

Smart strategies for the transition in coal intensive regions

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Blueprint on the Region of Western Macedonia's energy transition

WP 6 – Task 6.4 / D6.5

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Executive summary

Blueprints are guidance documents providing a detailed description of a process planning / development and implementation over time. Moreover, the Blueprint developed in the frame of TRACER Project for each one of the target regions (among them the Region of Western Macedonia - WMR) should include all key documentation to set out the options available and actions required to meet the region's energy demand.

Therefore, the current Blueprint (on *Western Macedonia Region's energy transition*):

- outlines the concrete actions and the corresponding steps that the regional authorities, the industry and individual stakeholders will need to take to adapt their business practices and models to move down a trajectory consistent with the planned energy transition;
- is based on the high priority measures of the Region of Western Macedonia's Roadmap (TRACER D6.4, 2022), on how to implement, firstly till 2030 and in the long term till 2050, of what emerged from the projections for the energy transition of Western Macedonia Region (WMR) in the perspective of its "green" transformation and the corresponding R&I strategy developed (TRACER D6.2, 2021), and the agreed strategies for re-skilling and re-training of the local workforce in the Region (TRACER D6.3, 2022).

Therefore, the "*Blueprint on Western Macedonia Region's energy transition*" aims to be a key TRACER Project's document, which will synthetically describe and schedule the energy transition process (planning, development and implementation) of the Western Macedonia Region over time (up to 2030 at first, and to 2050 in the longer term). At the end, a referential "in brief" document, entitled "*Blueprint Benchmark*", is annexed to help make the WMR's path towards a sustainable energy system visible and to allow easy comparisons of all the nine (9) carbon intensive regions which are target regions of the TRACER project.

1 WMR's common vision statement

The reconstruction of the regional economy and the attraction of investments in new innovative and green technologies, such as those of RES, as well as energy storage technologies, in particular hydrogen, are a high priority for the Region of Western Macedonia and, at the same time, a necessity both for the achievement of the European "Green Deal" and the protection of the environment. The primary objective of the Region in this process is to take special care to secure all the jobs on the one hand and the economic and development achievements of the region on the other.

One of the issues which is of serious concern in WMR and maintains a high ranking in the fears and/or challenges the region is facing is the inevitable loss of a considerable number of jobs directly and/or indirectly connected to lignite mining and the operation of TPPs. This is an issue that needs to be dealt with the implementation of appropriate strategic approaches that will ensure the replenishment of existing jobs through the combination of a number of actions and suitably targeted initiatives. **Capacity building and the re-training / re-skilling** of the existing labour force and of the human resources employed in the lignite industry should be ranked as a high priority.

There is an indisputable need for the creation of new potential and perspectives in the region. A key point is that there is a **high availability of skilled human resources and of trained technical staff**, especially in the energy sector. On the other hand, a major concern

is that the region might not be able to deal with the lack of employment opportunities, in view of the de-lignification plan being extremely pressing in terms of time that does not allow for a smooth treatment of this issue, and this will mainly affect younger people. Furthermore, a large number of scientists prefer to emigrate and look for a job in other regions of the country or abroad. To prevent this and maintain the interest of the re-skilled workforce, there must be a **wide umbrella of financial and fiscal incentives to increase local business activity** and attract both domestic and international investments. The production model of WMR must be rebooted and be ready to be enriched with new activities that will create new jobs.

The next common vision is the **need for the restructuring of the overall production model of WMR** to a new (multi-sectoral) one, linked also to the previously mentioned topic of jobs replenishment. What is visualised is that the new production model will be non-dependent on coal, yet maintaining its “energy” character and be based on the exploitation of new alternative and environmentally friendly resources and technologies (RES, hydrogen, energy storage). It should further expand to other sectors (e.g. agricultural, manufacturing, agri-food, mild forms of tourism exploiting the natural landscape and the cultural background).

The attraction of the interest of local, national and / or international investors with a long-term horizon will significantly contribute both to the enhancement of a new production model for the area but also to the **improvement of the RDI potential in the region**, which is currently rather low. This is due to the lack of competitiveness, as many years of monopoly conditions have not favoured the creation of economies of scale. A benefit to the region is the existence of a significant technological and research infrastructure, which needs to be upgraded and expanded to support new business activities, still energy based, but in innovative sectors and products. This, coupled with the available highly trained technical staff, could constitute a very efficient and powerful tool for the new orienting of the production and economy of the area to alternative (energy and not only) paths.

2 WMR's projection of the energy mix

The decarbonization of the area of Western Macedonia constitutes a part of the National Energy and Climate Plan (NECP, 2019) and has started in the early 2010s, with the gradual reduction of lignite activity which is planned to be completed by 2025. The units that will be closed in Western Macedonia are of a total of 3,400 MW net capacity / 3,775 MW installed capacity. There is the exception of the new Ptolemaida 5 unit, which is expected to operate until 2028 with lignite and/or a mixture of fuels (with the conversion to a natural gas fired unit afterwards been the most prominent nowadays).

In addition to the lignite fired TPPs there are approximately 530 MW of installed hydro power in WMR (the Polyfyto HPP with a design capacity of 375 MW_e and the Ilarion HPP with a design capacity of 154 MW_e), which produce approximately 740 GWh per year. There is also a small hydropower plant (SHPP) operated by PPC that harnesses the ecological supply of the Ilarion Dam. It has an installed capacity of 4.2 MW and an average annual power output of 22 GWh. Apart from that, according to the most recent available data, there are 12 more SHPPs with a total capacity of 18.9 MW in Western Macedonia.

As for solar energy, in January 2020 there were 133.33 MW of PV systems installed in Western Macedonia, from which 19.49 MW is the capacity of PV units installed as “PV rooftop systems”, 41.69 MW correspond to installations of ≤ 100 kW, 34.1 MW of PV systems in the category of > 100 kW and ≤ 500 kW, another 15.28 MW are installations of > 500 kW and ≤ 1 MW, 16.77 MW of PV systems with capacities > 1 MW and ≤ 5 MW, while there is one PV park of 6 MW installed capacity. Finally, in WMR there are 5 units developed for the

exploitation of biogas from biomass (agro-wastes treatment), cogenerating electric and thermal power, of 1.48 MW_{el} installed capacity.

An important issue resulting from the path to decarbonization is the fact that lignite, except for power production, is used in parallel for district heating, covering the needs of about 42,000 households and businesses in many towns of the region, corresponding to a total demand of ~600 GWh. It is planned that during the transitional period the district heating for the area will be provided through the interconnection of Amyntaio, Ptolemaida and Kozani with a network of hot water pipes, as well as a connection with a new CHP unit, supplied with natural gas. The plan is to create a *thermal hub* of total thermal power which will initially rise to 400-420 MW_{th}, having a system backup to approximately 120-140 MW_{th}, produced by 5 units (more precisely from the modification of an existing unit and the construction of 4 new) using natural gas, electricity and a mixed biomass combustion with a small amount of lignite.

To secure the provision of gas in order to cover the thermal needs of the area, the 10-year investment plan of DESFA for the period 2020-2029 includes the development of the gas transmission network in Western Macedonia by creating three new metering and regulating stations. From these stations it will then be possible to construct the medium and low-pressure network, which will transport the natural gas to the cities of the region.

Additionally, there is a plan for growth of RES installations in the region's area. Wind energy projects, for example, are expected to rise to approximately 2,133 MW of capacity. Currently, there are in operation 6 wind parks with an installed capacity of 146.5 MW, and 66.6 MW of wind energy projects with installation licence, waiting for the operation licence (with expected date of starting operation no later than 2023). Also, there are 795.7 MW of wind energy projects with approval of their EIAs, and a number of projects of 746.5 MW capacity that have obtained Production License. These can be considered as "mature" and are expected to start operation until 2030 (especially the 100.95 MW selected in the auctions held between 7/2018 & 7/2019). There is also a number of projects that have applied for granting a Production License, with a total capacity of 377.6 MW (to become operational after 2030).

The total capacity of all solar thermal (CSP) units to be installed in the (former) lignite mines of WMR rise up to 102 MW_e. Small hydroelectric projects (SHPP) being in the licensing stage are of total capacity of 9.14 MW, while the mature biomass projects in the area are counting to 6 with a total capacity of 40.67 MW. Furthermore, there is a theoretical potential for residual biomass in the Region (500,000 tons of dry biomass/year, with fuel energy content of 2,600 GWh/year), which could be exploited and supply an up to 25 MW_e power plant. Priority is thus given to the development of energy crops in the mines soils for producing biomass as a fuel and for advanced biofuels. It is an activity that matches the specialties of human resources of the region, has a great leverage of economic activity and employment, utilizes the restored lands and is of great energy and environmental importance.

The installation of PV parks of more than 2.1 GW capacity in WMR (basically from PPC, the ~1.9 GW, but also from another state-controlled company, ELPE) is a main priority of the state. Some of the already licenced PV projects are to be located in the areas of lignite mines, and it could be made possible that these are functioning by 2025. In connection with the increase of the generated power from RES, a number of projects concerning the installation of storage facilities (batteries) are planned in WMR, such as the 250 MW capacity project of Eunice and the 6 projects for which PPC Renewables has received Electricity Production Licenses.

Finally, an Important Project of Common European Interest (IPCEI) on Hydrogen, the "White Dragon", is about to start in WMR. This project will use large-scale RES electricity for the production of green hydrogen by electrolysis (500 MW of PVs will be directly connected to

the electrolytes). The H_2 will be stored directly (short-term hydrogen storage) and indirectly (piped to the main gas pipeline) and, through high temperature fuel cells, will supply the country's electricity system as a stable unit for green power and heat. The generated heat, as a by-product of electricity production, could have a complementary use to the district heating networks of Western Macedonia, as well as in other applications that require heat and / or cooling (industries, data centres, greenhouses, etc.). The project is expected to have a H_2 production of 250,000 tons/year for energy and 58.000-71.000 tons/year for other uses.

3 WMR's available options meeting the planned energy transition

As it was mentioned in the previous Section, according to the Region's installed energy mix forecast, which will be covered by a pool of energy generation technologies, using natural gas as transition fuel and, basically, by renewable energy sources (mainly PVs and wind energy, but also biomass/biogas fuelled facilities), WMR is expected to successfully complete its "green" transformation in the medium term while retaining its character as the "energy centre" of Greece. However, there are other serious issues that need to be addressed, one of them being the restoration of the (former) lignite mines.

In the Region of Western Macedonia, the total land taken by mining rises to 170 km², from which the ~40 km² have already been reclaimed (according to PPC's data of 2015, restored areas rise to 27.3% of the total), thereof 20 km² reforested, 15 km² agricultural land and 5 km² parks, lakes, etc. Based on the EIA of the mines in the *Kozani Regional Unit*, the restoration works are expected to be completed by 2053. Finally, once the restoration programme has been implemented in all points (2053), there will be 50.15 km² of cultivable areas, 53.74 km² afforested and 11.67 km² residual lakes.

To conclude, the current CRP foresees land restoration of 81% of the total operation area by 2050, with woodland (45%), agricultural land (46%) and lakes (9%), as well as with remaining areas of special use (0.8%), facilities (0.3%) and other infrastructure (3.4%). Thus, there is going to be some land available for the development of RES (e.g., Greece's largest biomass CHP plant providing 25 MW_{el} and 45 MW_{th}, planned to be installed at an area of approximately 5.8 ha, the PPC's PV park on reclaimed waste heaps surfaces of Ptolemais lignite mines, in four plots covering 500 ha, etc.).

The overall responsibility for reclamation lies on the mining companies. As soon as the land is reclaimed, it will pass to the local authorities (for the time being, the cultivated land is rented to local farmers at 100 € per ha and year). In principle, efforts should be placed on capitalizing on the infrastructure left by the universal withdrawal of the lignite industry in the region, such as in the change of use of lignite power plants (re-use), and in the integration of the depleted lignite mines in the area's urban fabric in terms of circularity and sustainability.

Apart from all the above, the further and focused development and support of R&I in the field of energy and the environment is a vital and necessary condition for the development and operation of most of the aforementioned projects and actions. R&I is an independent post-lignite activity that should be promoted in the affected areas (TRACER-D6.2, 2022). In WMR there is a large research community within the operation of University of Western Macedonia (UoWM) and CERTH. However, there is a need for a systematic and focused strengthening, reconstruction and empowerment of research bodies and their focus should be on exploring the technologies and production techniques of the priority developments that will be selected.

An important factor that makes the region lagging behind in terms of business and growth indicators is the lag of companies in terms of innovation. Particularly important for enhancing

the competitiveness of the productive system is the role of R&I and the connection of research centers and universities with business. Therefore, it is an urgent need to strongly support RDI activities, with the aim of developing high value-added businesses, products and services and, consequently, creating jobs above the average wage level.

In this direction it contributes the goal of the Region for the establishment and development of an innovation hub for hydrogen (H₂) and green energy and environmental technologies, with emphasis on green hydrogen, RES and energy savings, in order to signal a new environment for development of the new economy in WMR. Thus, in addition to the "White Dragon" Project, WMR will acquire a complete H₂ ecosystem which will include a Centre for Hydrogen Studies, a cluster of H₂ companies in Ptolemaida, and an electronic platform for H₂ technology applications. A Hydrogen technology park will complement the infrastructure of this technology, in order to quickly promote the use of green hydrogen and to favour the investment environment for corresponding large-scale productive investments in the Region.

The Lignite Centre of Western Macedonia employed 3,200 people in September 2020, while about 2,000 job positions were maintained by satellite companies that cover the operational needs of PPC SA on a constant basis. After 2025, these jobs will experience a state of high uncertainty, while significant losses are already recorded in satellite companies. According to other estimations, the lignite phase-out in WMR by 2025 (or by 2028) is expected to lead to a significant decline of the regional GDP, to a loss of 21,000 both direct and indirect jobs (as more than 25% of the local jobs are directly or indirectly related to the lignite industry), as well as to a loss in the total income of €9 billion in the period 2018–2028.

The decarbonization process of WMR has concerned local and national institutions and in the past various studies and analyses have been made for it, especially as regards the future of the local workforce employed in the lignite 'industry'. A more specific and updated analysis on new jobs that can be created through this process in WMR was presented in the *Report on the needs for workforce retraining* (TRACER D6.3, 2022). The results were:

- (1) Jobs in wind energy projects: between 1,864 and 2,113 (from which 634 locally), with 1,005 to 1,035 created job positions if manufacturing is not included.
- (2) Jobs in new SHPPs: ~50 jobs for the manufacturing, ~137 job-years for the construction and installation, and ~22 for the O&M phases respectively.
- (3) Jobs (FTE) in the PV industry: between 2,200 and 7,000, with the moderate forecast giving a number of around 3,400 positions, which fall to 2,800 if manufacturing is not included.
- (4) Jobs (FTE) in new biomass projects: for O&M will be more than 60; the exploitation of part of the total residual biomass potential of the region and the set-up of the foreseen 25 MW_e power plant can give ~50 new jobs.
- (5) Jobs for CSP projects: between 1,020 and 1,316 in the manufacturing and construction & installation phases, and between 102 and 51 job positions for their O&M.

As for the hydrogen sector, in accordance with what is provided for the "White Dragon" project proposal, 9,700 direct and 29,000 indirect jobs are considered as needed during the development phase of the project (until 2029), while after that (from 2030 onwards) there are going to be 2,970 permanent direct jobs only in H₂ production, with at least 10,400 indirect.

There are other sectors that are expected to create jobs, during the decarbonisation procedure. Funding schemes / support policies for Energy Efficiency are expected to be implemented in the region and new jobs will be created in this field, while engineers, technicians and other field workers will be employed in the decommissioning of mines and former power production from lignite facilities. The projected numbers of created positions (TRACER D6.3, 2022) are:

- (1) Energy savings (efficiency): 0.2 FTE/year for equipment and 0.3 FTE/year for construction
 (2) Decommissioning engineering: 3,000 jobs for 8 years appr.

With the implementation of all (or most of) the abovementioned projects, which will ensure the smooth transition of the region in the post-lignite era, it is estimated that the new jobs to be created by 2028/2030 shall be able to compensate for the jobs to be lost in PPC and for those of the contractors, while they may also cover the short-term unemployed persons of the region. This will also result in an inflow of a new high-skilled workforce, e.g., specialized scientists and executives, combined with the absorption of the affected human resources in the affected areas.

The professional specialization of the human resources in WMR concerns mainly the technical experience and skills related to the production of electricity and lignite mining, earthworks, and machine management, and this existing specialization could consist of the competitive advantage of the area. The majority of the newly created jobs will be targeted to cover the activities and needs related to the restoration of the former mine lands and to the development of clean energy projects. The construction phase of these investments will last until at least 2030, and will absorb the lost job positions of the technical staff of the region, as it requires similar skills and qualifications.

The demand for professional skills may however become differentiated as the operation phase of the projects succeeds their construction. The operation of new companies in the area will increase the demand for specialized personnel (researchers, managers), while the further diversification of the economic activities will create demand for skills characterising professions such as the ones of agronomists, winemakers, farmers, tourism professionals, administrative employees. Taking into consideration the existing skill set/scenery of the region, it is estimated that about half of the PPC workforce and the short-term local unemployed may need reskilling to be absorbed by new economic activities.

4 WMR's high priority measures and concrete actions

The measures proposed under each one of main axes of the "Action Plan" to overcome the barriers in the fields of energy and environment related R&I and reskilling/retraining of the local workforce (TRACER D6.4, 2022) were as follows:

R&I in the field of energy and environment

Axis 1: Enhancement / reconstructing of the regional research bodies / institutes	Measure 1: Creation of new and / or reconstructing of existing R&I facilities Measure 2: Implementation of exchange programmes among collaborating universities/ institutes Measure 3: Improvement of the qualification and/or skills of the researchers in the energy sector
Axis 2: Strengthening of the synergies and cooperation between research bodies/ centres and business	Measure 1: Establishment of a link between the R&I research institutes, universities, the business and the local society to enhance the access to R&I outputs and/or achievements Measure 2: Alignment of visions, goals and means for both research institutes and business Measure 3: Implementation of awareness events on a two-fold basis on the activities of the research institutes and the business goals and plans

Axis 3: Involvement of the energy sector stakeholders in the business discovery process	Measure 1: Promotion of the partnerships between stakeholders, by supporting advisory and networking actions Measure 2: Empowering of the role of all market players in their involvement in projects implementation
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Reskilling/retraining strategy

Axis 1: Develop respective training courses to fill the knowledge, skills and competences gap of the existing workforce of the region	Measure 1: Create the respective curriculum, design the training course and identify the trainers' profile. Measure 2: Ensure the respective capacity building of the existing VET infrastructures
Axis 2: Up-skill training for engineers or other STEM and non-STEM professionals or even new RES professionals (e.g. in the hydrogen sector)	Measure 1: Develop up-skilling courses and promote master courses for engineers and other RES professionals Measure 2: Provide engineers and professional unions with the necessary information, support and material to diffuse to their members, pointing out the need for experts in the respective domains
Axis 3: Informing the regional and national market and the existing and future workforce on the jobs and training / reskilling potential	Measure 1: Create an informative campaign for schools nationally (e.g. through school vocational guidance) addressing the issue and presenting the upcoming opportunities both in technical and higher education level. Measure 2: Informing the regional market on the potentials resulting the decarbonized period and era.
Axis 4: Supporting the transition during the reskilling, for both the workforce and the local community / market	Measure 1: Create initiatives which would enable the existing workforce to attend the training and to choose the appropriate course. Measure 2: Provide the local market / community with financial incentives to support the transition through the retraining of the workforce

Due to the speed-up of the decarbonization process in WMR, all Measures mentioned above have as timeframe for their implementation the period between 2023 and 2030. Following the assessment and prioritization of the proposed measures to meet the objectives of the *R&I Strategy* (TRACER-D6.2, 2022) on the one hand, and of the reskilling/retraining needs of the workforce (TRACER-D6.3, 2022) on the other, the Measures defined as “high priority” and further analysed in the *Roadmap* (TRACER-D6.4, 2022), including the identification of the involved bodies, as well as of potential funding mechanisms, were the following:

Measures regarding the R&I Strategy

Axis 1	Enhancement/restructuring of the regional research bodies / institutes
Measure 1	Creation of new and / or reconstructing of existing R&I facilities
Action 1	Establishment of new laboratories: → Creation of suitable mechanisms to support the establishment of new laboratories in research bodies/institutes, appropriately equipped to meet the needs of R&I priority technologies
Action 2	Provision of financial incentives for creation and/or refurbishment of R&I facilities: → Development of a series of new financial incentives to encourage the investment in R&I facilities

Measure 2	Implementation of exchange programmes among collaborating universities/institutes
Action 1	Establishment of exchange programs → Development of exchange programs among universities at postgraduate level → Encouragement of the process for exchange of students that follow a PhD thesis
Measure 3	Improvement of the qualification and/or skills of the researchers in the energy sector
Action 1	Implementation of capacity building activities related to R&I addressed to academia and research entities → Organisation of workshops, conferences, best practices exchange addressed to scientists and researchers for the enhancement of their ability to meet the needs of supporting and implementing projects in the market field → Resources for the financial supporting of the various capacity building activities (in both public and private sectors)
Axis 2	Strengthening of the synergies and cooperation between research bodies/centres and business
Measure 1	Establishment of a link between the R&I research institutes, universities, the business and the local society to enhance the access to R&I outputs and/or achievements
Action 1	Launching of the link among the research bodies and business actors at regional level: → Suggesting the implementation of various activity programs to be implemented by cooperation between research bodies/institutes and business of the private sector
Action 2	Creation of links between the R&I “community”, business and the local society: → Focus on the entrepreneurial activity, by enhancing the training in it, targeting at more skilled workforce for supporting the higher business development rates → Awareness raising regarding various opportunities for investing in business → More intense involvement of young potential entrepreneurs in the business sector → Facilitation of a frequent coordination between the public and private sector and the research community → Joint undertaking → Exploitation and incorporation outputs from R&I activities within various sectors
Measure 2	Alignment of visions, goals and means for both research institutes and business
Action 1	Elaboration of common lines in training and setting of goals for research institutes and business: → Clear setting of goals and visions for both research institutes and business → Ongoing employee training and development to build and / or improve skills and knowledge for a better alignment with research institutes goals → Enhancement of resources and tools → Regular cooperation and exchange of feedback between research institutes and business
Measure 3	Implementation of awareness events on a two-fold basis on the activities of the research institutes and the business goals and plans
Action 1	Assurance of the necessary means for implementation of awareness events:

	→ Enhancement of funding for the implementation of awareness raising events → Elaboration of tools and mechanisms for the monitoring of the events efficiency
Axis 3	Involvement of the energy sector stakeholders in the business discovery process
Measure 1	Promotion of the partnerships between stakeholders, by supporting advisory and networking actions
Action 1	Establishment of formal communication links: → Establishment of links among a large pool of stakeholders from various fields → Enhancement of knowledge – sharing in all spheres of the market area → Coordination for the limitation of the fragmentation of the domestic R&I landscape
Measure 2	Empowering of the role of all market players in their involvement in projects implementation
Action 1	Enlightening the field for market players/business/enterprises: → Provision of clarity to business enterprises about the future R&I landscape in the fields of energy/environment → Provision of resources for the business sector to contribute to the increase of the activities of those already undertaking R&I initiatives and / or mobilise other companies unfamiliar with this support → Enhancement of public-private partnerships

Measures regarding the local workforce retraining / reskilling

Axis 1	Develop respective training courses to fill the knowledge, skills and competences gap of the existing workforce of the region
Measure 1	Create the respective curriculum, design the training course and identify the trainers' profile
Action 1	Establishing a network of training experts specialized on energy → Creation of a Network of training experts and a focus group of stakeholders from the RES market, in order to define specifically the qualifications of the needed workforce → Creation of a focus group of stakeholders from the RES market, in order to define specifically the qualifications of the needed workforce → The Network and the Focus Group work together in order to define the curriculum and the trainer's profile
Measure 2	Ensure the respective capacity building of the existing VET infrastructures
Action 1	Identify the most suitable VET infrastructures and upgrade them, if necessary → Registry of the existing equipment in the VET facilities in the region (and in selected cities) and of the infrastructures → The training experts Network will decide the suitability of the existing infrastructures and indicate the missing equipment of the laboratories
Axis 2	Up-skill training for engineers or other STEM and non- STEM professionals or even new RES professionals (e.g. in the hydrogen sector)
Measure 1	Develop up-skilling courses and promote master courses for engineers and other RES professionals

Action 1	Action needed in order to: → Engage the network of training experts specialized on energy for the training courses → Engage the respective VET centres for the training courses → Promote the courses in order to get the trainees started.
Action 2	Design Master courses or relevant postgraduate short courses for engineers or other STEM and non-STEM professionals in order to expertise in the RES industry
Axis 3	Informing the regional and national market and the existing and future workforce on the jobs and training/ reskilling potential
Measure 1	Create an informative campaign for schools nationally (e.g. through school vocational guidance) addressing the issue and presenting the upcoming opportunities both in technical and higher education level
Action 1	Prepare a campaign (leaflets and through internet) for youth or people interested in career changing → Prepare the informative material → Sent it to VETs, schools, Professional orientation centres, job finding offices, OAED etc. → Organise info days for youngsters in schools, VETs and other training/ educational institutions
Measure 2	Informing the regional market on the potentials resulting the decarbonized period and era
Action 1	Organisation of a workshop/ conference in the region → Invitation of stakeholders, authorities (from ministries, and regional bodies) and experts (from the scientific and business community) → Presentation of relevant success stories → Analyse of the current and future working opportunities and challenges → Underlying of the benefits of the decarbonization in economical, societal and environmental sectors
Axis 4	Supporting the transition during the reskilling, for both the workforce and the local community/ market
Measure 1	Create initiatives which would enable the existing workforce to attend the training and to choose the appropriate course
Action 1	Activities in support to the provision of training on the needed skills: → Provision of vouchers (for attending the training/ for covering supermarket or other basic needs) → Consultancy service to the workforce for their career reorientation
Measure 2	Provide the local market / community with financial incentives to support the transition through the retraining of the workforce
Action 1	Creating supporting initiatives for the local community in order to assist the decarbonization process: → Provision of benefits to the local companies who are hiring family members of former workers in the coal industry → Provision of vouchers or recognition of contribution to the decarbonization of the region

5 References

- HELLENIC MINISTRY OF ENVIRONMENT AND ENERGY (2019). "National Plan for Energy and Climate", Athens, December 2019, available at: https://ec.europa.eu/energy/sites/ener/files/documents/el_final_necp_main_en.pdf
- TRACER-D6.1 (2021). "Projections for the transition to 2030 / 2050 in the target regions", Brussels, May 2021. Retrieved from https://tracer-h2020.eu/wp-content/uploads/2021/06/TRACER-D6.1_Energy-Projections.pdf
- TRACER-D6.2 (2022). "Research & Innovation strategy in the field of energy for the Region of Western Macedonia", Brussels, January 2022. Retrieved from https://tracer-h2020.eu/wp-content/uploads/2021/09/TRACER-D6.2-4_R&I_Strategy_GR_WMR.pdf
- TRACER-D6.3 (2022). "Report on the needs for workforce retraining", Brussels, April 2022. Retrieved from https://tracer-h2020.eu/wp-content/uploads/2021/09/TRACER-D6.3_Needs-for-workforce-retraining.pdf
- TRACER-D6.4 (2022). "Roadmap for the Region of Western Macedonia", Brussels, May 2022. Retrieved from https://tracer-h2020.eu/wp-content/uploads/2021/09/TRACER-D6.4-Roadmap_WMR_GR.pdf

ANNEX

Region of Western Macedonia Blueprint Benchmark

GREECE

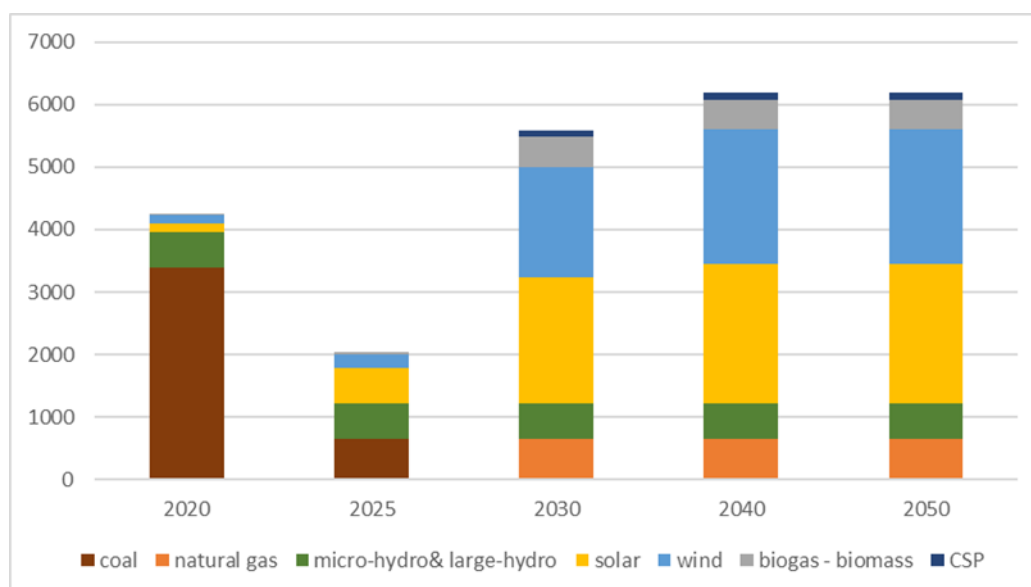
Western Macedonia (EL53)

SURFACE (km ²)	9,451
POPULATION (inhabitants)	268,800 (2019)
GDP PER CAPITA (EUR)	14,284 (2019)



DIRECT EMPLOYMENT IN THE COAL INDUSTRY (power and/or heat generation, mining) (pers.)	7,200 (2018)
UNEMPLOYMENT RATE (%) or UNEMPLOYMENT (pers.)	19.8 % or 21.900 (3 rd semester of 2021)

TIMELINE OF WESTERN MACEDONIA'S ENERGY MIX FORECASTING (MW)



JOB CREATION POTENTIAL DURING THE DECARBONISATION PROCESS

TOTAL ESTIMATED JOBS YEARS 2030/2050	HYDRO	SOLAR PV*	WIND*	BIOMASS	HYDROGEN**
3,637 + 38,700 (H₂) TOTAL= 42,337 / 3,952 +13,370 (H₂) TOTAL= 17,322	209 / 22	2,528 / 2,800	840 / 1,020	60 / 110	38,700 (9,700 direct & 29,000 indirect jobs) / 13,370 (2,970 permanent direct jobs & 10,400 indirect)

* SOLAR PV & WIND: Manufacturing *not* included

** HYDROGEN: According to the "White Dragon" project proposal

WMR ENERGY TRANSITION TIMELINE

YEARS	PRIORITY MEASURES / AREAS	CONCRETE KEY ACTIONS	SERVICES	MILES TONES
2030	Creation of new and reconstructing of existing R&I facilities	Establishment of new laboratories Provision of financial incentives for the creation and/or refurbishment of R&I facilities	R&I facilities	Coal phase out
	Implementation of exchange programmes	Establishment of exchange programs among collaborating institutes	Universities/ Institutes	
	Improvement of the qualification and/or skills of the researchers in the energy sector	Implementation of capacity building activities related to R&I addressed to academia and research entities	Academia and Research entities	
	Establishment of a link between the research institutes, business and the local society to enhance the access to R&I outputs and/or achievements	Launching of the link among the research bodies and business actors at regional level Creation of links between the R&I "community", the business and the local society	Research institutes, universities, the business and the local society	
	Alignment of visions, goals and means for both research institutes and business	Elaboration of common lines in training and setting of goals for research institutes and business	Universities/Institutes	
	Implementation of awareness events on a two-fold basis on the activities of the research institutes and the business goals and plans	Assurance of the necessary means for the implementation of awareness events	Research Institutes/ Business	
	Promotion of the partnerships between stakeholders	Establishment of formal communication links	Stakeholders	
	Empowering of the role of all market players in their involvement in projects implementation	Enlightening the field for market players/business/enterprises	Stakeholders	
	Create the respective curriculum, design the training course and identify the trainers' profile	Establishing a network of training experts specialized on energy	VET & trainers	
	Ensure the respective capacity building of the existing VET infrastructures	Identify the most suitable VET infrastructures and upgrade them, if necessary (f.i., providing the laboratories with the necessary equipment)	VET	
	Develop up-skilling courses and promote master courses for engineers and other RES professionals	Engage the network of training experts specialized on energy for the training courses Engage the respective VET centres for the training courses Promote the courses to get the trainees started Design MSc or postgraduate short courses for engineers or other STEM and non-STEM professionals to expertise in RES	VET & Universities/ research institutes	
	Create an information campaign for schools to present the upcoming opportunities	Prepare a campaign (leaflets / through internet) for youth or people interested in career changing both in technical and higher education level	Education system	
	Informing market on the potentials resulting the decarbonized era	Organisation of a workshop/ conference in the region	Local society	
	Create initiatives which would enable the existing workforce to attend the training and to choose the appropriate course	Provision of vouchers (for attending the training/ for covering supermarket or other basic needs) Consultancy service to the workforce for their career reorientation	State	
	Provide the local market / community with financial incentives to support the transition through the retraining of the workforce	Provision of benefits to local companies who hire family members of former workers in coal industry Provision of vouchers or recognition of contribution to the decarbonization of the region	State	
2040	Update the training courses and identify the trainers' profile	Update of the network of training experts specialized on energy	VET & trainers	
	Develop/update the up-skilling courses and promote master courses for engineers and other RES professionals	Implement & promote the up-skilling courses Design & implement MSc or postgraduate short courses for engineers or other STEM and non-STEM professionals to expertise in RES	VET & Universities/ research institutes	
2050	Update the training courses and identify the trainers' profile	Update of the network of training experts specialized on energy	VET & trainers	
	Develop/update the up-skilling courses and promote master courses for engineers and other RES professionals	Implement & promote the up-skilling courses Design & implement MSc or postgraduate short courses for engineers or other STEM and non-STEM professionals to expertise in RES	VET & Universities/ research institutes	