W. Macedonia, for 3,491 projects (7.05%) with an average intervention cost of €10,856, which leads to a total of 66 GWh of primary energy savings in the whole of WMR. There were 39,607 interventions across Greece with a total budget of €409,9 million, which generated approximately 10,000 job-years throughout the programme's 4 years of duration[154]. It should be noted that there are 159,230 residencies in WMR[155], while according to the region's Energy Certificates (EC) statistics, 38.2% out of a total of 14,272 residencies with an EC fall in the H class i.e. have the worst energy performance rating. It is therefore estimated

[146] PPC. March 2016. "Annual Economic Report 1st January – 31 December 2015" https://goo.gl/yz4sJ3
[147] Ministry of Finance. 2009. "Draft directives for the estimation of employment opportunities created by the implementation of NSRF projects (acts)". https://goo.gl/SanJb9
[148] Gamesa. 2012. "Gamesa expands its manufacturing base in India by opening its first blade factory" http://goo.gl/99VXyd
[149] Gamesa. 2006. "Gamesa opens its first high-tech manufacturing plant with an investment of 50 million dollars". http://goo.gl/Xo9UZF
[150] Capital.gr. 15/06/2009. "€185 million investment by HelioSpherato in a PV panel production unit". http://goo.gl/W7Ueg5
[151] Zachariou, A. Solar Cells Hellas Group. 9-12/11/2009. 3rd IENE energy week. http://goo.gl/NJbe64
[152] Silcio Solar Technologies. http://goo.gl/Xwnq0a
[153] Pardo Garcia Nicolas et al. 2012. "Best available technologies for the heat and cooling market in the European Union" http://goo.gl/3hCIvB
[154] MEE. 2015. "Saving at Home", http://goo.gl/NTVMFw
[155] ELSTAT. 2014. "Population - Residential Census 2011" http://goo.gl/5vFQ5F

that there are approximately 60,672 buildings that fall in class H in the whole of WMR and, hence, require immediate energy upgrading[156], which are also more likely to belong to the poorer members of society[157]. It is therefore obvious that in order for WMR's building stock to be substantially upgraded, there need to be significantly bigger investments, in far more buildings.

The mild development scenario assumes that between 2016 and 2030 there will be three phases of investments, each equal to that of the first, 4-year phase of the "Energy Saving at Home" programme, targeted at the energy upgrade of the building stock. That makes a total of 3x€37.9 = €113.7 million. With such an investment, approximately 10,473 residencies (3x3,491) will be upgraded, which accounts for only 17% of the number of buildings that are estimated to fall in class H. The medium and strong development scenarios assume the energy upgrade of 1/3 and 1/2 of the building stock that today falls in class H, therefore creating additional primary energy savings of approximately 400 and 800 GWh, respectively. These investments will also contribute to a rise in the value of the buildings, the protection of lower class households from energy poverty[158], a reduction in household energy expenses, the improvement in the buildings' indoor quality and to a reduction in expenses related to energy generation and distribution infrastructure.

The jobs created in each scenario were estimated based on the size of the required investment and the number of man-hours per €1 million invested, which in turn were estimated using as reference the 2011-2015 first phase of the "Energy Saving at Home" programme. In order to estimate the local added value, we assumed that only the (net) salaries will be contributing to the local economy, which, according to a recent study[159], makes up for 42% of the total investment cost. The size of the investment for each of the three scenarios is estimated by multiplying the number of houses expected to receive energy upgrades by the average cost of interventions in W. Macedonia (€10,856) during the first edition of the "Energy Saving at Home" programme.

6.4.2.3. Exploitation of fly ash

Fly ash is the main solid residue of lignite combustion. There were approximately 11 million tonnes of fly and wet ash produced in PPC facilities in 2012[160], 80% of which were produced in W. Macedonia and 20% in Megalopolis. Despite the relative disadvantages of Greek fly ash, many years of research have now provided adequate knowledge on the subject that, if appropriately used, can contribute to new innovative practices for its exploitation. There

[156] It's interesting to note that a large share of buildings in WMR (67.4%) were constructed prior to the implementation of the Building Insulation Regulation (E. Panas, *Research on the energy poverty in Greece*, Athens University of Economics and Business, 2012)

[157] In a recent announcement, the TCG/WM estimates that even households in WMR with a family income exceeding €50,000 are considered poor in energy terms, as a result of the particularly high heating requirements (TCG, WM, *TCG-WM recommendations regarding the taxation of heating oil and the related impacts on Western Macedonia*, 2014)

[158] The share of WMR households whose energy expenses exceed 10% of their annual income is 66.9%, compared with a 39.5% average across Greece (CRES, National Poverty Observatory, http://www.cres.gr/energy-efficiency/poverty.html)

[159] Greek Energy Forum. 2016. "New jobs in the Energy sector: a roadmap to prevent "Brain Drain" (By: Alex Lagakos, Dimitrios Sarantopoulos, Konstantinos Zakoulas, Alexandra Sdoukou, Professor Athanasios Dagoumas, Efros Georgiadis)", http://goo.gl/N4IzJv

[160] PPC. S.A. "Waste Management", https://goo.gl/EuHhyi

have been many alternative uses suggested e.g. in road construction[161], the evaporative cooling of buildings[162], slope and soil stabilisation[163], brick manufacturing, remediation of polluted soil, and most importantly in the cement industry, as a substitute for clinker[164].

Unfortunately, most of the ash produced today is released to the environment, despite the fact that it contains many of lignite's toxic elements. Indicative of the limited alternative uses of fly ash is the fact that Lafarge - AGET Heracles[165] used just 350,000 tonnes of ash in 2013, while the TITAN group[166] used slightly over 200,000 tonnes in 2010. Perhaps the most well-known widespread use of fly ash as a substitute to cement was in the Platanovrisi dam in Drama, where between 1995 and 1997 there were 135,000 tonnes of fly ash used, comprising 80% of the concrete mixture, at a ratio of approximately 225 kg of fly ash to 50 kg of cement per cubic meter of concrete[161]. It's interesting to note that a study comparing 14 European countries estimated the average usage rate of fly ash at 58% of the final product produced[167]. The equivalent rate in Greece is approximately 8.5%[168].

Apart from the fact that fly ash can improve significantly the properties of both fresh and hardened concrete, its use as a cement substitute in infrastructure works (roads, ports, dams, networks etc.) and - under certain circumstances - in residential buildings, can lead to important energy savings and to a reduction in the CO_2 emissions of the cement industry, considering that the production of 1 ton of cement leads to the emission of 0.6-0.8 tonnes of CO_2 into the atmosphere. It also reduces carbon monoxide, nitrogen oxide and volatile organic compound emissions resulting from the process of cement production[169]. Therefore, W. Macedonia can see the development of fly ash as an alternative material and particularly as a cement substitute over the next years.

According to a study by the Institute for Solid Fuels Technology and Applications (ISFTA)[170], one unit with the potential of processing 165,000 tonnes of fly ash can create 30 jobs at an investment cost in the range of €4.4 million. Therefore, processing 1,000,000 tonnes of fly ash for alternative uses annually till 2030 will create approximately 180 direct jobs[171] and will reduce the annual CO_2 emissions by 600,000-800,000 tonnes. It was once again assumed that the local added value of this activity will be generated from the workers' income.

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[161] Eskioglou, P. 2012. "The use and economic efficiency of Fly Ash" http://goo.gl/ZiQQ1r

[162] Eleftherotypia 2011. "Ash, the cooling method of the future", http://goo.gl/IY5Qp6

[163] Papagianni, I. 2005. "The feasibility of the plan to harness Greek Fly Ash", 3rd Workshop, TCG-WMC Department, "Nation-wide plan for harnessing Fly Ash of high calcium content"http://goo.gl/AElEjL

[164] Stivanakis, V. 2003. "Research and Development of new building materials from solid by-products of lignite burning in the Megalopolis energy centre" Doctoral Thesis, Chemical Engineer Department of Patras http://goo.gl/TsZgiE

[165] Lafarge. 2014. "Sustainability Report" http://goo.gl/3YgTCh

[166] TITAN. 2012. "Sustainable Development, our natural way forward", http://goo.gl/fYRREY

[167] Union of the Electricity Industry. 1999. "*Fly Ash from Coal Fired Power Plants, A Non-Hazardous Material*". 1999

[168] Papagianni, I. 2005. "The purpose of the plan to harness Greek Fly Ash". Minutes of the 3rd Workshop "Nation-wide plan for harnessing Fly Ash of high calcium content", Kozani, 22 January 2005

[169] Tsikardani, E., Koukouzas, N., Kakaras, E. 2005. "Economic and Environmental Assessment of the use of fly ash in the production of cement products", Minutes of the 1st National Conference on the Exploitation of Industrial By-products in Building Construction, EVIPAR, Thessaloniki, 24-26 November 2005. http://goo.gl/JtjbUr

[170] Tsikardani, E. and Papanikolaou, D. 2005. "Feasibility-Sustainability Study of the Fly Ash Processing Unit", http://goo.gl/MA2cRX

[171] Koimtsidis, l. 2005 TCG-WMC "Historical overview and potential of the plan" 3rd Workshop: "Nation-wide plan for harnessing fly ash of high calcium content": http://goo.gl/rQhYpI

6.4.2.4. Waste management

In 1995, the first agreement for a Public-Private Partnership (PPP) for the construction of the first Integrated Waste Management System (IWMS) in W. Macedonia was signed, valid for 25 years and with a budget of €250 million. Part of the funding (€50 million) will be provided by the European Investment Bank, the Jessica programme and private funds; the Greek state will fund IWMS' operation with €125 million throughout the investment, while the remaining sum will be provided by the inhabitants of the municipality. The agreement includes the construction of a mechanical recycling/composting plant, a new Waste Treatment Plant in PPC's South Field, as well as a new waste transshipment station in Kozani. The IWMS will have a waste capacity of 120,000 tonnes, with the guaranteed quantity reaching 90,000 tonnes. Sorting at source (fourfold separation of paper, plastic, aluminium, glass) will still be carried out by the Waste Management System of Western Macedonia (DIADYMA S.A.), with a concessionaire commitment to additional recycling of 35% of the final waste that ends up at the plant[172]. The operation of the IWMS will create 150 permanent jobs, with the annual net income of employees reaching €3.5 million, according to experts.

6.4.2.5. Processing of aromatic and pharmaceutical plants

The other processing businesses in the region deal mainly with nutrition, wood, cork and furnishing, and are primarily related to local products of the primary sector. Over the past years there has been an increase in the potential of wineries (in the RU of Kozani and Florina), dairy and cheese production units (in the RU of Grevena and Kozani), meat packing industries, grain mill industries, organic products processing units, aromatic and pharmaceutical plants processing units (mainly saffron, oregano, chamomile, mountain tea, hippophae etc.) for the production of innovative products (e.g. oregano oil to be used as a natural antibiotic in the livestock sector, tea from Kozani saffron), as well as animal feed production units.

Today there are approximately 48 hectares of aromatic plants being cultivated. The cooperative employs 3 permanent and 3 temporary workers during the distilling period[173]. Assuming that the ratio between the personnel and the cultivated hectares remains the same, and in line with the job creation scenarios of the primary sector, according to the mild development scenario the cultivation of 500 hectares of aromatic plants over a 15-year period will create 31 permanent and 31 temporary jobs in the region. In a similar way, in the medium development scenario, 700 hectares will create 44 permanent and 44 temporary jobs and in the strong development scenario, 1,000 hectares will create 62 permanent and 62 temporary positions. To convert the temporary jobs to permanent, a 3-month employment scheme was assumed, while the estimation of the local added value from this activity assumed a €550 monthly salary, based on current data from the cooperative[123]. Using the same source and 2016 data, the investment cost of a modern distillery reaches 2,000 €/hectare.

[172] Kathimerini. 11/06/2015. "The first PPP waste management agreement has been signed" http://goo.gl/yaSWKq

[173] Personal communication with Ms. N. Tsaggadoura (2015 figures).

6.4.3. Tertiary sector

As in the cases of the primary and secondary sectors, in order to estimate the jobs that are likely to be created in the tertiary sector, as well as the required investments in the region, there were three different scenarios devised, of a mild, medium and strong development. The job creation potential and the corresponding investments were calculated focusing on the broader sector of education (universities and technical institutes), which also includes other research-technological institutes of the region, and tourism, with the main sub-categories being industrial and alternative (eco-) tourism.

Generally speaking, the establishment and support of academic institutions and research facilities in the region, the designation of natural and cultural heritage (particularly industrial) and the further tourism development of lake ecosystems (Polifitos[174,175], Vegoritida, Zazari and Himaditida[176], Vithos in Voio, Drosopigi in Florina, Prespes and more) and river ecosystems (Pramoritsa[177], Aliakmonas etc.) can enhance the multi-sided tourism product that WMR offers.

6.4.3.1. Higher Education and Research

The academic institutions in WMR today include the University of Western Macedonia[178], based in Kozani, with 6 departments spread out in Kozani and Florina, and the Technological Educational Institute of Western Macedonia[179], also based in Kozani, with departments in all the RUs of WMR. In addition, WMR features important institutes for research and technology, the support of businesses and the overall extroversion of the region, which all need to play a key role in the transition to the post-lignite era[180]:

- Business and Technology Development Centre (KETA)[180]
- Technological Research Centre (TRC) of Western Macedonia[181]
- Euro Info Centre[182]
- Chemical Processes and Energy Resources Institute (CPERI, former ISFTA)[183]
- Waste Management System of Western Macedonia (DIADYMA S.A.)[184]
- Environmental Centre (KEPE)[185]
- Chambers of Commerce and Craft Industries of the four RU of WMR
- Regional Development Agency of Western Macedonia (ANKO)[186]
- Regional Development Agency of Florina (ANFLO)[187]

[174] https://sites.google.com/site/limnepolyphytou/anaptyxe-kai-tourismos
[175] Ecological Movement of Kozani, D. Bousbouras 2015. Polifitos lake. Natural Environment-biodiversity-avifauna: https://issuu.com/ecokoz/docs/polyfyto_full
[176] http://ornithologiki.gr/page_iba.php?aID=46
[177] http://www.anko.gr/leader/Projectp.asp?ProjectID=279
[178] University of Western Macedonia. http://goo.gl/KCrmLu
[179] Technological Educational Institute of Western Macedonia. http://goo.gl/KMEavl
[180] KETA-ANKO. "Business Development Report for Western Macedonia". http://goo.gl/wPAF7h
[181] Technological Research Centre (TRC) of Western Macedonia http://www.ktedm.gr/index.php/el/
[182] Euro Info Centre http://goo.gl/xb7KYt
[183] Chemical Processes and Energy Resources Institute http://goo.gl/qIxL2P
[184] DIADYMA http://goo.gl/TJzIOZ
[185] Environmental Centre http://goo.gl/Dlkymq
[186] Regional Development Agency of Western Macedonia http://goo.gl/8g7sO4

- Regional Development Agency of Kastoria (ANKAS)[188]
- Regional Development Agency of Grevena (ANGRE)[189]

The job creation calculations in research and technology were based on the recommendations described in the Smart Specialisation Technical Manuals[190] by the local stakeholders. It was assumed that the jobs described in the proposals reflect the employment potential in the field of research and technology. In this context, there are 70 jobs estimated in the mild development scenario, and 90 and 140 jobs in the medium and strong development scenarios, respectively[191].

The size of the corresponding investments described in the Smart Specialisation Technical Manuals (€170 million) is assumed to reflect the strong development scenario, dropping to €60 and €110 million in the mild and medium development scenarios, respectively. The potential increase in employment also takes into account the scheduled construction of the University of Western Macedonia's campus in the RU of Kozani[192], budgeted at €40 million (excluding VAT).

6.4.3.2. Tourism

The tourism sector is a particularly underdeveloped one in WMR, as compared with the other regions in Greece, as it comes last in terms of "heads in beds". To date, WMR's main tourist attractions are its three ski resorts in Kastoria, Prespes and Nymfaio. Over the summer months, tourism is also noted in locations such as Agios Panteleimonas, Vlasti, Siatista and Nestorio. However, the transition to a post-lignite era requires tourism to become one of the main pillars of development in the region.

Despite its poor performance to date, WMR has a series of comparative advantages that are yet to be exploited. Tourist areas are still unsaturated, while the rich natural environment and cultural heritage are ideal for mild tourism development. According to a study by the Greek National Tourism Organisation (GNTO)[193], some of the most valuable and interesting ecosystems in Greece are located in WMR. Specifically, its mountainous areas accommodate rare fauna and flora species, while the region also features 2 of Greece's 10 National Parks (Prespes in Florina RU and Valia Kalda in Grevena RU), along with 9 Natura 2000 sites and 7 regions of outstanding natural beauty. It also features perfectly preserved stone houses settlements (Voio villages, Prespes settlements, Korestia settlements, Verno mountain settlements and more) and a network of stone bridges of a high cultural, architectural and historic value, while the towns of WMR feature manor houses and intact structures of Macedonian architecture which, despite being extensively studied, still remain unexploited.

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[187] Regional Development Agency of Florina http://goo.gl/iCHBLW
[188] Regional Development Agency of Kastoria http://goo.gl/ahxp1y
[189] Regional Development Agency of Grevena http://goo.gl/zg8IOj
[190] Intermediate Managing Authority of Western Macedonia. 2014. "Smart Specialisation Strategy for the Western Macedonia Region 2014 - 2020" http://goo.gl/9uzDu5
[191] This is a moderate estimate, considering that the average ratio of research personnel to the total EU workforce is 1.01% (*source: http://goo.gl/eSzvuW*). In the case of WMR that translates to 791 employees in research-related fields.
[192] Western Macedonia Region. "Construction of the Western Macedonia campus in Kozani's Active Urban Planning Zone" http://goo.gl/v3Dyd6
[193] GNTO, 2003. "Regional Tourism Development Reports" http://goo.gl/mB3a7s

The Tourism Agency of Western Macedonia was established in order to boost tourism in the region[194], while encouraging is the fact that there has been a recent increase in tourism investments in WMR[195]. The potential of tourism in WMR relies on the development and designation of new forms of tourism activities, such as medical tourism[196], urban tourism[197], MICE tourism (Meetings, Incentives, Conferences, Expo), through the upgrade of the Western Macedonia Exhibition Centre in Koila (Kozani RU), cultural-religious tourism, industrial tourism and ecotourism. This study focuses on industrial tourism and ecotourism.

Industrial Tourism

The mild, medium and strong development scenarios for industrial tourism were based on the scenarios presented in the feasibility study of CERTH-ISFTA regarding the construction of a technology park in the Ptolemaida-Amyntaio basin[198]. The activities and services proposed in the park are the following:

- Informing visitors about the importance and the technologies of energy generation in general, and about power production using lignite and renewable energy sources, in particular.
- Organised visits to mines and thermal power stations, as well as to restored areas, in order to point out the ways of recovering natural ecosystems and agricultural lands.
- Recreation activities in restored areas, such as wetlands or wildlife refugees.

According to the feasibility study, in the mild, medium and strong development scenarios it is estimated that 24, 44 and 55 full-time and part-time jobs will be created, requiring a total investment of €7.8 million, €10.9 million and €13.9 million, respectively. It is also assumed that the salaries of the workforce, along with the other annual operational costs of the business (security, cleaning, maintenance, promotion, other expenses) remain within WMR. Hence, the operation of the technology park between 2020-2030 will directly add to the region's economy €12.4 million, €15.63 million and €16.6 million in the mild, medium and strong development scenarios, respectively.

It's interesting to note that over the past few years there has been an important mobilisation of bodies in WMR aimed at the protection and promotion of industrial heritage[199]. The related interventions increased significantly following the recent demolition of TPS LIPTOL's facilities[200].

Ecotourism

[194] Tourism Agency of Western Macedonia. http://goo.gl/U9kQTL
[195] Ministry of Tourism. 2013. "Greek Tourism Strategic Plan 2014-2020". http://goo.gl/DdKmmu
[196] Institute of Social and Preventive Medicine. 2012. "Development of Medical Tourism in Greece" http://goo.gl/9y4kAm
[197] World Tourism Organization. Destination Management Organizations. http://goo.gl/YP8Y1Q
[198] CERTH-ISFTA. 2004. "Feasibility study - preliminary study for the construction of an Energy Technology Park in the Ptolemaida-Amyntaio basin aimed at the development of Industrial Tourism", http://goo.gl/iH5Z5N
[199] See e.g. Biennale of Architectural and Urban Restoration BRAU3, website http://industrialheritage.gr/
[200] TCG WM intervention: http://goo.gl/O3GsJU

WMR has an excellent developmental potential regarding Special and Alternative Types of Tourism. The Special Types of Tourism are defined by Law 4276/2014 as follows:

- **Rural Tourism** (Article 27): *is any form of organised sustainable tourism development that aims at engaging visitors with nature and rural activities, by providing economic and social support to the countryside, without posing threats to the environment and the particular cultural characteristics of a region.*
- **Agrotourism** (Articles 26 – 30): *is a special type of rural tourism which deals with the provision of reception, hospitality or even catering services in spaces functionally integrated with agricultural facilities, in combination with activities related to agricultural production, as well as the preservation and designation of the natural and man-made agricultural landscape.*
- **Enotourism** (Article 25): *is a special form of tourism which relates to the provision of reception, guided touring, hospitality and catering services in spaces functionally integrated with wine making or wine production (vineyards) facilities. These services are provided in combination with activities related to viniculture and wine production.*

As part of developing the eco-tourism infrastructure of the region there have already been comprehensive studies on the creation of pathways and trail networks in the Voio region (Siatista - Neapoli - Tsotili - Pentalofos, and the mountainous regions of Askios, Mourikios, Ontria, Voio), as well as promotion services (documentaries, tourist guides, website in three languages etc.) which received funding through the PINDOS National Project but haven't been realised yet[201].

The project comprises 13 sub-projects, of a total €1 million (study and construction) budget. The realisation - construction - supervision of the 13 sub-projects is expected to create 3 full-time and 3 seasonal (4-month) jobs per project. The mild development scenario of the present study assumed that the project is carried out in only one part of the Kozani RU (the wider mountainous region of Voios-Askios-Mourikios) requiring a total investment of €1 million, while the medium and strong development scenarios assume that the project is carried out in 2 and 4 RU of WME, rising the investment to €2 million and €4 million, respectively.

It should be noted that there is additional potential in the ecotourism sector that has not been examined in the present study, e.g. by creating jobs in the management bodies of the protected areas, in the promotion, preservation and management of Natura sites and National parks, in providing accommodation - guided tours to eco-tourists etc.

Table 6.5 summarises the jobs and the corresponding value directly added to WMR's economy per suggested sector, for the three scenarios of mild, medium and strong development, while Table 6.6 presents the corresponding total investments required, and the jobs and local added value created. Even in the strong development scenario, the required investment doesn't exceed the construction costs of PPC's two new lignite units (Ptolemaida V and Meliti II).

[201] Pindos Project: Along Voios' pathways. http://goo.gl/dUkXvE

The most significant part of the investments is directed to RES (58,5%, 59% and 63% for the mild, medium and strong development scenarios, respectively), which at the same time constitute the main contributors to job creation in the secondary and primary sectors (49%, 38.7% and 36.9% for the mild, medium and strong development scenarios, respectively) as well as to the generation of local added value (67.3%, 61.1% and 60.9% for the mild, medium and strong development scenarios, respectively).

Table 6.5: Alternative Economic Activities Scenarios in the Western Macedonia Region

Scenarios	Mild Development		Medium Development		Strong Development	
Primary sector						
	Direct Jobs	**Direct Local Added Value (million €)**	**Direct Jobs**	**Direct Local Added Value (million €)**	**Direct Jobs**	**Direct Local Added Value (million €)**
Expansion of saffron production	854	90.00	1,709	180.00	2,563	270.00
Expansion of aromatic plants	121	48.75	169	68.25	242	97.50
Energy crops	1,000	312.00	1,000	312.00	1,000	312.00
Forestry	218	0.64	382	1.13	491	1.45
Total Primary	2,193	386.64	3,260	445.53	4,296	509.45
Secondary sector						
Renewable Energy Sources	800	378.10	1,036	470.68	1,691	737.84
Energy saving	185	47.75	370	95.51	555	143.26
Exploitation of fly ash	180	45.36	180	45.36	180	45.36
Waste Management	150	52.50	150	52.50	150	52.50
Processing Cooperative	39	3.87	55	5.41	78	7.73
Total Secondary	1,354	527.58	1,791	669.46	2,654	986.69
Tertiary sector						
Universities	70	100.00	130	150.00	215	210.00
Industrial Tourism	24	12.40	44	15.63	55	16.60
Ecotourism	16	1.00	32	2.00	64	4.00
Total Tertiary	110	113.40	206	167.63	334	230.60
Total	**3,657**	**1,025.82**	**5,257**	**1,280.10**	**7,284**	**1,723.14**

Table 6.6: Total direct jobs, direct local added value and required investments in the mild, medium and strong development scenarios

	Mild Development	Medium Development	Strong Development
Jobs	3,657	5,257	7,284
LAV (million €)	1,025.82	1280.10	1,723.14
Investments (million €)	1,228.5	1,666.69	2,351.67

6.5. Analysis of scenarios

The scenarios presented in the previous section refer only to direct job creation and local added value (LAV) contributing directly to WMR's economy, without taking into account the multiplying benefits expected to be brought about by the interaction between various sectors of the local economy. These multiplying interactions are estimated in this chapter, using two groups of multipliers: those computed based on the most recent 2011 Hellenic Statistical Authority (ELSTAT) data, and those based on a study by the Academy of Athens, which nevertheless uses older data (2005 and 2001)[202] and different economic sectors compared to ELSTAT. The latter were also used by the Technical Chamber of Greece, Department of W. Macedonia (TCG/WM) in 2012, in the assessment of the cost of Western Macedonia's transition to a low lignite production model[203]. On the one hand, using two groups of multipliers offers the ability to compare the results with older studies - specifically that of TCG/WM - and, on the other hand, the ability to verify the results using a wider spectrum of calculations.

The methodology followed to estimate the multipliers for the jobs and the Local Added Value (LAV) created is presented in Annex I. The following section presents the results for the six scenarios that were described in the previous chapter.

The data regarding direct employment opportunities and the corresponding value directly added to the economy of Western Macedonia, as that was presented in the previous section, was distributed to the various sectors and then the *total* jobs created and the local added value for each scenario were estimated.

As can be seen in Table 6.7, the inaction scenario will have severe impacts on WMR's economy, as it is estimated that there will be a total of 6,128 jobs and €1.135 billion of LAV lost, based on ELSTAT's multipliers. These losses will be even greater if the calculations are based on the older multipliers of the Academy of Athens/TCG-WM (13,089 jobs and €2,426 billion). One can easily draw that the TCG/AA multipliers result to twice the multiplying variations. This is mainly due to the fact that - apart from the TCG/AA multipliers being based on much older data - the sectoral composition is very different between the two sets of estimations. Moreover, the data regarding LAV and employment that was used refers to different time periods. In any case, in order to analyse the potential variations in Western

[202] Academy of Athens. 2007. "Research Department, Intersectoral relationships of the Greek Economy at a National and Regional Level". http://goo.gl/WFWOQs
[203] TCG Dep. Western Macedonia. 2012. "Cost assessment of Western Macedonia's transition to a low lignite production model" http://goo.gl/y0AipF

Macedonia's economy, it is crucial to make comparisons between scenarios that use the same multiplier estimates and the same benchmarks.

Table 6.7: Total Jobs and Local Added Value in the "Inaction" Scenario

ELSTAT multipliers				
	Jobs		**Local Added Value**	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, forestry and fishery	0	-28	0.00	-5.21
Mines, quarries, industry, electricity, natural gas, steam, air conditioning and water, sewage treatment, waste management and remediation	-4,625	-5,044	-857.28	-934.87
Processing	0	-420	0.00	-77.79
Construction	0	-9	0.00	-1.60
Wholesale and retail trade, car and motorcycle repair, transport and storage, accommodation and catering services	0	-177	0.00	-32.79
Information and communication	0	-31	0.00	-5.71
Finance and insurance activities	0	-105	0.00	-19.42
Real Estate	0	-90	0.00	-16.73
Professional, scientific and technical activities, administration and support activities	0	-178	0.00	-33.05
Public administration and defence, compulsory national insurance, education, activities related to human health and social care	0	-19	0.00	-3.45
Arts, entertainment, recreation, other service-based activities, household activities as employers, undifferentiated household activities regarding the production of goods and services for own use, activities of extraterritorial organisations	0	-28	0.00	-5.27
Total	**-4,625**	**-6,128**	**-857.28**	**-1,135.87**
Academy of Athens/TCG-WM multipliers				
	Jobs		**Local Added Value**	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, hunting, forestry, fishery	0	-92	0.00	-17.05
Mines, quarries, fuels, lubricants	-4,625	-11,727	-857.28	-2,173.70
Industrial and chemical products	0	-467	0.00	-86.50
Supply of electricity, natural gas, water	0	-205	0.00	-38.04
Construction	0	-23	0.00	-4.32
Transport, Communications	0	-40	0.00	-7.35
Trade	0	-252	0.00	-46.65
Banks, Real Estate Market	0	-261	0.00	-48.41
Houses	0	0	0.00	0.00

Public Administration and Defence	0	0	0.00	0.00
Health, Education	0	0	0.00	0.07
Other services	0	-22	0.00	-4.05
Total	**-4,625**	**13,089**	**-857.28**	**-2,426.14**

Needless to say that in a region where unemployment is surging, inaction is not an option.

In addition, and according to the results of the analysis (Table 6.8), the construction of Ptolemaida V will not suffice to solve the problem either. Based on ELSTAT's multipliers, its construction and operation will generate only 20% of the jobs and LAV (1,208 positions and €224 million) that will be lost as a result of closing down the lignite TPS by 2030. The Academy of Athens/TCG-WM multipliers result to more jobs and a higher LAV (2,353 jobs and €436 million, respectively) as a result of the operation of Ptolemaida V. However, these multipliers result to similarly higher losses in jobs and LAV. Hence, the replacement rates of lost jobs and LAV remain low (18%).

Table 6.8: Total Jobs and Local Added Value in the "Ptolemaida V" Scenario

ELSTAT multipliers				
	Jobs		**Local Added Value**	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, forestry and fishery	0	6	0.00	1.03
Mines, quarries, industry, electricity, natural gas, steam, air conditioning and water, sewage treatment, waste management and remediation	912	995	169.05	184.35
Processing	0	83	0.00	15.34
Construction	0	2	0.00	0.32
Wholesale and retail trade, car and motorcycle repair, transport and storage, accommodation and catering services	0	35	0.00	6.47
Information and communication	0	6	0.00	1.13
Finance and insurance activities	0	21	0.00	3.83
Real Estate	0	18	0.00	3.30
Professional, scientific and technical activities, administration and support activities	0	35	0.00	6.52
Public administration and defence, compulsory national insurance, education, activities related to human health and social care	0	4	0.00	0.68
Arts, entertainment, recreation, other service-based activities, household activities as employers, undifferentiated household activities regarding the production of goods and services for own use, activities of extraterritorial organisations	0	6	0.00	1.04
Total	**912**	**1,208**	**169.05**	**223.98**

Academy of Athens/TCG-WM multipliers				
	Jobs		Local Added Value	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, hunting, forestry, fishery	0	16	0	3
Mines, quarries, fuels, lubricants	662	1841	123	341
Industrial and chemical products	0	82	0	15
Supply of electricity, natural gas, water	250	302	46	56
Construction	0	5	0	1
Transport, Communications	0	7	0	1
Trade	0	50	0	9
Banks, Real Estate Market	0	45	0	8
Houses	0	0	0	0
Public Administration and Defence	0	0	0	0
Health, Education	0	0	0	0
Other services	0	4	0	1
Total	**912**	**2,353**	**169**	**436**

A 10% improvement is noted in the scenario according to which both Ptolemaida V and Meliti II are constructed (Table 6.9). Specifically, using ELSTAT's multipliers, it is estimated that the two lignite units will create 1,878 permanent jobs and inject €348 million to WMR's economy, which is approximately 30% of the jobs and LAV expected to be lost as a result of closing down the TPS, as was described in the introduction.

Table 6.9: Total Jobs and Local Added Value in the "Ptolemaida V and Meliti II" Scenario

ELSTAT multipliers				
	Jobs		Local Added Value	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, forestry and fishery	0	9	0.00	1.60
Mines, quarries, industry, electricity, natural gas, steam, air conditioning and water, sewage treatment, waste management and remediation	1,417	1,545	262.65	286.42
Processing	0	129	0.00	23.83
Construction	0	3	0.00	0.49
Wholesale and retail trade, car and motorcycle repair, transport and storage, accommodation and catering services	0	54	0.00	10.05
Information and communication	0	9	0.00	1.75
Finance and insurance activities	0	32	0.00	5.95
Real Estate	0	28	0.00	5.12
Professional, scientific and technical activities, administration and support activities	0	55	0.00	10.12

Public administration and defence, compulsory national insurance, education, activities related to human health and social care	0	6	0.00	1.06
Arts, entertainment, recreation, other service-based activities, household activities as employers, undifferentiated household activities regarding the production of goods and services for own use, activities of extraterritorial organisations	0	9	0.00	1.61
Total	**1,417**	**1,877**	**262.65**	**348.01**

Academy of Athens/TCG-WM multipliers

	Jobs		**Local Added Value**	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, hunting, forestry, fishery	0	25	0.00	4.62
Mines, quarries, fuels, lubricants	997	2,801	184.80	519.11
Industrial and chemical products	0	125	0.00	23.23
Supply of electricity, natural gas, water	420	502	77.85	92.99
Construction	0	9	0.00	1.60
Transport, Communications	0	11	0.00	2.09
Trade	0	78	0.00	14.50
Banks, Real Estate Market	0	70	0.00	12.92
Houses	0	0	0.00	0.00
Public Administration and Defence	0	0	0.00	0.00
Health, Education	0	0	0.00	0.02
Other services	0	6	0.00	1.14
Total	**1,417**	**3,627**	**262.65**	**672.22**

One can safely draw from the above that investments in the range of €2.5 billion in two new lignite units of a total 1,110 MW gross nominal capacity will be unable to tackle the severe unemployment problem in Western Macedonia, which is expected to reach its peak in the following 15 years. Hence, it is important to examine whether a solution can be provided by alternative sectors of the economy, as these are presented in the mild, medium and strong development scenarios described above.

Even in the mild development scenario (Table 6.10), which was based on particularly conservative assumptions, there are approximately the same number of jobs created and a greater LAV (5,791 jobs and €1.466 billion respectively) compared to the losses resulting from shutting down the lignite Thermal Power Stations (Inaction scenario), using ELSTAT's multipliers. This outcome is different when the Academy of Athens/TCG-WM multipliers are used, according to which the mild development scenario will create 6,549 jobs, approximately half of those expected to be lost according to the inaction scenario (13,089 jobs, see Table 6.7). However, the LAV of the mild development scenario is comparable to that expected to be lost by the closure of the lignite stations by 2030 (€1.836 billion and €2.426 billion in the mild development and inaction scenarios, respectively). It can therefore be concluded that the economy of Western Macedonia is far from collapsing, even in the mild development scenario.

Table 6.10: Total Jobs and Local Added Value in the "Mild Development" Scenario

ELSTAT multipliers				
	Jobs		**Local Added Value**	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, forestry and fishery	2,193	2,531	386.64	443.48
Mines, quarries, industry, electricity, natural gas, steam, air conditioning and water, sewage treatment, waste management and remediation	469	647	375.24	424.65
Processing	39	782	2.06	148.72
Construction	846	912	148.47	161.11
Wholesale and retail trade, car and motorcycle repair, transport and storage, accommodation and catering services	0	357	0.00	69.56
Information and communication	0	19	0.00	5.17
Finance and insurance activities	0	129	0.00	29.07
Real Estate	0	76	0.00	16.30
Professional, scientific and technical activities, administration and support activities	0	208	0.00	45.99
Public administration and defence, compulsory national insurance, education, activities related to human health and social care	70	74	100.00	103.76
Arts, entertainment, recreation, other service-based activities, household activities as employers, undifferentiated household activities regarding the production of goods and services for own use, activities of extraterritorial organisations	40	55	13.40	18.46
Total	**3,657**	**5,791**	**1,025.82**	**1,466.26**
Academy of Athens/TCG-WM multipliers				
	Jobs		**Local Added Value**	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, hunting, forestry, fishery	2,193	2,862	386.64	520.19
Mines, quarries, fuels, lubricants	0	739	0.00	305.46
Industrial and chemical products	330	1,254	97.86	302.81
Supply of electricity, natural gas, water	139	240	277.38	320.38
Construction	846	872	148.47	156.14
Transport, Communications	0	37	0.00	9.35
Trade	0	254	0.00	65.22
Banks, Real Estate Market	0	121	0.00	35.19
Houses	0	0	0.00	0.00
Public Administration and Defence	0	0	0.00	0.00
Health, Education	70	73	100.00	100.76
Other services	79	98	15.47	20.55

Total	**3,657**	**6,549**	**1,025.82**	**1,836.05**

Significant improvement is achieved in the medium development scenario (Table 6.11), as based on ELSTAT's multipliers, there will be 2,197 more jobs created compared with those that will be lost by shutting down the lignite stations by 2030, while the LAV created is estimated at €1.834 billion, approximately €0.7 billion higher than that of the inaction scenario (see Table 6.7). As in the case of the mild development scenario, however, using the Academy of Athens multipliers leads to fewer jobs (9,328) in the medium development scenario compared with those expected to be lost in the inaction scenario (13,089). Using those multipliers, the LAV of the medium development scenario (€2.268 billion) is much closer to the one expected to be lost as a result of shutting down the lignite units by 2030 (€2.426 billion). It should be noted that the projected development in this scenario results to a significant increase in the local added value and to job creation (i.e. it is not a "jobless" development, where there is a shortage of jobs created). The "success" of this scenario is due to the direct creation of jobs and added value in more than two sectors, which translates to significant economic development, as a result of the multiplying effects.

Table 6.11: Total Jobs and Local Added Value in the "Medium Development" Scenario

ELSTAT multipliers				
	Jobs		**Local Added Value**	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, forestry and fishery	3,260	3,760	445.53	511.57
Mines, quarries, industry, electricity, natural gas, steam, air conditioning and water, sewage treatment, waste management and remediation	568	817	447.04	507.17
Processing	55	1118	2.89	190.39
Construction	1,168	1,260	217.01	235.07
Wholesale and retail trade, car and motorcycle repair, transport and storage, accommodation and catering services	0	517	0.00	86.72
Information and communication	0	27	0.00	6.58
Finance and insurance activities	0	188	0.00	35.69
Real Estate	0	108	0.00	20.82
Professional, scientific and technical activities, administration and support activities	0	297	0.00	60.66
Public administration and defence, compulsory national insurance, education, activities related to human health and social care	130	137	150.00	155.14
Arts, entertainment, recreation, other service-based activities, household activities as employers, undifferentiated household activities regarding the production of goods and services for own use, activities of extraterritorial organisations	76	98	17.63	24.12
Total	**5,257**	**8,325**	**1,280.10**	**1,833.94**

Academy of Athens/TCG-WM multipliers				
	Jobs		Local Added Value	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, hunting, forestry, fishery	3,260	4,202	445.53	600.15
Mines, quarries, fuels, lubricants	0	1,078	0.00	375.11
Industrial and chemical products	330	1,591	97.86	352.17
Supply of electricity, natural gas, water	238	384	349.18	401.76
Construction	1,168	1,206	217.01	226.64
Transport, Communications	0	52	0.00	11.41
Trade	0	356	0.00	79.52
Banks, Real Estate Market	0	166	0.00	43.73
Houses	0	0	0.00	0.00
Public Administration and Defence	0	0	0.00	0.00
Health, Education	130	135	150.00	150.95
Other services	131	159	20.52	27.09
Total	**5,257**	**9,328**	**1,280.10**	**2,268.53**

The strong development scenario (Table 6.12) offers the greater benefits to the economy of WMR. Using ELSTAT's multipliers, there are almost twice the jobs created (11,595) and more than twice the LAV (€2.468 billion) compared with the inaction scenario. A similar outcome is noted even when the older multipliers of the Academy of Athens/TCG-WM are used, as it is estimated that there will be 12,865 jobs created, practically the same as those expected to be lost by the scheduled closure of the lignite units (13,089). Finally, using the same multipliers, the strong development scenario leads to a LAV that is greater by €0,62 billion compared to the inaction scenario.

Table 6.12: Total Jobs and Local Added Value in the "Strong Development" Scenario

ELSTAT multipliers				
	Jobs		Local Added Value	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, forestry and fishery	4,296	4,960	509.45	586.31
Mines, quarries, industry, electricity, natural gas, steam, air conditioning and water, sewage treatment, waste management and remediation	732	1,076	639.33	722.35
Processing	78	1,593	4.13	261.41
Construction	1,844	1,987	339.63	367.10
Wholesale and retail trade, car and motorcycle repair, transport and storage, accommodation and catering services	0	719	0.00	114.17
Information and communication	0	38	0.00	9.12
Finance and insurance activities	0	258	0.00	46.47
Real Estate	0	154	0.00	28.98

Professional, scientific and technical activities, administration and support activities	0	434	0.00	85.82
Public administration and defence, compulsory national insurance, education, activities related to human health and social care	215	225	210.00	217.23
Arts, entertainment, recreation, other service-based activities, household activities as employers, undifferentiated household activities regarding the production of goods and services for own use, activities of extraterritorial organisations	119	151	20.60	29.52
Total	**7,284**	**11,595**	**1,723.14**	**2,468.49**

Academy of Athens/TCG-WM multipliers

	Jobs		**Local Added Value**	
SECTOR	Direct Results	Multiplying Results	Direct Results	Multiplying Results
Agriculture, hunting, forestry, fishery	4,296	5,536	509.45	692.45
Mines, quarries, fuels, lubricants	0	1,496	0.00	530.74
Industrial and chemical products	330	2,085	97.86	434.20
Supply of electricity, natural gas, water	402	603	541.47	615.37
Construction	1,844	1,896	339.63	352.72
Transport, Communications	0	71	0.00	14.90
Trade	0	488	0.00	105.38
Banks, Real Estate Market	0	230	0.00	59.16
Houses	0	0	0.00	0.00
Public Administration and Defence	0	0	0.00	0.00
Health, Education	215	221	210.00	211.17
Other services	197	238	24.73	33.31
Total	**7,284**	**12,865**	**1,723.14**	**3,049.40**

The results of Table 6.12 - for both groups of multipliers - highlight the fact that investments of a similar scale to those required for the construction of Ptolemaida V and Meliti II (€2,351 billion, Table 6.6) can create many more jobs and a much greater LAV for WMR.

The following graph presents a comparison between the 6 scenarios with regards to the jobs and LAV they create compared with the inaction scenario, using the ELSTAT multipliers.

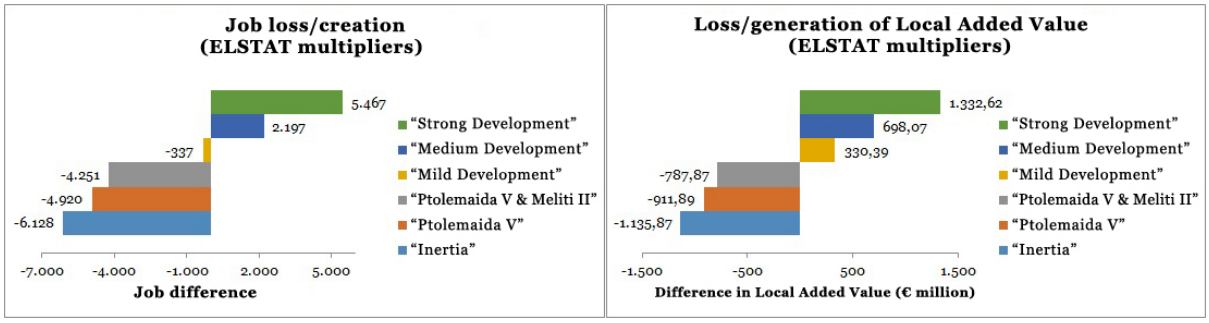

Figure 6.1: Comparison of 6 scenarios regarding job opportunities and the Local Added Value they create compared with the "Inaction" Scenario (ELSTAT multipliers).

In conclusion, in the inaction scenario, which assumes that the existing thermal power stations will close down and that no measure will be taken, the local economy takes a major blow, since a significant share of jobs and local added value will be lost. In the following two scenarios, in which support to the economy is provided through the prolongation of activities of the same nature, i.e. the construction of one or two new lignite units, the economy of Western Macedonia is unable to recover. The multiplying impacts of all scenarios, including these two, are confirmed by the use of two groups of multipliers (ELSTAT and TCG/AA). The alternative scenarios for supporting WMR's economy, i.e. the "mild", "medium" and "strong" development scenarios, prove that a targeted policy and support of specific sectors can not only preserve jobs and generate local income, but it can also lead to significant additional development in the region.

6.6. The incompatibility of developing alternative activities with the perpetuation of the lignite model of power production

It would be reasonable for someone to wonder whether it would be possible for the region of Western Macedonia to develop the alternative activities presented in this report alongside the mining and burning of lignite.

To begin with, the perpetuation of the lignite model of electricity production has been proven unsustainable from a pure economic perspective (for further details see Chapter 2). Moreover, a series of studies have pointed out the harmful impacts of lignite activities on human health, local communities and the environment[204], which should have been enough to end the exploitation of lignite. However, they also come at a cost, borne by citizens across the country, including the W.Macedonia region. This cost can be assessed using data provided by the European Environment Agency (EEA)[205] (which nevertheless omit the cost resulting from the mining and transportation of lignite), according to which the external cost per MWh produced in Greece's lignite stations ranges between 76.3€-127.9€/MWh. Shutting down Kardia's and Amyntaio's power units by 2023, as well as those of Ptolemaida[206], will generate savings in the range of approximately €6.3-10.6 billion by 2030. Of course, even greater savings can be achieved by preventing the construction of the Ptolemaida V and Meliti II units.

This cost should also include that of operating new mines (Komnina, Proasteio) or expanding the existing ones (Ahlada, Vevi, Kleidi etc.), the associated expropriations, the restoration of additional areas etc. Apart from the economic aspect, there are also costs related e.g. to the cultural heritage of the region, as was recently demonstrated in the demolition of TPS LIPTOL's facilities - which constituted an industrial heritage landmark of the region - in order to use the deposits lying beneath it. Besides, further delays should be expected in the restorations, as the simultaneous operation of the mines makes it much more difficult - or even impossible - for PPC to carry out its related commitments.

[204] See e.g. "The new Ptolemaida V lignite unit", Assessment, WWF Greece, 2013
[205] EEA, “Revealing the costs of air pollution from industrial facilities in Europe”, 2012
[206] See Ch. 6, *Shut down timetable*. The hours of operation have been estimated based on those of the Kardia and Amyntaio plants for 2014 and the way those are affected by the implementation of the Industrial Emissions Directive 2010/75/EU, while for the Ptolemaida unit the hours of operation of 2014 were used.

The prolongation of the lignite activities will undoubtedly keep undermining the development of other economic sectors, along with all the potential associated economic benefits. A recent study by the TCG WM[207] showed that, as a result of the PPC's activities, the region has already been deprived of revenues in the range of €2.6 billion (between 1999-2009) which would have resulted from the development of other economic activities, particularly those of the primary sector. The pressure put on the primary sector is also evident from the size of the areas in WMR's energy basin occupied by PPC, which are expected to further increase by 25% in order to meet future lignite needs[208]. WMR's reliance on lignite has also contributed to the one-sided development of the local workforce's skills and to the constraint of traditional occupations; the perpetuation of this dependence will further intensify the current situation, making the transition even harder to achieve.

Finally, depending on whether PPC will play a key role in the future of WMR, by insisting on the prolongation of the lignite model of electricity production, its dire financial straits are expected to create a conflict between the simultaneous development of thermal power production and clean energy units. This has also been demonstrated in the past, as the plans for developing photovoltaic parks in both Megalopolis and Kozani were put off by the difficulty in securing sufficient funding[209].

[207] TCG W.M., "Portrayal and assessment of WMR's economic sectors with regards to the development of lignite production", 2013
[208] M. Korasidis and P. Koukoulopoulos, "Using the closed mines in the primary sector", Letter to the MEECC, 18/12/2014
[209] H. Floudopoulos, "PPC: Following Megalopolis' PVs, Kozani's PVs are also to be suspended", Article. Source: http://legacy.capital.gr/news.asp?id=1622031

7. PRECONDITIONS AND FUNDING TOOLS FOR THE TRANSITION TO A POST-LIGNITE ERA

7.1. Preconditions

Completing the relocation of the afflicted settlements, and ensuring the gradual restoration/reuse of the mining areas and the welfare of the region's workforce are prerequisites for the successful transition of WMR to a post-lignite era. To these, one should add the preparation of a plan for the alternative use of the district heating systems that have been operating in WMR for decades.

7.1.1. Completing the relocation of the afflicted settlements[210]

The relocations of the Kardia (1976, 700 inhabitants), Exohi (end of '70s, 300 inhabitants) and Haravgi (mid-90's, 2,000 inhabitants) settlements have already been completed[211]. The public infrastructure works for the new approved settlements for the inhabitants of Komanos and Klitos are at their final stage, with many of Klitos' residents having already been relocated. The residents of Pontokomi decided on a referendum (14/09/2008) to relocate south of Kozani's Active Urban Planning Zone (AUPZ), in a 130-hectare area[212]. Their relocation is currently under approval by the urban planning committee. Regarding the settlements of Akrini and Anargyroi, the relocation areas have already been designated, while, following the issue of the associated Presidential Decree, the relocation plan has been submitted to the Ministry of Environment by PPC's competent committee, and is currently awaiting approval[210]. In addition, the Decision for the Approval of Environmental Terms (AET) of Achlada Mines SA foresees the relocation of the settlements of Achlada, Upper Achlada and Lower Achlada, while, finally, the operation of new mines in the area requires the expropriation of the existing Kleidi settlement in the municipality of Amyntaio (RU of Florina) and the Pteleonas settlement in the Eordaia municipality (RU of Kozani)[213].

Settlement relocations are still carried out on the basis of the expropriations act, given the lack of an institutional framework; in practice, they constitute an "act of confidence" between the local community and PPC. A review of the relocation costs reveals that PPC has spent approximately €121 million between 1972 and 2008[214]. This sum consists of roughly €811,000 for the Kardia settlement, €6 million for Haravgi and Exohi, €34.6 million for Komanos and €79.8 million for Kleitos. The cost of relocating Pontokomi is estimated at €180 million. At the same time, efforts are made to fund the costs of relocating the settlements of Pontokomi, Mavropigi, Akrini, Pteleona, Kleidio, Anargyroi, Komanos, Kleitos and Achlada through the Operational Programme (OP) for Infrastructure, Environment and Sustainable Development, with a total budget of €100 million. It's also important to note that the relocation costs that PPC has had to cover over the years are particularly low, given

[210] TCG-WM. 2014. "Outline of PPC's commitments - obligations towards the society of Western Macedonia, related to its activities in Greece's largest energy centre" http://goo.gl/EIGSh6
[211] WWF Greece. 2013. "Ptolemaida 5 and Meliti 2: Economic viability report of the new lignite units"http://goo.gl/tL6FGY
[212] E. Mitsiakou, S. Miltiadou. Technical Years. 2010 "Eco-urban planning. Designing the new Pontokomi". http://goo.gl/EOpNpS
[213] TCG-WM. 2011. "TCG/WM Assessment of the issues related to the supply of Meliti's TPS and the operation of Florina's lignite mines". http://goo.gl/6N7S1B
[214] Kathimerini. 21/09/2008. "PPC's forced migrants" http://goo.gl/dt1vF7

the size of the populations relocated, the areas that were expropriated and the settlements that were wiped out. With regards to the planned relocations of Pontokomi[212], Akrini and Anargyroi, the company is expected to cover 50% of the total relocation cost, while the remaining 50% will be covered by the State Budget and the Special Development Programme (SDP)[215]. However, this is a flawed decision, since an obligation for which PPC is entirely responsible is transferred by 50% to the taxpayer or to other funding resources (SDP), which would otherwise be used to fund the post-lignite era. As for supporting the inhabitants of the afflicted settlements, PPC's financial contribution can be broken down into three major categories[216]: rent allowance (for 18 months), one-off allowance for social restoration (€20,000 per afflicted resident) and points awarded (due to locality) in ASEP (Supreme Council for Civil Personnel Selection) competitions regarding permanent and temporary jobs at PPC.

Given the lack of a binding framework, the relocation of settlements is a rather problematic - and at times confrontational - process[217]. Its real cost is distributed on a case-by-case basis, with the outcome usually constituting in one more hidden, indirect "subsidy" by the government and the local community to PPC.

It is therefore necessary to establish a concrete legal framework for settlement relocations, rather than to rely on the wider scheme of expropriations and the "good will" of the stakeholders involved, and to speed up the realisation of all the necessary relocations.

7.1.2. Land restoration and hand over

According to PPC (Figure 7.1), the restored areas in 2015 amounted to 27.3%[218]. The plan foresees the restoration of 81% of the total area by 2050, with 45% and 46% of it comprising of forests and agricultural land, respectively, and 9% lakes. Areas of special use will occupy an additional 0.8%, while the remaining facilities and other infrastructure will cover 0.3% and 3.4% respectively by 2050[219].

[215] L. 3937/2011. http://goo.gl/cdeyUy
[216] L. 3734/2009. http://goo.gl/lk4Ehi
[217] Ta Nea. 16/01/2009. "The PPC is kicking us out". http://goo.gl/Zig983
[218] Dimitris Zarafidis, Director of Operational Support of the Lignite Centre of W. Macedonia: "PPC's plan for the restoration and use of WMLC areas". Workshop "Post-lignite era - The Challenge for Western Macedonia" Kozani. 08/04/2016 https://goo.gl/ejtCjl
[219] TCG-WM. 2012. "Restoration of PPC SA mining areas in the Lignite Centre of Western Macedonia. - Obligations of the Corporation, concerns deriving from the project's EIA. - International practices". http://goo.gl/eAlG2b

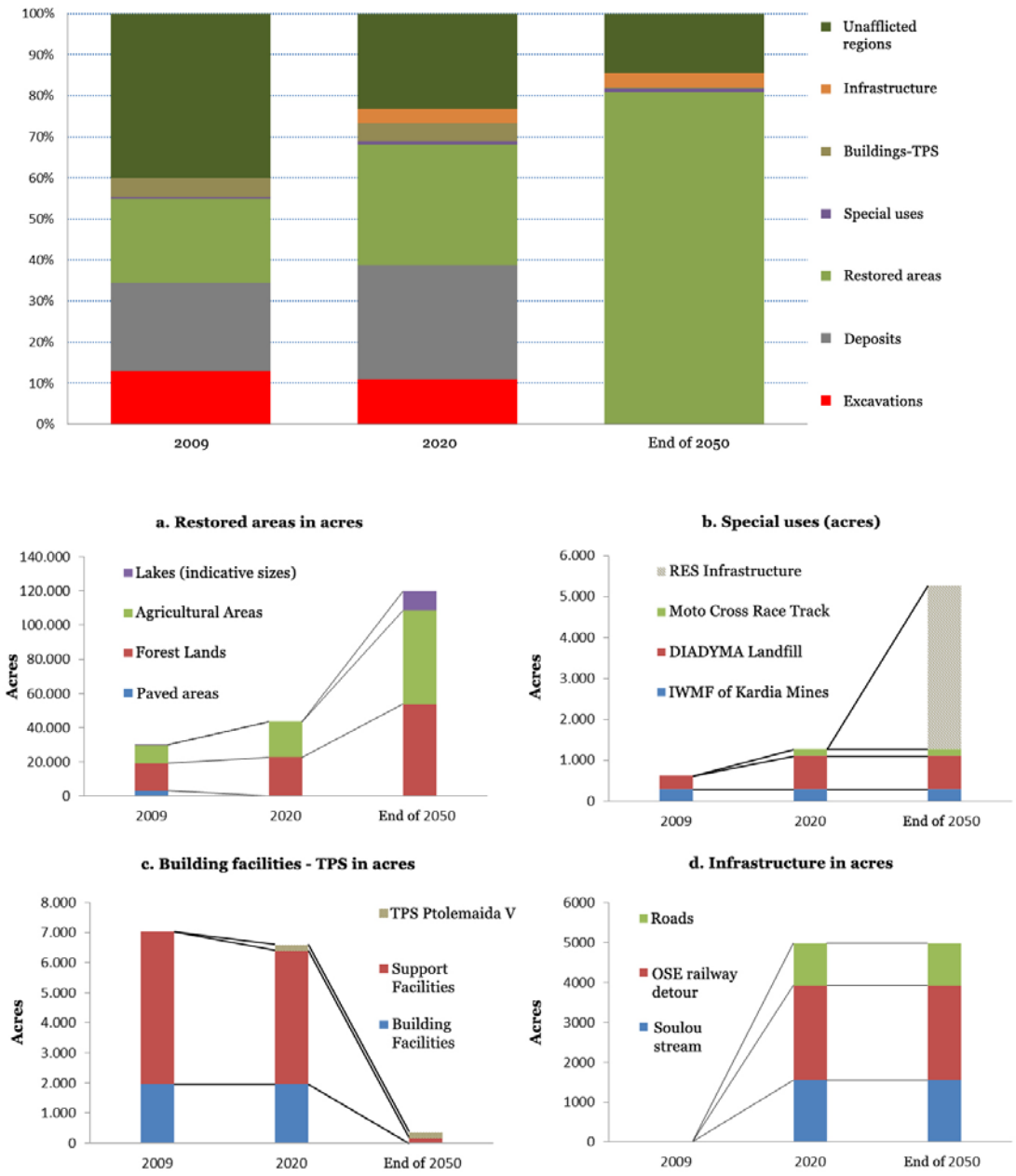

Figure 7.1: Land uses (top) and plan of restorations for mining areas

A more realistic designation of land uses in the restored areas is deemed necessary. For example, in the European Union, over 50% of the restored mining areas are now covered by forests or meadows[220]. In China, however, where there is a shortage of cultivatable land, over 70% of the restored mining areas are used for agricultural purposes[221]. Based on international experiences (see Ch. 4) the restored mines have, in most cases, been converted to forest or agricultural lands.

[220] Peter Wirth, Barbara Černič Mali, Wolfgang Fischer (Editors). 2012. "Post-Mining Regions in Central Europe Problems, Potentials, Possibilities". http://goo.gl/88bH9T

[221] X. Bian, H.I. Inyang, J.L. Daniels, F.J.L., Otto, F., Struthers, S. 2010. "Environmental Issues from Coal Mining and Their Solutions", Mining Science and Technology, 20 (2), 215–223.

One of the prerequisites for planning a post-lignite transition is the proper soil restoration. According to various studies[222], the random mixture of aggregates in deposit areas, which was PPC's common practice at least till the early 2000s, has led to the permanent damage of large areas of cultivable land, ruling out in this way a valuable natural resource from the restoration process. This practice is in direct opposition with international restoration practices (see Ch. 4), which are defined by long-term and systematic planning. It should be pointed out that the local community opposes the existing plan of restorations described in the associated EIA. As part of open deliberations, in line with international practices and the TCG-WM[223], the demands of citizen and local bodies need to be incorporated into a new, more comprehensive, long-term timetable that will include an accurate plan for final land uses, along with possible financing resources. This plan should be made publicly available and should include the obligation to release progress reports on the implementation of restorations.

Apart from the restoration works, detrimental to the post-lignite transition is to resolve the issue of handing over restored areas to the local community. For this purpose, it is necessary to abolish article 1 of l.1280/1982 according to which "*mining areas are returned to the State without any compensation*"[224]. PPC and the State should arrange the hand-over of land to the local community following comprehensive planning and transparent selection and re-use criteria.

To sum up, the following are deemed necessary:

- A comprehensive long-term plan and timetable for the restoration and hand-over by PPC of all the areas to the local community.
- The rational management of the restored areas based on long-term planning and following a restoration timetable.
- Publicity and transparency in handing over land.
- Determining the uses and the criteria for exploiting the areas handed over. Priority should be given to innovative, vertically integrated businesses, processing businesses, activities related to RES and new technology, industrial tourism facilities, recreation and sport facilities.
- Setting out strict rules and criteria for the land handed over for cultivation (implementing good agricultural practices, including the limited use of water-fertilisers, reinforcing and encouraging organic farming and livestock).

Finally, it is recommended to give priority in the hand-over of restored areas to cooperatives, organisations such as Social Cooperative Enterprise (SCE) and to the landless and unemployed, on the basis of income criteria and by securing funding through programmes such as the new Rural Development Programme (RDP)[218].

7.1.3. District Heating

In Greece there are district heating facilities operating today in the town and suburbs of

[222] Koziakis, N. 2003. "Environmental Soil Restoration in lignite fields. The case of Kozani RU (LCWM)". Thesis, Engineering Faculty of the Aristotle University of Thessaloniki.
[223] TCG-WM. 2014. "Outline of PPC's commitments - obligations towards the society of Western Macedonia, related to its activities in Greece's largest energy centre". http://goo.gl/EIGSh6
[224] l. 2941/2001, article 9.

Ptolemaida (Proastio area), the wider region of Kozani (city of Kozani, Nea Haravgi, AUPZ), in Filotas and in Amyntaio. The thermal energy used is provided by the TPS Kardia, TPS Ag. Dimitrios and TPS Amyntaio, respectively. More recently, a district heating system was also installed in Megalopolis, while the district heating of Florina will be funded by the Strategic Investment Plan 2014-2020. District heating offers multiple environmental (reduction of air pollution) and socio-economic benefits, such as job creation, energy and money saving, increasing the available income per household etc.[225]. The total installed capacity across the country reached 450 MW_{th} in 2012. The distribution network, comprising of 660 km of pipes, serves more than 125,000 citizens and 4,700,000 m^2 of indoor spaces. The annual turnover of PPC's district heating facilities is approximately €16 million[226].

It's obvious that closing down the aforementioned TPSs that are currently providing thermal energy to the towns of W. Macedonia will create the need to identify and develop alternative sources of energy. WWF Greece's respective techno-economic report[227] investigates and provides a comparative assessment of alternative scenarios centred around the use of RES, based on the current conditions in the country.

7.1.4. Retraining of workforce

While the upcoming changes in the energy system will benefit environmental protection and human health, they will also inevitably affect the workers employed in the TPS and the mines (see also 6.1).

A ***just transition*** needs to provide the tools and means to all those expected to lose their jobs that will ensure that the impacts on them and their families will be held to a minimum. There is no doubt that the transition process, however inevitable, will not be easy. The new jobs that will be created in the region do not necessarily correspond to the qualifications of the workers affected, while an additional challenge lies with ensuring satisfying salaries, benefits and a good working environment.

Therefore, the central government needs to take the necessary steps that will ensure not only the protection but also the retraining of the workforce. These steps could consist of the following:

1. Offering income support, for a given period of time, provided that the beneficiaries are enrolled in retraining programmes.
2. Providing consultation on retraining programmes, funding tools and programmes to support entrepreneurship.
3. Providing coupons of participation in retraining programmes.
4. Programmes to gain work experience.

Priority for the participation in the aforementioned programmes along with funding for the development of new activities should be given to the members of society that will be affected

[225] Kalimeris P. & Katsagounas I. 2007. "The contribution of District Heating to the improvement of the management of our energy resources. The case of the town of Kozani". Master Thesis, Electrical and Computer Engineering Department. National Technical University of Athens.
[226] TCG-WM. 2012. "TCG/WM Recommendations for exploiting dry lignite in small scale de-centralised energy systems" http://goo.gl/QUMfEJ
[227] WWF Greece. 2016. "District Heating Alternatives in W. Macedonia".

the most by the end of lignite activities and to the more vulnerable members of society in general. Participation in the aforementioned programmes should be flexible, i.e. it shouldn't exclude part-time workers, it shouldn't take away unemployment benefits etc.

Moreover, the skill diversification sectors should be designed to include both unskilled workers and those skilled enough to move to a completely new field of work. Following the example of the POWER[228] initiative in the USA, the training of the workforce can focus on the fields of handling mechanical equipment (work in the energy equipment industry, construction, building materials, natural gas infrastructure, waste management sectors etc.), traditional crafts (farming, fish farming etc.) and on up-and-coming sectors of high demand (broadband services, informatics, e-commerce, digitisation services etc.). Needless to say that the cost of implementing the associated programmes will be significant - for example the POWER initiative will provide approximately €12.5 million to support 2,400 workers formerly employed in the coal industry of the State of Kentucky[229].

7.2. National funds

The implementation of the scenarios of mild, medium or strong development for revitalising WMR's economy that were presented in the previous chapter require political will, a timetable and a detailed plan that will involve the central and local administration, as well as local communities. However, they also require significant funds for investments that will be carried out over a 15-year time frame. The main national funds that can be used to fund the transition to a post-lignite era are presented below.

7.2.1. Special Duty for Development (local fund)

In 1996, the Special Duty for Development (SDD)[230] or Duty for the Development of Industrial Regions was introduced, amounting to 0.4% of PPC's annual turnover and distributed to the Regional Units (RU) of Florina, Kozani and Arcadia, according to the energy produced by the lignite TPS of each region. In 2012, this rate was raised to 0.5% of PPC's annual turnover[231]. The duty is funnelled through a Special Development Programme (SDP), in the form of a 5-year single-funded programme. The most recent SDP (2012-2016) is expected to provide €110 million to the RU of Kozani and €28 million to the RU of Florina. However, there have been significant delays in the provision of the SDP resources by PPC in recent years (e.g. the procedures for providing the resources corresponding to 2012 began in November 2015), and as a result, the end of the programme has been shifted from 2016 to 2019-2020. The average annual turnover of PPC between 2010-2014 was €5.8 billion[232], and hence the corresponding local development resource ranged between €27.5 and 29 million /annum for all 3 energy RU (Kozani, Florina, Arcadia). For WMR in particular, the sum is estimated between €15 and25 million /annum.

[228] *POWER Dislocated Worker Grants - Resources for Coal Miners*, US Department of Labour, Division of Coal Mine Workers' Compensation (DCMWC). Available at: https://goo.gl/jg4a4K
[229] Press Release, US Department of Labor, 27/10/2015. Available at: https://www.dol.gov/opa/media/press/eta/ETA20152072.htm
[230] 2941/96, Article 20.
[231] l. 4062/12, Article 40.
[232] PPC S.A. Annual Reviews. https://goo.gl/oZnuRM

However, the most important issue arises from the way this resource is used, along with all the associated planning, management and publicity procedures[233]. An investigation into the distribution of these funds reveals that, in the end, the local resource is used to support projects irrelevant to the transition to a post-lignite era, along with a lack of long-term, comprehensive regional planning that could deal with the challenges brought about by this transition. It should also be noted that there have been specific complaints regarding the misspending of local resources[234].

It's obvious that the size of the local resources and, above all, the strategy for distributing the corresponding funds need to be revised. In this respect, the Ecological Group of Kozani[235] suggested tripling the regional development fund and distributing 30% of it to environmental - living standard projects (this share is approximately 10% today) and 70% to post-lignite era investments (i.e. approximately 40 million €/annum for WMR). A recommendation for increasing the Regional Development Fund from 0.5% to 1.2% of PPC's annual turnover was also made by ANKO[236].

7.2.2. Fossil fuel levy

There is a fossil fuel levy in force in many countries[237], in line with the "polluter pays" principle. The absence of such a levy in Greece in practice constitutes an indirect, "hidden" subsidy towards lignite power production. In 2006, the need for such a levy was recognised at a central government level, and the associated law was voted, setting out a levy of €0.3/GJ[238]. However, the levy - which was expected to provide approximately €110 million annually - was abolished a few months later under pressure from PPC[239].

Rather than a fossil fuel levy, a special levy for lignite was introduced in 2012**,** rated at 2€/MWh[240], which provided €45 million and €39 million in 2014 and 2015 respectively[241]. The sum was allocated to LAGIE's RES fund (RESF) from which RES producers are being paid, although part of it should have been provided to the regions mostly afflicted by the mining of lignite. Increasing the levy to 4€/MWh, a recommendation that has already been made in 2013 as part of public consultations[242], could generate additional resources for funding the transition of the RU of Kozani, Florina and Arcadia to a post-lignite era.

Determining the size of the special levy for lignite in the future, along with the share that will be funnelled to the transition to a post-lignite era, is directly linked to a comprehensive re-planning of the RESF aimed at eliminating the existing liabilities that favour electricity

[233] MD No. D5-HL/B/F.5.179 2284/05/02/2013
[234] Ethnos. 08/03/2010. "Society is denouncing the misspending of the regional development fund". http://goo.gl/rc4CiF
[235] Ecological Movement of Kozani. 2010. "The misspending of the regional development fund carries on". http://goo.gl/Fw2cSS
[236] Amanatidis, G. ANKO Chief Executive 2014. "Operational Development Plan for the Post-lignite Era in Western Macedonia", Workshop "Transition of Greece and Western Macedonia in particular to a post-lignite era: challenges and opportunities". Athens. 06/12/2014. http://goo.gl/do8Lsj
[237] MEECC. 2013. "Assessment of charging practices for the exploitation rights of water and lignite resources in power production". http://goo.gl/uNS4bO
[238] l. 3483/2006
[239] Kathimerini (OIKO). Elafros, G. "Lignite duty free" 20/02/2006. http://goo.gl/utJqxE
[240] M.D. D5/B/3982, OGG B' 342/16/02/2012
[241] LAGIE SA. 2016. "Special RES & CHP Account Monthly Bulletin, January 2016" http://goo.gl/chQKGj
[242] Energypress. 24/09/2013. http://goo.gl/Fm1fdQ

suppliers as well as at supporting RES development and the transition to a post-lignite era in WMR and Arcadia.

7.2.3. Auctioning of air pollutant emission allowances

According to Directive 2003/87/EC, which sets out the rules for the operation of the European Union Emissions Trading System (EU ETS) or simply the Carbon Market, every year CO_2 emission allowances are allocated to EU Member States to be auctioned. The revenues from these auctions constitute national resources. Greece decided to transfer the entire sum of the 2013-2015 period to LAGIE's RES fund[243]. In 2014 and 2015, the auction revenues in the country amounted to €131 million and €195 million, respectively, according to LAGIE's official database[244].

As a result of the recent changes the EU made to the EU ETS[245], the emission allowance cost is expected to skyrocket from 7.5€/ton (end of 2014) to 30€/ton between 2025-2030[246,247], according to many analysts, including the European Commission itself, which estimates that the weighted average of allowance cost will be approximately 25€/ton[248] during the 4th period of the EU ETS (2021-2030). For Greece in particular, the public revenues are estimated to exceed €6 billion between 2015-2025[249], therefore constituting a financial resource of approximately €600 million /year over a decade, up from €131 million and €195 million that were collected in 2014 and 2015, respectively.

The expected increase in public revenue from the auctioning of emission allowances can be used to cover the needs of the RESF and to support the transition to a post-lignite era. As a matter of fact, the European Commission's recommendation on the review of the EU ETS Directive that was submitted in July 2015, states that: "*Proceeds from the EU ETS should also be used to promote skill formation and reallocation of labour affected by the transition of jobs in a decarbonising economy, in close coordination with the social partners*".

In this context, and prior to the UN Climate Change Conference in Paris, WWF Greece suggested that part of the revenue from the auctioning of emission be allocated to job creation in the three lignite RUs of Greece, and specifically to economic activities not related to lignite exploitation[250,251]. Following that, the mayors of Greece's 5 "energy" municipalities made a specific amendment proposition related to this demand, which they submitted to the

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[243] l. 4062/2012, Article 39.
[244] http://goo.gl/vPPSE8
[245] European Parliament. 06/05/2015. "ETS market stability reserve: MEPs strike deal with Council". http://goo.gl/ovzX5n
[246] Thompson Reuters. 2015. "Reviewing Europe's carbon market: fight for free allocation, slightly higher prices - Carbon prices are estimated to reach €30/t in 2030, according to Point Carbon analysts". http://goo.gl/EUoZxw
[247] Carbon Market Watch. 2014. "What's needed to fix the EU's carbon market, Recommendations for the Market Stability Reserve and future ETS reform proposals». http://goo.gl/yuvr2q
[248] FleishmanHillard. 2015. "Reforming the EU Emissions Trading System. Outcomes & Analysis". http://goo.gl/W8cLsg page 6: "It is interesting to see however that in the Q&A, the Commission says that the innovation fund will have 400 million allowances worth a predicted value of €10bn when sold. This implies that the Commission foresees a shadow price of € 25/tCO_2 "
[249] Carbon Insight. 2015. "Future of EU carbon market still at stake as governments remain at odds: analysis from Point Carbon team at Thomson Reuters" http://goo.gl/zMXtbU
[250] Kozan.gr. 11/11/2015. "WWF Greece: Free Emission Allowances or a post-lignite era?" http://goo.gl/d5q8p8
[251] WWF Greece. Special Permanent Committee of the Greek Parliament on the Environment. 18/11/2015. http://goo.gl/HzcKB7

Ministry of Environment and Energy (MEE) and the MPs of the three lignite RUs[252] prior to the vote on the related draft bill which determined the allocation of the auction revenues for the 2016-2020 period. The proposition was officially supported by the Western Macedonia Region[253]. Unfortunately the Minister rejected the demand[254], depriving thus, for the time being, WMR of a very important funding resource for the transition to the post-lignite era, despite the fact that it was backed up by several MPs of various political parties, including the ruling one. The proposal should nevertheless be re-examined by the government, given the ongoing revision of the 2003/87/EC Directive.

7.2.4. Duty from large hydro power units

According to a proposal by the TCG-WM[255], additional funding resources for the post-lignite era could result from introducing an administrative duty for the operation of large hydro power stations (>15MW), based on the electricity produced in each of the units. It should be noted that small hydro power units - which have fewer environmental impacts compared to the larger ones - are already subject to a 3% special duty[256].

A related study presents the different approaches followed at an international level regarding imposing exploitation right charges on hydro power production[257]. In Switzerland there is a system of fixed exploitation right duties for water resources (€52 per kW of gross capacity). Other countries (France, Brazil, Colombia, Canada) impose charges based on the selling rates of the electricity produced, which range between 4% and 25%. In China, exploitation rights are priced on the basis of a unit charge, which varies between regions. Norway imposes three different types of charges, attributed to the respective Municipalities:

- unit charge in hydro power production (~1.6€/MWh)
- allowance charges based on the financial surplus, at a rate of 30%
- fixed charge on the net river momentum that will be exploited in electricity production (at an average rate of 0.8€/MWh).

According to the TCG-WM, taking into account that in 2010 the administrative duty for lignite in Western Macedonia added up to €19.5 million, i.e. 0.8 € per MWh produced in the region, the exploitation of its water potential would return a sum in the range of €725,000, assuming the same administrative charge rate[223].

Perhaps a fixed charge per unit of installed capacity, as is the case in Switzerland, or a unit charge system similar to that of Norway, could constitute an additional funding tool for the post-lignite era. There are approximately 530MW of installed hydro power in WMR,

[252] Energypress.gr. 21/12/2015. "Statement of the mayors of the energy municipalities regarding the funds deriving from the auctioning of CO_2 emissions". http://goo.gl/x8uNse
[253] energeiakozani.blogspot.gr. 28/01/2016. "The proposition made by the energy municipalities regarding the regulation on the revenues from the auctioning of unallocated greenhouse gas emissions is backed up by the Western Macedonia Governor". http://goo.gl/TYYM67
[254] Greenagenda.gr. 08/03/2016. "The MEE rejects the demand of the energy municipalities regarding CO_2 auctioning revenues".». http://goo.gl/eCwVSU
[255] TCG-WM. 2011. "TCG/WM Recommendations for a RES duty for lignite and large hydro power stations". http://goo.gl/Ou9j08
[256] L. 3468/2006. The duty is calculated based on the selling price of electricity to the Power Operator (excl. tax).
[257] MEECC. 2013. "Assessment of charging practices for the exploitation rights of water and lignite resources in power production". http://goo.gl/3TykvZ

including the Ilarionas station, which correspond to approximately 16% of the total installed capacity in the country[258] and produce, bearing annual variations, approximately 600GWh[259] per annum. Implementing an exploitation right duty for water resources, as is the case in certain cantons of Switzerland, would generate approximately €27 million, while a usage charge based on the energy produced, as is the case in Norway, would generate approximately €1 million per annum. One should also bear in mind that the energy market and the power production mix differ between each country. Therefore these rates should serve only as a general guide.

In any case, priority in the distribution of a likely operation duty of large hydro power stations should be given to those residing in areas adjacent to dams and hydro power units, since, despite losing large areas of irrigable land, they have received less compensation compared to the inhabitants of lignite regions.

7.2.5. Energy Saving Fund

The 2012/27/EU Energy Efficiency Directive makes provisions for the establishment of a national energy efficiency fund in order to support initiatives in the energy saving sector. The incorporation of the Directive into national legislation (l.4342/2015, OGG A 143/09/11/2015), dictates that this special fund will support actions of a social nature, such as giving priority to the implementation of energy saving measures in households hit by energy poverty. As was already mentioned in section 6.4.2, the share of WMR's households whose energy expenses exceed 10% of their annual income is 66.9%, compared with the rest of the country where the rate is 1.7 times lower. The magnitude of the issue of energy poverty in WMR, intensified by the region's climate conditions, is also evident in TCG-WM's assessment, according to which even the households whose income exceeds €50,000 fall in the "energy poverty" category.

The measures to protect vulnerable energy consumers are also clearly cited in European Directives (2009/73/EC and 2009/72/EC), under the condition that their implementation doesn't oppose the smooth operation of the energy markets. In fact, many European countries are already implementing strong energy efficiency policies for vulnerable households, with varying degrees of success (see *Habiter Mieux* in France, *Energiesprong* in the Netherlands, *Energiesnoeiers* in Belgium, *Stromspar-Check* in Germany, *Warm Zone* in the United Kingdom etc.)[260,261].

The size of the funding resources that will end up in the Fund - particularly through the contributions of electricity suppliers and operators of distribution networks - and their future use will be delineated in a decree that will be issued following the recommendations of the Ministry of Environment and the Ministry of Finance.

[258] LAGIE. 2016. "DAS Settlement System Monthly Bulletin. April 2016." http://goo.gl/NyKgOL
[259] "I. Argirakis. Managing Director of Hydro Power Production. "Using Hydro Power Stations as Multi-purpose Projects". http://goo.gl/lFAm2r
[260] INSIGHT_E. 2015 "Energy poverty and vulnerable consumers in the energy sector across the EU: analysis of policies and measures"
[261] Buildings Performance Institute Europe. 2014. "ALLEVIATING FUEL POVERTY IN THE EU"

7.2.6. Other national and European funding

During the 2014-2020 programming period there will be €2.31 billion allocated to the regions in transition, whose per capita GDP falls between 75% and 90% of the EU-27 average (Western Macedonia, Mainland Greece, Ionian Islands, the Peloponnese, Crete, Northern Aegean Islands)[262]. Table 7.1 presents the available funding, in an attempt to estimate the likely cash flows per programme to WMR (~€495 million for the 2014-2020 period).

Table 7.1: Other National Resources - Potential Cash Flows to WMR

Programme	Axes related to the post-lignite transition	Budget	Comments
Regional Operational Programme (ROP) of Western Macedonia (WM)[263]	Supporting the transition to a low emission economy and promoting the adaptation to climate change.	€264.5	The WM ROP is limited due to the high GDP resulting from lignite activities. However, since this GDP is not returned to WMR but is rather dispersed across the country, it leads to a loss of funding resources.
Sectoral Operational Programmes (OP)[264]			
OP Competitiveness, Entrepreneurship and Innovation (OP-CEI)[265]	• Labour and business adjustment to the new demands of development • Entrepreneurship development with sectoral priorities • Development of entrepreneurship support mechanisms	≈66 million €	
OP Human Resources Development, Education and Lifelong Learning[266]	• Tackling unemployment • Providing quality options for education • Skills upgrading and sustainable employment, enhancing social cohesion	≈9.8 million €	This OP constitutes an important funding resource for restructuring economic activity and retraining the workforce, based on the needs for structural changes that are expected to be brought about by the post-lignite era
OP Public Sector Reform (OP-PSR)[267]	Strengthening organisational, institutional and operational capacity of public administration and local authorities for the benefit of citizens and businesses.	≈7.3 million €	This could include part of the costs related to managing-monitoring the operation plan for the transition to the post-lignite era.
OP - Rural Development Programme (RDP) 2014-2020[268]	Priority 5: "increasing the efficiency of the resources and supporting the transition to a low carbon emission economy that will be resilient to climate change, with regards to the agriculture,	≈147 million €	Taking into account the need to increase significantly the contribution of the primary sector to the total product produced in WMR, the OP-RDP can comprise a highly valuable

[262] European Commission. "Coherence Policy and Greece". http://goo.gl/bLcuuE
[263] Regional Operational Programme (ROP) of Western Macedonia (WM). https://goo.gl/HGRXYN
[264] The OP Fishery and Sea and the OP Technical Assistance are omitted from the analysis
[265] OP Competitiveness, Entrepreneurship and Innovation (OP-CEI) http://goo.gl/zt6UYU
[266] OP Human Resources Development, Education and Lifelong Learning http://goo.gl/U5qvvp
[267] OP Public Sector Reform (OP-PSR) http://goo.gl/I4gIOu
[268] OP - Rural Development Programme (RDP) 2014-2020 http://goo.gl/pt1uAT

	food production and forestry sectors"		funding tool for the restructuring of WMR's local economy.
Total		**≈495 million €**	

It should be noted that for the European Programmes that do not clarify the distribution of resources per region, the estimate was made assuming that the six regions that will be placed under a transitional support regime[269] are Western Macedonia, the Ionian Islands, Central Greece, the Peloponnese, Northern Aegean and Crete (Table 7.2). In order to estimate the funding per capita, we divided the overall budget of each OP by the total population of the six regions under transition. In this way, we estimated a per capita distribution of the resources in WMR.

Since the distribution of funds per region is not stated in the OP Rural Development, we used the annual total 2015-2020 cash flow, using as a basis the distribution of hectares per region, in order to calculate the funding sum/hectare indicator. The irrigated rural areas across the country amount to 117,488 hectares, which constitutes 34.3% of the total cultivable rural land in Greece (342,580 hectares). There are 3,669 hectares[270] of irrigated rural land in Western Macedonia, i.e. 3.13% of the total irrigated land in the country. Hence, the RDP contribution in WMR is estimated based on this ratio.

Table 7.2: Population of Regions under transition (2011 census-Source: ELSTAT)

WESTERN MACEDONIA REGION	283,689
IONIAN ISLANDS REGION	207,855
PELOPONNESE REGION	577,903
NORTHERN AEGEAN REGION	199,231
CRETE REGION	623,065
CENTRAL GREECE REGION	547,390
Total	2,439,133

7.3. International lending resources

Apart from using national and European funds, the economic activities for the transition to a post-lignite era that were presented in the previous chapter can also be funded by borrowing money from international financial institutions.

7.3.1. The European Bank for Reconstruction and Development (EBRD)[271]

The EBRD supports projects mainly in regions of Central and Eastern Europe and Central Asia, while in the past its role was to provide support to countries of the former Eastern Bloc.

[269] Hellenic Confederation of Commerce and Entrepreneurship recommendations as part of planning the 2014-2020 Partnership Convention http://goo.gl/4KnMim
[270] Ministry of Rural Development and Food. Special Secretariat for European Funds and Infrastructure. "Rural Development Programme for Greece 2007-2013". http://goo.gl/YfPBqB
[271] The EBRD in Greece. http://goo.gl/JcZeMZ

As part of the efforts to deal with the ongoing economic crisis, in 2014 Greece applied to receive funding and technical support until 2020. The EBRD is currently participating in 6 programmes of a total budget of €320 million. Despite its involvement in projects threatening the environment and human rights[272], the bank has agreed to participate in programmes such as the upgrade and improvement of the efficiency of district heating systems, photovoltaic parks, wind parks, upgrading public transport, installing energy meters in households, improving electricity distribution networks etc.[273].

7.3.2. European Investment Bank (EIB)[274]

The European Investment Bank (EIB) is the European Unions' bank and operates by collaborating closely with other EU institutions, with the ultimate aim of implementing EU policies. As part of the post-lignite transition, the potential of submitting financing proposals to the EIB for development projects that can help achieve the wider aim of a low carbon economy should be examined. Some examples of sectors that are directly or indirectly related to a post-lignite transition, funded by the EIB, include agricultural development, energy, regional development, education, research and technology[275]. It should also be noted that the EIB recently refused to provide funds for PPC's new lignite unit Ptolemaida V due to its high CO_2 emissions[276], while its board members have publicly expressed their support to projects related to RES, energy saving, network upgrade etc.[277].

7.3.4. European Globalisation Adjustment Fund (EGF)[278]

Based on article 2 (field of implementation)[279] the EGF funds activities related to: "... *workers made redundant and self-employed persons whose activity has ceased as a result of major structural changes, a rapid decline of the Union market share in a given sector, provided that these redundancies have a significant adverse impact on the local, regional or national economy".* It is obvious that workers in the lignite mining and combustion sector in WMR fall in this category and hence the potential of securing such funding should be considered.

7.3.5. The World Bank[280]

The World Bank is involved in funding transition projects related to closing down and restoring mining activities for over 20 years. It has actively supported over 20 countries that were (or are) in the process of ending mining activities, restoring lands and restructuring their productive sector. More specifically, the World Bank played a key role in the

[272] CEE Bankwatch. Who we monitor – European Bank for Reconstruction and Development (EBRD). http://goo.gl/V11zBq
[273] EBRD – Project Summary Documents http://goo.gl/xqdkJj
[274] European Investment Bank (EIB). http://www.eib.org/
[275] EIB funding sectors http://goo.gl/nXYzUl
[276] WWF Greece. 09/01/2014. "The European Investment Bank turns down Ptolemaida V" http://goo.gl/DwvkHT
[277] Capital.gr. 13/11/2013. "Energy and waste management funding discussed in a meeting between G. Maniatis - EIB". http://goo.gl/PTT0jg
[278] European Globalisation Adjustment Fund. http://goo.gl/oMa35C
[279] Regulation (EU) No 1309/2013 of The European Parliament and of The Council of 17 December 2013 on the European Globalisation Adjustment Fund (2014-2020) and Repealing Regulation (EC) No 1927/2006. http://goo.gl/QlmqP3
[280] http://goo.gl/t1MzVK

restructuring of the coal mining sector in state companies in Central and Eastern Europe, as well as in the former Soviet Union. The help provided to national governments included the provision of large loans and credits aimed at mitigating the impacts of mining activities on the job sector (in some cases with the participation of hundreds of thousands of workers) and on the environment. The World Bank also provides legal and regulatory consultation to governments. Through the International Finance Corporation (IFC), the World Bank Group also makes direct investments in private mining companies, helping improve their sustainability and to ensure the timely planning of the actions necessary for restoring and closing down a mine. In addition, the World Bank offers consultation regarding the best international practices and experiences regarding mine closures.

Despite the fact that Greece, as a developed country, does not fit the criteria for receiving loans from the World Bank[281], following the Bank's decision to make a special exemption, an IFC inspection team recently visited the country in order to investigate investment opportunities in infrastructure, energy etc.[282]. In any case, Greece can receive consulting services - which the World Bank has already been providing to Greece in various sectors[283].

7.3.6. Other possible European funds - Programmes

This category (Table 7.2) includes possible European funding resources which can be used to secure funds either in the form of loan agreements or by submitting co-funding proposals.

[281] Kathimerini, 11/12/2012. "World Bank providing Greece with expertise, not loans, says Kim". http://goo.gl/Zrx1TK

[282] K. Sokou, "The World Bank is looking for investment opportunities in Greece", newspaper Kathimerini, Article, 25/10/2015. http://goo.gl/nN7Knp

[283] K. Sokou, "EU Commission and IFC on the same page", Newspaper Kathimerini, Article, 03/01/2016. http://goo.gl/fXZBkG

Table 7.2: Other European resources

Programme	Axes related to the post-lignite transition	Total Budget	Comments-Recommendations
Horizon 2020	Promoting excellence and supporting research structures in WMR.	€80 billion (no specific budget per country)	Requesting funding through the submission of proposals-collaborations with other bodies Particular interest lies in projects such as Competitive Low Carbon Energy[284] and Smart Cities & Communities[285]
COSME 2014-2020.[286]	• Supporting services towards small and medium-sized enterprises (SMEs) • Support for increasing the number of startups and supporting SMEs in increasing the skills of the workforce in specific sectors based on their needs, potential and on market needs. • Facilitating SMEs access to funding	€2.3 billion (no specific budget per country)	COSME is the EU programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises (SMEs). Tourist enterprises are also eligible.
CLLD (Leader) 2014-2020[287]	Focusing on agricultural regions and communities, CLLD/LEADER provides flexibility and potential to plan and implement local development strategies of an integrated and multi-sectoral nature, by implementing interventions of a public or private nature (see also OP-RDP)[288]	400 million €	LEADER has proven to be a strong development funding tool in times of crisis. It aims to create 2,000 jobs in Greece throughout the 2014-2020 programming period[289]
Interreg Balkan-Mediterranean 2014-2020[290]	Transnational collaborations in the entrepreneurship, innovation and environment sectors between: Greece, FYROM, Bulgaria, Albania, Italy and Cyprus	60 million €	

[284] H2020 programme. Competitive Low Carbon Energy. https://goo.gl/u1aE3u
[285] Smart Cities and Communities. https://eu-smartcities.eu/
[286] COSME 2014-2020. http://goo.gl/DgPC1v
[287] CLLD (Leader) 2014-2020 https://goo.gl/tOq60z
[288] ANKO 2016. "Leader: an innovative approach to local development" http://goo.gl/sC9XNR
[289] European Commission. "Factsheet on 2014-2020 Rural Development Programme for Greece". http://goo.gl/yoHxAy
[290] Interreg Balkan-Mediterranean 2014-2020 http://goo.gl/TC6SC8

Juncker package (The Investment Plan for Europe)	Interesting sectors that are eligible[291]: • Energy saving in residencies, public buildings and SMEs • Energy Saving • Smart distribution networks • Clean energy • De-carbonisation of the transport sector	€315 billion (no specific budget per country).	This package is expected to fund mainly large-scale projects (>10 million €), PPP projects and SMEs. Particular interest lies in the energy sector, the recent submission of an investment proposal in the RES sector budgeted at €1 billion (pumped hydro energy storage, wind parks and hybrid systems projects)[292].
LIFE+ programmes[293]	• Actions and projects related to the transition to a low carbon economy • Actions to preserve and promote the natural capital of the region (avifauna, biodiversity, ecotourism).	€3.4 billion (no specific budget per country)	The restoration of the asbestos mines (former Asbestos Mines of Northern Greece) was co-funded by the LIFE programme[294]. Submitting specific proposals can contribute to the promotion and preservation of WMR's biodiversity and ecosystems.
The JESSICA programme[295]	The sectors of interest for the post-lignite transition are[296]: • Cultural heritage sites for tourism or other sustainable uses • Regeneration of industrial areas - including decontamination • Office space for SMEs, IT and/ or R&D sectors • University buildings, including medical, biotech and other specialised facilities • Energy efficiency improvements	Loaning	The sectors funded by JESSICA directly coincide with the priorities and needs created by WMR's post-lignite transition; it is therefore deemed necessary to make specific proposals that will designate and cover those needs.
The JEREMIE programme	It encourages the use of financial aid for improving the access of SMEs to EU funds. These funds can support: • Establishing new SMEs or expanding existing ones • Funding for research and	Loaning	The JEREMIE programme can form an important funding development tool for

[291] European Investment Project Portal. http://goo.gl/BTUIOQ
[292] Kathimerini. Chrysa Liaggou 20/04/2016. "Private entities awaiting the Juncker package" http://goo.gl/MqYc4e
[293] LIFE Programme. http://goo.gl/9hAfV0
[294] LIFE-Asbestmine project. 2007. "Using the AMNG mines as a asbestos waste deposit" http://goo.gl/N88HeT
[295] JESSICA. (Joint European Support for Sustainable Investment in City Areas) http://goo.gl/dsaupu
[296] JESSICA. Project eligibility. https://goo.gl/NXcHQe

	development • Technological upgrade for achieving low carbon economy targets • Productive investments that create and maintain sustainable jobs.		entrepreneurship, since the sectors it funds directly coincide with the priorities for modifying the entrepreneurial base, creating new products and achieving the targets set out by the EU for the transition to a low carbon and smart specialisation economy (RIS3).
The RECHAR programme[297]	The programme funds projects to support employment in regions with coal/lignite reserves that are under transition in Germany, France, Spain and Portugal.	-	RECHAR is closely linked to the needs of a post-lignite transition, as it aims, between others, at restructuring economic activities, protecting the environment and supporting occupational training schemes in areas dominated by coal mining.

[297] European Commission. RECHAR. http://goo.gl/Km6o3r

8. Conclusions

This report is an attempt to outline and assess the cost of a transition plan to a post-lignite era in the Western Macedonia Region (WMR) based on alternative economic activities, many of which have already been proposed by stakeholders in Western Macedonia.

At a first stage, it examined whether the perpetuation of the lignite model of electricity production through the construction of new lignite plants is capable of mitigating the negative impacts that will be brought upon W. Macedonia by the scheduled withdrawal of existing lignite units by 2030. The results of the economic assessment were negative: Ptolemaida V and Meliti II can reinstate only 30% of the jobs and the local income that will be lost as a result of closing down specific lignite units over the next 15 years, despite the fact that their construction will require investments of the order of €2.5 billion. It is therefore necessary to investigate the potential that alternative sectors of the economy have in tackling this issue.

For this purpose, three scenarios were formulated, of a “mild”, “medium” and “strong” development rate, which assume the development of economic activities in WMR that are not related to lignite extraction and combustion and whose implementation extends over a 15-year period. Specifically, emphasis in the primary sector was placed on the cultivation of Kozani saffron and aromatic and energy plants, along with the further sustainable development of the forestry sector. In the secondary sector, the fundamental pillar was the development of Renewable Energy Sources in the Western Macedonia Region (with regards to installation, operation as well as manufacturing of green energy equipment), promoting energy savings - that will also create job opportunities in the construction sector, waste management, fly ash processing, and processing of aromatic plants. Finally, the tertiary sector relies on the development of tourism, with an emphasis on industrial tourism and ecotourism, as well as on research in academic institutions and research centres in Western Macedonia.

In order to estimate the direct and indirect effects that the implementation of these scenarios will have on the economy of Western Macedonia as a whole, input-output analysis was used at a regional level, regarding both job creation and local added value (LAV). For comparison purposes there were two different groups of multipliers used: those derived from the 2011 Hellenic Statistical Authority (ELSTAT) data, and those based on a study by the Academy of Athens, which, however, uses older data (from 2005 and 2001) and different economic sectors compared to ELSTAT.

Even in the mild development scenario, which was based on particularly conservative assumptions, there are more jobs created and a higher LAV compared to the losses resulting from shutting down the lignite plants, based on ELSTAT's multipliers. This pattern is different when the older multipliers of the Athens Academy are used, according to which the mild development scenario will create approximately half the jobs that are expected to be lost according to the inaction scenario. Nevertheless, even when using the Athens Academy/TCG-WM multipliers, the LAV of the mild development scenario is comparable with that expected to be lost by shutting down the lignite plants by 2030.

Significant improvement is achieved in the medium development scenario, as based on ELSTAT's multipliers, there will be 2,197 more jobs created compared to those that will be lost by shutting down the lignite stations by 2030, while LAV is estimated at €1.834 billion, approximately €0.7 billion higher than that of the inaction scenario. However, as in the case of the mild development scenario, when the Athens Academy/TCG-WM multipliers are used there are fewer jobs created compared with the inaction scenario. Based on the same multipliers, the LAV of the medium development scenario is much closer to that expected to be lost as a result of the shutting down of the lignite plants by 2030.

The strong development scenario presents the greater benefits to the economy of WMR. Using ELSTAT's multipliers, it was found that more than twice the jobs can be created and more than twice the LAV can be generated compared to the inaction scenario. A similar outcome is noted even when the Academy of Athens/TCG-WM multipliers are used, as it is estimated that in practice there will be the same number of jobs created compared to those expected to be lost by the scheduled closure of the lignite plants. Finally, using the same multipliers, the strong development scenario leads to a LAV greater by €0.62 billion compared to the inaction scenario.

It's interesting to note that in the strong development scenario, the required investments are of a similar order to the combined construction costs of PPC's two new lignite units (Ptolemaida V and Meliti II).

In all three scenarios, the RES sector contributes significantly to the total direct employment opportunities (49%, 38.7% and 36.9% in the mild, medium and strong development scenarios, respectively) and the most to the direct Local Added Value (67.3%, 61.1% and 60.9% in the mild, medium and strong development scenarios, respectively), as, apart from the secondary sector, it also has a positive effect on the primary sector, brought on by the cultivation of energy plants required for the planned operation of PPC Renewable's biomass unit. Hence, by making a decisive turn to RES, the current “energy nature” of WMR can be retained even once the existing lignite plants have been shut down and without the need to construct new ones.

The actual implementation of the proposed scenarios of mild, medium or strong development for revitalising WMR's economy require political will, a timetable and more elaborated scenarios, with the involvement of the central and local administration, and local communities. It also requires significant capital. The report concludes with the designation of possible national or European funding resources, in order to achieve the transition to a post-lignite era within a 15-year time frame.

Appendix I: Methodology for the Estimation of Local Multipliers

Input - Output Models

Input - Output modeling is probably one of the most used analytical frameworks in applied regional research, especially when potential changes in a regional economy is the question at hand. The main reason that Input – Output models are preferred over alternative approaches, such as time - series econometric models (which effectively use data from several moments in time, usually data with a "long" time dimension), is simply that in most cases time - series datasets are simply not available. Input - Output models are characterized by internal "consistency"; if the datasets used in the models are frequently updated, these models can give a blueprint of the regional economy as well as potential changes of it.

Input - Output models in practice

Input - Output models have been extensively used for sub-national economic analysis. There are many examples of regional Input - Output models in the relevant bibliography; that is, when the economy under examination is a regional one. There are however other research examples in which the spatial unit of the Input - Output models varies; there are in fact cases in which the spatial unit is rather "small". For instance Cole[298,299] used Input - Output methodology in intra-urban and urban level. Hewings et al.[300] used a four-region metropolitan area model; Robison and Miller[301,302] and Robison[303] constructed community models. Jackson et al.[304], Schwarm et al.[305] and Richardson et al.[306] on the other hand used U.S.A. states as their spatial units; similarly, Eurostat[307] and Hoen[308] used E.U. regions. Other research makes use of even "bigger" spatial units; for instance, in the analysis of the Institute of Developing Economies- Japan External Trade Organization[309] there was an Input - Output model in which ten Asian countries comprised the spatial units (the Asian "multinational" or

[298] Cole, S. (1987) "Growth, Equity and Dependence in a De-Industrializing City Region", *International Journal of Urban and Regional Research*, 11, pp. 461–477

[299] Cole, S. (1999) "In the Spirit of Miyazawa: Multipliers and the Metropolis," in Geoffrey J. D. Hewings, Michael Sonis, Moss Madden and Yoshio Kimura (eds.), *Understanding and Interpreting Economic Structure*, Springer, Berlin, pp. 263–286.

[300] Hewings, G.J.D., Okuyama, Y., Sonis, M. (2001) "Economic Interdependence within the Chicago Metropolitan Area: A Miyazawa Analysis," *Journal of Regional Science*, 41, pp. 195–217

[301] Robison, M.H., Miller, J.R. (1988) "Cross-Hauling and Nonsurvey Input-Output Models: Some Lessons from Small-Area Timber Economies," *Environment and Planning A*, 20, pp. 1523-1530

[302] Robison, M.H., Miller, J.R. (1991) "Central Place Theory and Intercommunity Input-Output Analysis," *Papers in Regional Science*, 70, pp. 399-417

[303] Robison, M.H. (1997) "Community Input-Output Models for Rural Area Analysis with an Example from Central Idaho," *Annals of Regional Science*, 31, pp. 325-351

[304] Jackson, R.W., Schwarm, W.R., Okuyama, Y., Islam, S. (2006) "A Method for Constructing Commodity by Industry Flow Matrices," *Annals of Regional Science*, 40, pp. 909-920

[305] Schwarm, W.R., Walter R., Randall W. Jackson, R.W., Okuyama, Y. (2006) "An Evaluation of Method for Constructing Commodity by Industry Flow Matrices," *Journal of Regional Analysis and Policy*, 36, pp. 84-93.

[306] Richardson, H.W., Gordon, P., and Moore, J.E. (eds.) (2007) *The Economic Costs and Consequences of Terrorism*, Edward Elgar, Cheltenham

[307] Eurostat (2002) "The ESA 95 Input-Output Manual. Compilation and Analysis," August, 2002.

[308] Hoen, A.R. (2002) *An Input-Output Analysis of European Integration*, Elsevier, Amsterdam

[309] Institute of Developing Economies–Japan External Trade Organization (IDE-JETRO) (2006) *Asian International Input-Output Table 2000*. Vol. 1 "Explanatory Notes" (IDE Statistical Data Series No. 89). Chiba (Tokyo): IDE-JETRO.

"multilateral" tables). Finally, there is the class of models of the "Leontief world Leontief»[310,311,312,313].

Regional Input – Output models can have different "internal" organization. In most cases one region takes the place of the sole spatial unit (instead of a whole country); this particular region is supposed to be "isolated" from the economic structure of the "rest" of the country. There are, however, examples of regional Input - Output models in which many regions are examined simultaneously. These latter models can be divided in "interregional" and "multiregional" models.

Input - Output models can be used to estimate changes in a regional economy following an exogenous "disruption" (for instance, if there is an economic crisis affecting the region); in order to calculate the effects of the exogenous change on the local economy, it is necessary to estimate the regional multipliers, which in turn will be used to calculate the regional effects. In this study, several steps were taken to calculate regional multipliers (as there are no regional multipliers available by the Hellenic Statistical Authority):

Step 1: From the National Input - Output Table to the National Technical Coefficients

Probably the biggest problem for the Input - Output analysis of the Greek regions is the paucity of data; the Hellenic Statistical Authority does not construct regional Input - Output tables. It does, however, construct a National Input - Output table; the latest National table available was from 2010 (it is not publicly available) and the National Statistical Authority of Greece kindly provided us with permission to use it.

A National Input - Output table comprises several rows and columns. A sub-total of this table gives the relationships between the producing sectors of the economy; these relationships essentially are "the production recipes for each of the sectors, in terms of inputs from all the sectors" (Miller & Blair 2009, p. 21). The data in the National Input - Output table of the National Statistical Authority is in millions of euros; this table was used as the basis for the calculation of the National Technical Coefficients.

The National Input - Output table, as already mentioned, is comprised of many rows and columns, each representing different sectors of the economy (65 sectors in total). These sectors were aggregated into eleven "bigger" sectors, due to the fact that they should be compatible with the data used in a next step to calculate regional figures; these latter data is available only in eleven sector breakdown (see below for a more extensive analysis).

The National Technical Coefficients values can be calculated if the value of a particular producing sector is divided by the total output of that sector. In compact form this relationship is:

$$x_{ij} = a_{ij} X_j$$

[310] Leontief, W. (1974) "Structure of the World Economy: Outline of a Simple Input-Output Formulation," *American Economic Review*, 64, pp. 823-834.

[311] Leontief, W., Carter, A.P., Petri, A.P. (1977) *The Future of the World Economy*, Oxford University Press, New York.

[312] Fontana, E. (2004) "Leontief and the Future of the World Economy," in *Wassily Leontief and input-output economics*, Dietzenbacher, E. & Lahr, M. L. (eds.), Cambridge University Press, Cambridge, pp. 30–46.

[313] Duchin, F., Lange, G.M. (1994) *The Future of the Environment*, Oxford University Press, New York

where x_{ij} is the flow of output from sector i to sector j, a_{ij} is the technical coefficient relating inputs to output, and X_j is the gross output of sector j. The previous expression can be written equivalently as:

$$a_{ij} = \frac{x_{ij}}{X_j}$$

In order for this relationship to hold it has been assumed (implicitly in most studies) that the flow of output from sector i to sector j is "in fixed proportions". A second assumption is that there are no constraints on the economy's productive capacity (either at national or regional level). An example of a two productive sector economy and its corresponding Input - Output table is offered in the Miller & Blair[314]:

	Processing Sector 1	Processing Sector 2	Final Demand (f_i)	Total Output (X_i)
Processing Sector 1	**150**	**500**	350	1000
Processing Sector 2	**200**	**100**	1700	2000
Payment Sector	650	1400	1100	3150
Total Outlays (X_i)	**1000**	**2000**	3150	6150

The Technical Coefficients table is derived if the relationships between the two producing sectors (Processing Sector 1 & 2) are divided with the total output (Total Outlays row in the above table). Thus, the Technical Coefficients table A would be:

	Processing Sector 1	Processing Sector 2
Processing Sector 1	0,15	0,25
Processing Sector 2	0,2	0,05

How to get the National Multipliers from the National Technical Coefficients

The National Technical Coefficients table can be used in order to calculate exogenous changes in the economy (a more extensive presentation of this methodology can be found in Miller & Blair 2009). The aforementioned example of Miller & Blair shows how a change in the final demand vector will alter the figures in the rest of the economy. The total impact of the final demand change in the economy will be the sum of "direct" and "indirect" effects; the direct effects are the changes in the productive sectors of the economy (i.e. in an demand increase the productive sectors must increase their respective output), and the indirect effects are secondary changes as one sector has to increase its production in order to facilitate the increased production of other sectors. If the final demand vector is denoted with f_n, the total increase can be calculated as the product of f_n vector times the matrix L (where $L = (I - A)^{-1}$ and I is an identity matrix with the same dimensions as matrix A) as following:

[314] Miller, R.E., Blair, P.D. (2009) «Input- Output Analysis: Foundations and Extensions». Cambridge University Press, Cambridge.

$$L \times f_n$$

The end product will be the new total output of the sectors of the example's economy.

Step 2: Estimation of the Location Quotients (LQs)

The National Technical Coefficients and Multipliers could be used in the case of a regional economy under the (very) strong assumption that Greek regions have a similar economy structure (between them and) with the national economy. This assumption does not hold in the Greek case, and as has been analyzed in another section in this report, the regional economy of West Macedonia has a specific structure which differs substantially from the national one. It is for this reason that it is necessary to estimate both National Technical Coefficients and Multipliers for the region of West Macedonia.

This estimation has as a prerequisite the calculation of Location Quotients (LQs); this is necessary because Location Quotients are used in the "transformation" of National Technical Coefficients and Multipliers to their respective Regional Technical Coefficients and Multipliers. This is one of the most common methods in empirical research.

What is a Location Quotient;

Location Quotient (LQ) is a measure of the relative contribution of one specific area, (in our case a region), to the whole (in our case the country), for a given outcome (an extensive presentation can be found in Papadaskalopoulos[315] or Mayer & Pleeter[316]). The Location Quotient (LQ) for employment is defined as:

$$LQ = \frac{\frac{A_{ir}}{A_r}}{\frac{A_{in}}{A_n}}$$

where:
A_{ir} = employment in sector *i* in region *r*,
A_r = total employment in region *r*,
A_{in} = employment in sector *i* nationwide,
A_n = total employment nationwide.

Location Quotients can be calculated, not only in terms of employment, but also for production variables, etc[317]. Needless to say, that in the case of production, A_{ir} will refer to the production of sector *i* in region *r*, etc.

The Location Quotients in this report were calculated with the use of data from the National Statistical Authority regarding Employment and Value Added for the year 2011. These Location Quotients were calculated as following: firstly, Employment data from 2011 census was aggregated into eleven sectors, as a result of the fact that Value Added data is available at regional level only in these eleven sectors; it is only in this way that comparison in terms of Employment and Value Added will be meaningful.

[315] Papadaskalopoulos, A. (2000) *Methods of Regional Analysis*, Papazisis, Athens. [in Greek]
[316] Mayer, W., Pleeter, S. (1975) "A theoretical justification for the use of location quotients", *Regional Science and Urban Ecoomics*, 5, pp. 343-355.
[317] Norcliffe, G. (1983) "Using location quotients to estimate the economic base and trade flows", *Regional Studies*, 17, pp. 161-168.

In the next phase, the actual figures for Location Quotients were calculated. For instance, the Location Quotient for Employment regarding the "primary" sector (comprised of agriculture, forestry, and fisheries) is obtained as follows:

According to the National Statistical Authority, Employment in the "primary" sector in West Macedonia, in 2011 was 11.792; the respective figure for Greece as a whole (nationwide) was 372.209. Total Employment in the region of West Macedonia in 2011 was 83.530, when the respective figure for Greece as a whole was 3.727.633.

According to the Location Quotient formula the respective LQ will be:

$LQ = \frac{\frac{11792}{83530}}{\frac{372209}{3727633}}$=1,414

The Location Quotients for each of the eleven sectors were calculated in terms of Employment, but also in terms of Value Added (using the National Statistical Authority data for Value Added, which is offered in millions of euros).

Step 3: Calculation of National Technical Coefficients with the Use of Location Quotients

The National Technical Coefficients were in this step estimated with the help of Location Quotients. This procedure is relatively simple; if the value of a Location Quotient is equal to one, the sector is considered having a "balanced" economic activity. If the LQ value is smaller than one (in some research, this threshold takes the value 0,75, though most researchers are in favor of the threshold of "one") the sector is considered as "non-basic". This means that there are net imports in the region for this economic activity. If the LQ value is bigger than one (some researchers consider that this value should exceed 1,25), it is presumed that this sector is "basic"; that means that this economic activity in the region has a "surplus" output which is exported to other regions or abroad (other countries). In practice, if LQ value is equal to or bigger than one, then the national figure is multiplied by one; if the LQ value is smaller than one then the national figure is multiplied by the value of the Location Quotient. For instance, the Location Quotient for the "primary" sector (i.e. agriculture, forestry, and fisheries) is 1,414 and the Location Quotient for the "financial" sector is 0,522; these LQs will be used as "weights" (the National Technical Coefficients will be multiplied with) and the LQ for the "primary" sector will take the value of "one", when the value of the "financial" sector will be 0,522. In the next phase, a matrix, dimension 11 to 11, will be constructed with all elements equal to zeros, with the exception of the diagonal ones, which will have the values of adjusted LQs (i.e. the value for each sector). This table will be multiplied by the National Technical Coefficient matrix (an extensive presentation of this procedure can be found in Miller & Blair 2000):

Stop 4: Regional Multipliers Estimation

After the Regional Technical Coefficients are estimated, that is the matrix *A* for West Macedonia region (it has to be noted that two A matrices were estimated, one in terms of Value Added, and one in terms of Employment), it was possible to estimate the Regional Multiplier *L* (again two L matrices were estimated, one in terms of Value Added, and one in terms of Employment); with regional matrices A and L, it was made possible to estimate the

different scenarios for the economy of West Macedonia. As already mentioned, the Multiplier matrix can be derived from the Technical Coefficients matrix: $L = (I - A)^{-1}$ where I is an identity matrix with the same dimensions as matrix A (sign -1 indicates the inversion of (I-A) matrix).

Some comments on the analysis dataset

The available data regarding Value Added provided by the National Statistical Authority of Greece is broken down in eleven economic sectors. These sectors are:

National Statistical Authority of Greece Sectoral Breakdown

AA	Sector
1	Agriculture, forestry and fishing
2	Mining and quarrying, manufacturing, electricity, gas, steam, air conditioning and water supply, sewerage, waste management and remediation activities
3	Manufacturing
4	Construction
5	Wholesale and retail trade, repair of motor vehicles and motorcycles, transportation and storage, accommodation and food service activities
6	Information and communication
7	Financial and insurance activities
8	Real estate activities
9	Professional, scientific and technical activities, administrative and support service activities
10	Public administration and defence, compulsory social security, education, human health and social work activities
11	Arts, entertainment, recreation, other service activities, activities of households as employers, undifferentiated goods and services producing activities of households for own use, activities of extraterritorial organisations and bodies

It has to be noted that the dataset for sector 2 (Mining and quarrying, manufacturing, electricity, gas, steam, air conditioning and water supply, sewerage, waste management and remediation activities) includes “manufacturing”. The data for this sub-sector is also given, so “manufacturing” was subtracted from sector 3 (in our analysis “new” sector 2 does not include manufacturing) and, thus, our analysis has eleven instead of ten sectors. The data for Value Added, as already mentioned, is provided in millions of euros in current prices. It was decided to use 2011 figures in order to be compatible with the data for Employment (from the census of 2011); the census data was used for the calculation of the Employment figures per sector, both at national and regional (West Macedonia) level.

Step 5: Calculation of the Time - Sectoral Dimension of the Multiplier Effects

It would take several “rounds” for the multiplier effects to be materialized in the regional economy; in this study each round is defined as a calendar year. Thus, the total multiplier effect can be calculated for each round. The changes for the next round (i.e. the next year) will be:

$$A \times f_n$$

The next round is given by:

$$A^2 \times f_n$$

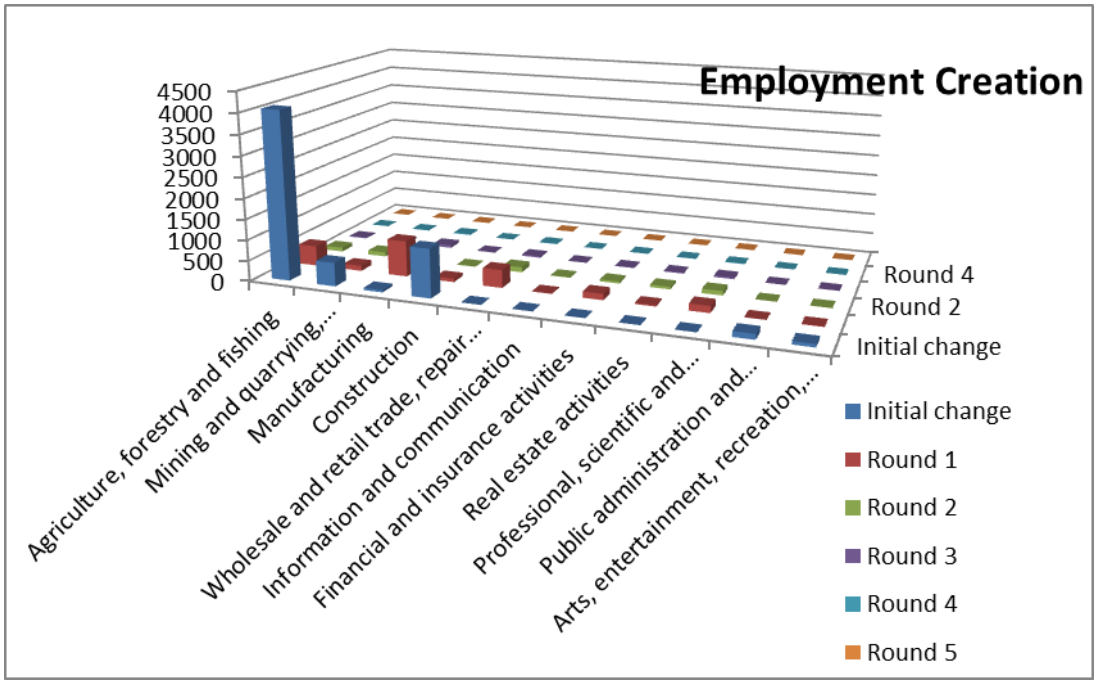
The round after the next by:

$$A^3 \times f_n$$

and the total change can be approximated:

$$L = (I - A)^{-1} = (I + A + A^2 + A^3 + \cdots)$$

In the empirical analysis (different scenarios) for the West Macedonia region the total multiplier effects are presented; indicatively, in some cases the time - sectoral breakdown is also presented (these breakdowns are estimated for all different scenarios). For instance, the next chart shows the time - sectoral changes for the "medium" scenario of regional growth:



An Alternative Set of Regional Technical Coefficients and Multipliers

The Academy of Athens has estimated a set of National Technical Coefficients and their responding Multipliers[318]. In a previous study of the Technical Chamber of Greece,[319] the Academy of Athens sets of Technical Coefficients and Multipliers were used in order to estimate the Regional (West Macedonia) Technical Coefficients and Multipliers (these Coefficients and Multipliers will be referred henceforth as TEE/AA). In this study, it was decided to use the National Input - Output Table of the Hellenic Statistical Authority of Greece for the estimation of the Regional Technical Coefficients and Multipliers; it is also decided, however, that a second set of calculations will be offered using the alternative sets of Technical Coefficients and Multipliers of the TEE/AA.

The main reason for the fact that the basic estimations in this study are those using the Hellenic Statistical Authority of Greece Input - Output table (will be referred henceforth as ELSTAT) is that the Hellenic Statistical Authority has changed the "sectoral" breakdown of Employment and Value Added data in the last few years. Thus, the most recent data is not compatible with the Technical Coefficients and Multipliers of the TEE/AA, since the data

[318] Academy of Athens (2007) Research Office, "Cross-sectoral interconnections of the Greek economy at national and regional level", Athens.

[319] TEE, West Macedonia Branch (2012) "Estimation of West Macedonia's transition to a low lignite production regime".

used in the TEE/AA study were rather dated (Employment data was for the year 2001, and Value Added data was for the year 2005). In any case, the use of both ELSTAT and TEE/AA Technical Coefficients and Multipliers make the results of this study comparable with those of the previous study of TEE/AA.

A Note on the Employment Data of ELSTAT

As already mentioned, the data used in the TEE/AA study (2012) regarding Employment was rather dated (of 2001). In this study, the census 2011 data are used; in the census of 2011 the data regarding Employment is given by sex, age cohorts, and sector of economic activity at national and regional (that is the 13 Greek regions, i.e. NUTS II regional level according the E.U. nomenclature). It has to be mentioned that this data is not available at prefectural level (regional level NUTS III); that means that there is no sectoral data for Employment for the prefectures of West Macedonia. The Employment data has the same sectoral breakdown as the data for Value Added.

“We shan’t save all we should like to – but we shall save a great deal more than if we never tried.”

Sir Peter Scott, founding chairman of the World Wildlife Fund (WWF)

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