cintran Unravelling the Challenges of Structural Change

POST-LIGNITE ERA IN WESTERN MACEDONIA

ASSESSING THE SOCIO-ECONOMIC IMPLICATIONS OF JUST TRANSITION FUNDS

MARCH 2024

Executive Summary

The purpose of this policy brief is to discuss the current state and the prospects for socio-economic development in Western Macedonia. For the past decade the region has faced important challenges: the economic crisis from 2009, closure of lignite mines and electricity plants and the recent energy crisis. These have significantly impacted the region's economy as well as its transformation potentials in a carbon neutral content. We contribute to the debate of the efficiency of the alternative proposed interventions and investments plans by performing an impact assessment of the Just Transition funds in terms of employment and gross value added. This allows to single-out which actions have the highest effect on the regional economy; an information that can be used as a guide in future policy planning.

1. Coal mining in Greece and in Western Macedonia

The exploitation of lignite reserves in Greece started in the nineteenth century but it wasn't until after World War II and specifically in 1951 that the country has begun to use lignite for electricity production. Lignite became the main source of electricity in the country contributing with more than 60% in total gross production up until the 2000's when it gradually began to fall. Figure 1 shows the active mining area and exploit-able lignite reserves in Greece. Western Macedonia has the largest lignite deposits and active mines.

In 1956, the Region of Western Macedonia slowly entered the era of intensive and fully industrialized mining activity, led by the Public Power Cooperation (PPC SA). Gradually, the region developed into Greece's powerhouse. Production peaked between 2001 and 2004, offering a significant boost to the national economy. Starting at 1.4 million tons in 1960, production rose to 11.7 million tons in 1975, 27.3 million tons in 1985, and 55.8 million tons in 2002, which was the maximum amount ever recorded. Coal mining operations and electricity production has offered a significant boost to the national economy (Kavouridis, 2008). The rate of approximately 50 million tons per year was maintained until 2012; afterwards production levels began to decline due to the decommissioning of older units, higher carbon prices and the increased penetration of renewable energy sources (RES) following EU's decarbonization directives(WWF, 2016 and Ziouzios et al. 2021) This decline accelerated after the decision of the Greek Government in 2019 to have all lignite plants shut down by 2028, aligning with the ambitious European Green Deal (COM (2019) 640/11.12.2019). The decision called for most units – representing over 80% of the current installed capacity – to stop operating by 2023 (Government Gazette B' 4893/31-12-2019).

However, the energy crisis that broke out in 2022 forced the Greek Government to extend the operation of three additional lignite units of Western Macedonia until 2025. The extension of the operation time of the lignite units is part of the country's new planning to ensure energy supply adequacy, especially following the European recommendation/call to reduce the use of natural gas, particularly from specific importing sources. (JMD 36060/1155/E.103/2013 (GS B 1450)). In addition, in April 2023 a newly constructed 660 MW lignite plant ("Ptolemaida V") was commissioned and is planned to operate until 2028.

After 2028, it will run on natural gas or an alternative, low-polluting fuel (e.g., biomass). What this fuel will be will depend much on economic and geopolitical circumstances.[1]

Figure 1: Lignite deposits in Greece

EU's decarbonization strategy exerts pressure on the economies that depend heavily on coal-related activities. Decommissioning of coal plants and the associated closure of coal mines drives unemployment higher and regional income lower. These first-round effects are usually followed by a second round of impacts such as the decrease in activities of sectors that are related to the coal industry and the decrease in regional expenditure leading to an overall decrease in regional dynamics and welfare. For this reason, the EU has set a goal of no one being left behind and has designed and promotes interventions to support its most vulnerable members during the transition.

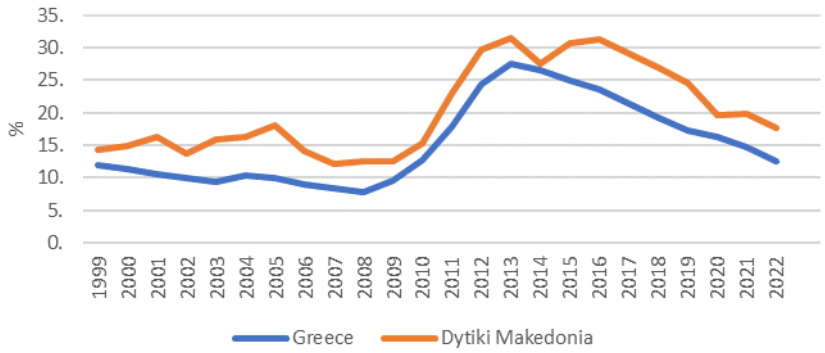
The European Green Deal comes with a solid investment pillar, the Sustainable Europe Investment Plan (COM (2020) 21/14.1.2020). This plan "covers the amounts used under the Just Transition Mechanism, which will help the most affected regions going through the transition". The Just Transition Mechanism (JTM) provides targeted support to regions heavily dependent on fossil fuels or GHG-intensive industries to mitigate the socio-economic impacts of their transition to climate neutrality, leaving no one behind. A roadmap for implementing the JTM in Western Macedonia has been included in the National Energy and Climate Plan (NECP, 2023).

[1] https://www.gem.wiki/Ptolema%C3%AFda_power_station

2. The regional economy

Western Macedonia has a population of approximately 254,000. It is one of Greece's most sparsely populated and least-developed regions, with more than 80% of its surface area classified as mountainous or semi-mountainous. The region is located away from major transportation routes, and its economy is underdeveloped. Manufacturing plays a relatively minor role in the regional economy which depends mainly on the mining and energy-related activities. The region is characterized by a poorly diversified labour market, with prime-age workers and low to medium skilled workers dominating its labour force (Cristiaensen and Ferre, 2020) and persistently high unemployment rates (Figure 2). In 2010, at the onset of the economic crisis, the unemployment rate was 15.4%, peaked at 31.6 % in 2013 and remained strikingly high until 2017 (29.1%) when it started to gradually fall, reaching 17.7% in 2022. Nonetheless, the region records the highest unemployment rate in Greece and one of the highest in Europe (according to Eurostat the region is included in the top-10 regions in terms of unemployment from 2011 and onwards).

Figure 2: Unemployment rates in 1999-2022 in Western Macedonia, Greece and the EU27.
Source: Eurostat



Regional GDP has shrunk from €5.1 billion in 2010, to €4.7 billion in 2015 and to 3.7 billion in 2021. In the period between 2010-2021 there was a decrease of 27% in GDP in nominal terms and over 41% in real terms, as shown in figure 3. Main drivers of this decline have been the global financial crisis, which hit Greece's economy hard, and the decline in lignite production (TRACER WP3 Report, 2019). Regional GDP per capita in 2021 was equal to 14.1 thousand Euro, well below the 17 thousand Euro at the national level and equal to 44% of the EU27 average. The poor regional performance can be attributed to the persistently high unemployment and to an economy built around fossil-based power generation, lacking diversification and high value-added activities that could spur innovation and boost competitiveness (European Commission, 2022). The tight lignite phase-out schedule that the Greek government has put forward poses further socio-economic stress on the region, exposing existing structural weaknesses of the local economy.

Figure 3: GDP annual growth at national and regional level.
Source: Eurostat

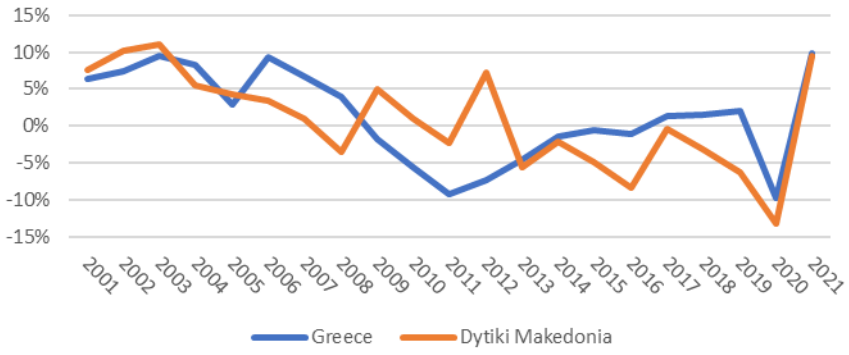
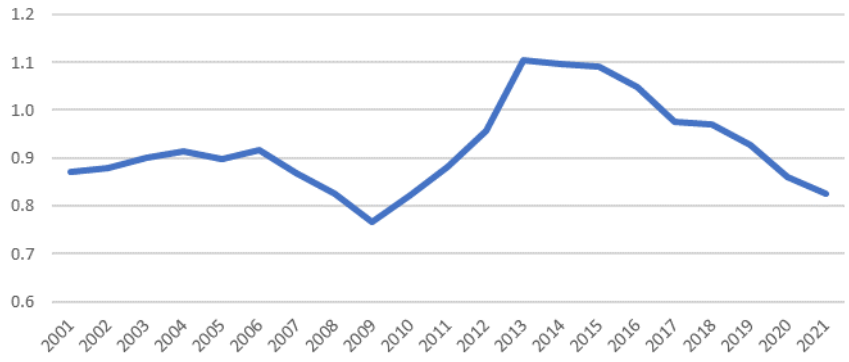
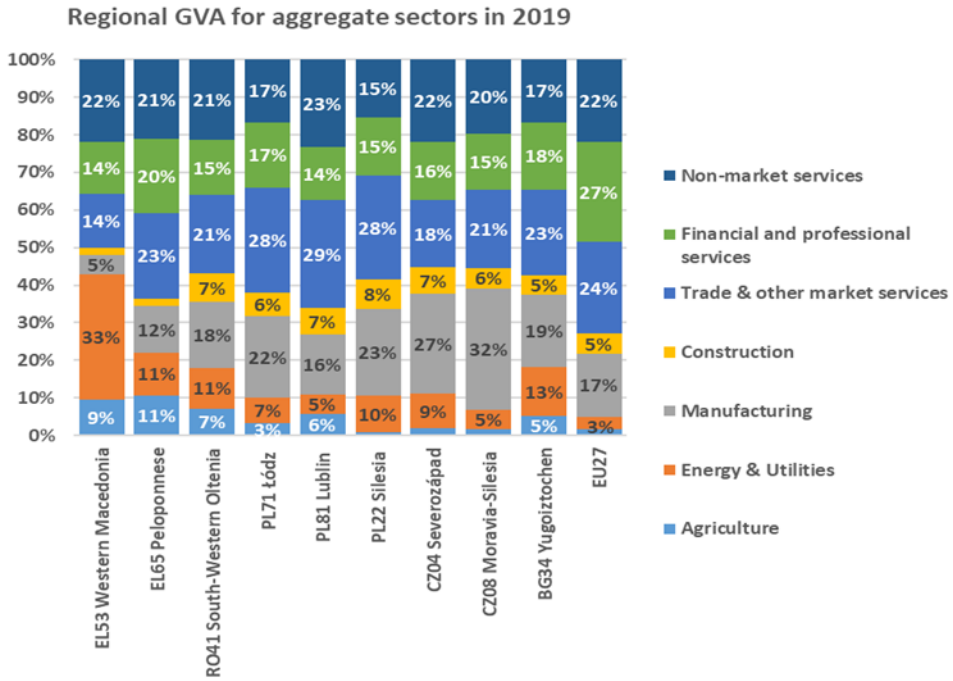


Figure 4: GDP per capita indexed to national level.
Source: Eurostat



Compared to other fossil fuel-intensive regions in Europe, Western Macedonia exhibits the highest dependency in terms of income generation from energy-related activities and the lowest diversification, which further weakens its adaptive capacity to the low-carbon transition. As mentioned above the main income sources are mining, and power generation. The industrial sector is especially important in the two cities of Kozani (73%) and Florina (20%) regional units (Eurostat, 2020). Non-market services, i.e., public administration mainly, represents the second largest sector in Western Macedonia (accounting for 22% of the regional GVA), fo20llowed by financial and professional services and wholesale and retail trade, each making 14% of the region's GVA.

Figure 5: Regional GVA for aggregate sectors in 2019 in coal-intensive EU regions and the EU27
Source: Eurostat



3. Just Transition Fund (JTF) in Western Macedonia

With the preponed 2030 lignite phase-out, new framework conditions for the lignite mining, the JTF supports affected territories in diversifying their model of economic development and enabling compensating schemes and transitory mechanisms for vulnerable households. Backing productive investments in small and medium-sized enterprises and in new firms, linking research and innovation with

environmental rehabilitation and clean energy uptake, introducing schemes for up- and re-skilling workers, delivering targeted job-search assistance are strategic objectives of the JTF.

At the same time, the Operational Program of Western Macedonia sets as priority for the region to become “a sustainable, competitive regional economy with sustainable jobs, a high-quality environment and social cohesion” through sector specialization, transition to a low-carbon economy, development of sustainable transportation and ensuring social cohesion and sustainable employment. Sector specialization refers to strengthening the R&D sector, developing the information and communications technology sectors in the region, improving the competitiveness of SMEs, and promoting low-carbon solutions. Areas of smart specialization include agriculture, tourism, the renewable energy sector, and the vertically integrated leather industry sector (from livestock to leather products), traditionally developed in the region.

The criteria used in the allocation methodology of the JTF are meant to reflect the relevant economic and social indicators of the European Member States and regions concerned. The criteria are: (i) the GHG emissions of industrial facilities when these exceed the EU average; (ii) the level of employment in coal and lignite mining; (iii) the level of employment in industry; (iv) the production of peat; and (v) the production of oil shale. Moreover, the methodology factors in Gross National Income (GNI) per capita to ensure an appropriate concentration of resources on the least developed Member States. Overall, this method of allocation is meant to channel funds to Member States and regions that are most exposed, while offering support to all Member States concerned.

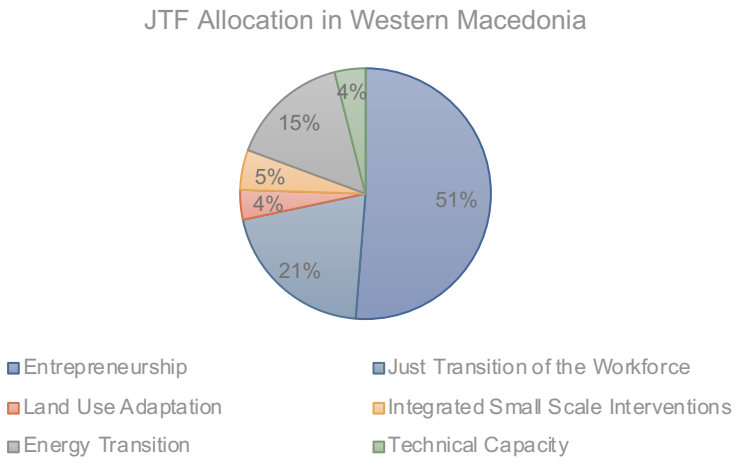
On June 16, 2022, the European Commission approved the Just Transition Fund programme for Greece and the three Territorial Just Development Transition Plans that accompany it, with a total budget of approximately €1.63 billion (European Commission, 2022). Greece's Just Transition Development Plan of lignite areas deals mainly with Western Macedonia, and to a lesser extent with other fossil-dependent territories, i.e., Megalopolis and adjacent municipalities and the islands of North-South Aegean and Crete. The JTF seeks to reorient the local economy from fossil fuel extraction to clean energy and the creation of new jobs, upskilling and reskilling of people affected by the transition. The approved JTF Programme is based on five priorities as shown in **Figure 6**.

Figure 6: Priorities of the Greek Just Transition Fund Programme.

The Programme, to be financed mainly by the JTF, is based on five development pillars that tap the region’s competitive advantages and can help create quality local jobs. Emerging sectors are: Clean energy, industry and trade (especially industries traditionally associated with the region, such as the leather industry), smart agricultural production, sustainable tourism, technology and education.

According to the JTF Development Plan about 994 million € will be channelled into transforming Western Macedonia from a lignite-dependent area into a modern and climate-neutral energy and industrial hub. The main strategic priority of the Plan is to set up an Innovation Zone that serves as an umbrella organisation for coordinating the development of infrastructure and nurturing entrepreneurship. JTF resources are allocated as follows: 51% in entrepreneurship, 21% in the local workforce, 4% in land use adaptation, 5% in integrated small-scale interventions, 15% in the clean energy solutions and 4% in building technical capacity.

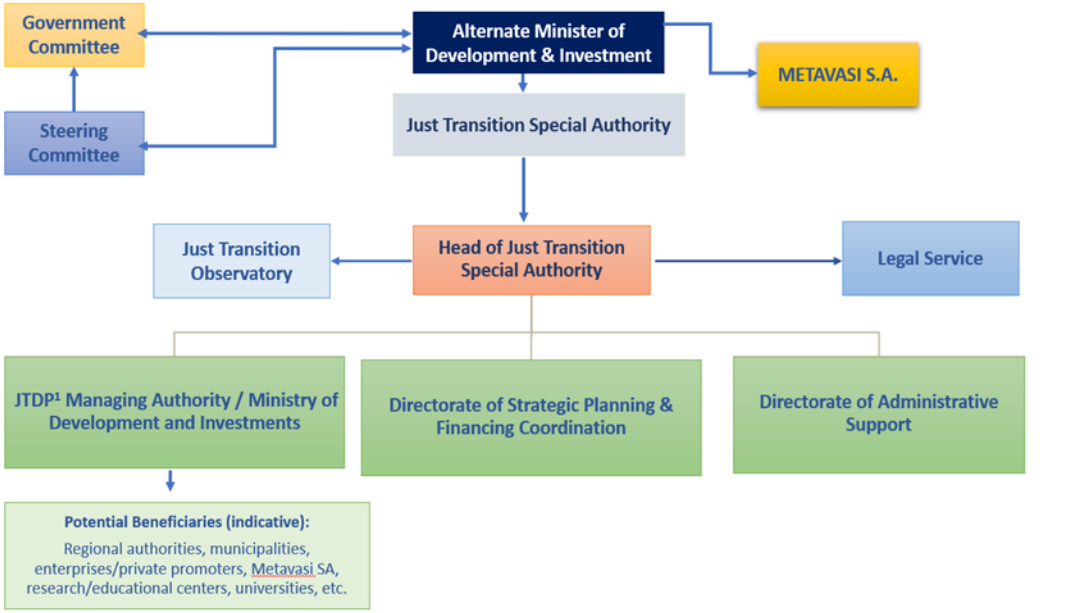
Figure 7: Allocation of Just Transition Fund measures in Western Macedonia region
Source: Just Transition Territorial Plan



It becomes evident that the low-carbon energy transition in Western Macedonia pre-supposes a radical restructuring of the local economy, the adoption of new business models, and the development of new skills. Large investments and a decisive policy response at all levels will be required.

Acknowledging the need for effective and efficient governance of the Just Transition Development Plan, the Greek Ministry of Development and Investment set up a Specific Authority to manage the Plan, acting as an independent public body under ministerial responsibility. Figure 8 depicts the establishment of a private legal entity in the form of a société anonyme (S.A.) according to Law N. 4872/2021 (Just Transition Development Plan of lignite areas, 2020). The corporate name of the company is “Hellenic Company Fair Development METAVASI SA” and its distinctive title is "METAVASI SA”.

Figure 8: Just Transition Special Authority (Law 4872/2021)



OTHER SUPPORTING POLICY TOOLS

On top of the Just Transition Development Plan, there are additional financial tools and initiatives that are expected to finance directly or indirectly the transition process in Western Macedonia:

Programme «Western Macedonia» NSRF 2021 – 2027

The "Western Macedonia" Programme 2021-2027 is part of the Partnership Agreement for Regional Development 2021-2027 of Greece for the period 2021-2027. For Western Macedonia, the total budget of the Programme amounts to €394.110. The Programme's strategic goal for Western Macedonia is three-fold: (i) mitigate the economic impacts of COVID-19 (ii) overcome the lasting effects of the economic crisis; and (iii) accelerate the transition to the post-lignite period. Tackling unemployment is at the heart of the Programme, with emphasis on carefully selected interventions such as reskilling and upskilling labor force in digital technologies, development of the tourism sector and infrastructure with a special focus on "cultural tourism" etc. that bring significant added value and help meet the objectives of the NSRF 2021-2027 and the EU Policy Objectives for the period 2021-2027[2].

Green Fund

The Green Fund is an agency supervised by the Ministry of the Environment with the mission to provide administrative, economic, technical and financial assistance for the promotion of sustainable development with a n emphasis on economic areas. In the context of supporting the Just Development Transition areas, the Fund runs the Programme "Financing of projects and actions for the development of sustainable economic activities of low carbon footprint in the Regional Areas of Kozani, Florina and the Municipality of Megalopoli in the Regional Unit of Arcadia" with a total budget of 60,671,543 euros for the years 2023-2025. The program is funded via the revenues of emission allowance auctions in 2018 and 2019[3].

Funding under Important Project of Common European Interest (IPCEI)projects

Two projects have received funding under the EU's Important Project of Common European Interest (IPCEI) which aims to promote innovative projects that support industrial growth, green transition, jobs etc. within the European Union.

The first project under the name of Green HiPo, is a project that involves the development, design, and manufacture of fuel cells and electrolysers to produce green hydrogen in a new, state-of-the-art facility in Western Macedonia. The project is set to offer a critical boost to the region's efforts to transition from a coal-based to a green economy. The Green HiPo is part of 41 projects that received financing in the context of "IPCEI Hy2Tech" by the European Commission. The funding of the projects amounts to euro 782.1 million and the beneficiary is Advent Technologies Holdings, Inc[4].

The second project approved to join the IPCEI to be realized by B&T Composites S.A.[5] is the "H2CAT TANKS" in Florina. With an investment of 18 million euros the project will support the construction of special high-pressure tanks from composite materials and carbon fibres for hydrogen storage. B&T Composites will develop the high-pressure hydrogen cylinders as well as the corresponding certification process according to the latest codes and standards. A consortium of companies and universities formed through the matchmaking process of IPCEI will hand to the company the technical specifications, requirements and objectives for the storage system integration and application, while the company is set to develop its own internal target specifications as well.

With the projects mentioned above, Kozani, the capital of Western Macedonia, has joined the Mission for 100 climate-neutral and smart cities by 2030. Until recently a leading energy producing area, Kozani

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2 Special programme management service "Western Macedonia, CCI: 2021EL16FFPR011, Version 1.2/ 5.9.2022

3 Financing of projects and actions for the development of sustainable economic activities with a low carbon footprint in the P.E.Kozani,Florina and in the Municipality of Megalopolis of P.E. Arcadia financed via the Green Fund

4 https://advent.energy/

5 https://www.btcomposites.gr/

is now preparing for making its transition to a clean energy future as smooth and equitable as possible. The uptake of energy efficiency and RES, enabled by the digital transformation of the economy lies at the heart of Kozani's efforts to become a sustainable, circular, and digital city[6].

4. Socio-economic analysis

We follow a static multiplier approach based on Input Output (IO) table to estimate the effects of additional demand generated by the support measures of the Just Transition Fund on value added and employment. This type of analysis allows us to quantify the benefits for the regional economy under the proposed action plan and to evaluate the efficiency of the proposed allocation of resources.

The IO table is a very useful tool for economic impact assessment as it gives a full picture of the economy at a certain point in time (year). It includes records of all transactions between firms, households, government, and the Rest of the world. In the IO table one can find information on households' spendings, i.e., how much they consumed as well as which types of goods and services they consumed, on the income generation by sector and by broad type (capital earnings vs. labor earnings), taxes, imports, exports etc. The IO table used in our analysis differentiates between 64 activities[7]. High sectorial resolution allows for a better understanding of sectorial interdependencies and a more robust impact assessment analysis.

Leontief multipliers are estimated from the Input-Output table. These multipliers embody the information on sectorial interlinkages (how much and which inputs are used in the production process), on import dependence etc. and are used to calculate what the impact of a change in demand will be in terms of output, employment, GVA. In our analysis we calculate 2 types of multipliers:

1. the GDP multiplier which provides a quantification of the Gross Value Added that will be generated in the economy by 1m. € of additional demand for a specific economic activity that delivers goods or services,
2. the employment multiplier which provides a quantification of the employment (in persons) that will be generated in the economy by a respective 1 m. € of additional final demand.

To quantify the JTF measures for Western Macedonia we (i) use the publicly available information on budget allocation by type of measures and (ii) translate the measures into demand for goods and services using a coefficient matrix. That associates investment measures with sectoral demand by economic activity (i.e. the 64 sectors) and is based on expert judgement, and finally (iii) the import share of domestic demand by economic sector to enable the explicit consideration of domestic additional demand generated.

The two matrices below show the top sectors in terms of GDP multiplier and employment multiplier. In principle services have both a high GDP and employment multiplier, due to their limited tradability and their labour intensity. On the other hand, industrial activities may be beneficial in terms of gross value added but they create relative less jobs (i.e. higher capital intensity) compared to other activities.

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6 https://climateneutral2030.cityofkozani.gov.gr/tag/kozani_to2030

7 The detailed list of activities is provided in the Annex. The classification of activities follows the NACE rev.2 (for more information please see https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Statistical_classification_of_economic_activities_in_the_European_Community_(NACE))

Table 1: GVA multiplier by sector of activity (NACE rev.2) – top and bottom five sectors

	GVA per €
Imputed rents of owner-occupied dwellings	0.98
Employment services	0.97
Education services	0.97
Real estate services excluding imputed rents	0.96
Public administration and defense services; compulsory social security services	0.94
Machinery and equipment n.e.c.	0.22
Furniture and other manufactured goods	0.22
Mining and quarrying	0.11
Motor vehicles, trailers, and semi-trailers	0.09
Computer, electronic and optical products	0.07

Table 2: Employment multiplier by sector of activity (NACE rev.2) – top and bottom five sectors

	Jobs per million €
Employment services	59.03
Other personal services	57.62
Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	53.92
Products of forestry, logging and related services	47.14
Products of agriculture, hunting and related services	45.81
Coke and refined petroleum products	3.95
Motor vehicles, trailers and semi-trailers	2.84
Mining and quarrying	2.01
Computer, electronic and optical products	1.71
Imputed rents of owner-occupied dwellings	1.16

The measures with the highest GVA potential are those presented in **Fehler! Verweisquelle konnte nicht gefunden werden.**. These include mostly measures that are part of the "Workforce Transition" category[8], notably measures that refer to "Support for adult education (excluding infrastructure)", "Support for adaptation of workers, enterprises and entrepreneurs to change, Pathways to integration and re-entry into employment for disadvantaged people". These JTF measures are also those with the highest employment potential (**Table 4**), as they are associated with an additional demand for labour-intensive economic activities such as services. Further, the main economic activities under the "Workforce Transition" category rely on a predominantly domestic value chain. The extent to which the domestic market of Western Macedonia will respond to this additional demand for services is critical for evaluating the associated socio-economic benefits.

The measures with the lowest effect on GVA are those with the lowest domestic component over the entire value chain. These are, for example, investments in clean energy, notably investments in solar plants, smart grids, alternative fuel infrastructure and high efficiency co-generation, district heating and cooling. These interventions rely on a high share of imported technological equipment and have the lowest employment multiplier effect. Still, our analysis does not take into consideration other important

[8] For more information on the different categories please see Annex

criteria such as energy security, climate mitigation and air pollution benefits, or the increased capacity of the region to attract other types of private investments.

The additional GVA or employment generated in the region via the new demand triggered by the JTF investments depends on (i) the level of the multiplier per measure category and (ii) the budget allocation per category. **Fehler! Verweisquelle konnte nicht gefunden werden.** indicates that the largest contribution is expected from interventions to improve access to employment; these also feature high GVA and employment coefficients. However, the second largest contributions are expected from measures with lower multiplier effects that see a high budget allocation, i.e., "Support for large enterprises through financial instruments, including productive investments" and "SME business development and internationalization, including productive investments" under the "Entrepreneurship" category. Still, these types of measures can exhibit strong growth dynamics related to the improvement of economy's productive capacity, the business environment and the competitiveness of domestic enterprises (the last two are not measured by our analysis). On the contrary, measures with very low multiplier effect and a relatively high budget allocation, such as investments in

Table 3 GVA coefficient by type of JTF measure and associated GVA generated by type of JTF measure according to the announced budget allocation in the W. Macedonia region; source: author's calculations.

JTDF Intervention type	Type I coefficient for additional GVA per m. €	GVA generated by intervention
Support for large enterprises through financial instruments, including productive investments	0.52	94
SME business development and internationalisation, including productive investments	0.52	59.1
Digitising SMEs (including e-Commerce, e-Business)	0.5	15.8
Research and innovation activities in public research centres,	0.54	10.3
Business infrastructure for SMEs (including industrial parks and sites)	0.57	14.5
Incubation, support to spin offs and spin outs and start ups	0.53	20.2
Support for innovation clusters including between businesses, research organisations	0.53	9.2
Research and innovation activities in SMEs, including networking	0.54	5.3
ICT: Other types of ICT infrastructure (including large-scale computer resources/equipment)	0.26	3.2
Investment in fixed assets, including research infrastructure, in public research centres	0.42	4.3
Research and innovation activities in micro enterprises including networking	0.54	6.4
Renewable energy: solar	0.03	1.4
Renewable energy: biomass	0.12	2.7
Energy efficiency renovation of existing housing stock	0.52	6.1
Energy efficiency renovation or energy efficiency measures regarding public infrastructure	0.52	5.1
Smart Energy Systems (including smart grids and ICT systems) and related storage	0.17	5.3
High efficiency co-generation. district heating and cooling	0.12	2.2
Alternative fuels infrastructure	0.08	0.3

JTDF Intervention type	Type I coefficient for additional GVA per m. €	GVA generated by intervention
Research and innovation activities in large enterprises, including networking	0.54	2.3
Government ICT solutions, e-services, applications	0.17	1.1
Energy efficiency and demonstration projects in SMEs	0.12	0.7
Rehabilitation of industrial sites and contaminated land	0.63	20.3
Commercial, industrial waste management: prevention	0.61	3.8
Measures to improve access to employment	0.81	108.8
Specific support for youth employment and socio-economic integration of young people	0.81	13.5
Infrastructure for vocational education and training and adult learning	0.65	9.9
Support for adaptation of workers. enterprises and entrepreneurs to change	0.9	14.2
Measures promoting work-life balance.	0.88	5.7
Pathways to integration and re-entry into employment for disadvantaged people	0.9	6.1
Support for adult education (excluding infrastructure)	0.93	4.4
Clean urban transport infrastructure	0.25	3.1
Information and communication	0.72	7.2
Preparation. implementation. monitoring and control	0.77	7.5
Evaluation and studies. data collection	0.77	13.8

solar power, are estimated to bring very limited value added and new jobs to the region. Nevertheless, these measures can be associated with the Greek National Energy and Climate Plan and the EU's energy security targets and justified by the high-level electricity transmission infrastructure already in the region. When compared, energy efficiency measures under the "Energy transition" category have a much higher multiplier effect. Implications for employment are aligned with implications for GVA. In terms of sectoral contribution to GVA and employment, services and then construction are driving regional economic growth.

Table 4: Employment coefficient by type of JTF measure and associated additional employment generated by type of JTF measure according to the announced budget allocation in the W. Macedonia region; source: author's calculations.

Intervention type	Coefficient per Mil. EUR in jobs	Additional employment generated
Support for large enterprises through financial instruments, including productive investments	19.64	3560
SME business development and internationalisation, including productive investments	19.64	2237
Digitising SMEs (including e-Commerce, e-Business)	15.12	480
Research and innovation activities in public research centres,	19.6	373
Business infrastructure for SMEs (including industrial parks and sites)	21.43	547
Incubation, support to spin offs and spin outs and start ups	16.61	638
Support for innovation clusters including between businesses, research organisations	16.61	291

Intervention type	Coefficient per Mil. EUR in jobs	Additional employment generated
Research and innovation activities in SMEs, including networking	19.6	192
ICT: Other types of ICT infrastructure (including large-scale computer resources/equipment)	8.1	100
Investment in fixed assets, including research infrastructure, in public research centres	15.06	156
Research and innovation activities in micro enterprises including networking	19.6	234
Renewable energy: solar	1.27	59
Renewable energy: biomass	5.1	112
Energy efficiency renovation of existing housing stock	20.01	235
Energy efficiency renovation or energy efficiency measures regarding public infrastructure	20.01	193
Smart Energy Systems (including smart grids and ICT systems) and related storage	6.89	209
High efficiency co-generation. district heating and cooling	5.1	94
Alternative fuels infrastructure	3.19	13
Research and innovation activities in large enterprises, including networking	19.6	82
Government ICT solutions, e-services, applications	6.89	42
Energy efficiency and demonstration projects in SMEs	4.95	29
Rehabilitation of industrial sites and contaminated land	24.46	782
Commercial, industrial waste management: prevention	19.88	122
Measures to improve access to employment	36.66	4900
Specific support for youth employment and socio-economic integration of young people	36.66	608
Infrastructure for vocational education and training and adult learning	25.3	386
Support for adaptation of workers. enterprises and entrepreneurs to change	44.08	695
Measures promoting work-life balance.	36.05	233
Pathways to integration and re-entry into employment for disadvantaged people	44.08	300
Support for adult education (excluding infrastructure)	38.55	183
Clean urban transport infrastructure	10.22	126
Information and communication	21.03	210
Preparation. implementation. monitoring and control	24.05	235
Evaluation and studies. data collection	24.05	431

5. Conclusions and discussion

For decades, Western Macedonia served as Greece's electricity production hub, with more than 70% of lignite extracted from open mines and used in local thermal power plants to meet the country's electricity needs. However, with climate neutrality at the heart of EU and national policymaking, there is growing consensus that a future beyond lignite needs to be imagined and pursued in Western Macedonia. This will not be easy since the long-term dependence on lignite has created conditions of

technological and economic lock-in. Western Macedonia is more disadvantaged in macroeconomic terms compared to the rest of Greece. GDP is shrinking, local population is aging, and less than 1 in 3 persons is working in the region.

These structural weaknesses make the socio-economic challenges resulting from the low-carbon transition even harder to address. The risk of a sluggish economy is imminent. Hence, there is an urgent need to design and implement successful supporting policies that overturn this trend and bring the most benefit to local communities. Currently, the Just Transition Fund pours money (994 million EUR) into different measures included in the region's Just Transition Development Plan in support of entrepreneurship, employment, clean energy uptake, etc. In our analysis we assess the socio-economic effect of these measures by looking at the additional sectoral demand (i.e., the 64 NACE sectors) that they generate and how this externally financed demand affects the GVA and employment.

The measures with the highest potential to generate additional GVA and employment are not those that necessarily receive the largest share of the JTF budget. From a static perspective this means that current allocation is not optimal and does not maximize potential benefits that could be drawn from higher investments in reskilling and upskilling the labour force. Most of the resources are driven towards innovation activities, R&D and to the support of enterprises. These interventions have a relative lower multiplier, but they can induce a growth potential that can be capitalized in the future. Still, the budget is contributing to meeting the challenge.

The measures with the lowest effect are those with the lowest domestic component over the entire value chain. For example, clean energy investments rely on technology imports, and as a result they do not generate additional jobs. However, it should be noted that although the allocation of JT resources is not optimal there are some limitations in our approach. The long-term growth and dynamic effects of the JTF are not considered. This assessment does not consider the growth dynamics of human capital development through training and reskilling but rather the socio-economic benefits borne out of the additional demand for the delivery of training and re-skilling services. Similarly, our methodology does not consider the productivity that emerges from research and innovation activities and the incorporation of ICT solutions, hence does not account for the growth prospects of such interventions. Further research is needed to consider i) the growth effects and the effectiveness of measures and not only demand effects; and ii) the inclusion of dynamic characteristics to the analysis, including price and income driven effects as well as competitiveness (i.e. analysis with e.g. a CGE model). More broadly, considering that population decline, very low degree of economic diversification and weak innovation in Western Macedonia may undermine the success of the JTF Development Plan, the preparation of a Risk Analysis Study may be necessary, which should come forward with alternative policy proposals in case of failure of the Development Plan to meet its objectives.

In summary, this brief attempted to describe the socioeconomic landscape in Western Macedonia and to examine the economic implications of the JTF. The findings, suggest that employment measures are associated with higher (direct) economic gains for the region compared to other measures examined. However, the re-skilling and upskilling of regional labour force also has the potential of creating growth dynamics, through productivity gains and to lead to the development of new high value-added activities (relative to innovation, technology etc.). In overall, actions and measures targeting to the support of most vulnerable regions during the transition should consider, both direct and dynamical implications given the regional specificities (e.g. labor force status, infrastructure status, accessibility etc.). Most of the direct impacts can be captured by sectorial multipliers while for the dynamic analysis further research is needed (with the application of the corresponding modelling tools). Finally, further effort should be channelled towards periodically monitoring the implementation of the Plan. To this end, specific target performance indicators should be developed, and opinion polling should be performed, to ensure feedback from the local population and involved stakeholders informs the redesign of the Plan, where needed.

References

Konstantinos Kavouridis, Lignite industry in Greece within a world context: Mining, energy supply and environment, Energy Policy, Volume 36, Issue 4, 2008, Pages 1257-1272, ISSN 0301-4215, https://doi.org/10.1016/j.enpol.2007.11.017)

Ziouzios, D., Karlopoulos, E., Fragkos, P., & Vrontisi, Z.. Challenges and Opportunities of Coal Phase-Out in Western Macedonia.,2021, Climate, 9(7), 115.

National Energy and Climate Plan (NECP) Available online: https://energy.ec.europa.eu/system/files/2020-03/el_final_necp_main_en_0.pdf (accessed on 17 September 2023)

Moodie, J.; Tapia, C.; Löfving, L.; Gassen, N.S.; Cedergren, E. Towards a Territorially Just Climate Transition—Assessing the Swedish EU Territorial Just Transition Plan Development Process. Sustainability 2021, 13, 7505. https://doi.org/10.3390/su13137505.

EUROSTAT energy balances Available online: https://ec.europa.eu/eurostat/web/energy/data/energy-balances (accessed on 17 September 2023)

Christiaensen, Luc & Ferré, Céline, 2020. "Just Coal Transition in Western Macedonia, Greece-Insights from the Labor Market," Jobs Group Papers, Notes, and Guides 32547274, The World Bank.Report on the current role of coal mining and related policies in the TRACER target regions Available online: http://www.bserc.eu/fileObj.php?oid=102 (accessed on 17 September 2023)

EU Cohesion Policy: €1.63 billion for a just climate and energy transition in Greece, European Commission - Press release, Brussels, 16 June 2022 Available online: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3711 (accessed on 17 September 2023)

Master Plan Public Consultation Available online: https://www.sdam.gr/sites/default/files/consultation/Master_Plan_Public_Consultation_ENG.pdf (accessed on 17 September 2023)

Special programme management service "Western Macedonia, CCI: 2021EL16FFPR011, Version 1.2/ 5.9.2022 Available online : http://www.antagonistikotita.gr/epanek_en/events.asp?cs=21 (accessed on 17 September 2023)

Green Fund Available online: https://ypodomes.com/egkrithike-i-chrimatodotisi-gia-quot-prasina-quot-erga-kai-draseis-sti-dytiki-makedonia (accessed on 17 September 2023)

Green Hipo Available online: (https://www.advent.energy/2022/06/16/advents-green-hipo-receives-notification-of-euro-782-1-million-funding/ (accessed on 17 September 2023)

H2CAT TANKS Available online: https://www.compositesworld.com/news/bt-composites-joins-rd-project-to-develop-novel-composite-hydrogen-storage-tanks (accessed on 17 September 2023)

COM(2020) 21/14.1.2020. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Sustainable Europe Investment Plan European Green Deal Investment Plan. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0021&rid=7

Eurostat. https://ec.europa.eu/eurostat/web/regions/database

Annex:

Table 5: Sectorial resolution of the Input- Output table according to the NACE rev.2 classification

NACE rev.2	Sector
A01	Products of agriculture, hunting and related services
A02	Products of forestry, logging and related services
A03	Fish and other fishing products; aquaculture products; support services to fishing
B	Mining and quarrying
C10-12	Food, beverages and tobacco products
C13-15	Textiles, wearing apparel, leather and related products
C16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials
C17	Paper and paper products
C18	Printing and recording services
C19	Coke and refined petroleum products
C20	Chemicals and chemical products
C21	Basic pharmaceutical products and pharmaceutical preparations
C22	Rubber and plastic products
C23	Other non-metallic mineral products
C24	Basic metals
C25	Fabricated metal products, except machinery and equipment
C26	Computer, electronic and optical products
C27	Electrical equipment
C28	Machinery and equipment n.e.c.
C29	Motor vehicles, trailers and semi-trailers
C30	Other transport equipment
C31_32	Furniture and other manufactured goods
C33	Repair and installation services of machinery and equipment
D	Electricity, gas, steam and air conditioning
E36	Natural water; water treatment and supply services
E37-39	Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services and other waste management services
F	Constructions and construction works
G45	Wholesale and retail trade and repair services of motor vehicles and motorcycles
G46	Wholesale trade services, except of motor vehicles and motorcycles
G47	Retail trade services, except of motor vehicles and motorcycles
H49	Land transport services and transport services via pipelines
H50	Water transport services
H51	Air transport services
H52	Warehousing and support services for transportation
H53	Postal and courier services
I	Accommodation and food services

NACE rev.2	Sector
J58	Publishing services
J59_60	Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services
J61	Telecommunications services
J62_63	Computer programming, consultancy and related services; Information services
K64	Financial services, except insurance and pension funding
K65	Insurance, reinsurance and pension funding services, except compulsory social security
K66	Services auxiliary to financial services and insurance services
L68A	Imputed rents of owner-occupied dwellings
L68B	Real estate services excluding imputed rents
M69_70	Legal and accounting services; services of head offices; management consultancy services
M71	Architectural and engineering services; technical testing and analysis services
M72	Scientific research and development services
M73	Advertising and market research services
M74_75	Other professional, scientific and technical services and veterinary services
N77	Rental and leasing services
N78	Employment services
N79	Travel agency, tour operator and other reservation services and related services
N80-82	Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services
O	Public administration and defence services; compulsory social security services
P	Education services
Q86	Human health services
Q87_88	Residential care services; social work services without accommodation
R90-92	Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services
R93	Sporting services and amusement and recreation services
S94	Services furnished by membership organisations
S95	Repair services of computers and personal and household goods
S96	Other personal services
T	Services of households as employers; undifferentiated goods and services produced by households for own use
U	Services provided by extraterritorial organisations and bodies

Table 6: List of interventions

Intervention	Amount (€)
Investment in fixed assets, including research infrastructure, in micro enterprises directly linked to research and innovation activities	1096284.9
Investment in fixed assets, including research infrastructure, in small and medium-sized enterprises (including private research centres) directly linked to research and innovation activities	1096284.9
Investment in fixed assets, including research infrastructure, in public research centres and higher education directly linked to research and innovation activities	10324440
Investment in intangible assets in micro enterprises directly linked to research and innovation activities	1305954.9
Investment in intangible assets in SMEs (including private research centres) directly linked to research and innovation activities	1249922.4
Investment in intangible assets in public research centres and higher education directly linked to research and innovation activities	5653860
Research and innovation activities in micro enterprises including networking (industrial research, experimental development, feasibility studies)	11926354.95
Research and innovation activities in SMEs, including networking	9796903.05
Research and innovation activities in large enterprises, including networking	4192713.15
Research and innovation activities in public research centres, higher education and centres of competence including networking (industrial research, experimental development, feasibility studies)	19030010.7
Digitising SMEs (including e-Commerce, e-Business and networked business processes, digital innovation hubs, living labs, web entrepreneurs and ICT start-ups, B2B)	31742302.8
Government ICT solutions, e-services, applications	6145500
Business infrastructure for SMEs (including industrial parks and sites)	25503825
SME business development and internationalisation, including productive investments	113919278.1
Support for large enterprises through financial instruments, including productive investments	181292250
Skills development for smart specialisation, industrial transition, entrepreneurship and adaptability of enterprises to change	9014833.95
Incubation, support to spin offs and spin outs and start ups	38411544
Support for innovation clusters including between businesses, research organisations and public authorities and business networks primarily benefiting SMEs	17514675
Innovation processes in SMEs (process, organisational, marketing, co-creation, user and demand driven innovation)	1816537.5
Technology transfer and cooperation between enterprises, research centres and higher education sector	4447896
Research and innovation processes, technology transfer and cooperation between enterprises, research centres and universities, focusing on the low carbon economy, resilience and adaptation to climate change	908268.75
Research and innovation processes, technology transfer and cooperation between enterprises, focusing on circular economy	908268.75
ICT: Other types of ICT infrastructure (including large-scale computer resources/equipment, data centres, sensors and other wireless equipment)	12291000
TOTAL	**509.588.908**
Priority 2: Energy Transition – Climate neutrality	
Energy efficiency and demonstration projects in SMEs or large enterprises and supporting measures compliant with energy efficiency criteria	5773588.8
Energy efficiency renovation of existing housing stock. demonstration projects and supporting measures compliant with energy efficiency criteria	11739343.77

Intervention	Amount (€)
Energy efficiency renovation or energy efficiency measures regarding public infrastructure. demonstration projects and supporting measures compliant with energy efficiency criteria	9655737.3
Renewable energy: solar	46654828.5
Renewable energy: biomass	22002697.5
Smart Energy Systems (including smart grids and ICT systems) and related storage	30377206.5
High efficiency co-generation. district heating and cooling	18442645.5
Commercial. industrial waste management: prevention. minimisation. sorting. reuse. recycling measures	4301850
Alternative fuels infrastructure	3997380.24
TOTAL	**152.945.278**
Priority 3: Land Use Change – Circular Economy	
Commercial, industrial waste management: prevention, minimisation, sorting, reuse, recycling measures	6145500
Rehabilitation of industrial sites and contaminated land	31956600
TOTAL	**38.102.100**
Priority 4: Workforce Transition	
Infrastructure for vocational education and training and adult learning	15240840
Other social infrastructure contributing to social inclusion in the community	3595117.5
Measures to improve access to employment	133646405.4
Specific support for youth employment and socio-economic integration of young people	16592850
Measures promoting work-life balance. including access to childcare and care for dependent persons	6452775
Support for adaptation of workers. enterprises and entrepreneurs to change	15757062
Support for adult education (excluding infrastructure)	4738542
Pathways to integration and re-entry into employment for disadvantaged people	6814130.4
TOTAL	**202.837.722**
Priority 5: Integrated Small-Scale Interventions	
Government ICT solutions. e-services. applications	1554450
Energy efficiency and demonstration projects in SMEs or large enterprises and supporting measures compliant with energy efficiency criteria	2938272
Energy efficiency renovation of existing housing stock. demonstration projects and supporting measures compliant with energy efficiency criteria	3328330.5
Energy efficiency renovation or energy efficiency measures regarding public infrastructure. demonstration projects and supporting measures compliant with energy efficiency criteria	2287210.5
Support to entities that provide services contributing to the low carbon economy and to resilience to climate change. including awareness-raising measures	513330
Renewable energy: solar	3759600
Other renewable energy (including geothermal energy)	1174875
Smart Energy Systems (including smart grids and ICT systems) and related storage	2400360
High efficiency co generation. efficient district heating and cooling with low lifecycle emissions	12001800
Clean urban transport infrastructure	12341610
Alternative fuels infrastructure	352549.26
Protection. development and promotion of cultural heritage and cultural services	8603700

Intervention	Amount (€)
TOTAL	**51.256.087**
Priority 6: Technical assistance	
Information and communication	10001403.6
Preparation. implementation. monitoring and control	9766862.4
Evaluation and studies. data collection	17918847.91
Reinforcement of the capacity of Member State authorities. beneficiaries and relevant partners	1750744.5
TOTAL	**39.437.858**

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Authors

Zoi Vrontisi	E3Modelling S.A
Sakis Mrofis	E3-Modelling
Dimitris Ziouzios	Regional Development Fund of Western Macedonia
Evangelos Karlopoulos	Regional Development Fund of Western Macedonia
Dimitris Mavrommatidis	Regional Development Fund of Western Macedonia
Kostas Fragkiadakis	E3Modelling S.A