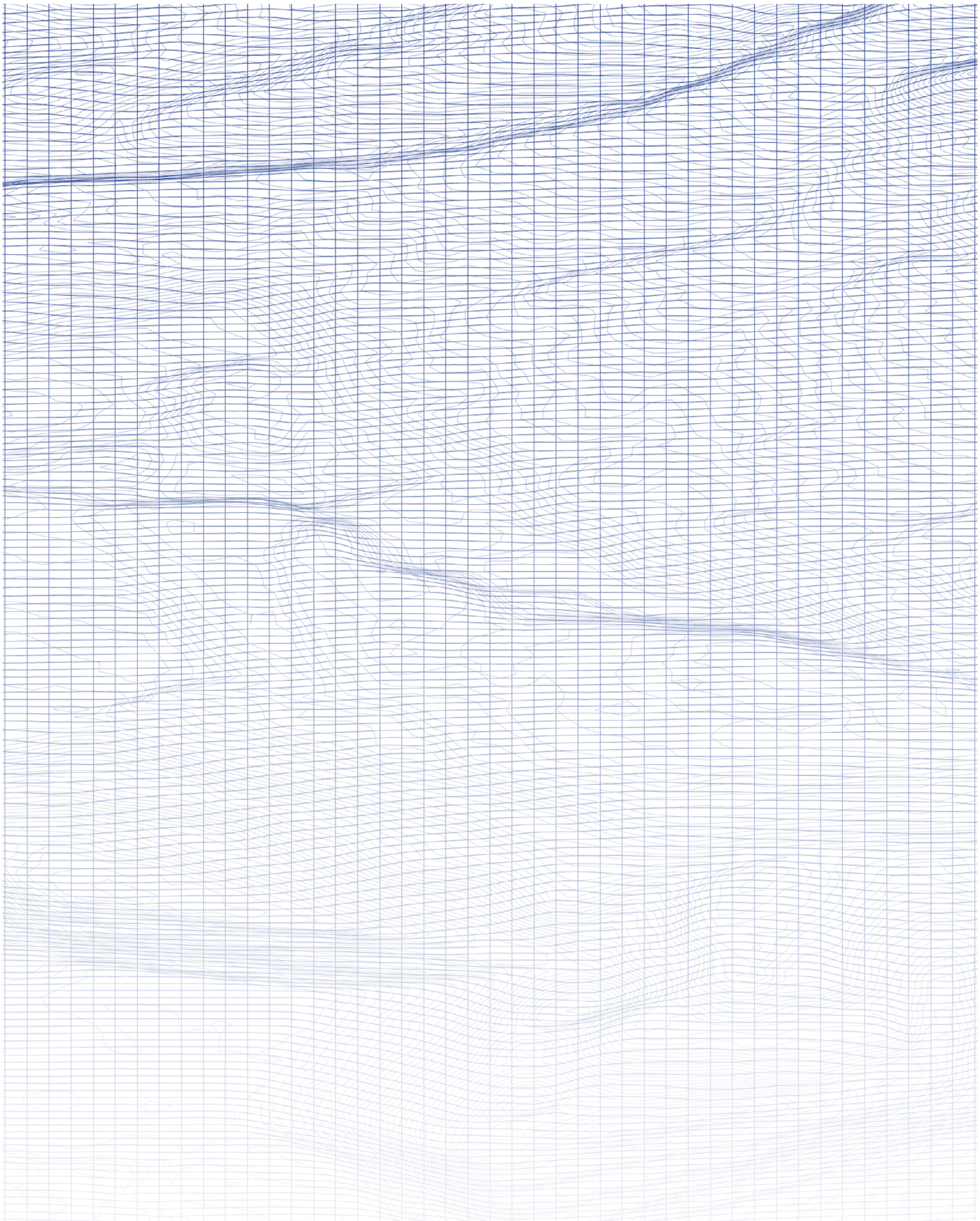


LANDSCAPES OF POWER

re-configuring the energy production landscape of western macedonia

anna kalligeri skentzou

COLOFON

Master thesis P5 report

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All the drawings in this thesis are drawn by the author
All the photographs in this thesis are taken by the author unless stated otherwise

Figure 01. *Expansion of solar park on the pastures of Western Macedonia*
Source: author

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Every thesis is a journey, and in this journey, even though it often felt like it, I was never truly alone. For this reason, I would like to express my sincere gratitude to the people who encouraged me along the way.

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Figure 02. *Miners collectively pulling a hose*
Source: Economopoulos & Elektrismou (1998)

ABSTRACT

The beginning of the 21st century is defined by geopolitical tensions around resources, an expected shortage of fossil fuel resources and the emerging climate crisis, amplifying the urgency of the transition to renewable energy sources. This energy transition has been at the forefront of public discussion, framed by the 2016 Paris Agreement and the 2019 European Green Deal. In this context, European member states must accelerate the decarbonisation of their industries and the transition to renewable energy sources. As each member state attempts to deal with this challenge, issues associated with social and spatial justice in coal-intensive European regions arise, calling for a coordinated, inclusive and collaborative plan aiming at a just transition.

This thesis uses the coal intensive region of Western Macedonia as a case study and proposes the reconfiguration of the energy landscape by formulating a territorial vision, based on an analysis and the evaluation of scenario building. More specifically, it develops a series of spatial and non-spatial strategies aimed at restoring ecological integrity, diversifying the energy production, re-using heritage spaces and promoting governance collaboration and social inclusivity. By examining the vulnerabilities, potential, and opportunities present in the territory of Western Macedonia, this thesis seeks to promote the reconfiguration of Western Macedonia, embracing principles of regenerative development, adaptive re-use, participatory planning and collaborative governance.

Key words : energy transition, energy landscape, Western Macedonia, regional design, Adaptive re-use



Figure 03. *The energy landscape of the Western Macedonia*
Source : author

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FOUNDATIONS

Without a sense of touch

without men

in a country that is no longer ours

nor yours.

George Seferis, Mythistoremata

(Seferis, 1927)

MOTIVATION

Personal

Coming from Greece, a neoliberal country that has been deeply affected by a series of crises, I have witnessed the effect that the absence of inclusive and effective planning can bring to society and the environment, namely the exploitation of local communities and the appropriation of nature. The current energy transition, along with the current energy crisis, marks a new era of uncertainty for Greek society and calls for the urgent creation of an adaptable framework of action to reshape our current energy production system to sustain life in the future. On the one hand, the spatial component of the energy transition amplifies issues regarding environmental justice and the rights of nature, and additionally, the uncertainty of the energy crisis uncovers social justice issues regarding the treatment of dependent communities.

Professional

The spatial and societal aspects of the current energy transition mark a challenge that demands an approach to spatial planning that aims to reconstruct the current energy production system by minimising the costs and burdens on social and ecological systems. This transition process requires a new conceptualisation of energy landscapes through redefining existing relations of exploitation and seeking to find synergies between man-made and natural systems and processes.

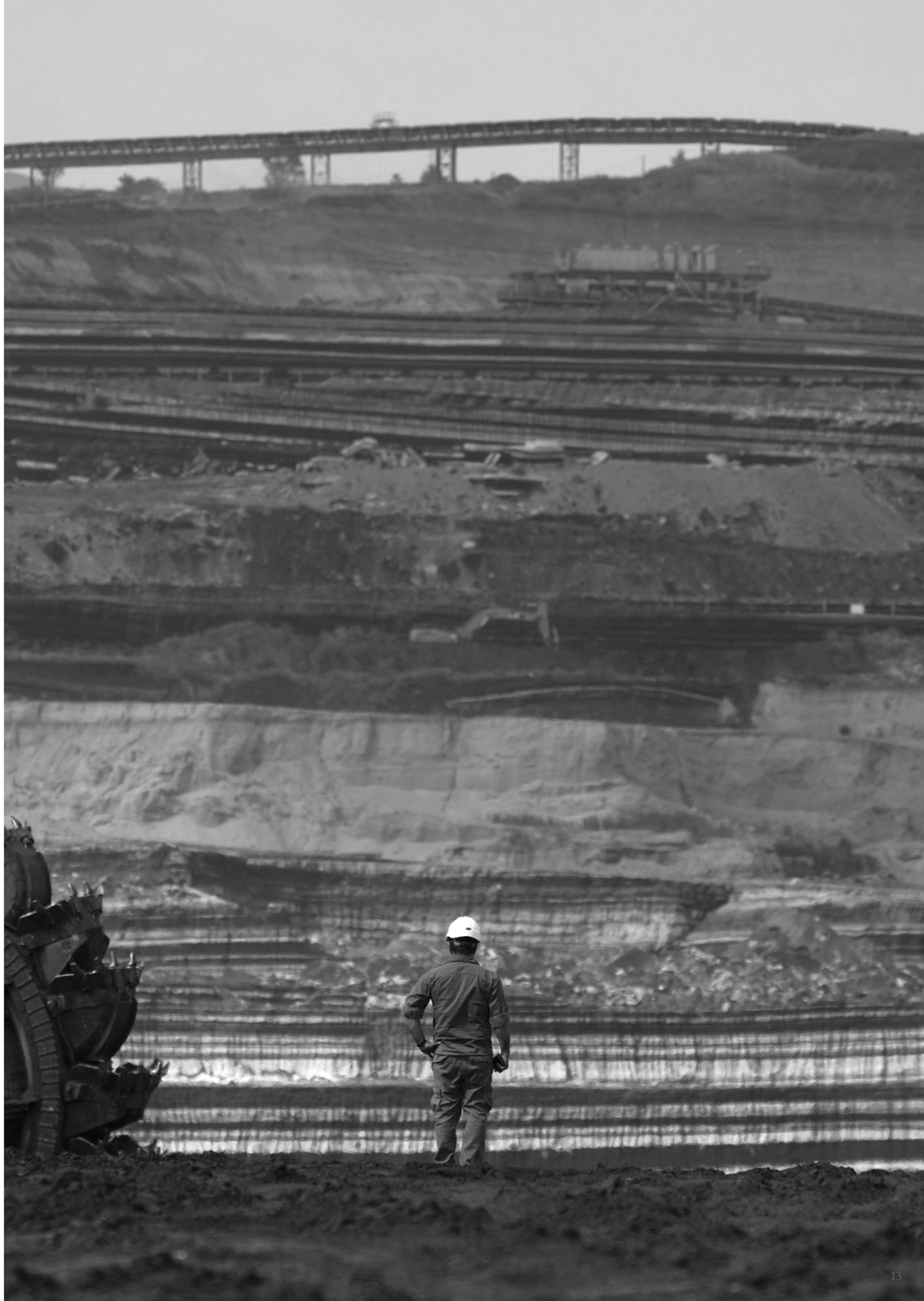


Figure 04. *Head coordinator of the South Field facing excavation equipment in the Lignite center of Western Macadonia*
Source: Stavrakis (2022)

PROBLEM FIELD | DEPENDENCIES, EXPLOITATION & ENERGY TRANSITION

Fossil Dependencies

At the start of the 21st century, the global energy production system is still part of the fossil fuel regime that was shaped during the period of Great Acceleration through the reorganisation of global supply chains and socioeconomic systems around this cheap, finite energy resource (Moore, 2015, p. 33). During this period, the exploitation of this resource enabled an energy intensivesive global urbanisation, connecting urbanised regions to remote productive landscapes, resulting in the duality of the speeding of climate change and degradation of ecological systems (Sijmons et al.,2014, p. 11). As a result, our urban environments, the global transportation systems, the resource extraction (food, minerals, energy) are all dependent on fossil fuel-based systems. (Sijmons et al.,2014, p.45)

Energy Transition

However, the current system of energy production is neither just nor sustainable. The climate crisis is a direct product of the current planarity dependency on fossil fuels, with the overexploitation of available fossil resources stressing the unsustainability of the prevailing energy regime. As these issues intensify, it is becoming clear that the transition from fossil fuels to renewable energy resources is an urgent necessity (Sijmons et al.,2014, p. 11). This Energy Transition, as contextualised by the Paris Agreement (2015) and the European Green Deal (2019), needs to re-invent spatial relations between energy production systems (Sijmons et al.,2014) and ensure social and spatial justice for involved parties (Ministry of the Environment and Energy, 2019).

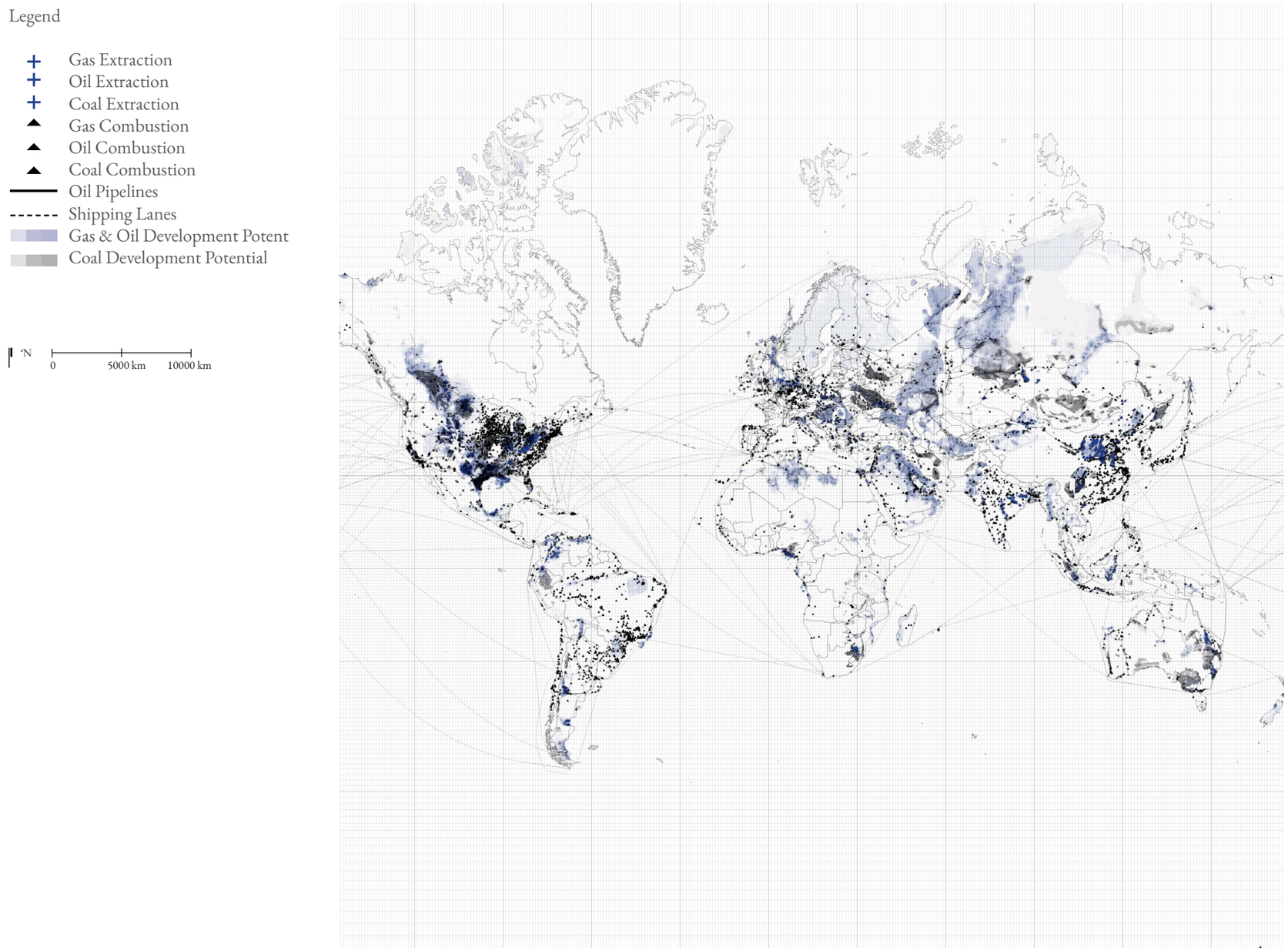


Figure 05. *Fossil Fuel Energy Regime Footprint*
Source: Global Energy Monitor (2022a), Global Energy Observatory et al. (2020), Oakleaf et al. (2019)

PROBLEM FIELD | ENERGY LANDSCAPES

Energy Landscape

The current mode of human urbanisation has resulted in the creation of agglomeration zones whose material needs are met through the operationalisation of non-city regions (Brenner et al., 2020). This process has resulted in the planning, functionalisation and operationalisation of regions and their integration into planetary systems of supply chains (Brenner et al., 2020). In the case of energy production, the process of operationalisation has resulted in the formation of distinctive energy landscapes (Sijmons et al., 2014, p.15). Energy landscapes can be described as: "observable landscapes that originate directly from the human development of energy resources" (De Jong & Stremke, 2020). According to the process they host, they can be further classified into landscapes of (resource) extraction, (energy) conversion, transport, storage and consumption (Sijmons et al., 2014).

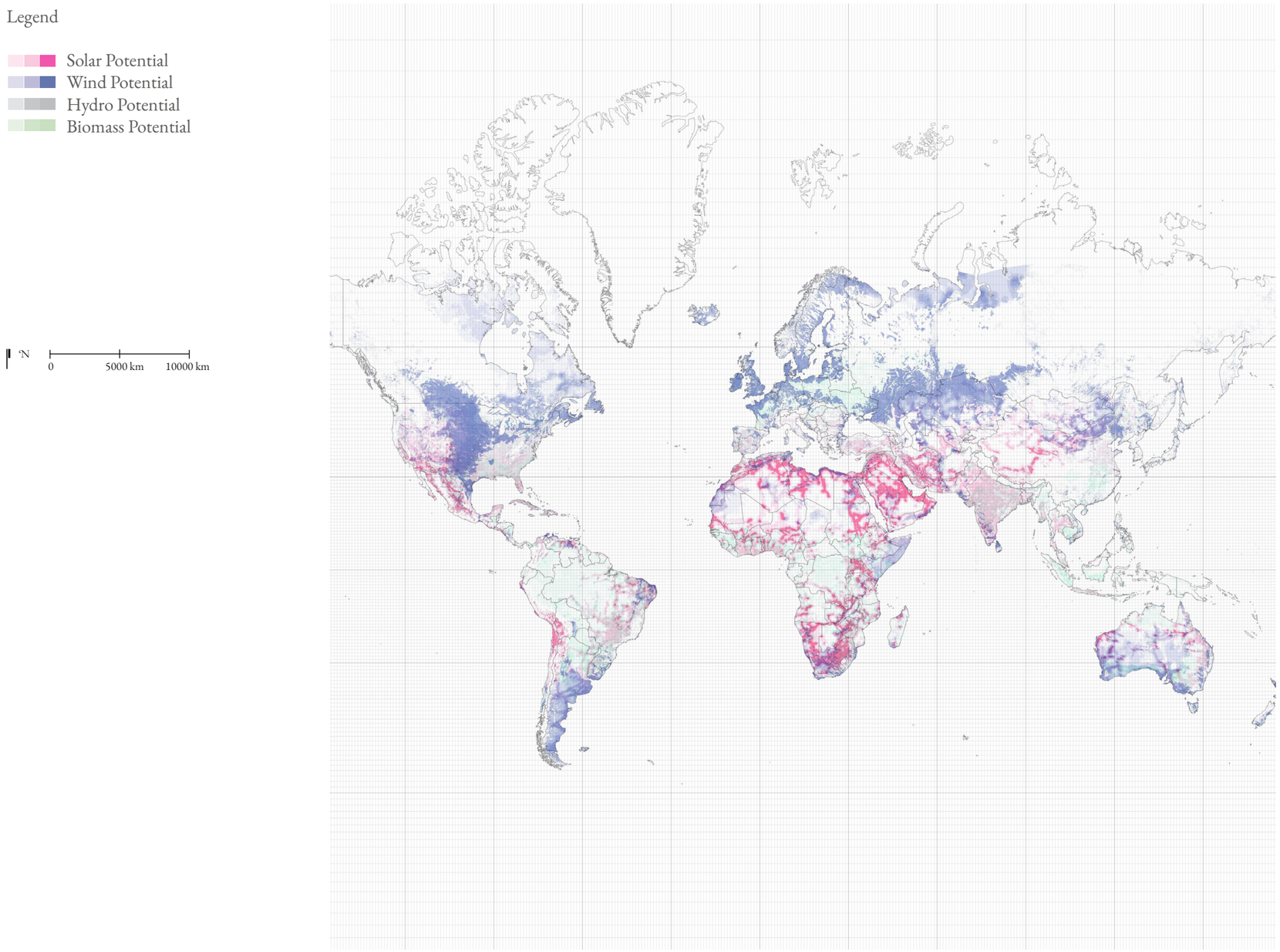


Figure 06. *Future Renewable Energy Regime Footprint*
Source: Global Energy Monitor (2022a), Global Energy Observatory et al. (2020), Oakleaf et al. (2019)

PROBLEM FIELD | ENERGY LANDSCAPES

Spatial Dimension

The energy transition is the transition of a system, with a spatial component determined by the energy source. Each energy source has a different spatial claim associated with the area required for raw materials, infrastructure, waste and extraction area (Sijmons et al., 2014). In general, renewable energy sources require 100-1,000 times more space than fossil fuels, as they generate less energy per square meter of land occupied (Smil, 2016). Additionally, renewable energy sources require different types of space, whose geomorphology holds a high potential for renewable energy extraction. Subsequently, the energy transition will increase the footprint of energy production systems and generate negative impacts on natural and agricultural systems.

Social Dimension

As the current global energy system primarily relies on fossil fuels, the dominant energy landscapes are associated with nodal points of oil, gas and coal extraction and conversion, which often occupy minimal space. Renewable energy resources require different spatial configurations, often expanding close to urban regions or on natural landscapes. Therefore, their implementation requires a shift in the contractual landscape and is thereby met with reservations and barriers from local communities (Pasqualetti, 2011).

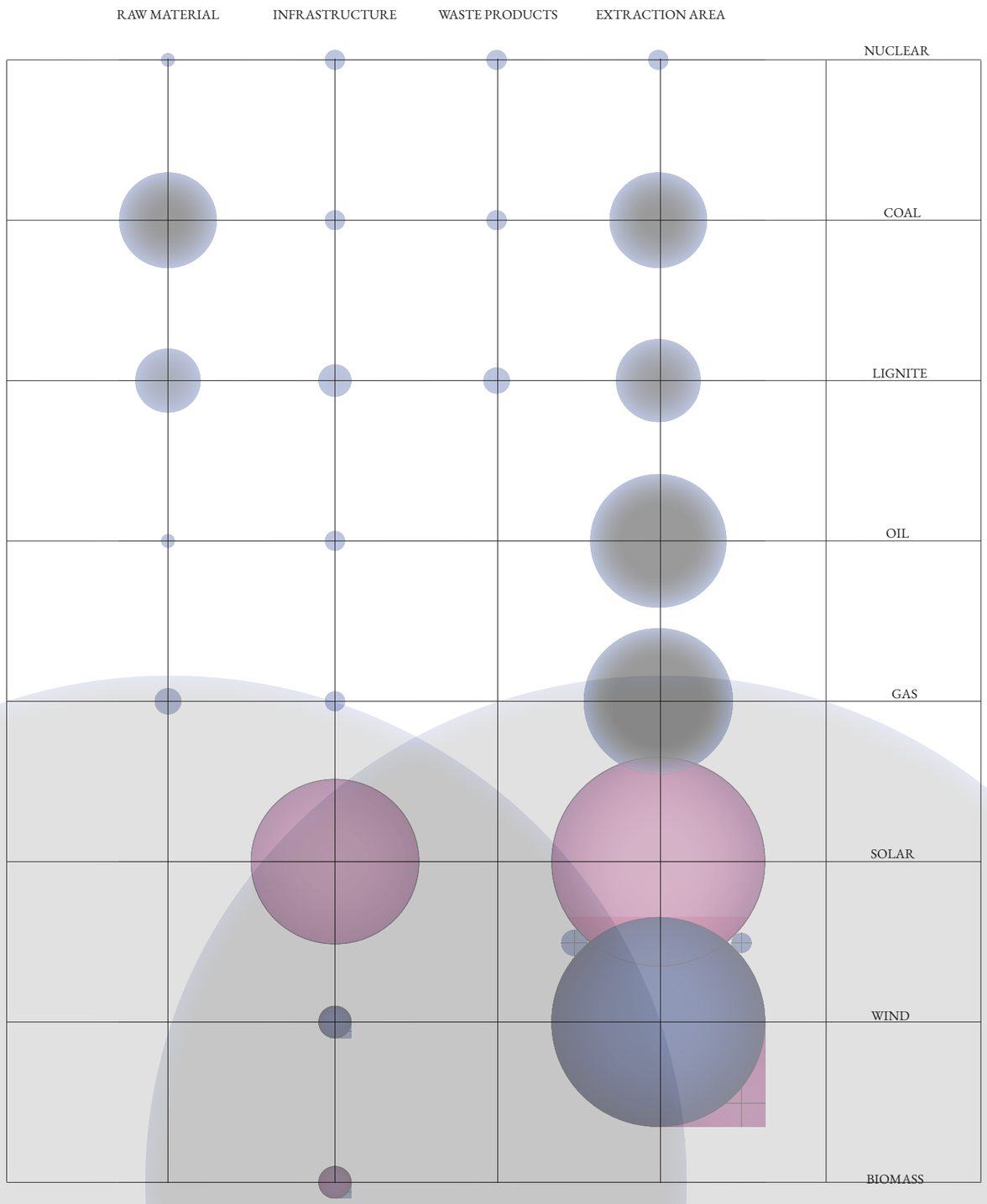


Figure 07. *Energy landscapes resource matrix.*
Source: Sijmons (2014)

PROBLEM FIELD | EUROPEAN ENERGY TRANSITION

European Dependency on Fossil Fuels

The page to the right shows the density of landscapes of extraction and conversion of carbon, lignite, oil and gas in Europe, Central and West Asia, along with the imports of fossil fuels and the number of imports for each country. When taking into account the fact that approximately 45% of the energy generated in the EU is based on fossil fuels and 60% of the required resources are imported, the dependency of the EU becomes clear. Additionally, the energy transition of the EU will affect both within and across its borders, resulting in the exposure of local communities.

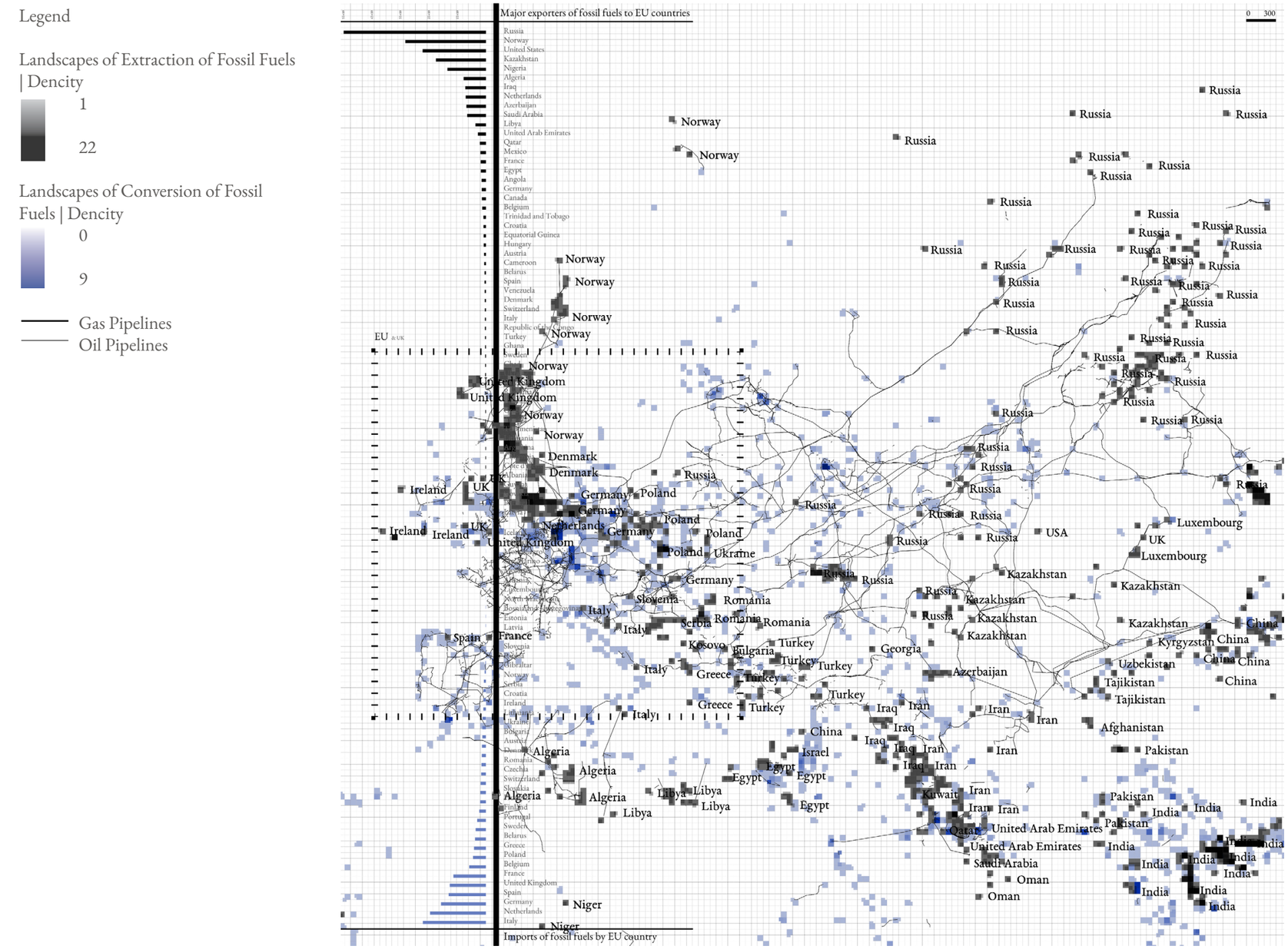


Figure 08. *Landscapes of Extraction and Conversion of Fossil Fuels | Focus on Europe & Central Asia*
Source: Geofabrik Download Server (2022) , Global Energy Monitor (2022a), Global Energy Observatory et al. (2020), Oakleaf et al. (2019)

PROBLEM FIELD | EUROPEAN ENERGY TRANSITION

Just Transition in Europe

Taking the baton from the Paris Agreement of 2015, the EU proposed spending 25% of its budget to serve climate targets. In December 2019, the European Green Deal set targets to reduce greenhouse gas emissions by at least 55% by 2030 and to achieve climate neutrality by 2050 (Topaloglou, 2021, p.12). This political decision required intensive socioeconomic transformations of regions within the EU associated with the extraction and conversion of fossil fuels. To accelerate and facilitate the structural change of these 41 coal-intensive regions of the EU-27, the European Commission introduced the Just Transition Mechanism, a founding tool aimed at the transition of the coal-intensive regions to a cordon-neutral economy.

The Just Transition Fund

The Just Transition Fund was set to be distributed unevenly among EU 41 carbon-intensive regions and was directed toward specific development pillars associated with the regeneration of the carbon-intensive regions and their economy. To use the resources of the Just Transition Fund, EU Member States were required to present detailed Territorial Just Transition Plans for each region in transition. These plans had to address the areas that are most affected, both economically and socially, by the transition to climate neutrality, be compatible with the National Energy and Climate Plans (NECPs), and be linked to the elimination of greenhouse gas-intensive activities such as the retirement of lignite and coal units. Additionally, EU Member States had to introduce a system of governance and stakeholders' involvement in the preparation, implementation, monitoring, and evaluation of the plans.

The utilisation of this resource is particularly urgent in Greece, primarily for two reasons. First, the country affected by the 2008 global financial crisis and the 2011 Greek financial crisis was left with limited social and economic resources to cover the monetary expenses of the transition. Second, the energy production of coal is dependent on the exploitation of lignite resources in the two coal regions. In the following section, these two issues are further expanded.

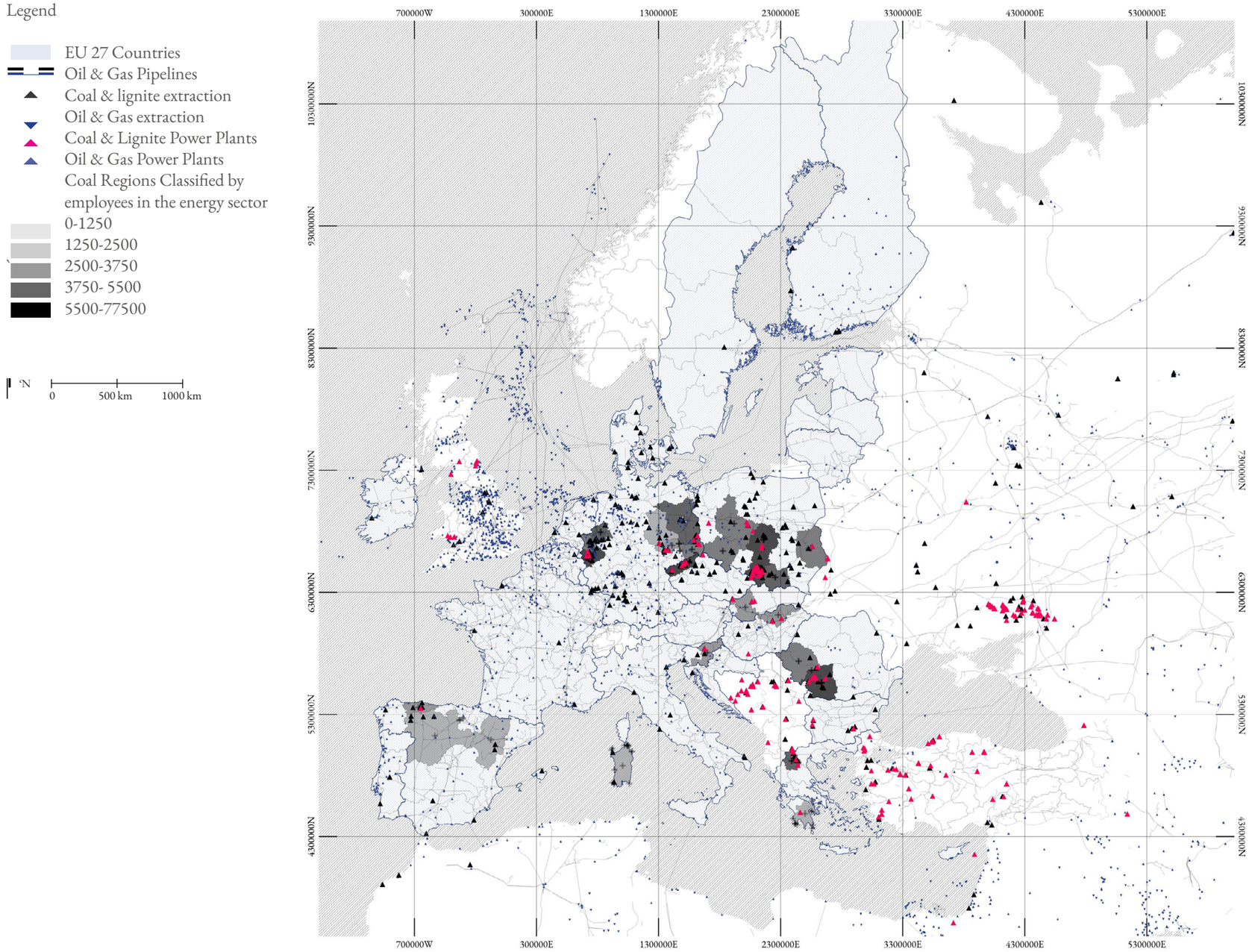


Figure 09. *Landscapes of Extraction and Conversion of Fossil Fuels | Focus on Europe & Central Asia*
Sources: Geofabrik Download Server (2022) , Global Energy Monitor (2022a), Global Energy Observatory et al. (2020), European Environment Agency (2018), Patricia et al. (2018)

THE SITE | ENERGY IN GREECE

Appropriation & Exploitation

At the end of the Second World War, the energy system in Greece was dependent on nodal points of oil-based power stations. In 1950, the Greek government founded the Public Power Corporation (PCC), intending to implement a national policy striving to create a national, uniform public energy network based on domestic resources to meet the increasing energy demand of the industrialisation and urbanisation of the country (Lamprou, 2010, p.26).

The demand for cheap energy was met through the intensive exploitation of domestic lignite resources. The established geologic lignite reserves in Greece are approximately 5 billion tons, spread across the country's territory. However, the "economically minable reserves" that could be exploited for energy purposes reached approximately 3.4 billion tonnes and were located in the high-altitude basins of Western Macedonia and Arcadia (Lamprou, 2010, p.29). The most important area was located in Western Macedonia, in the Kozani - Ptolemaida - Amyntaio - Florina axis, reaching approximately 2.8 billion tonnes, and the second most important area of concentrated resources is the Megalopolis region in Peloponnese, reaching approximately 223 million tons. (Lamprou, 2010, p.29) Gradually, the extraction of lignite began, and thermal power plants were constructed. By 1970, the two remote regions of Western Macedonia and Arcadia were completely integrated into the national energy system, supplying the majority of electricity for the urbanised regions.

Therefore, through the operationalisation of these areas, the need for cheap energy was met. Lignite became the primary fuel that supported the urbanisation and industrialisation of Greece and remained the main fuel for approximately 50 years until the beginning of the delignitasation period in 2016. During this period, the continuous extraction of lignite resulted in significant repercussions on the economic, social and ecological structure of these regions. In 2016, higher taxes on lignite-produced energy, along with the connection of Greece to gas infrastructure, resulted in the beginning of a slow process of de-lignification and a shift to gas.

The following section further analyses the issue of structural change and de-lignification, focusing on Western Macedonia, the region that underwent the greatest transformation.

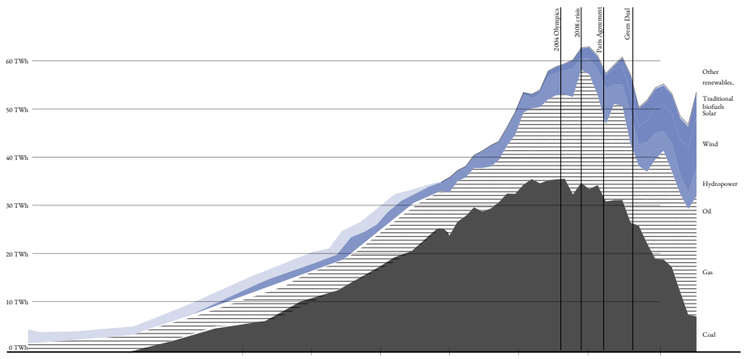


Figure 10. *(left) Energy Production by source*
Sources: Ember's Yearly Electricity Data et al. (2022)

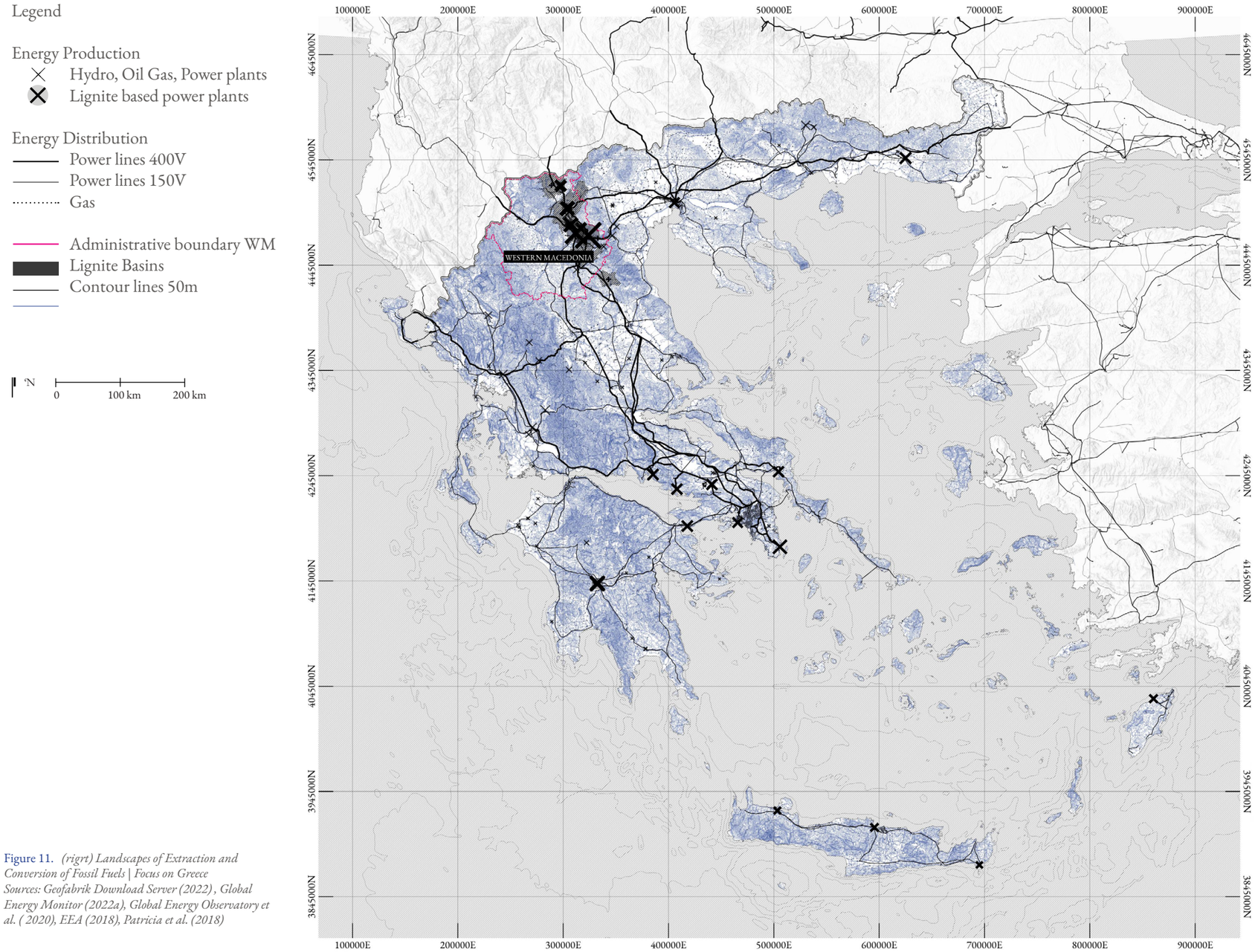


Figure 11. *(rigrt) Landscapes of Extraction and Conversion of Fossil Fuels | Focus on Greece*
Sources: Geofabrik Download Server (2022) , Global Energy Monitor (2022a), Global Energy Observatory et al. (2020), EEA (2018), Patricia et al. (2018)

THE SITE | WESTERN MACEDONIA | SOCIO-ECONOMIC CONDITIONS

The Region of Western Macedonia is a rural area located in the Northwest part of Greece, bordering Albania to the west and North Macedonia to the north. It covers an area of 9,451 km2, which accounts for 7% of the country's total area and is the only region in Greece not bordering the sea. The region contained 60% of the lignite reserves in the country, 40% of which has been already mined (WWF,2015, p.18).

Economic Structure

The organisation of the Region of Western Macedonia in an energy centre brought important changes in the economic structure. More precisely, the region shifted from agricultural to industrial production. In 2016, at the peak of lignite activity in the region, the mining and energy sectors generated 45% of the region's GDP, while the agricultural sector was only 6% (WWF,2016, p.18).

More precisely, the primary sector gradually shrank due to the loss of land value. The secondary sector was dominated by the mining and energy industries. Finally, the tertiary sector shrank due to the economic crisis (Karasmanaki et al., 2020). This resulted in a "monoculture" economy in the region, leaving it susceptible to change. Thereby, the region's economy became closely intertwined with the economy of the lignite, as illustrated by Figure 14 below.

Unemployment

Western Macedonia is one of the least populated regions in Greece and has been in a demographic decline since the beginning of the mining operations in 1956. The population of WM has shrunk by 19.5 % between 1961 and 2021, from approximately 317,700 to 255,000 residents. Additionally, the reallocation of the residents inside the region resulted in the accumulation of most of the residents in the area around urban centres like Kozani and Ptolemaida, as illustrated in Figure 11 to the right.

The shrinking of the lignite economy since 2016, has increased unemployment. More precisely, the unemployment rate is the highest in Greece, and one of the highest in Europe, reaching 20.3% in the working population and 46 % among young people.



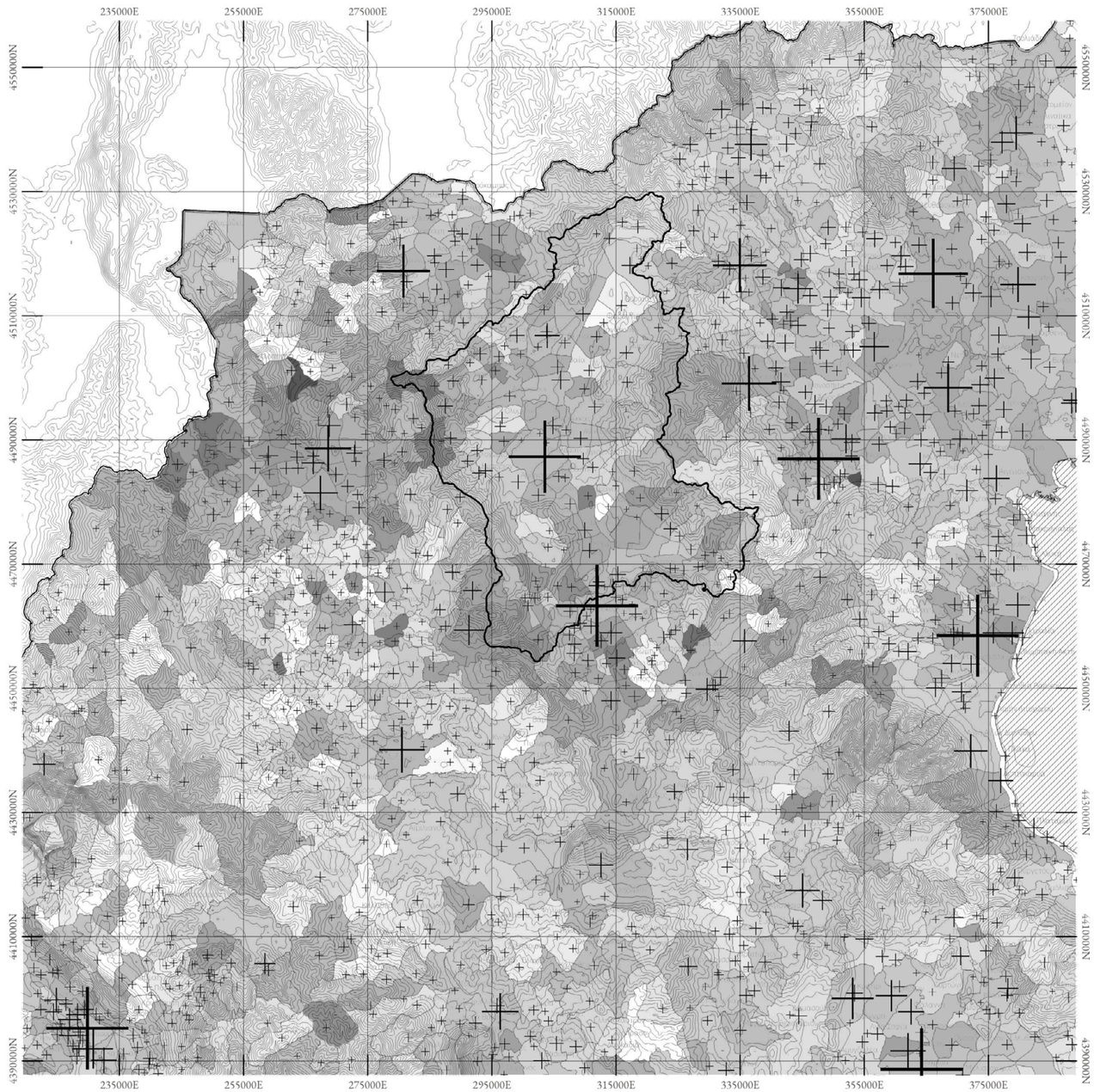


Figure 13. *(right) Population per Settlement and unemployment in Western Macedonia*
Sources: Geofabrik Download Server (2022) , ELSTAT, EEA (2018)

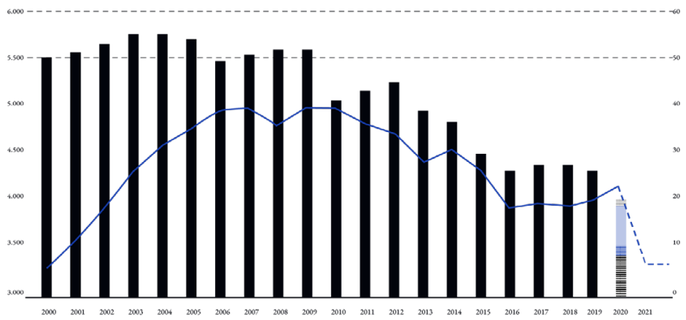


Figure 12. *(left) GDP in Western Macedonia*
Source: SDAM (2020a)

WESTERN MACEDONIA | ENVIRONMENTAL CONDITIONS

The expansion of the mining and energy sector in the region of western Macedonia had serious repercussions on the environment and the landscape of the region, specifically, the vegetation and the water structure.

First, primary landscape alteration is related to the lignite extraction process. The Lignite Centre of Western Macedonia employs open-pit mining practices and a continuous extraction method. This process results in the loss of topsoil with organic carbon and active biological processes that requires significant effort of remediation.

Second, the primary environmental issue is related to air pollution, released through the process of mining and PCC power plants and the LCWM, as illustrated in Figure 14 to the right. According to data, the European limit values were exceeded by more than 20% at 10 out of the 15 measuring stations in the Prefectures of Kozani and Florina (WWF, 2016, p.11).

In addition, lignite-fired plants have a significant impact on local water resources. More precisely, to cover the water needed for industrial purposes, PPC pumps from local water sources. In 2016, the water used for industrial purposes reached 72 million cubic meters, double the size of water for residential use. Additionally, to prevent flooding of the mines, the local aquifer is pumped out, resulting in a drastic decrease in the water level in the vicinity of the mines in Ptolemaida. Finally, water quality is affected by the heavy metal pollution load.

Concerning public health, no official epidemiological research has been conducted on the impact of air pollution on the health status of local residents, even though lignite-fired plants and lignite mines have operated in the region for over 60 years. Nevertheless, in three villages in the region, deaths from thromboembolic events in 1992-2013 rose from 43% to 55% (WWF, 2016, p.22).

Finally, the shrinkage of available arable land through land extrapolations, along with the lowering of the water body, has resulted in the intensification of agriculture through the use of fertilisers and intensive irrigation systems, amplifying issues of water shortage and chemical and ecological quality of open water bodies.

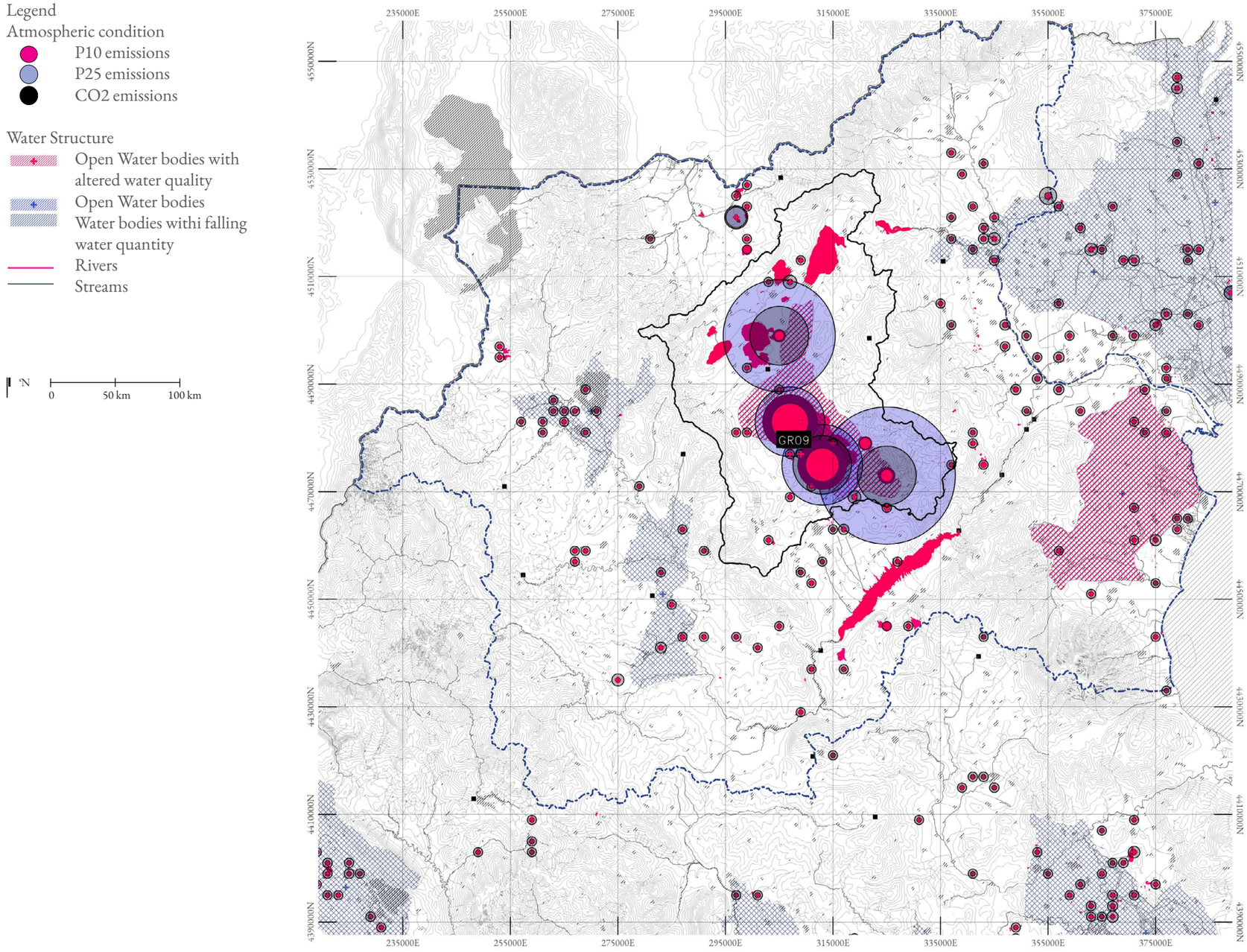


Figure 14. *Environmental Conditions in Western Macedonia*
Sources: Geofabrik Download Server (2022) , EEA (2018), SDAM (2020a), WWF (2015), MME (2014)

WESTERN MACEDONIA | RENEWABLE ENERGY EXPANSION

Since the 2016 Paris Agreement, energy production based on coal and lignite has become increasingly less profitable for energy companies. For this reason, in recent years, there has been a spike in the development of the renewable energy infrastructure within the territory of WM.

Because of the rapid development of renewable energy projects and the top-down approach of this expansion, the regional council of Western Macedonia decided to halt all new renewable energy infrastructure development in 2021 until a comprehensive spatial plan for the transition is developed (Todorović, 2021). More specifically, local governance actors demanded the final publication of the spatial plan and the environmental approval of the plan before any new development was carried out (Pitsiavas, 2021). At this point, it is important to mention that the region of western Macedonia is one of the few regions in Greece that have not had an updated and environmentally approved spatial plan since 2003. Consequently, the new land use transformations that are currently taking place are happening without any spatial consideration and are enabled and expedited because of the lack of a clear set of spatial instructions on the logic of renewable energy infrastructure development.

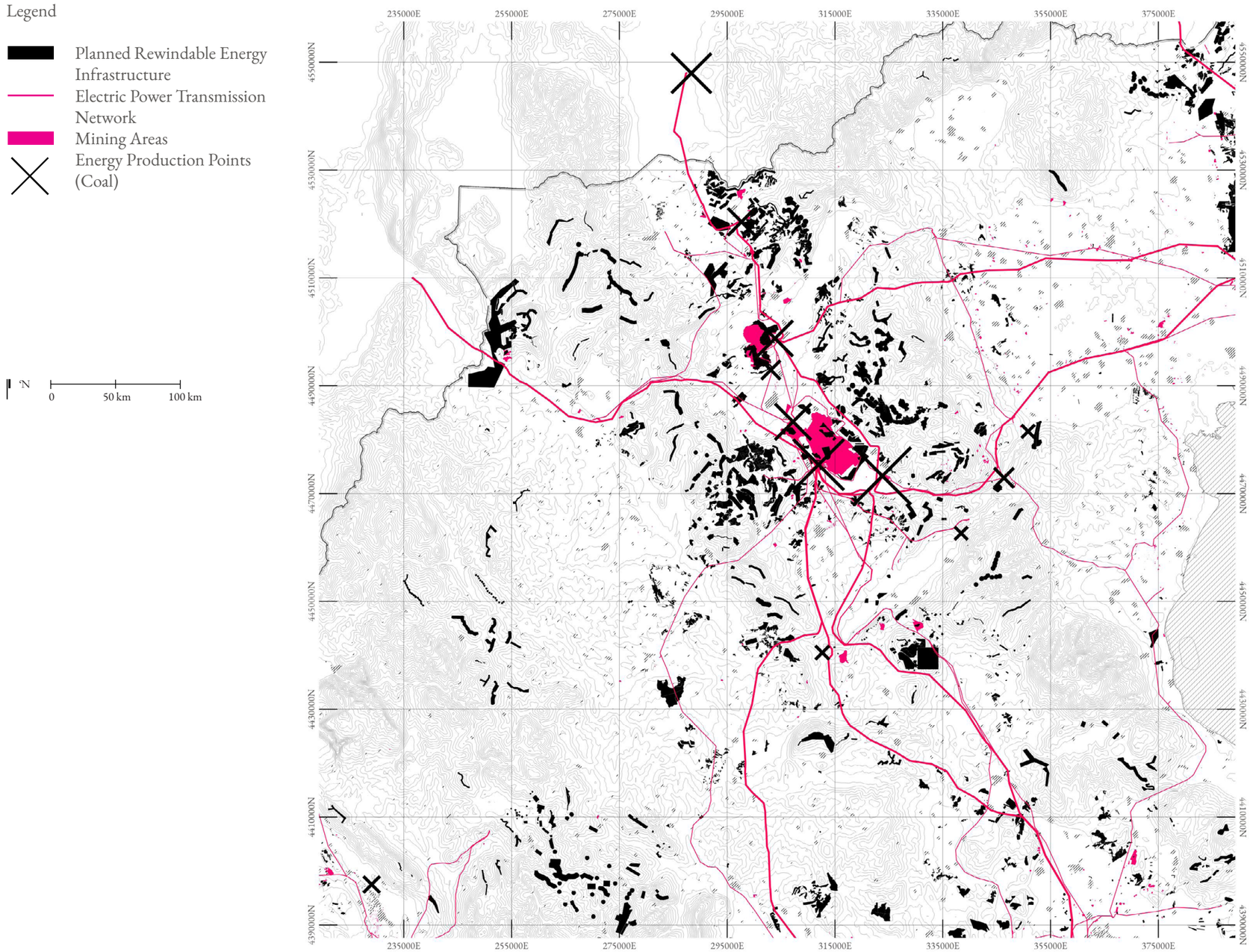


Figure 15. *Renewable energy infrastructure expansion in Western Macedonia*
Sources: Geofabrik Download Server (2022) , RAE (2021)

WESTERN MACEDONIA | NEGLECTED HERITAGE

As previously addressed, the necessity for European Coal regions lies in the decarbonization of their energy sectors. Consequently, numerous areas currently dedicated to energy production will soon become obsolete, leaving behind spaces that can be broadly categorised as various mining sites, thermal power plants, industrial railway networks, natural landscapes such as mining deposits and forests, the altered water network, as well as administrative and auxiliary buildings and infrastructure associated with the mining and energy sectors.

However, these spaces hold a significant place in the collective identity of the region. Some of them, due to their enduring presence, have integrated themselves as elements of the landscape. Given the profound, divisive and historical role of mining in these territories, they represent distinct notions for different members of the community, embodying collective memory and the history of the region. As the presses of shrinkage and withdrawal have already stated in Western Macedonia, discussions have commenced contemplating the future of these spaces.

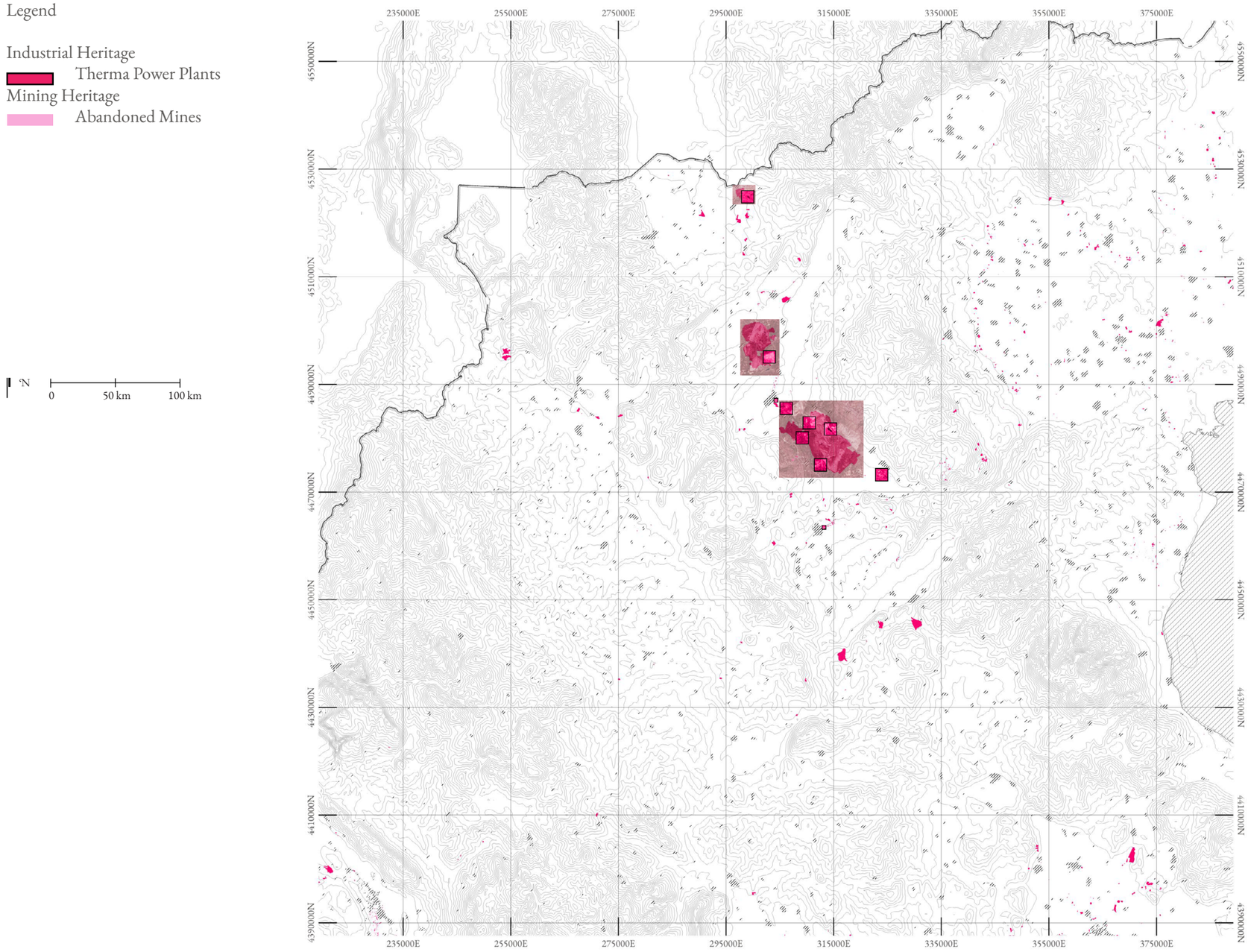


Figure 16. *Mining and IndustrialHeritage*
Sources: Geofabrik Download Server (2022) , , EEA (2018), Google Maps

WESTERN MACEDONIA | GOVERNANCE & POLICIES

The Greek Just Transition Plan

In September 2019, The Greek Prime minister announced the complete independence of Greece from lignite by 2028, making Greece a frontrunner in the European Union in regards to decarbonising its energy production, making the first lignite-producing country that defined a clear date for phasing out lignite before 2030 (Topaloglou, 2020, p.68). In November 2019, the Ministry of Environment and Energy published a revision of the National Energy and Climate Plan (NECP), which set out even more ambitious goals in relation to the phasing out of lignite and the depletion of renewables. In addition, the 2019 PCC Business plan set 2023 as the official date for the closure of all its existing lignite mines and power plants (Green Tank, 2020, p.12). From 2023, only one of the six lignite power plants, Ptolemaida V, will remain in operation.

Naturally, the decision to phase out lignite earlier further magnified the challenges the lignite regions were facing (Green Tank. 2020, p.11), resulting in social unrest in local communities and authorities, as a comprehensive plan for the "Just Transition" of the regions did not exist yet. It is important to note that from 2015 to 2018, the National Just Transition Fund had already been established, which was basically a pledge for the future allocation of national and European funds to transition the lignite areas to a "carbon neutral economy."

In January 2020, an inter-ministerial phase-out committee was established in order to draw a preliminary Just Transition Plan (SDAM) (Green Tank, 2020, p. 111). This task was assigned to a Steering committee, which included representatives from different Ministries, the Governors of the regions of Western Macedonia and Megalopolis and the CEO of PPC. It is important to emphasise that the mayors of the five energy municipalities and representatives of the employees and the residents were absent from this committee. In May 2020, a Technical committee was established with an advisory role in relation to the investment proposals and development plans. Finally, in June 2020, SDAM commissioned a team of consultants to prepare the first draft of the Just Development Transition Plan (Masterplan) along with Territorial Just Transition Plans for the region of Western Macedonia and Arcadia (Topaloglou, 2021, p. 69).

Conclusions

In the following months, the Master plan and the Territorial Just Transition Plans were published, following the axis set by the EU to the t, and describing the development of the region of WM as a new "green" energy, circular and innovation centre. Today, their implementation has begun; however, the exclusion of representatives from the local communities in the committees and the lack of their incorporation in the planning process raises issues regarding distributive and procedural Justice. Additionally, when taking into account the aforementioned spatial component of the energy transition, the need for a spatial investigation of the implementation of the Master Plan becomes an urgent necessity.

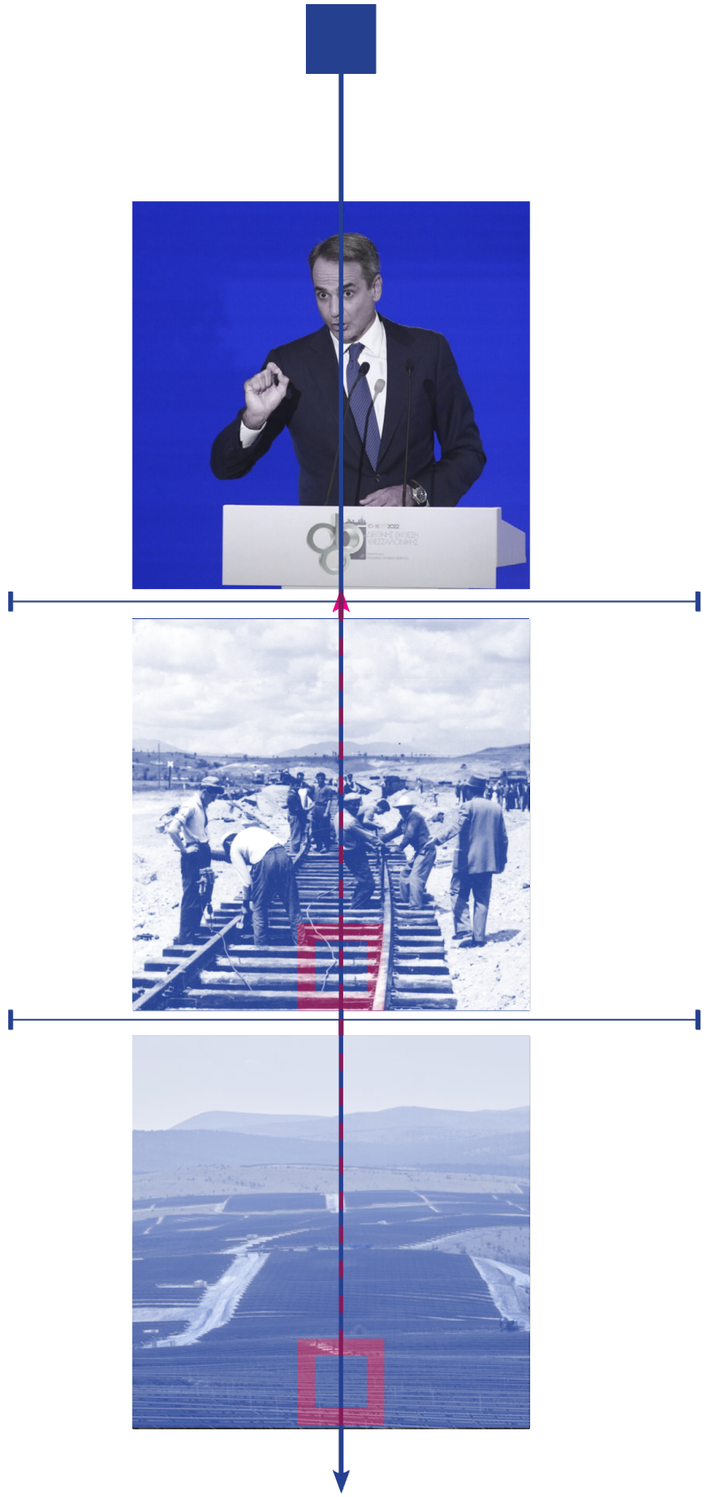


Figure 17. *Understanding Justice*
Source: author

PROBLEM FIELD MIND MAP

The diagram below illustrates the planetary and European context that frames the de-carbonization of the energy sector and the energy transition along with the challenges faced by the region of Western Macedonia (WM) and other coal-intensive regions of Europe. These regions must navigate a dual challenge in reality and try to alleviate the negative social, economic, environmental, and spatial impacts resulting from both the deployment of renewable infrastructure and the decline of the coal-based energy sector. The difficulty is amplified because of issues associated with transition governance, the unrealistic goals in relation to the decommissioning of lignite energy infrastructure and the lack of engagement of local communities. From this issues of social, procedural and environmental justice in relation to the transition arise.

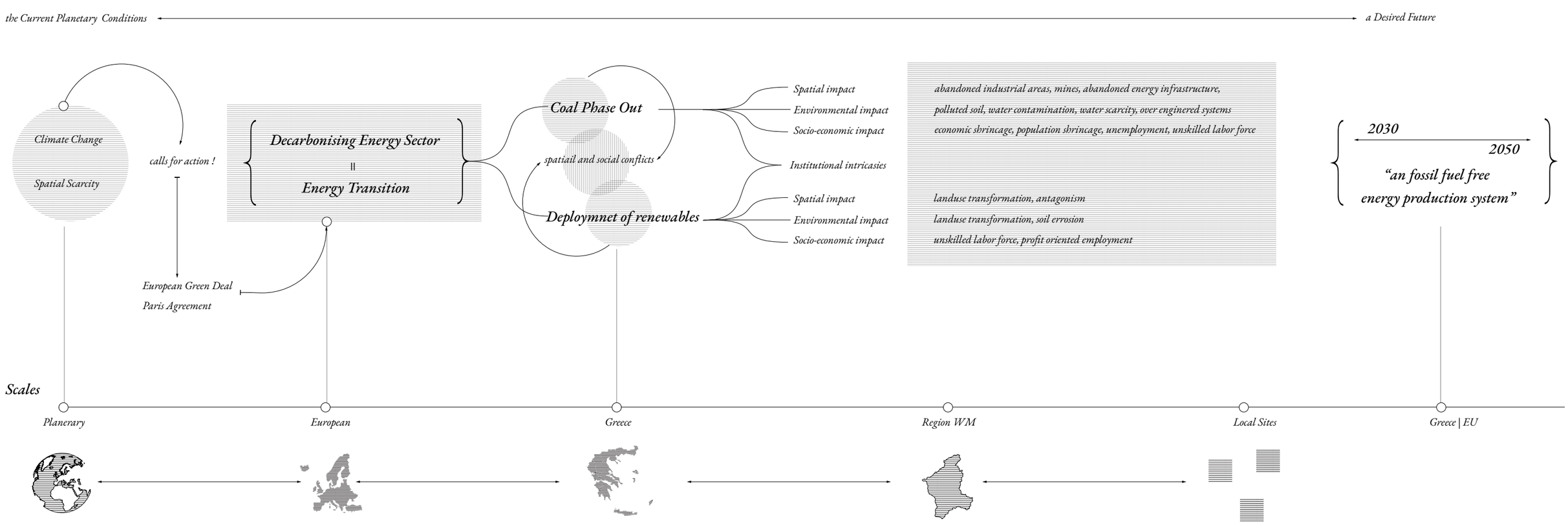


Figure 18. *Problem Field Min Map*
Source: author

PROBLEM STATEMENT

The energy production system in Western Macedonia is based on the operationalisation of the territory to exploit the available lignite resources for producing “cheap energy”. The infrastructural network developed to extract this material has resulted in the environmental deterioration of soils and water bodies. At the same time, the shrinkage of this system has resulted in the demographic and economic shrinkage of the territory. However, the current global paradigm shifts in energy production, along with European and national regulations, demands the reconfiguration of Western Macedonia’s “energy landscape”, exposing it to the dual (social, environmental and spatial) challenges of decarbonisation and deployment of renewables. However, as this process of transition has significant spatial and social impacts, the issues associated with spatial justice intensify. Within this context, a coherent plan that investigates the spatial and social impacts of the reconfiguration of the energy landscape of Western Macedonia is necessary.

RESEARCH AIM & OUTCOMES

Research Aim

Following the problem statement, the research aim of this thesis is formulated as follows:

This thesis aims to research how the re-configuration of the extractive energy landscape of WM can lead to a new regenerative production landscape by alleviating social, economic and environmental impacts.

Expected Products | Outputs

The projective aim of this thesis is to construct a series of exploratory design scenarios. Each scenario aims to focus on a regional vision based on a different development path for the region. Moreover, each scenario will be evaluated based on socio-economic, environmental and energy parameters. Finally, a final territorial vision will be constructed by selecting the most favourable scenario.

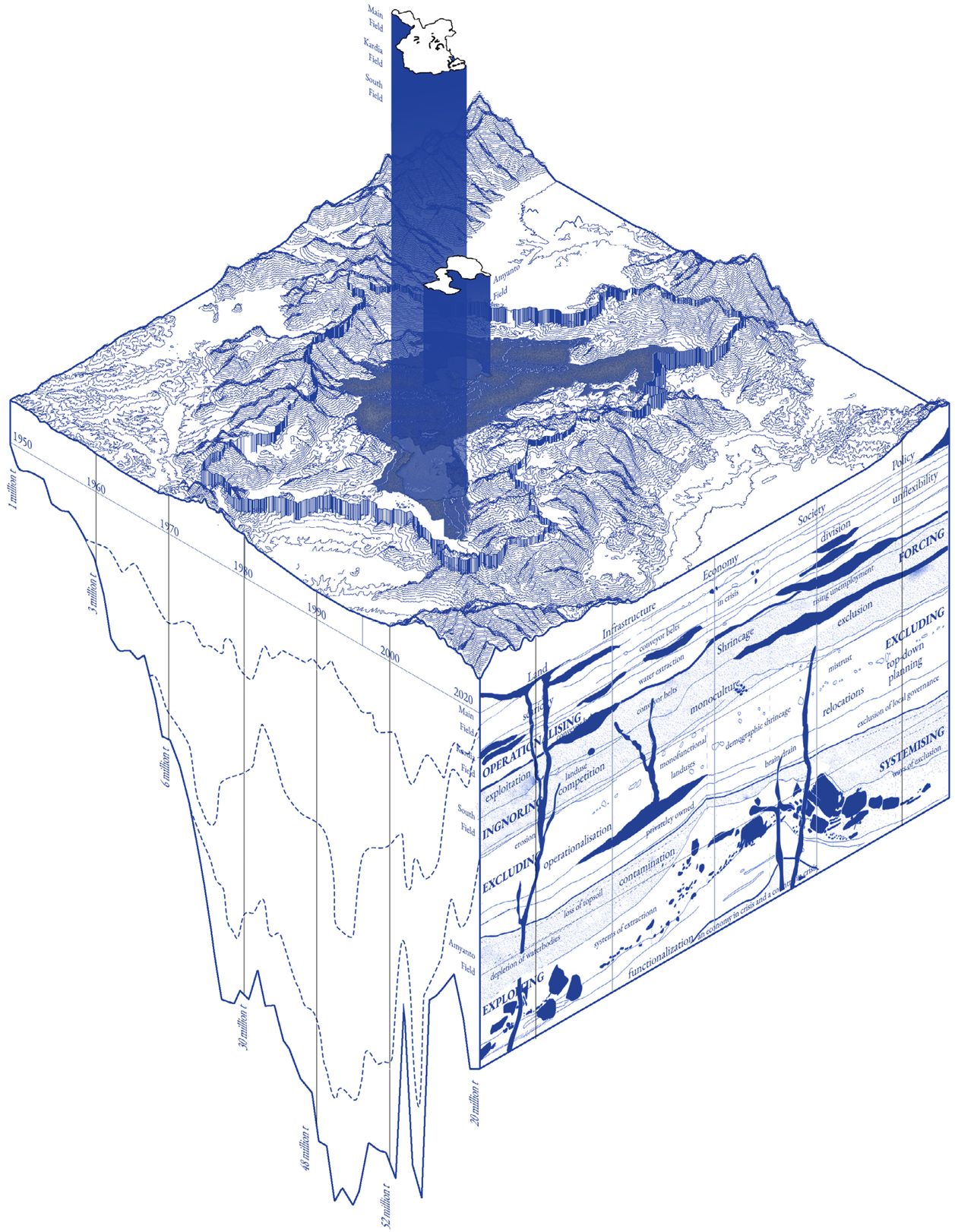


Figure 19. *Problem Statement | Abstraction*
Source: author

RESEARCH QUESTIONS

The main research question is derived from the problem statement, and is constructed as followes:

Main RQ

How can the re-configuration of the ***energy landscape*** of Western Macedonia establish a more ***environmentally and socially sustainable*** region while ensuring ***spatial, distributive and procedural Justice***?

RQ1 |

How did the increasing demand for energy supply shape the ***energy landscape*** of Western Macedonia?

Methods: Literature review, Documentary review, Analytical Mapping, System Analysis

RQ2 |

How was the land operationalized to sustain the energy system? What were the ***negative impacts*** on the ***social and natural systems***?

Methods: Literature review, Documentary review, Analytical Mapping, Field trip, Micro Stories

RQ3 |

What is the structure of the current ***governance mechanism*** of the energy transition and what are the social bad ***institutional challenges*** that arise?

Methods: Documentary Review, Stakeholder Analysis, Micro Story (Semi-structured Interview)

RQ4 |

How can a transition from an extractive energy system to a sustainable energy system be successfully realized in a period of ***uncertainty***? Which alternative scenarios could we be envisioning and designing for this territory?

Methods: Scenario Construction, Design Exploration

METHODOLOGY

I'm a broken ant
who lost its way
in the endless night.

Giannis Ritsos, A song to my sister

(Ritsos, 1937)

METHODOLOGICAL FRAMEWORK

The methodological framework outlines the structure of the thesis based on the phases, the methods used, and the connection between them.

The framework is divided into five chapters; Chapters 1 and 2 define the problem field and research aim. Chapter 3 seeks to answer the analytical research questions in a descriptive approach, and Chapters 4 and 5 have a projective approach and are the design outputs of the thesis project.

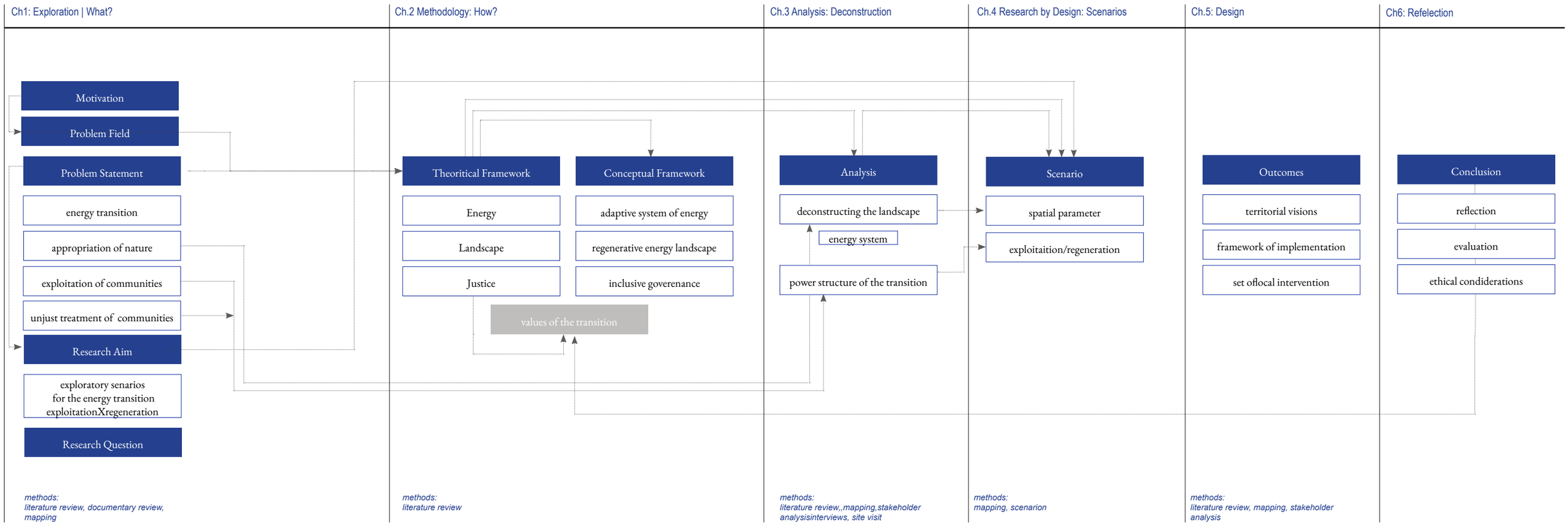


Figure 20. *Methodological Framework*
Source: author

THEORETICAL FRAMEWORK

ENERGY | SPACIAL IMPACT AND LANDSCAPE IMPACT

Energy Landscape

This thesis, rooted in the exploration of the energy transition and coal phase-out, necessitates a clear understanding of the intricate relationship between energy and the landscape. As outlined by Sijmons et al. (2014), each method of energy generation involves specific spatial alterations. Over time, energy and space have become inherently intertwined, and to quantify this connection, concepts such as kWh/m^2 have been introduced. The primary challenge in the energy transition lies in bridging the gap between the landscape and energy. The landscape, with its cultural value, serves as a mediator between the emerging renewable energy system and the spatial changes required for its development. Consequently, the new renewable energy sector cannot thrive without meticulous spatial planning and design.

The ongoing energy transition, because of its spatial impact, presents multifaceted challenges, including those in the realm of urban planning. It should not solely be the design outcome of technocrats and engineers but, as emphasised by Sijmons et al. (2014), viewed as a 'landscape challenge.' This transition revolves around the utilisation of space inherited from the fossil fuel era, and it will undoubtedly be a subject of significant contention as renewable energy expands. Moreover, the energy transition intensifies the pressure on landscapes, as the harnessing of renewables often demands more spatial resources.

ENERGY | SOCIAL ACCEPTANCE OF RENEWABLE ENERGY

Social Acceptance of energy landscapes

In addition to the spatial impact of the energy transition, one important concern that is emerging is the lack of social acceptance of new energy landscapes. Research conducted in this emerging field shows that there are numerous factors that affect the acceptance of renewable energy (RE) landscapes by local communities.

According to Rodríguez-Segura et al. (2023), in a research project conducted in Spain, the energy infrastructure's type, size, and locations are essential factors influencing local societal acceptance of renewable energy projects. Additionally, local communities view unfavourably the installation of RE infrastructure in areas that have high environmental sensitivity or ecological value. Lastly, acceptance can be influenced by criteria such as project transparency, offering financial benefits to locals, and more.

Finally, studies show that the acceptance of RE infrastructure varies between countries. More specifically, according to Delicado et al., northern Europeans have a higher degree of acceptance because, in general, people are more accustomed to large-scale landscape transformation. In contrast, in southern Europe, the lack of financial benefits in RE deployment further impacts societal acceptance.

THEORETICAL FRAMEWORK

LANDSCAPE | AS A MEDIUM

Landscape as a medium

According to principles of Landscape ecology, landscape can be utilised to maximise the integrity of ecological systems and limit land degradation and fragmentation when a new entity or structure is introduced in a landscape. As a practice, it puts emphasis on long-term planning and cross-disciplinary design, trying to find synergies between ecological and human systems (Waldheim, 2006). Additionally, landscape ecology principles help shape the composition of landscape and bring forward Tran scalar proposals to design. The use of landscape in the context of regenerative development, in the post-industrial and post-mining areas in WM would greatly provide an approach to design as a means of trying to establish synergies through infrastructure to try and generate ecological and social values.

LANDSCAPE | REGENERATIVE DEVELOPMENT

Regenerative Development

The theory of regenerative development argues that current practices of sustainable development are not effective in restoring human nature equilibrium and seeks to establish design principles for the co-existence of human and natural systems, opting to find ways of generating benefits for both systems (Mang & Reed, 2012). Additionally, in contrast to sustainable development, regenerative design principles seek to enhance the capacity of ecological systems and design processes of human systems embedded in natural ones. In relation to the transition from sustainable to regenerative practices, the article "The Political Ecology Playbook for Ecosystem Restoration: Principles for Effective, equitable, and Transformative Landscapes" highlights the importance of the transition from "policy incentives from business-as-usual activities to regenerative economic development that supports long-term restoration, sustainable livelihoods, community well-being, and social and environmental justice"(Osborn et al. l., 2021, p5).

For this thesis, the concept of regenerative development can be used to propose scenarios that opt to reverse the negative effects of the previous energy production system and restore to the landscape the ability to regenerate itself. More specifically, it is important to embed human processes that support the economy and society within natural processes. Additionally, within the context of regenerative development in the transition of WM, it is important to embed social values associated with community well-being in current development policies in order to ensure social justice.

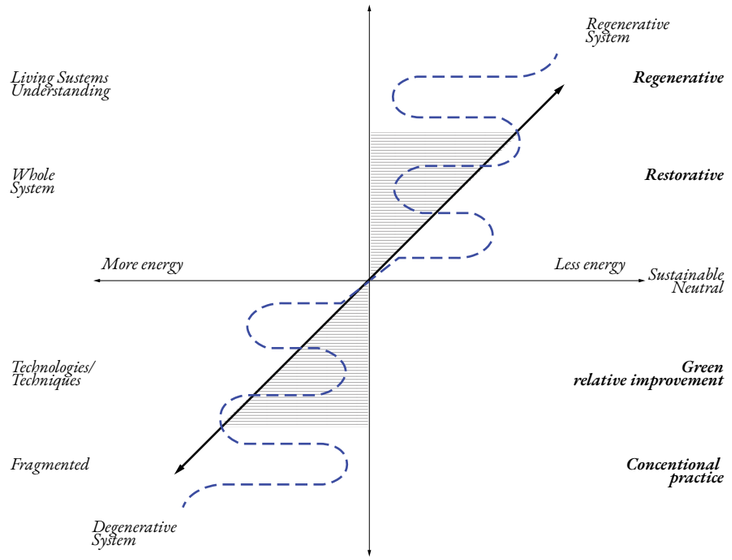


Figure 21. *Regenerative Development Diagram*
Source: Reed (2007)

GOVERNANCE | ENDOGENOUS GROWTH AND COLLABORATION NETWORKS

Endogenous growth and local development

According to endogenous growth theory, endogenous or local factors can have a significant role in economic growth while simultaneously recognising that development is dictated by exogenous factors (Stimson et al., 2009). Endogenous development can be associated with the capacity of local communities to respond to global challenges by utilising potential that exists within their region or territory. Through this change in perspective, local conditions can be improved, for example, the improvement of living conditions, decrease in rates of unemployment and alleviation of poverty (Vázquez-Barquero & Cohard, 2018). This model of development emphasises the role of local actors and local initiatives as an instrument of social and economic transformation by placing value on human capital, innovation and knowledge. Finally, endogenous growth theory emphasises the need for the creation of local, collaborative networks as drives of change that can relate to commodity chains on a national or global level (Vázquez-Barquero & Rodríguez-Cohard, 2018). Finally, within this context of the need for collaboration, endogenous growth theory stresses that the role of local institutions (local governance, knowledge sector) should promote policies and strategies that stimulate cooperation and the conditions for the creation of networks of collaboration (Vázquez-Barquero & Cohard, 2018). Finally, spatial components that are related to endogenous growth are resources, infrastructure (soft, hard), and industry agglomeration.

In relation to the transition of the energy landscape of WM, the value of this theory can be understood as the need for the creation of local collaborative networks of change, the strengthening of local institutions, and the coordination of policy to promote local growth.

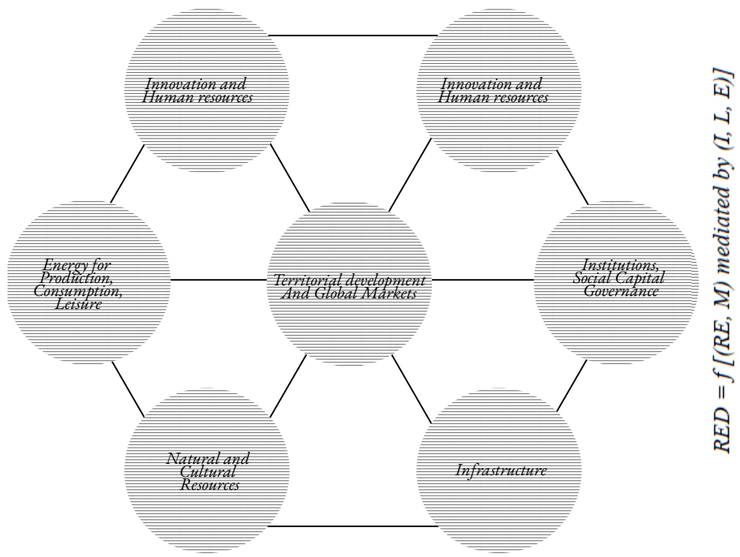


Figure 22. *Territorial development diagram, adapted*
Source: Vázquez-Barquero & Rodríguez-Cohard (2017)

SOCIETY | PARTICIPATORY PLANNING

Participatory Planning

In traditional planning, the conventional approach involves crafting a top-down master plan that extends across various levels of government and directly impacts local neighbourhoods. However, this unilateral decision-making process has led to numerous conflicts within society, as it often fails to acknowledge and comprehend the specific conditions and concerns of communities from a hierarchical perspective.

Hence, with the emergence of participatory planning, many countries have embraced this practice as a means to bridge the divide between top-down objectives and grassroots considerations. It involves engaging stakeholders in the decision-making process, allowing them to express their opinions and promoting equitable resource distribution (Smith, 1973). Arnstein (1969) introduced the concept of the 'Participation ladder,' which serves as an index indicating the extent of public engagement. This ladder comprises eight levels: manipulation, therapy, informing, consultation, placation, partnership, delegated power, and citizen control.

Place making

The term placemaking is used to describe the processes of creating places whose material features attract human activity to them. (Courage, 2017). It encompasses collective processes of creation or improvement of - mainly urban - environments through the redefinition of their social and economic context (Courage, 2017). The 'bottom-up' practice of place-making is based on collaboration between local communities, interest groups, non-governmental organisations and municipal authorities. It takes into account the needs of these groups, using them as a basis to create public spaces that promote social and economic sustainability and equity.

Therefore, the practice is process-based rather than end-product-based, promotes creativity, collaboration and participation, is embedded in the local context and maintains an ephemeral character.

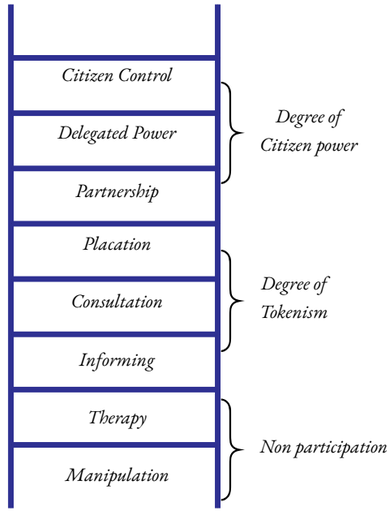


Figure 23. *The Participatory Ladder of Arnstein adapted from*
Source: Arnstein (1969)

CONCEPTUAL FRAMEWORK

HERITAGE | AS A DEVELOPMENT / PLANNING TOOL

Heritage and spatial planning

Heritage is a delicate and modifiable concept in which its significance is continuously being redefined by society, government and the market. From the traditional institutionalism approach that prioritizes aesthetics and structural integrity through conservation, the meanings of heritage have shifted to an understanding that includes social, cultural and economic dimensions in spatial planning. The integration of planning and historical built environment is a developing concept, and currently, there are three different approaches to addressing heritage (Janssen et al., 2017).

1. Sector Approach: Protection and Collection

The sector approach is the traditional approach that labels socio-economic values and spatial dynamics as threats to the cultural heritage and prioritizes conservation through the preservation of spatial elements.

2. Factor Approach: Negotiation and Revitalization

The factor approach is dynamic and versatile, highlighting heritage as a component of spatial quality that does not prioritize the conservation but the transformation of the regions as a whole. The emphasis is placed on the connection of material heritage with present practices, by promoting economic growth and enchantment of cultural qualities.

3. Vector Approach: Development and Continuity

Rather than the physical dimension, the vector approach prioritizes the narrative dimension of heritage through intangible values. It relies less on governmental and private initiatives, but more on active dialogue between local actors, like civic stakeholders and local inhabitants.

Janssen's standpoint isn't about favouring one approach over another. Instead, it's about recognizing the most effective approach for each specific situation (Janssen et al., 2017).

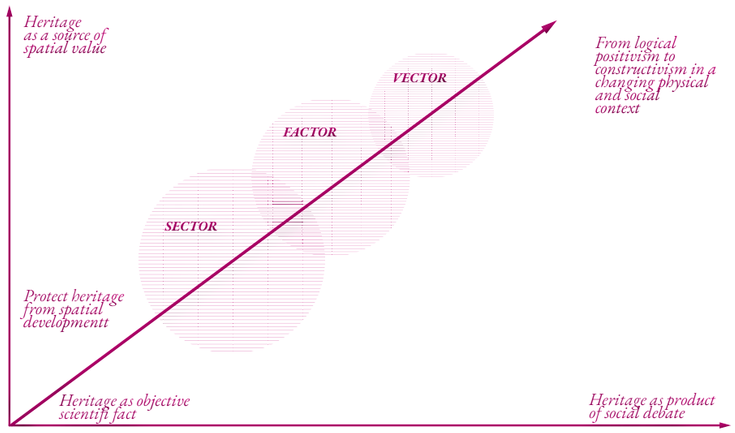


Figure 24. *Shifting conceptualizations of heritage*
Source: Janssen et al. (2017)

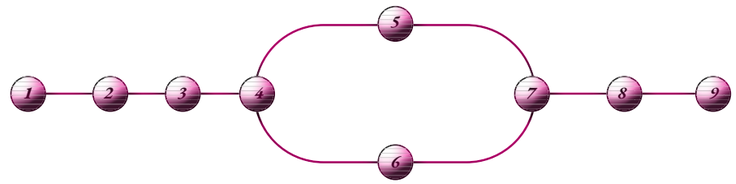
HERITAGE | AS INFRASTRUCTURE

Adaptive Reuse

Adaptive reuse is the process of converting buildings and infrastructure to other, more efficient and effective uses such that they can better serve user needs and have a useful extended life. Adaptive reuse is a type of building adaptation that almost always involves physical changes to the building to accommodate the new use (Douglas, 2006).

Adaptive reuse is usually prompted by the need to ensure that buildings have a beneficial, continuous use and is basically a response to accommodate changing occupancy needs (i.e., change in the purpose or level of activity in a building). As such, adaptive reuse can be considered a tool to prevent or overcome redundancy, obsolescence, and demolition of buildings (Douglas, 2006). Moreover, adaptive reuse is more and more becoming a key driver of urban regeneration (Bullen & Love, 2010). Since the last decades of the 20th century, adaptive reuse has also been regarded as a sustainable development strategy (Bullen & Love, 2010) and a tool for preserving threatened heritage values of buildings (Bullen et al., 2011). The principle of sustainability is manifested in the global movement to recycle buildings and lies, according to Fragner (2012), in "the arguments, structural interventions and architectural designs that leave enough room for future decisions and for uncovering new meanings in situations that we cannot yet foresee" (p.117).

In the context of WM, and as a heritage preservation tool, adaptive reuse can retain the heritage values of buildings threatened by alteration and demolition. Industrial heritage buildings have evidential value as part of the industrial past. They also have social and cultural value as part of the record of people's lives. Industrial heritage buildings may also be of scientific and technological significance in the history of engineering, manufacturing, and construction, or they may possess aesthetic qualities originating from their architecture or design (Douet, 2012).



1. Design to build
2. Design stage
3. Construction stage
4. Occupancy.
5. Maintenance
6. Adaption
7. Irreversible building obsolesce sets in
8. Building fully obsolete
9. Despose | Demolish

Figure 25. *Adaptive Re-use Industrial Heritage*
Source: Douglas (2006)

PROBLEM FRAMEWORK | RE-FRAMING

The problem statement framework is developed by including elements of the problem field, placing them within the different scales of the thesis project. The main scales that can be observed are the national, regional- territorial and local, with different conflicts and impacts materialising in different sectors. At the centre of the diagram are the energy production landscapes, both extractive and renewable.

In the governance and society sectors, the main conflicts arise from a top-down development approach that fails to include local actors in the planning process. Additionally, the lack of coordination between different governance and planning institutions results in the intensification of local conflicts.

In the energy, heritage and ecology sectors, the main conflicts arise from the lack of co-ordinated spatial planning and materialise on the local scale as an acute competition for space.

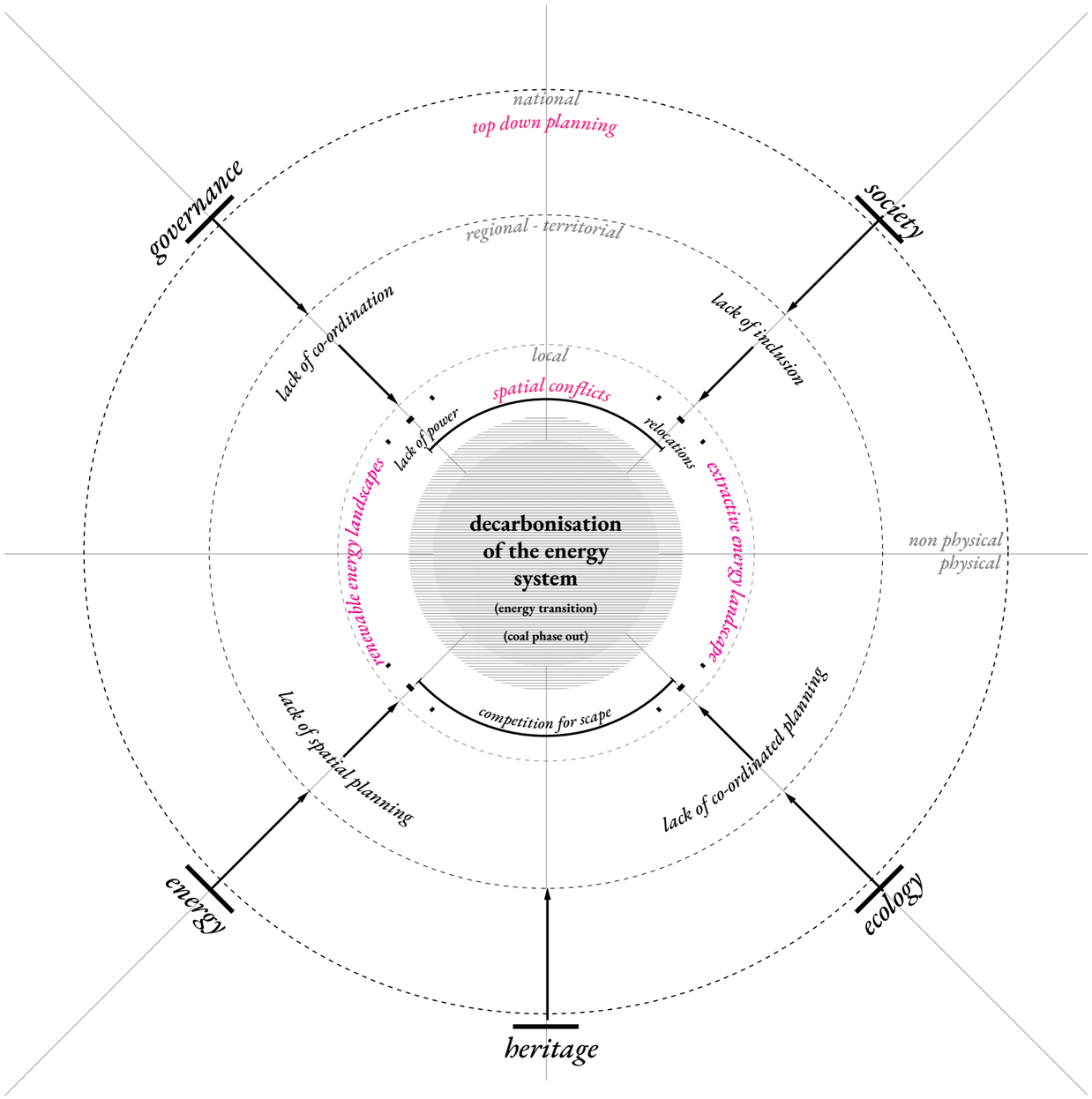


Figure 26. *Problem Field Framework*

CONCEPTUAL FRAMEWORK | DEFINING THE LENS

As a continuation of the problem statement framework, the conceptual framework is developed by including key elements of the problem field and practices and proposed ways of addressing these issues.

With the just decarbonisation of the energy systems, the project approach refers to spatial and systemic transformations from the smaller scale – of the extractive landscape- to the larger territorial scale, by reinforcing regenerative design, adaptive design, adaptive re-use, endogenous development and social engagement, trying to bring back the multidimensional aspect of the landscape, as a means of establishing spatial, distributional and procedural justice.

Below definitions and explanations of keywords can be found.

Spatial justice - Procedural justice - Distributive Justice

By distributive justice, this project refers to the fair and equal distribution of resources across scales. Procedural justice refers to a just, inclusive and transparent desertion-making and planning process, with the inclusion of different institutions on different scales. Finally, with spatial justice, the project refers to the fair distribution of benefits and burdens.

regeneration

By regenerative, the framework refers to the rehabilitation of the ecological network that will be established in the territory, aiming to address environmental impacts.

flexibility

By flexible, the framework refers to a new renewable energy space, that is diverse and capable of changing and adapting to future uncertainties.

revalorisation

By revalorised the framework refers to the recognition, integration and re-use of heritage sites in the new energy landscape.

collaboration

By collaborative, the project refers to the network of collaboration, ranging from different sectors and scales of governance institutions.

inclusivity

Finally, by inclusive the project refers to the inclusion of the involved community in the planning process. The practice of participatory planning is emerging as a key concept to answer to conventional top-down planning practices.

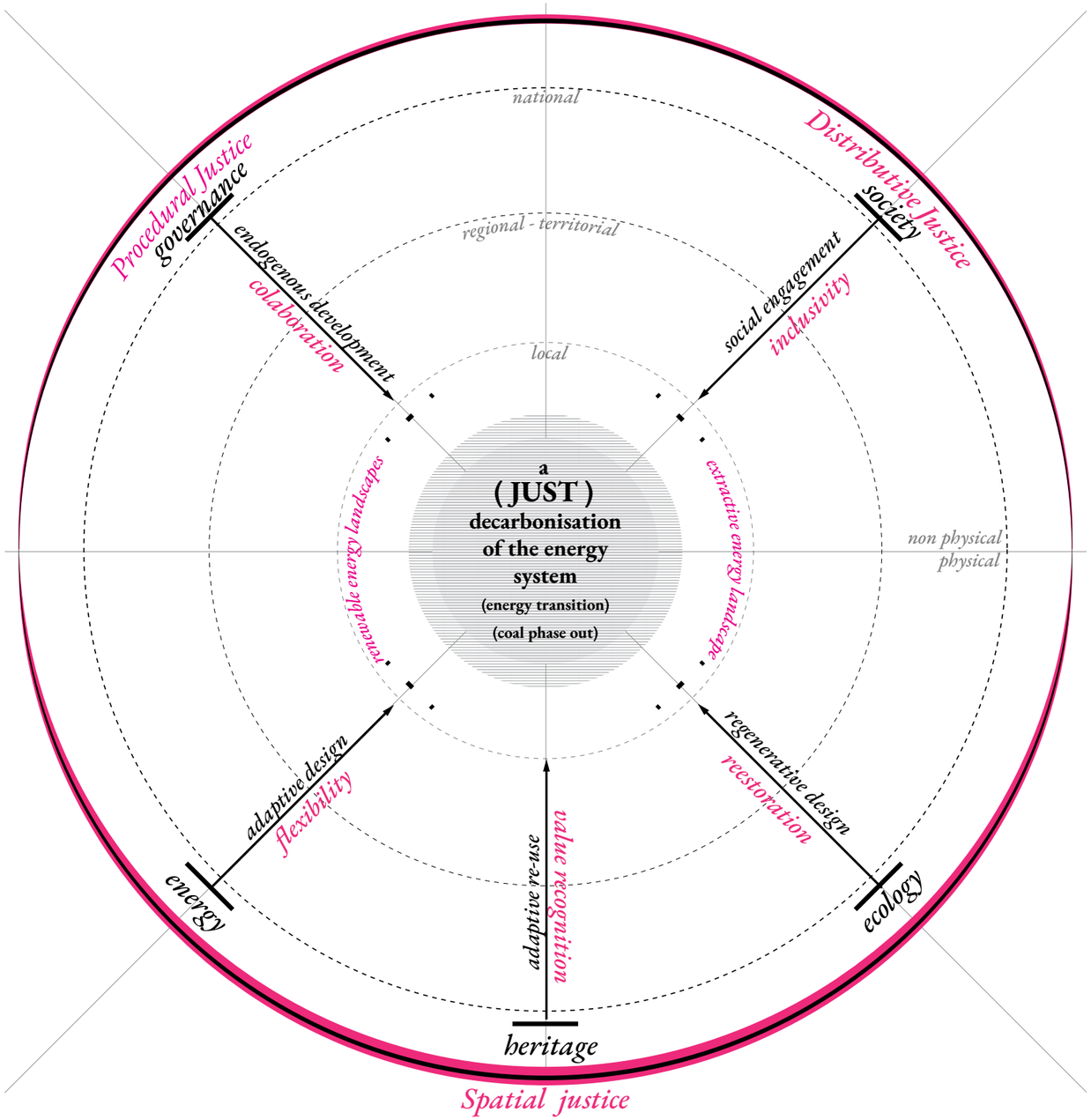


Figure 27. *Conceptual Framework*

APPLIED METHODS

Selecting suitable research and design methods posed a challenge because there was limited scholarly exploration at the crossroads of energy transition, spatial planning, landscape and heritage. These methods are employed at various points in the project, both individually and in combination, especially when examining subjects or issues that demand multiple approaches. The project predominantly employs seven methods to conduct research and analyse the context, and these methods are listed below:

1. Literature Review
2. Documentary Review
3. Stakeholder Analysis
4. Semi-structured Interviews
5. Field Trip
6. Mapping
7. Scenario Construction

In the upcoming sections, a comprehensive elaboration of the seven research and analysis methods utilised in the project. This will include preliminary objectives, the method's application process, and the outcomes derived from each method. Subsequently, the following section will delve into how the insights gained during the research and analysis phase of the project contribute to the formulation of the design and its associated outcomes.



Figure 28. *Methods and research questions*

METHODS (i)

Literature review

Definition

Collection of a body of information, corresponding to different stages and themes of the research phase of the thesis.

Sub-questions:

1,2

Main Data sources:

Google scholar, TU Delft library, Elsevier, Springer, YPEN (Ministry of Environment and Energy)

Objective:

Construction of the theoretical and conceptual framework of the thesis. Firstly, basic explanatory papers that explain the issue of the energy transition, in the global and Hellenic scale. Secondly, theory oriented papes that will provide and explain different overviews of the problems and concepts defined on the research.

Outcome:

To generate a conceptual and theoretical framework and inform the design section of the thesis

To evaluate existing opportunities and weaknesses in the current trajectory of the energy transition

Process:

- Compose a section anf a framework for research, through the pillars of energy, justice and landscape.
- Select papers, books and reports according to their relevance. Determine aspects that will be emphasised and addressed.
- Compose conclusions and findings according to each theme of research.

Aim Per Sub-question

1_ Define the characteristics of the current energy landscape. Identify and qualify relations between space and the energy system and its relation to landscape.

2_ Identify the aspects of the landscape where operationalized. Qualify spatial aspects and quantify the degree to witch these aspects were altered.

Documentary review

Definition:

Identification and understanding of the stakeholders involved with the problem and present in the area.

Sub-questions:

1,2,3

Main Data sources:

Hellenic Republic, SDAM, WWF, Region of Western Macedonia Planning Department, Region of Western Macedonia Just Transition Department, Ministry of Energy and Environment of Greece, Energy Municipalities

Objective:

To collect, compare and review Policy documents and Policy reviews. The aim is to create a clear understanding of the current and future policies that determine the process of the energy transition in Greece and the Just Transition in WM, and be able to understand the governance mechanism of the Transition.

Outcome:

Unpack the governance structure of the Just Transition and the energy transition in Greece, and identify its strengths and its weaknesses.

Process:

- Identify the key planning and policy documents
- summarize, compare, and relate the most important aspects in relation to the spatial aspect and the social impact
- Inform findings with existing revise
- Conclude, reflect on finding, and make suggestions that could be integrated in the design and the strategies developed further on.

METHODS (ii)

Stakeholder Analysis

Definition:

Identification and understanding of the stakeholders involved with the problem and present in the area

Sub-questions:

2,3

Main Data sources:

NGO's, Tracer, World Bank, Local Newspapers

Objective:

Identification of the stakeholders tinvolved in the process of the energy transition in the region of Western Macedonia.

Identification of level of operation, level of influence in decisionmaking and type of interest of each actor. Categorisation of the stakeholders

Outcome:

Reveal the power structure that governs the process of the energy transition.

Defining possible synergies between different groups for the scenarios and the design section of the thesis.

Process:

- To identify the main stakeholders related to and affected by the energy transition
- Detailed research to categorise the stakeholders according to their scale of operation
- Research to unfold the hierarchy anamog stakeholders, the existing conflicts and synergies
- Summarize the system of stakeholders, which will give input for the proposed strategic approach:
- Identify possible future opportunities for synergy and possible conflicts.
- Provide engagement strategies

Aim Per Subquestion

2_ Identify stakeholders negatively affected by the existing energy production system. Identify dependencies.

3_ Identify stakeholders related to the energy transition and identify the power relations between stakeholders in the process of the energy transition

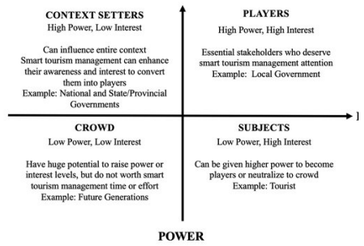


Figure 30. Power-Index Diagram
Source: Ackermann et all. (2011)

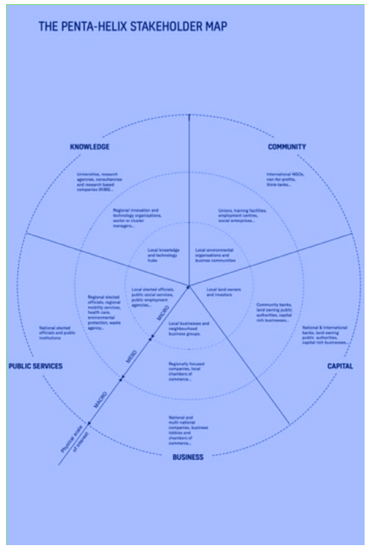


Figure 29. Stakeholder Categorization Diagram
Source: Hill et.all. (2018)

Mincro Stories | Semi- structured Interviews

Definition:

Identification and interview of members of critical stakeholder groups affected by the energy transition

Sub-questions:

2,3

Main Data sources:

Findings of Stakeholder Analysis, NGOs, Local Newspapers

Objective:

To identify unseen aspects of the energy transition, and how it is affecting local stakeholders. To determine the level of involvement of local stakeholders in the planning processes. To validate or not findings from the Literature review, Documentary analysis

Outcome:

A series of micro-stories that present the conclusions of the interviews

Process:

- Identification of stakeholder groups
- Drawing hypotheses from previews forms of analysis to structure a series of questions.
- Plan the site visit, ideate contact, and inform the interviewees about how the interview will be used
- Conduct interviews
- Draw a set of conclusions.

Aim per Sub question

2. To identify the ways in which local communities were affected through the energy production in the past
3. To understand to witch degree and in what way the local communities are included in the current energy transition and identify possible opportunities and shortcomings

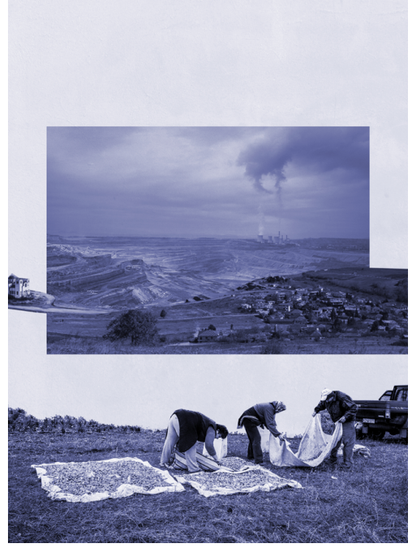


Figure 31. *Example of Micro story (source:author)*

METHODS (iii)

Field Trip

Definition:

Visiting sites in WM to gather visual documentation (photography, cinematography, drawings) related to the social and spatial impact of the energy transition

Sub-questions:

2,3

Main Data sources:

Findings from stakeholder analysis, documentation analysis and mapping

Objective:

To observe and map how the process of the energy transition shapes the experiences of local communities and the perceived landscape

To document the degree of the implementation of current plan (JTMP, TPWM)

Outcome:

Visual documentation

Revision of some of the aspects of the outcomes

Process

- Composition of base maps
- Choice of areas of visit & documentation: Mining sites, Renewable energy areas, Adjacent settlements,
- Plan the site visit
- Conduct the site visit
- Draw conclusions and findings

2_ Conduction of interviews with members of local stakeholders, Getting access to archives and datasets

3_ Documentation of the operationalized landscape

Analytical and Speculative Mapping

Definition

This method is defined by the collection of a body of information, corresponding to different stages and themes of the research phase of the thesis.

Sub-questions:

1,2,-,-

Main Data sources:

Google scholar, TU Delft library, Elsevier, Springer, YPEN (Ministry of Environment and Energy)

Objective:

Construction of the theoretical and conceptual framework of the thesis. Firstly, basic explanatory papers that explain the issue of the energy transition, in the global and Hellenic scale. Secondly, theory oriented papes that will provide and explain different overviews of the problems and concepts defined on the research.

Outcome

A series of maps on different scales providing context about the energy transition on different scales

Process

- - Download of multiple data sets from the main sources;
- - Mapping of general and main systems at different scales;
- - Definition of units of analysis to explore the spatial impact of energy transition
- - Further on, the design outcomes and interventions will be explored on the two scales of design.

Scenario Construction

Definition

This method is defined by the cformulation of exploratory scenarios.

Sub-questions:

4

Main Data sources:

All outcomes of the analysis phase

Objective:

exploration of different possible futures fon an eqitable energy landscape

Outcome

To generate a series of territorial visions and principles for local interventions

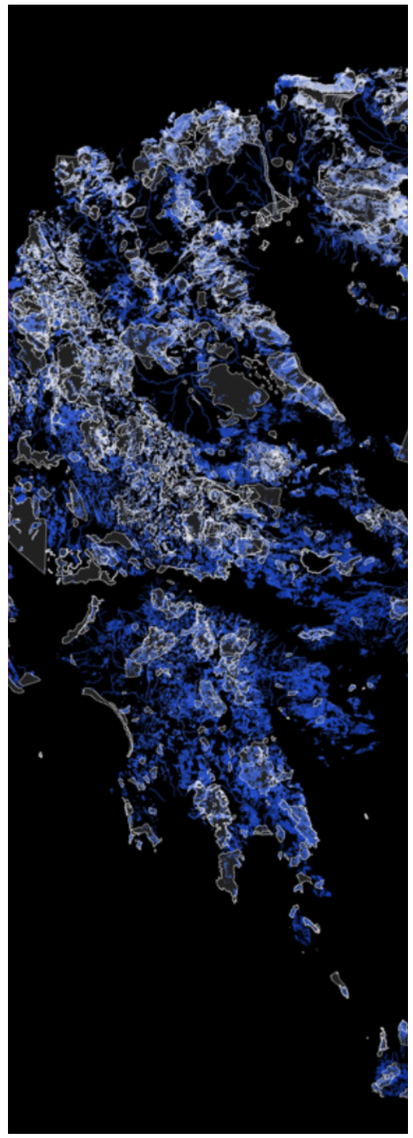


Figure 32. *Example of mapping (source:author)*

UNRAVELING

Rocks, a few burnt pines, a lone chapel

and farther above

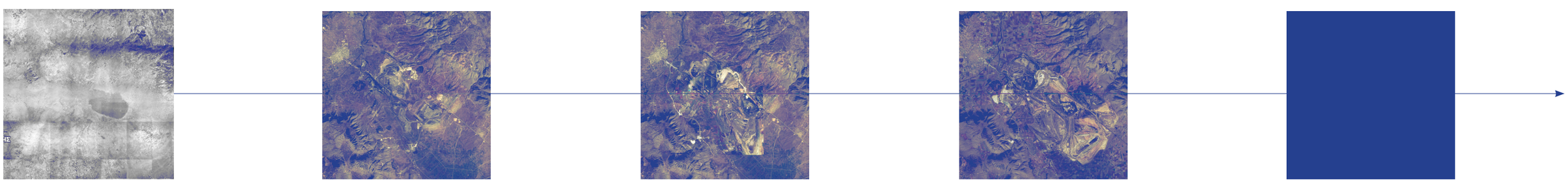
the same landscape repeated starts again

George Seferis, Mythistoremata

(Seferis, 1927)

INTRODUCTION

The productive landscape of the territory changes greatly from the beginning of the mining operations, transforming it from an agricultural landscape to a mining one. It has been shaped by a plethora of anthropogenic forces, with each force having a specific impact on the landscape. In this section, the relationship between the current extractive energy system and the landscape will be analysed.



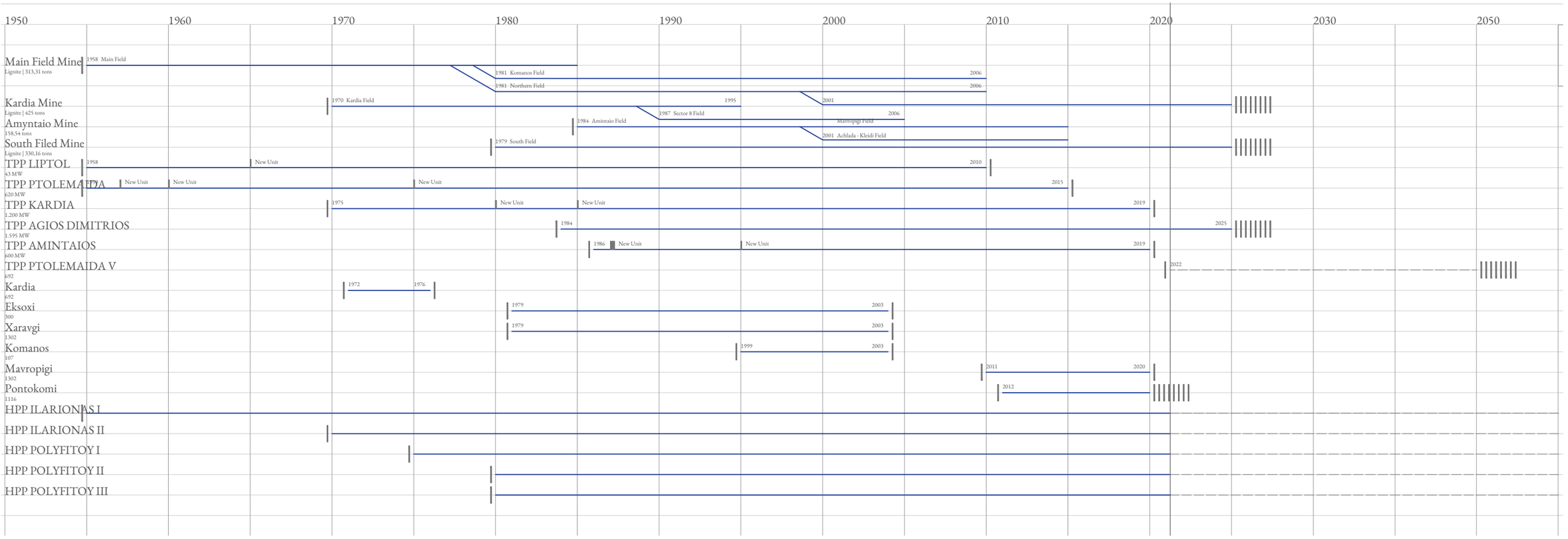


Figure 33. *(Down, center) : A timeline of exploitation*
Source: Google maps, WWF (2016)

Figure 34. *(Up, center) : Landscape transformation*
Source: Google maps, EEA (2018)

SYTSTEM

Bellow, the final system of energy production is depicted.

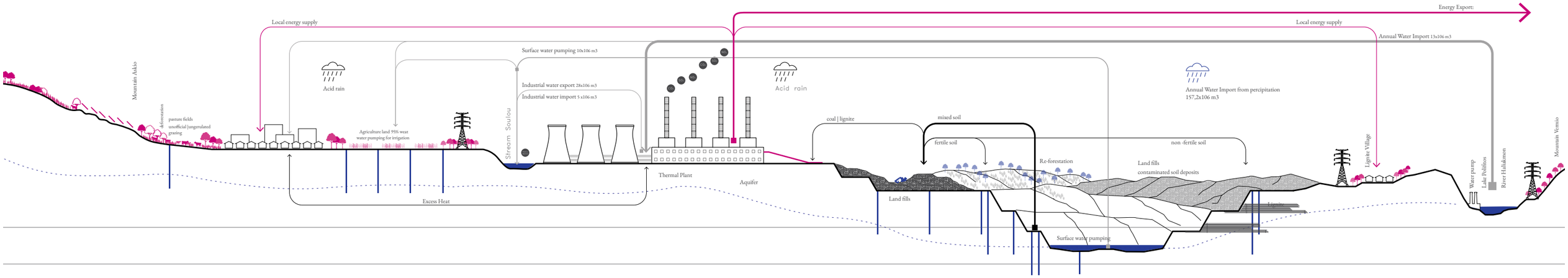




Figure 35. *Systemic Section*
Source: author

Figure 36. *Landscape Panorama*
Source: author

MAPPING | METHODS

The analysis phase was conducted in two scales:

The first analysis focused on mapping and understanding the extractive energy landscape, focusing on specific processes in energy production based on lignite.

The second analysis was conducted on the territorial scale, focusing on mapping the effects of the small, extractive scale to the territorial scale. It focused on the environmental and social effects on the territory and on specifying areas of potential growth and areas of neglect. In this analysis, space was abstracted in a grid, and each grid shell received a value according to the variable that was mapped as a way of addressing the lack of data in some of the mapped categories.

This specific analysis methodology can be replicated in territories that are undergoing similar transitions, either transitioning away from extractive productive landscapes or integrating renewable energy infrastructure.

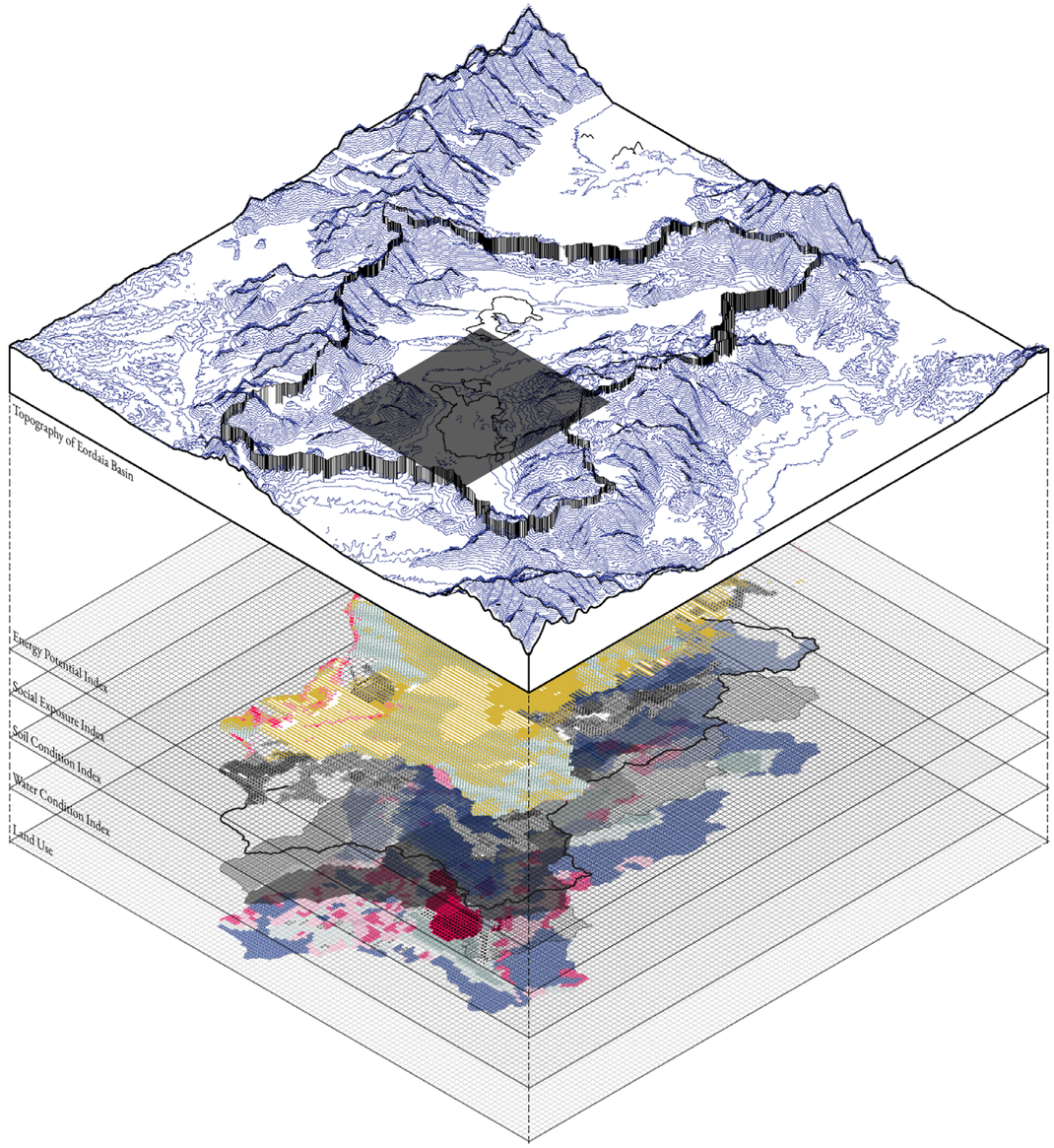


Figure 37. *Mapping Method*
Source: author

ENERGY | MINING AND LIGNITE PLANTS

The mining operations in Western Macedonia cover 180,000 km2, which consists of half of the once arable land of the region. PPC has been minimising the energy generated by lignite since the 2019 National Energy Plan. Originally, five mines were operating in the area; however, currently, only two remain in operation, the South Field Mine and the Main Field Mine. One of the closed mines, the Kardia Mine, is slowly being filled with deposits from the two active mines, while other areas of deposits are in the process of



Figure 38. *South Field Lignite Mine*

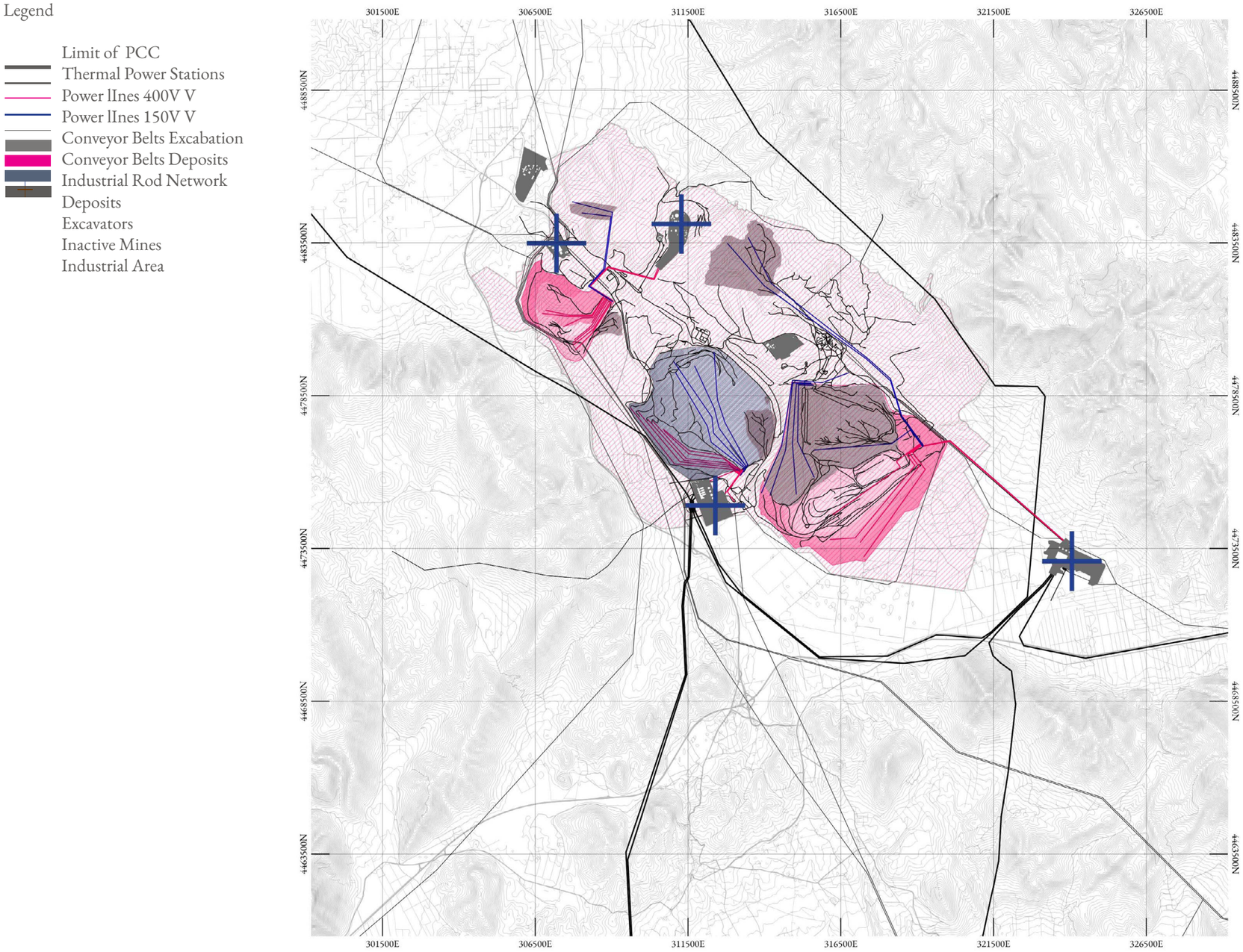


Figure 39. *Energy Production and Lignite mining*

ENERGY | RENEWABLES

Next to fossil fuel energy production, the expansion of renewable energy, specifically solar, has started in the region.

From the map on the right, it is evident that most of the proposed infrastructure is concentrated either within the limit of PPC, oftentimes overlapping with deposit or rehabilitated mines or on the adjacent hills and mountains.

This expansion results in conflicts in land use and conflicts among local stakeholders; more precisely, in the case of the hills, conflicts have risen between farmers and energy companies because of the rapid loss of pastures. In the case of the mines, conflicts are rising between local communities and PPC, because of the lack of consideration of local actors in the formation of the post-mining landscape.

Legend

- Limit of PCC
- Power lines 400V
- Power lines 150V
- Solar Parks
  - Operating / Under Construction
  - Rejected
- Wind Parks
  - Operating Under Construction
  - Rejected



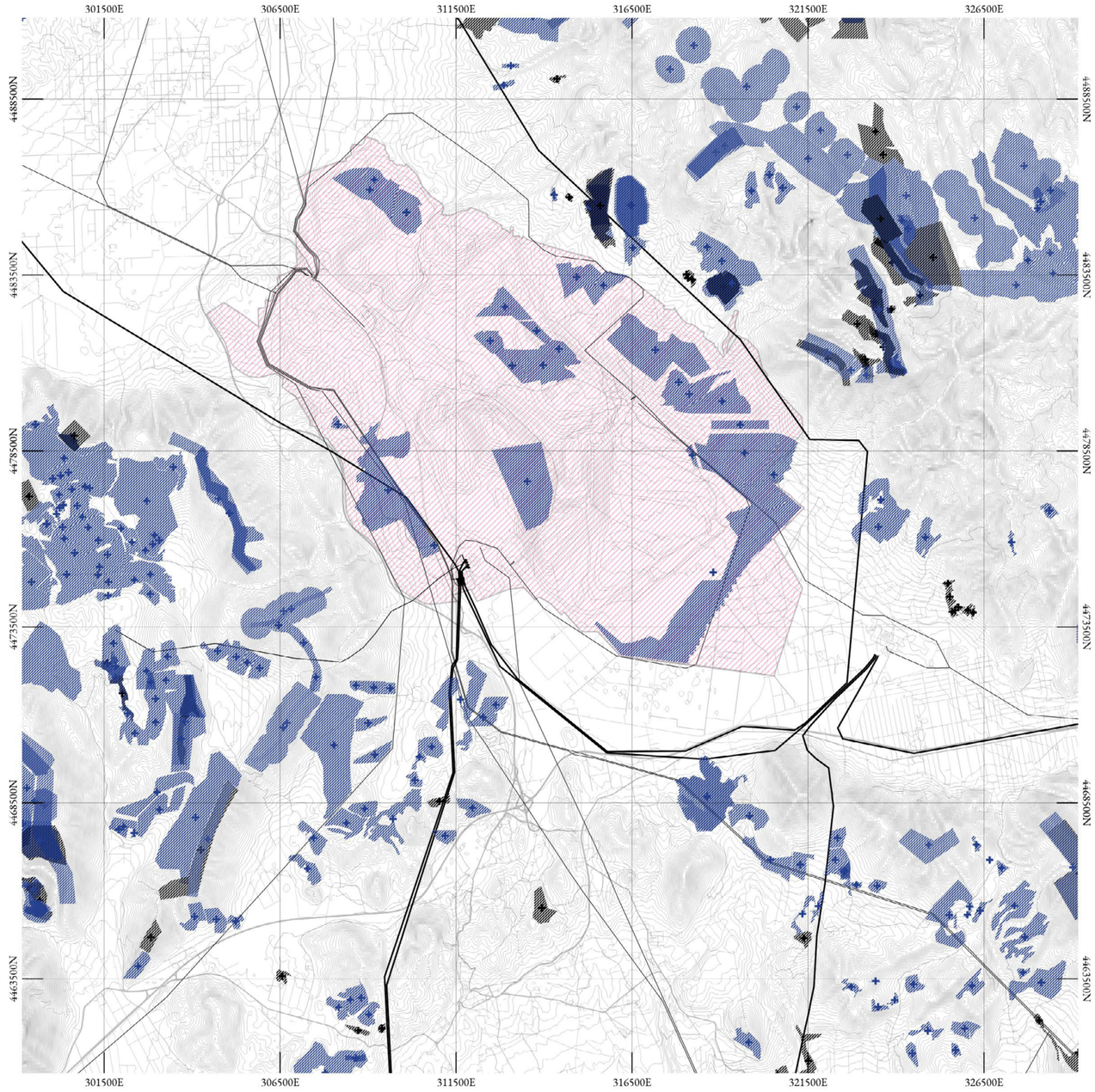


Figure 40. Construction of a solar park in WM
Figure 41. Energy Production | Renewables

LANDSCAPE | WATER STRUCTURE

The systems investigated previously have two main results on the water structure of the region. Firstly, water is needed for industrial use in the cooling towers of the thermal power plants, and secondly, water is removed from the local aquifer.

For industrial use, water is pumped up from Lake Polyfitos, located at a distance of 60 km and 390 meters below the level of the mines. From 1960 until 1997, PCC used water from Lake Vergotida, which resulted in the drop of the water level by 30 meters, the loss of 80% of its volume and the degradation of the water quality (WWF, 2015, p.35).

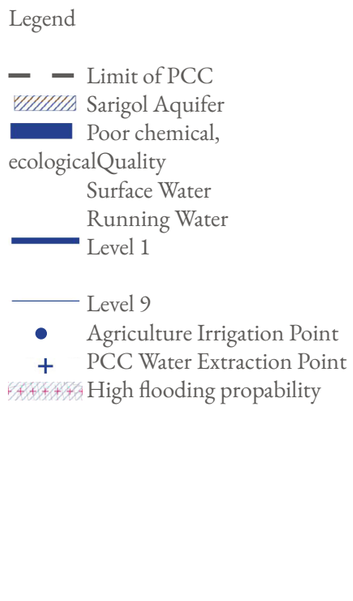
In addition to the depletion of open water sources, the water quality is compromised. More specifically, because of fly ash and the re-direction of water used in industrial use in open water systems, many open water bodies have high concentrations of heavy metals (WWF, 2015, p.36). In addition, because of the intensive agriculture and the extensive use of fertilisers in the adjacent agricultural lands, the open surface water is high in concentration of NO4 (Aschonitis, 2004).

Finally, next to the contamination and depletion of the open water bodies, the local aquifer is being depleted. Water is pumped out of the aquifer for two purposes. Firstly, to prevent the flooding of the open pit mines, and secondly, to be used in agriculture. The water being pumped out around the mines is directed toward the open water bodies (usually stream Soulou) or towards the lowest area of the mine and used in the mine to wet the surfaces and prevent ash from flying (Antonidis, 2004, p.97).

In short, the negative externalities of the existing energy production systems in the water structure can be divided into surface water and sub-surface water. They can be summarised in the depletion of the local aquifer, the depletion of open surface water reserves and the contamination of open surface water with heavy metals and ammonia.



Figure 42. Channelized water stream



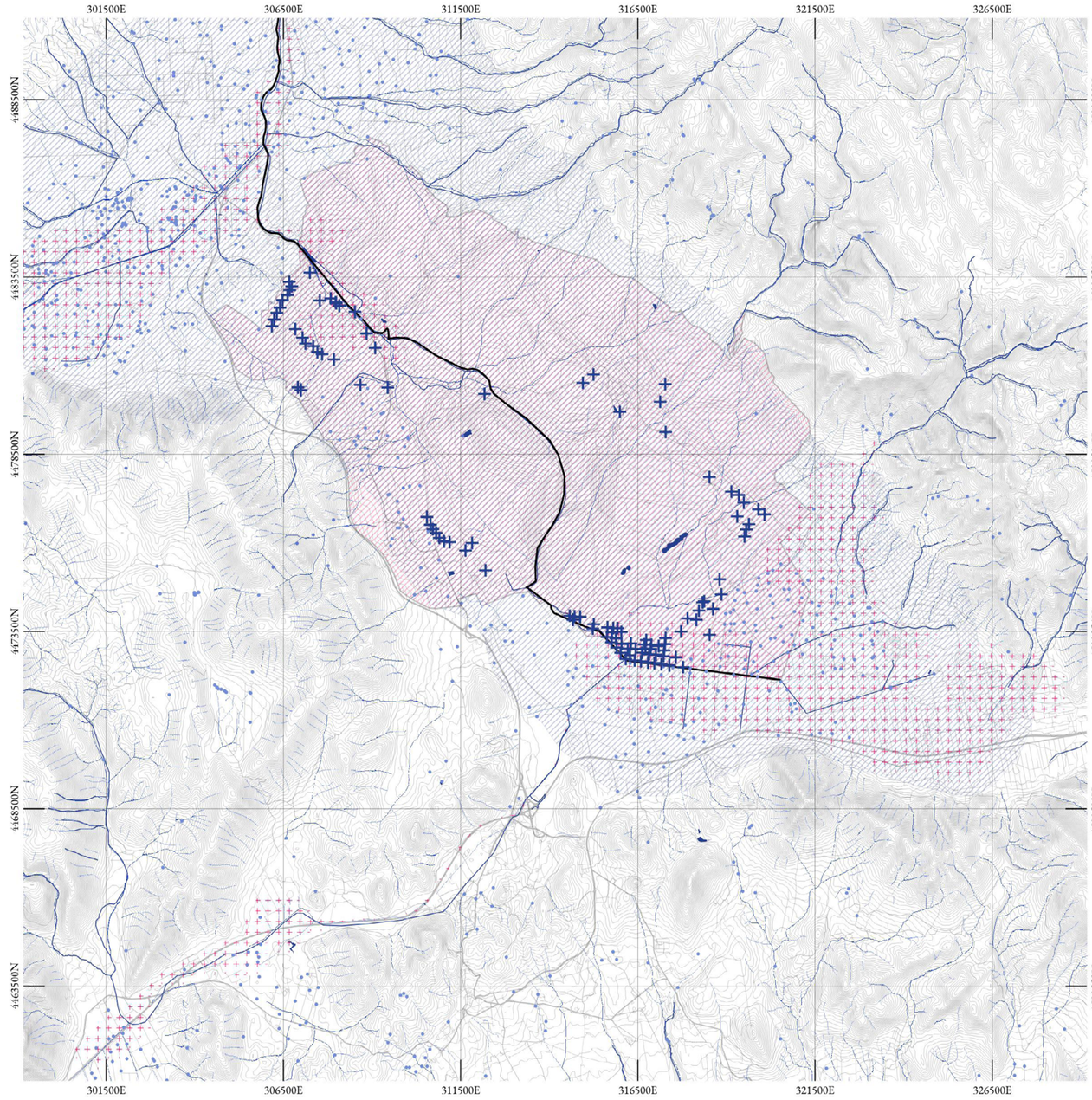


Figure 43. Water Structure

LANDSCAPE | ECOLOGICAL STRUCTURE

In addition to the impact on the water structure, the mining operations have resulted in large-scale alteration of local vegetation.



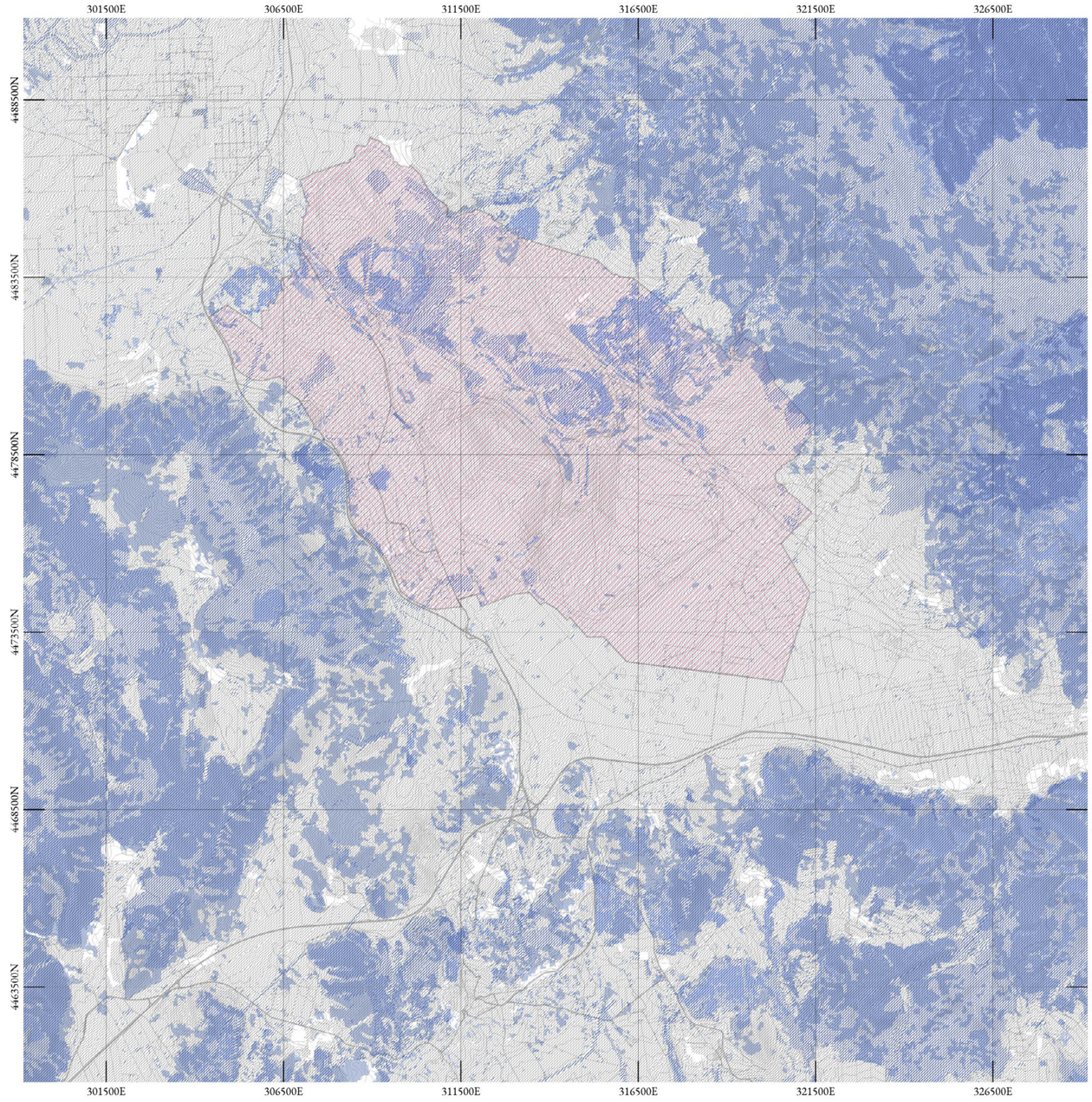




Figure 44. Different times of vegetation
Figure 45. ecological structure

SOCIETY | RELOCATION OF SETTLEMENTS

As a result of the mining operation of PPC in Western Macedonia, afflicted settlements have been subjected to forceful relocations with important financial, social and cultural implications. Since the beginning of the operations of PPC in 1956, six settlements have been relocated, while the relocation of a settlement of Pontokomi is still pending. In total, approximately 7,000 residents have been moved, and 2,500,000 km2 of land has been transferred to PPC (WWF, 2015, p. 79).

Because of the fact that no institutional framework was set in place in the last fifty years, the relocation of the settlements was carried out through expropriations, a method that proved to be rather problematic and confrontational. In practice, this method was based on the constitution of an “act of confidence” between the residents of the local community and the PPC, usually after a lot of pressure was placed on the settlements and their liveability was diminished.

Considering that mining operations are expected to be terminated in 2028, no further relocations are expected to take place in the future. Nevertheless, this investigation reveals the forceful manner in which local communities were treated, the lack of governmental provision and the power relation between the government and PPC.



Figure 46. The relocation of Mavropigi (source: PPC Archive)

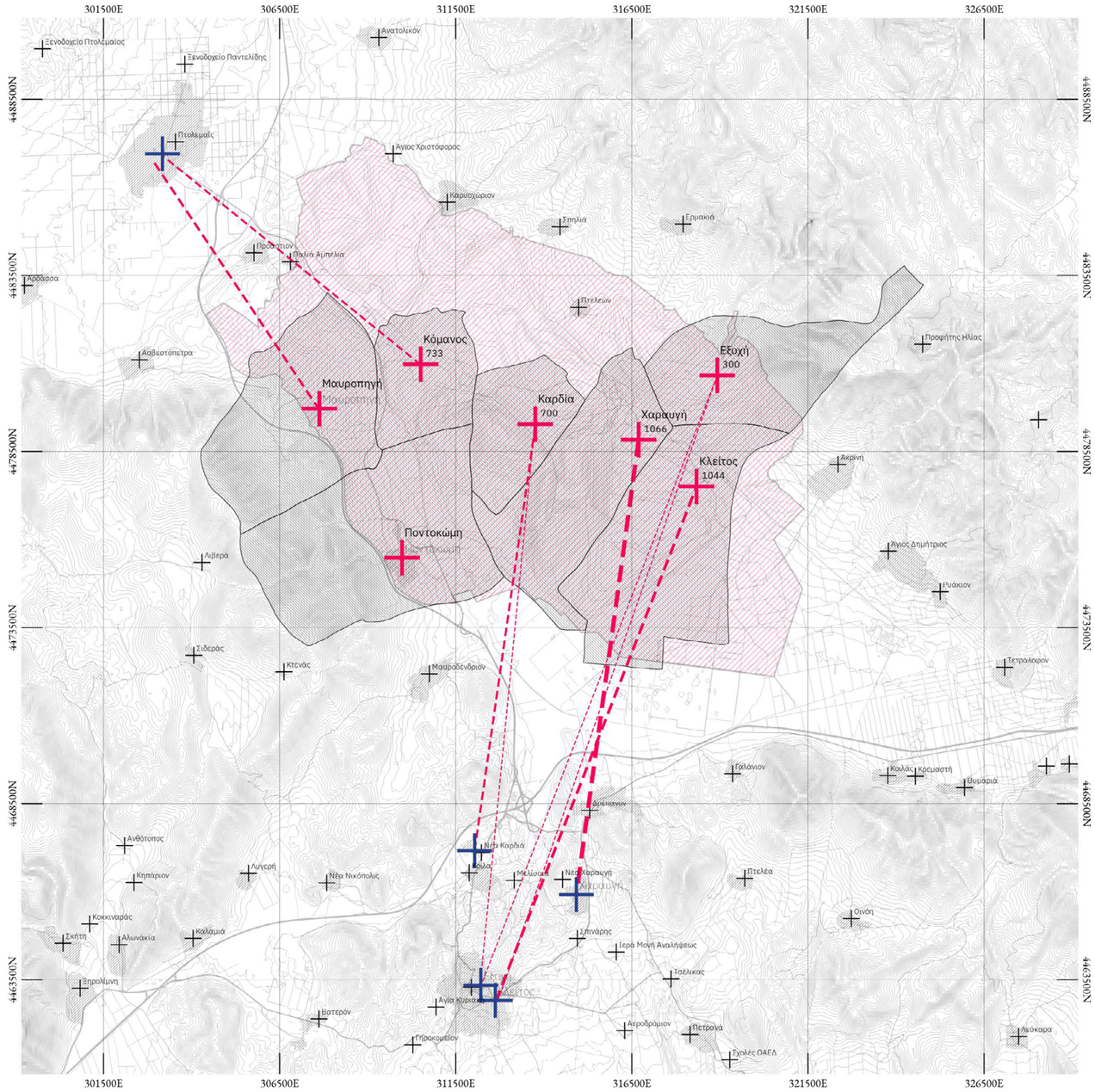


Figure 47. Relocation of settlements based on figure 3, (WWF, 2013, p.37)

TERRITORIAL MAPPING | LAND USE

The territory was mapped and classified into specific land uses: Protected areas, forests, pastures, agricultural areas, residential, industry, mining areas, deposits, and rehabilitation and water. Each land use received a different score on the way it can integrate renewable energy infrastructure

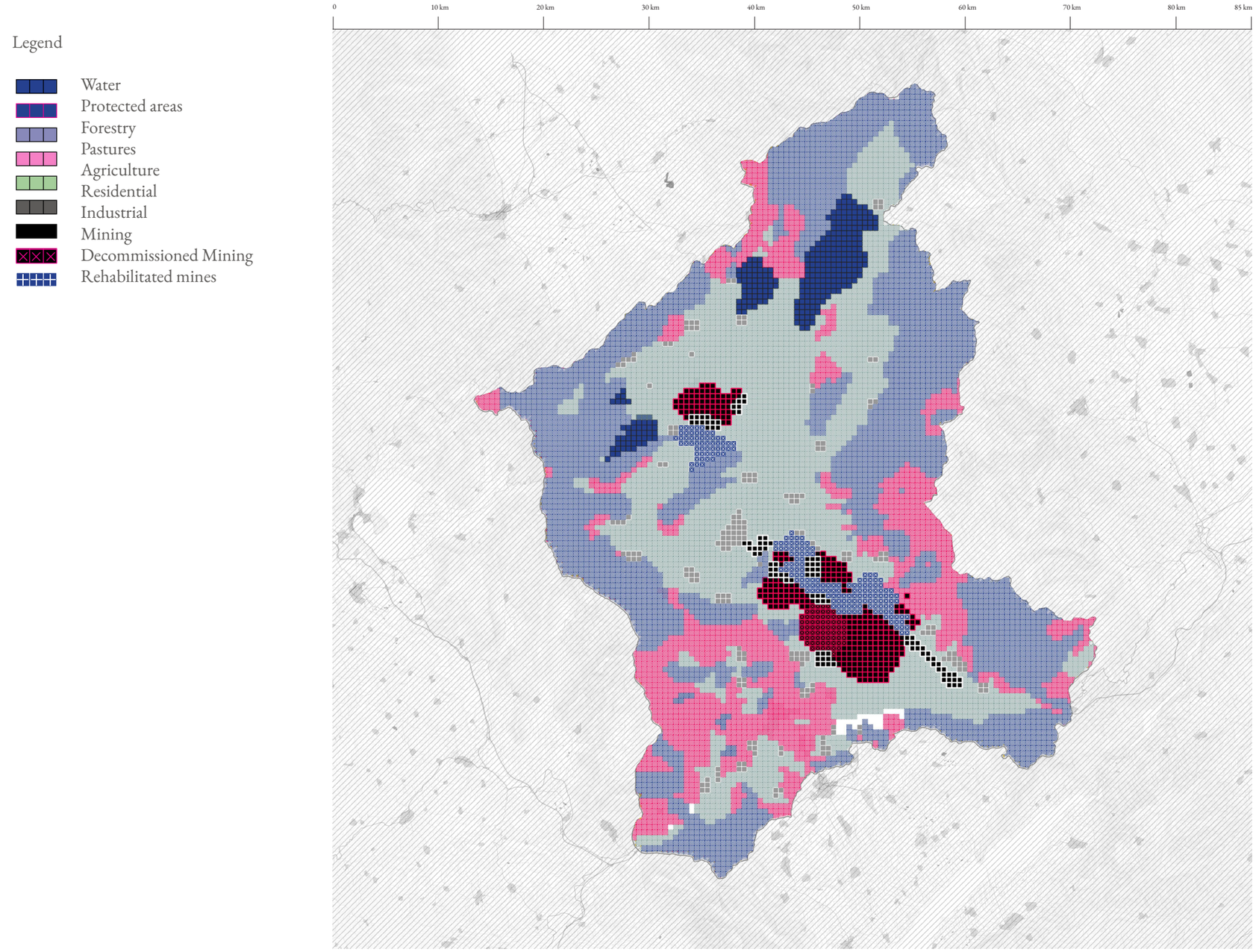


Figure 48. *Landuse*
Sources: EEA (2018)

TERRITORIAL MAPPING | SOIL

The current extractive energy system and the unregulated expansion of renewables have distinct yet specific impacts on the soil conditions of the territory. In the case of mining, they can be summarised as different types of contamination, like heavy metals. In the case of renewables, it can be summarised as topsoil destruction and erosion.

Legend

- Erosion
- Contamination | heavy metals
- Contamination | Nitrogen
- Open Mines

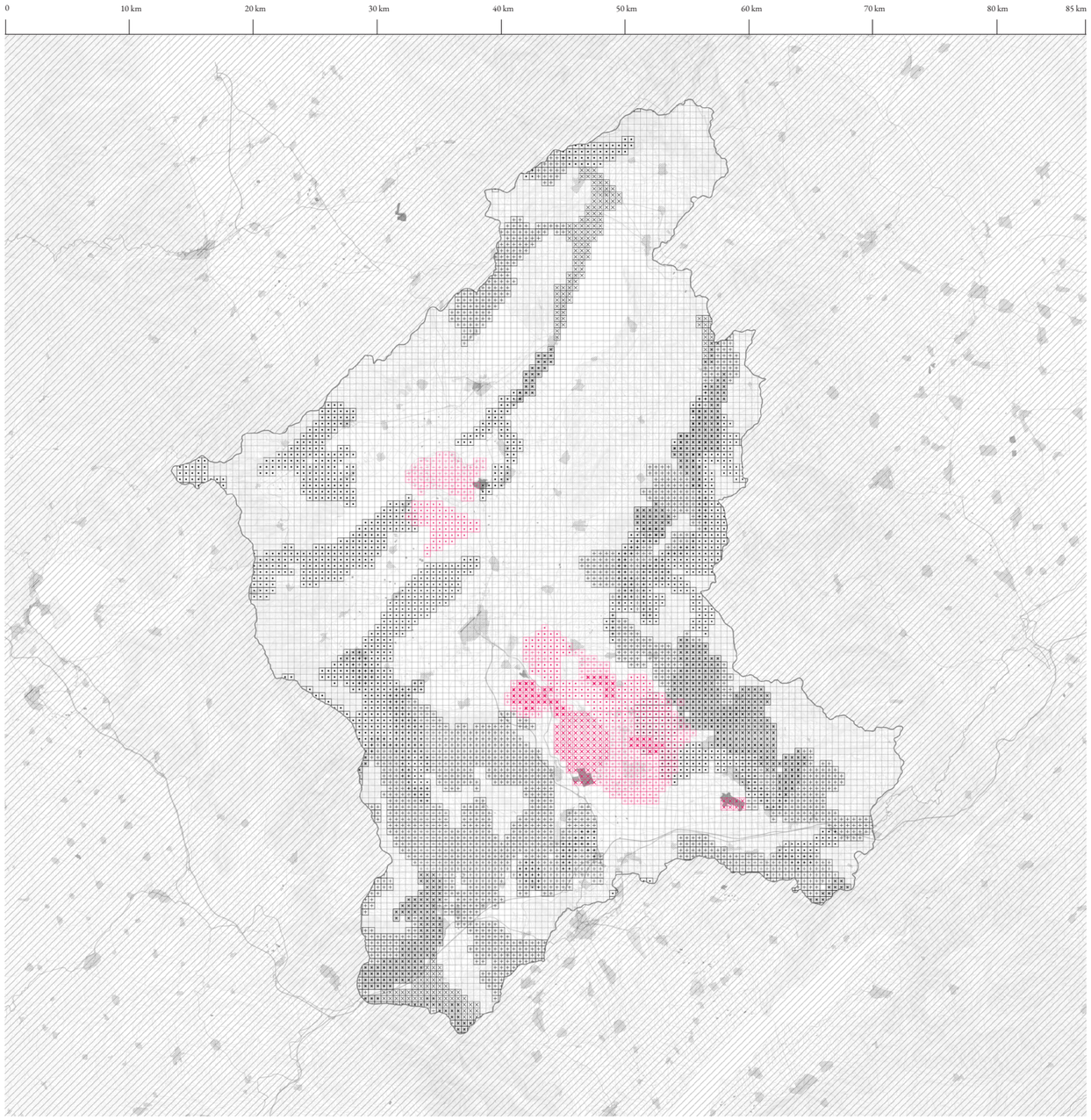


Figure 49. Soil Conditions
Sources: EEA (2018), WWF (2016)

TERRITORIAL MAPPING | PROTECTED AREAS

In this section, different protected areas are highlighted. These include Natura 2000 areas and Ecological rehabilitation areas. It is important to note that, currently, there is no clear spatial instruction regarding the expansion of renewable energy infrastructure in these protected areas.

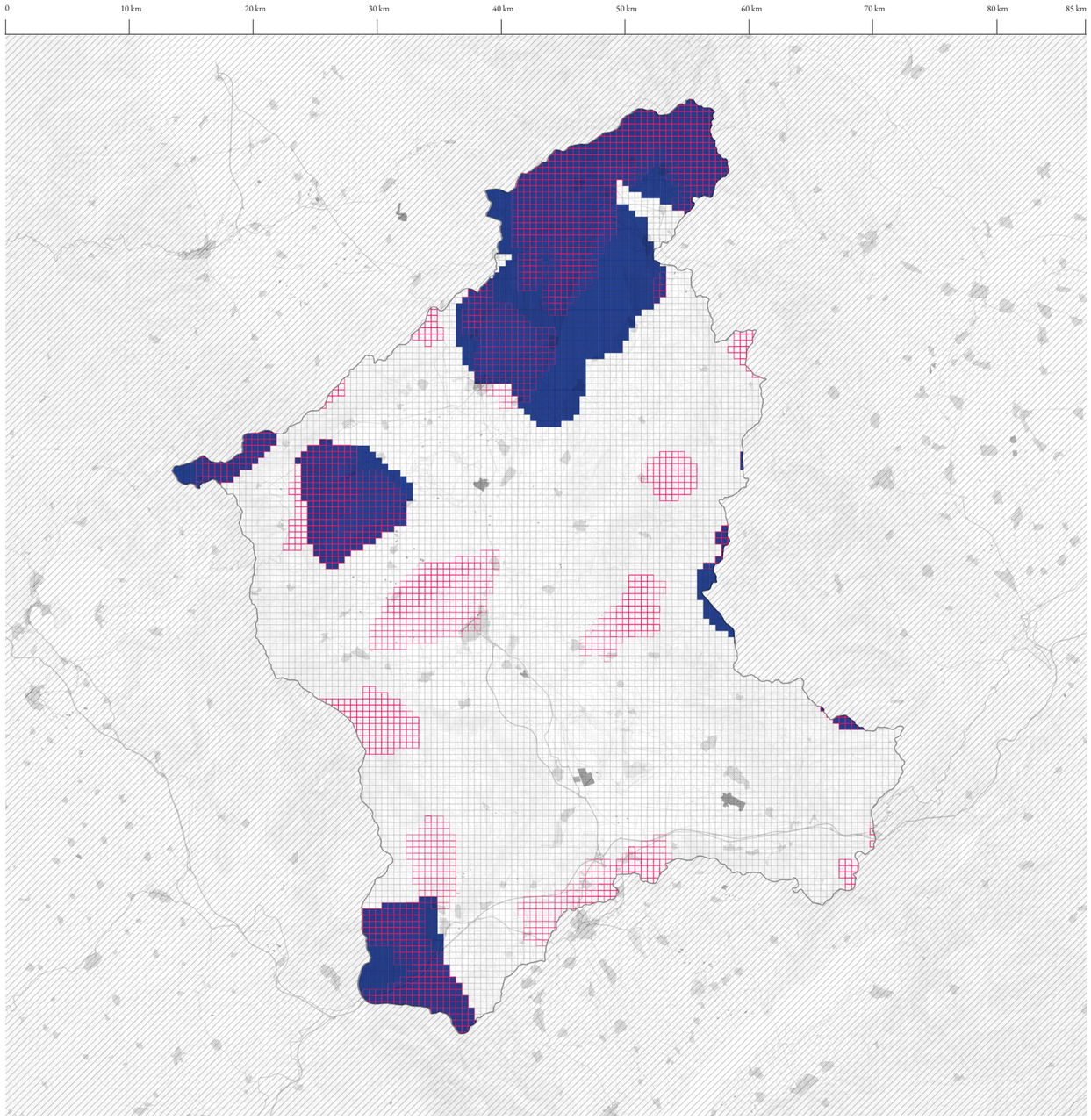


Figure 50. *Protected Areas*
Sources: EEA (2018), EEA (2000), RAE (2021)

TERRITORIAL MAPPING | WATER

As previously mentioned, the mining had a significant impact on the water network of the territory. In this section, the existing open water bodies and open water networks are documented, along with the ecological and chemical conditions. Additionally, existing water extraction and irrigation points are highlighted. Finally, the location of the depleted aquifer is included. It is important to note that a spatial territorial plan addressing the just decarbonisation of the energy sector must, to some degree, also address the negative environmental effects of the past energy production system.

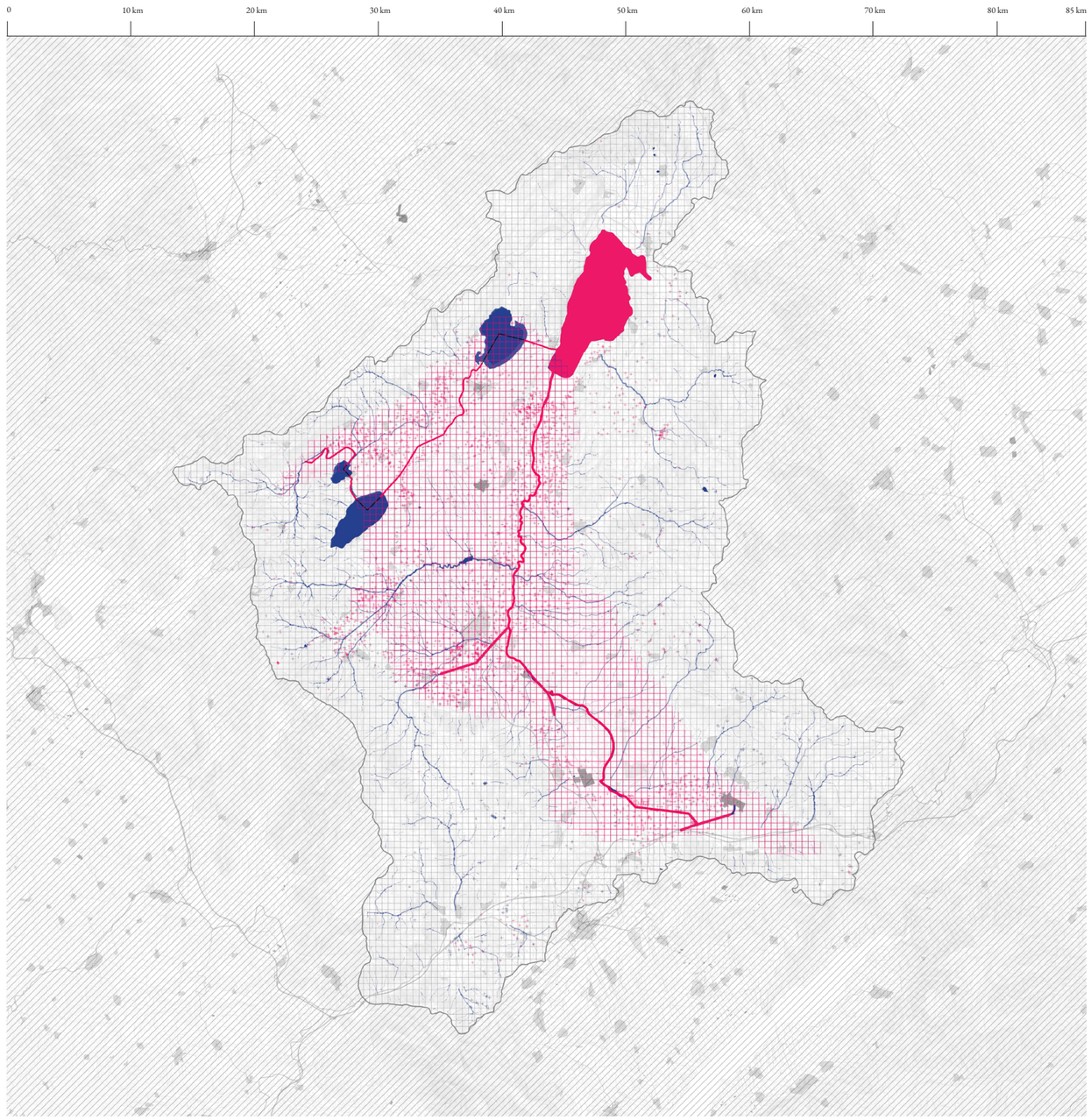


Figure 51. *Water Conditions*
Sources EEA (2018), MEE (2014)

TERRITORIAL MAPPING | ENERGY PRODUCTION POTENTIAL

In this section, the energy production potential for the territory is calculated. The study measures wind, solar and biomass energy production potential for the territory. For each energy type, the energy production potential was calculated, and each grid cell received a grade from 1-5. For the final map, the grids from the value tree and above were isolated.

At this point, it is important to highlight that different values could have been potentially included by experts on the field.

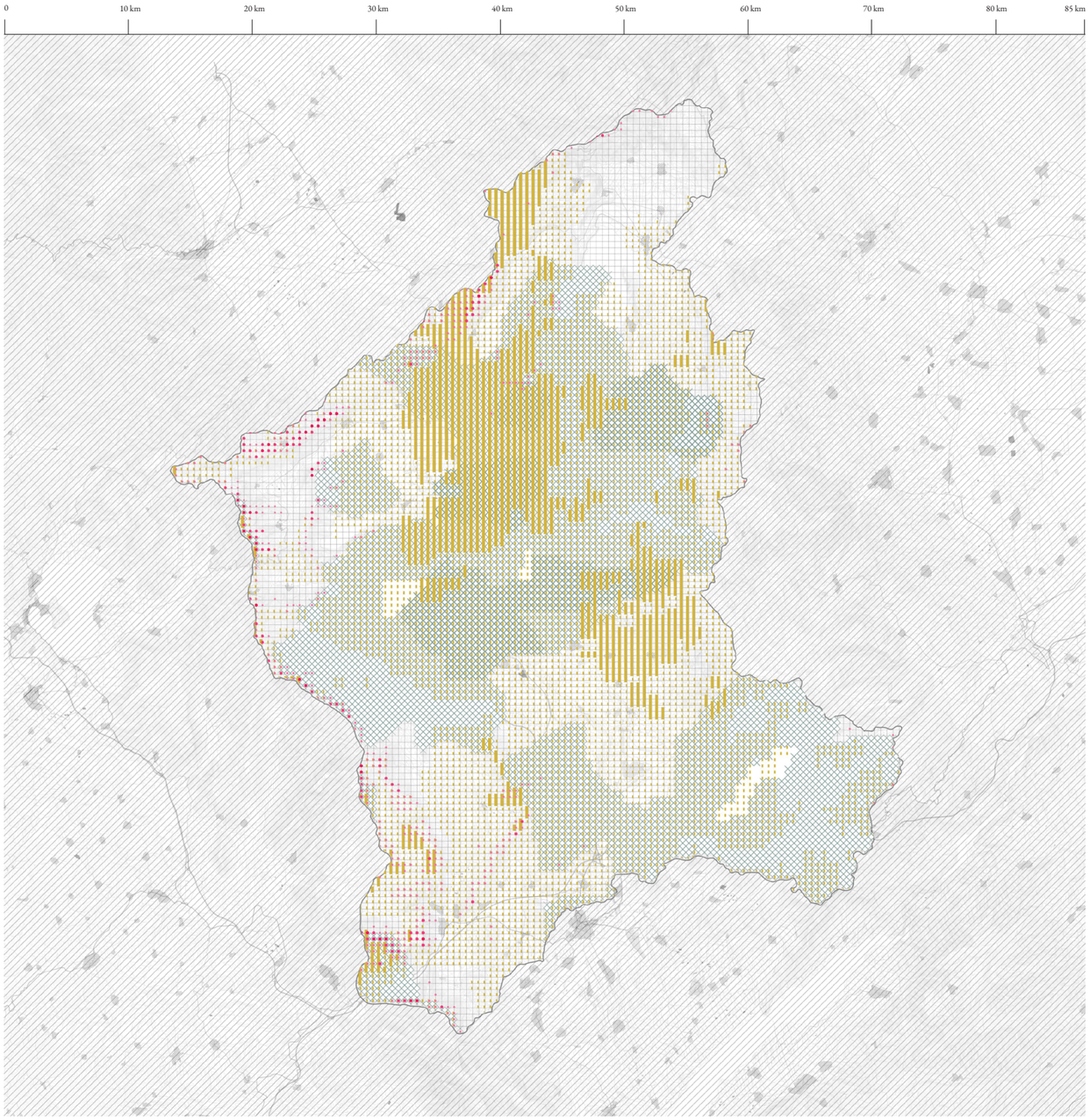


Figure 52. *Energy Production Potential*
Sources EEA (2018),RAE (2021)

TERRITORIAL MAPPING | SOCIO-ECONOMIC VULNERABILITY

As indicated in the previous sections, there is a degree of vulnerability associated with the shrinkage of the mining and energy sector and the local communities in the region. For this reason, the project attempted to map the territorial correlations of vulnerability by using nine factors, grouped in the 3 following sections listed below:

1. Employment Sector
2. Population Age & Job Mobility
3. Education level

In this section, Income information would have been included; however, they were not accessible to the author when the study was conducted.

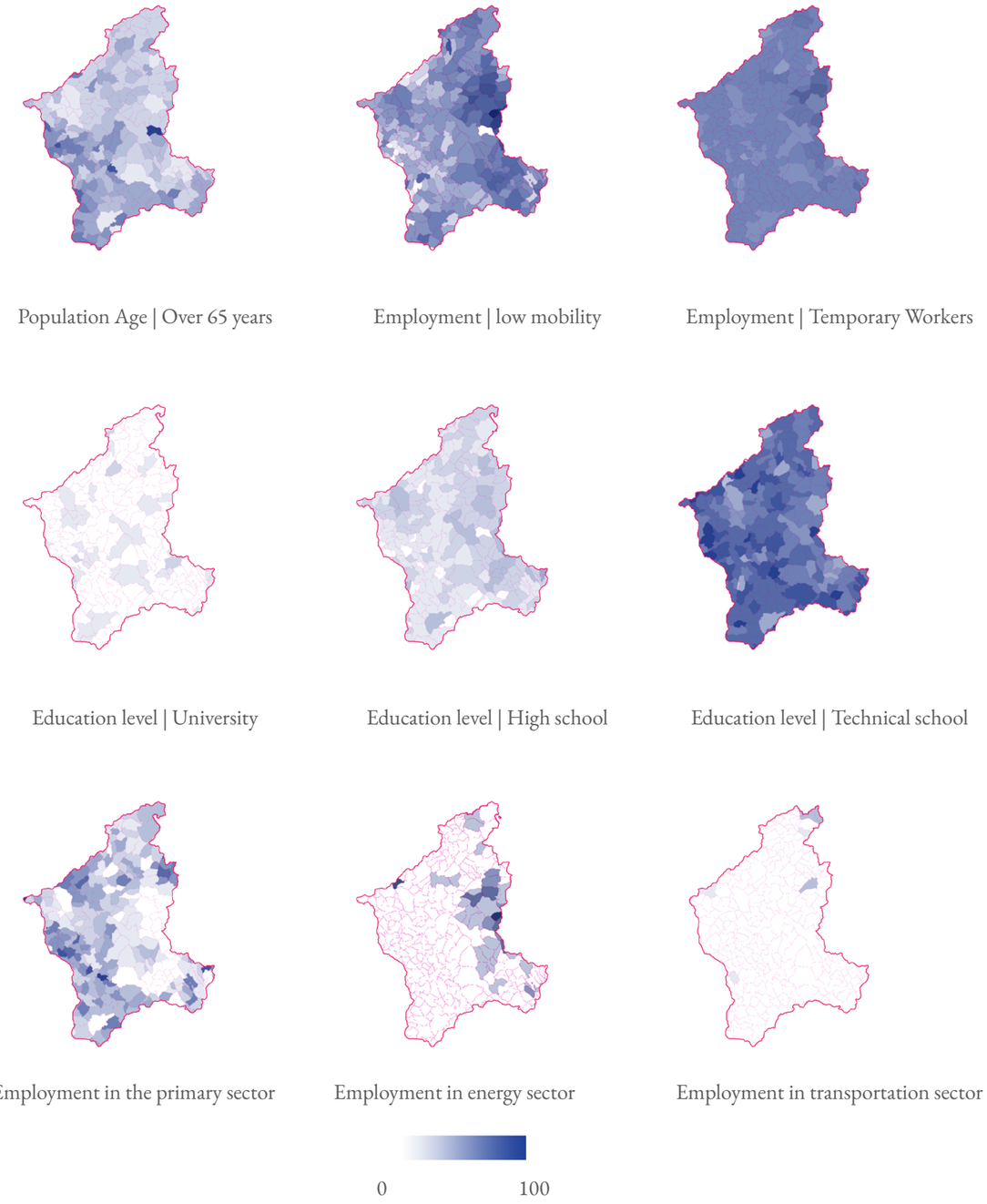


Figure 53. *Social Conditions*
Sources EEA (2018),ELSTAT (2021)

CONCLUSIONS | POTENTIAL

In this section, the potential areas of renewable energy integration are highlighted. More specifically, areas of land use like agriculture, low vegetation zones, pastures and industrial areas that could potentially be repurposed. Along with these land uses, the environmental conditions are included, as well as the energy production potential.

It is important to note that this land uses, even though they can receive RE infrastructure well, there must be a spatial study integrating buffer zones in relation to ecologically sensitive areas and residential areas.

Legend

Land Uses
- Protected areas
- Forestry
- Pastures
- Residential
- Industrial
- Mining
- Rehabilitated mines

Energy Production
- Solar
  - low
  - high
- Biomass
  - low
  - high
- Wind
  - low
  - high

Flexible Enegy Infrastructure
Flexible Agricultural Areas

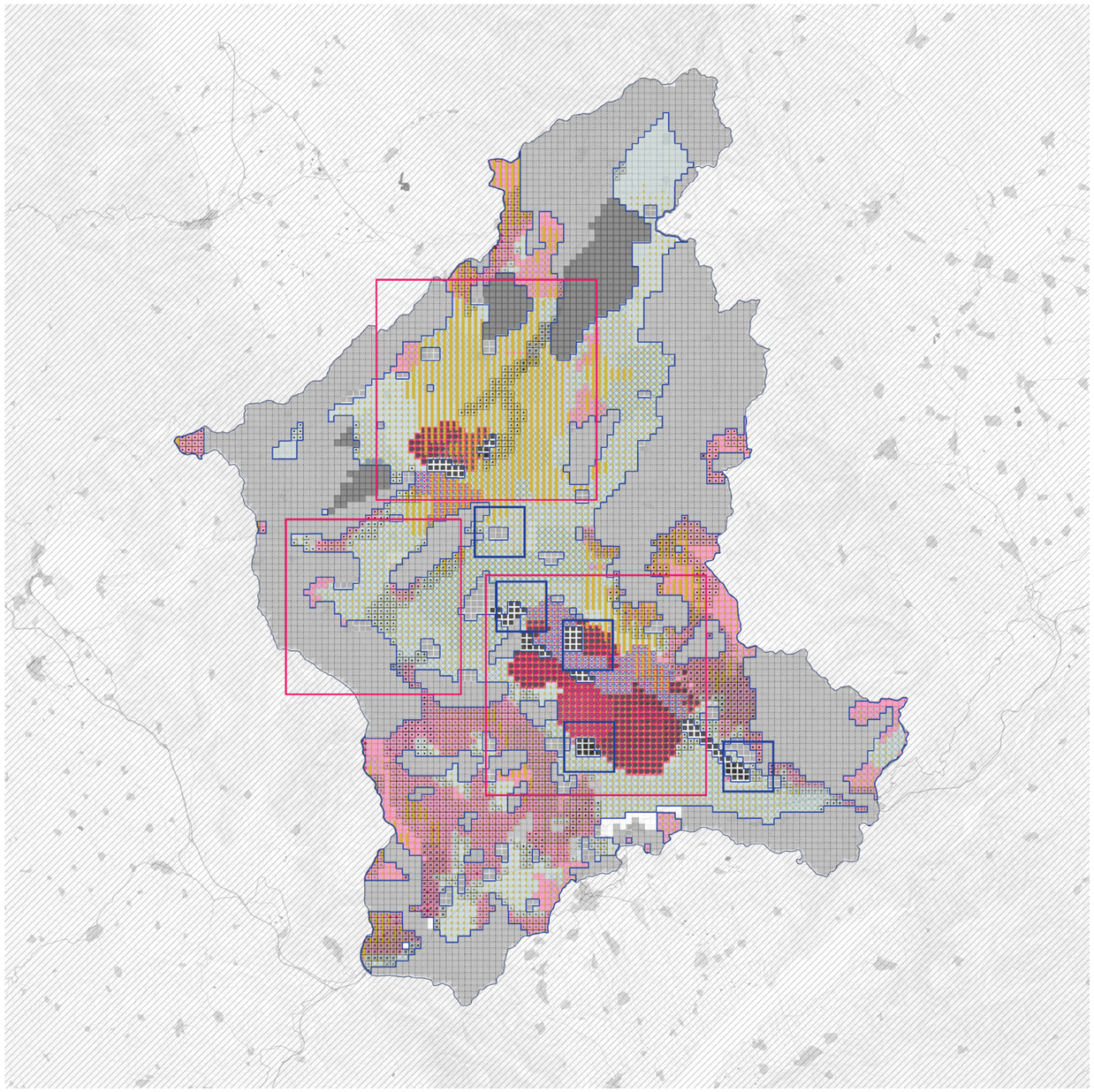


Figure 54. *Urgencies*
Source: author

CONCLUSIONS | URGENCIES

In this section, the potential future areas of urgency are highlighted. These include areas of high ecological sensitivity and areas of high environmental sensitivity. These areas are overlaid with soil conditions and energy production potential.

To elaborate further, many areas with high ecological value, like pastures and protected areas, are marked with both in energy production potential and have many specific crucial soil conditions, Additionally, environmentally sensitive areas, like mines, are marked medium in energy production potential. These areas are at the forefront of renewable energy expansion, and the environmental sensitivities need to be addressed in a potential future plan.

Legend

Water Conditions
- Open water body | Poor chemical quality
- Open water body | Poor quantity
- Aquifer |poor chemical and lowering quantity
- Open Water body | Good quantity
- Open Water body | Good quantity
- Water Extraction points

Soil Conditions
- Erosion
- Contamination | heavy metals
- Contamination | Nitrogen
- Open Mines

Protected Areas
- Natura 2000 Areas
- Ecological Rehabilitation Areas

Energy Production
- Solar
  - low
  - high
- Biomass
  - low
  - high
- Wind
  - low
  - high

- Environmental Neglection
- Ecological Sensitivity

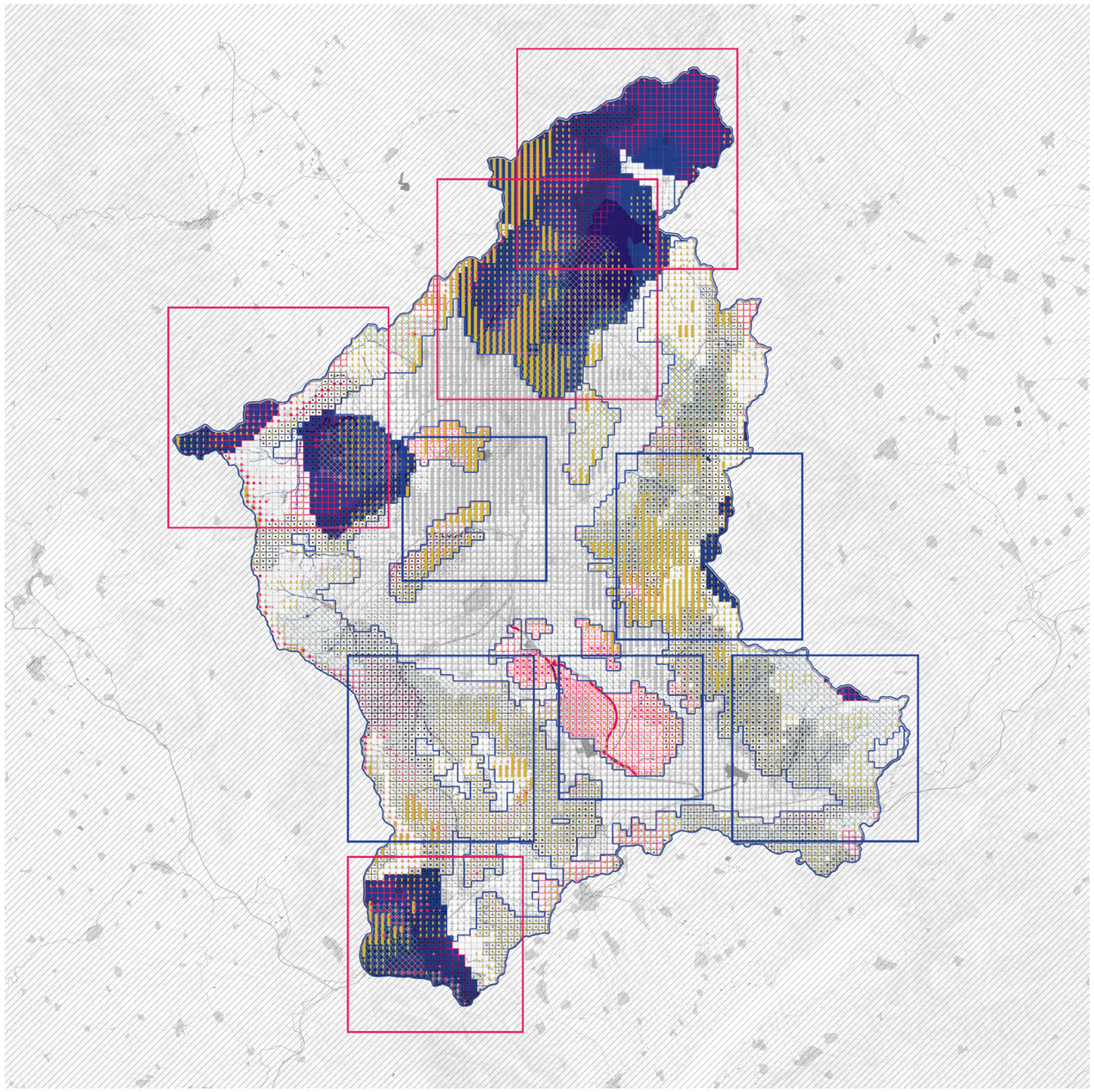


Figure 55. *Potential*
Source: author

THE POWER STRUCTURE | STAKEHOLDER ANALYSIS

Introduction

The analysis of the productive landscape of Western Macedonia shifts from the study of the spatial dimension to the underlying power structure of the territory. The process of structural change and regional planning involves a plethora of actors, that operate on different scales, belong to different disciplines and have different interests and roles.

For this purpose, the following pages attempt a stakeholder analysis, focusing on their categorisation, geolocation, positioning in the power interest matrix and finally the specification of their interests and power.

Stakeholder Categorisation (i)

The actors have been categorised into 5 five sections, according to the stakeholder classification of the Penta-helix stakeholder map (Hill, 2020, p.214), and each section is further divided into three sub-sections, according to the scale of action and operation of the actors.

Starting from the Civil Sector, developing a plan for the region of Western Macedonia involves multiple governmental bodies that operate at different scales and hold different roles and agendas. On the largest scale, the European Union and several departments define goals and set policies that affect the trajectory of the energy transition in Western Macedonia. Similarly, on a national scale, the current government and its ministries issue policies and set national goals. More specifically, the Ministry of Environment and Energy, the Ministry of Development, the Ministry of Finance and finally, the Ministry of Labour and Welfare issue laws and regulations. In addition, on the national scale, the planning instrument for the Just Transition SDAM operates by coordinating the planning process and issuing policy documents regarding the transition. On the regional scale, the spatial planning authorities can be classified into the region, the provinces and municipalities.

In the knowledge sector, knowledge institutions that operate at different scales can act as collectors of information. On an international and European scale, institutions, such as the World Bank, and NGOs, such as WWF, have conducted different studies that can inform the process. On a regional level, institutions that can provide valuable knowledge include the University of Western Macedonia, the Research Centre of Western Macedonia and the Development Company of Western Macedonia ANKO. It is important to note that, unlike the Civil sector, there is no absolute relation between scale and hierarchy.

● Public Sector
1.European Union
2.Hellenic Republic
3.Region of Western Macedonia
4.Union of Municipalities of Western Macedonia
5.Energy Municipalities
6.Ministry of Development
7.Ministry of Labor
8.Ministry of Finance
9.Ministry of Environment and Energy
10.SDAM
11.Forestry Department of WM
● Capital
12.Private Investors
13.Land Owners (“Metavasi A.E.”)
● Private Sector
14.PCC
15.Renewable Energy Companies
16.Lignite Mines (Lignite Center of Western Macedonia, Lignite mines of Achlada)
17.Transportation Companies
18.Waste Management Company
19.RAE
● Community
20.Labor Unions
21.Workers in mining, energy and transportation industries
22.Workers in the agricultural industry
23.Citizens
24. NGOs
● Knowledge Sector
24.University Western Macedonia
25.Research Center of the University of Western Macedonia
26.Development Companies
○ Non Humans
27.Nature
28.Animals

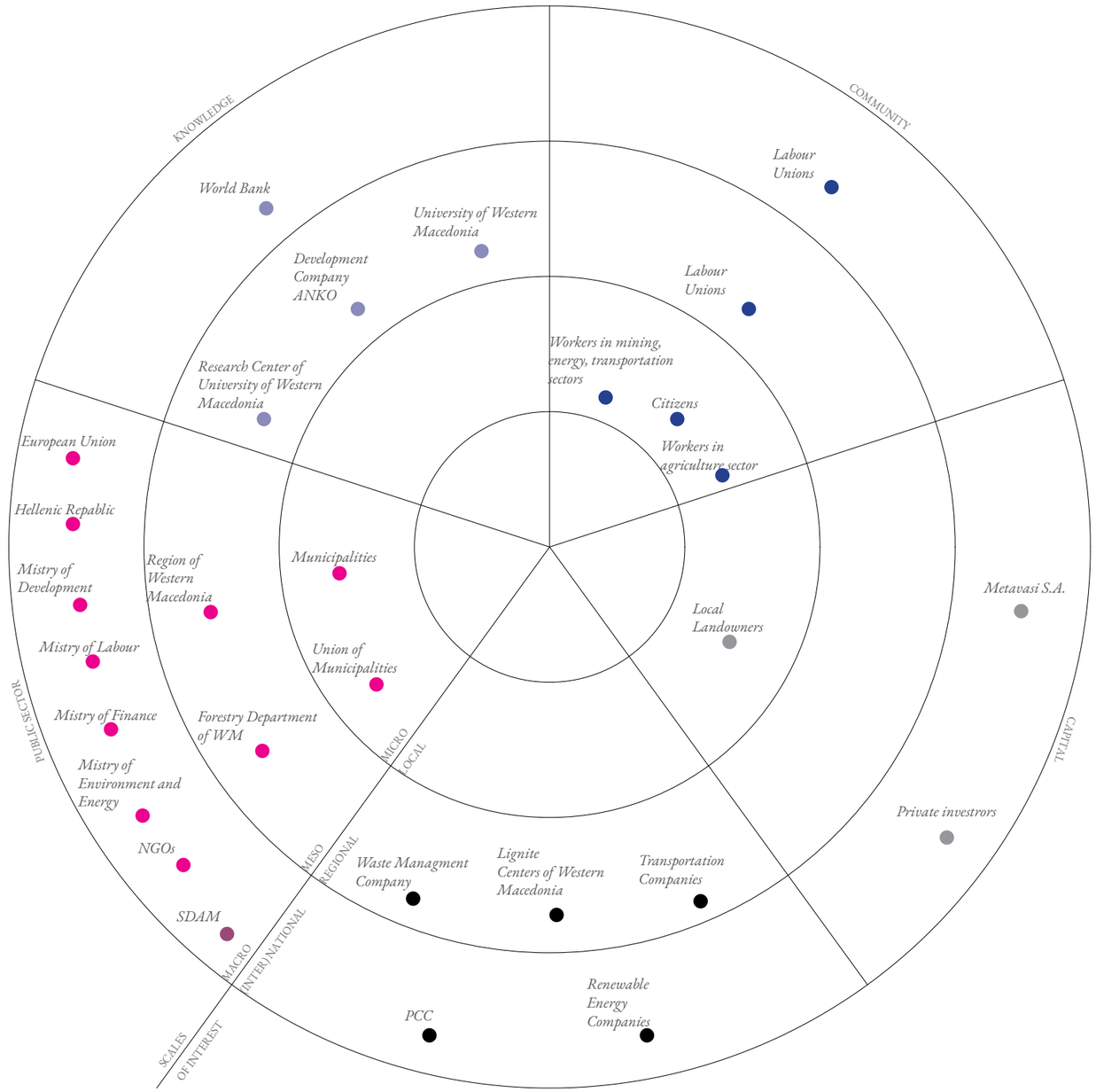


Figure 56. *Stakeholder Scales Diagram*
Source: author

Stakeholder Categorisation (ii)

In the community sector, there are multiple actors with limited power and minimal participation in planning processes. On a national and regional scale, there are several Labour Unions in the energy, mining and transport sectors which can advocate for the rights of the workers in the sector. On a local level, there are workers in the aforementioned fields, along with workers in the agriculture and farming sectors, who are affected by the process of the transition. It is important to note that even though the operation of these actors might have a large impact on space, they rely on participatory planning in order to be actively included in the planning process and have been systematically excluded in the past.

In the Capital sector, on the national scale, there are the private investors and the beneficiary Metavasi A.E., who can accelerate the process of the transition. The local scale is occupied by local landowners.

In the business sector, there are companies that operate on different levels and hold different interests. On the national scale, the energy companies, including the semi-national energy company PCC and multiple renewable energy companies, hold the most influence. On the regional scale operate companies in the transport sector, waste management and smaller lignite centres that support the energy production process. Finally, on the local scale, small supply companies. Again, it is important to note that the classification according to scale is not the most relevant, as many of the actors hold competing interests, and there is no absolute relation between scale and hierarchy. Additionally, companies on higher levels, such as PCC, might operate at lower levels as well.

Synergies & Conflicts

On the diagram to the right, the main synergies and conflicts between stakeholders are depicter.

Currently, the main synergies in the transition process can be observed between all stakeholders that are currently involved in the decision-making, planning process and execution. More specifically, this includes the national planning institutions and the transition governance (SDAM), RE energy companies, PPC, large-scale companies in the energy and mining sectors, local land owners and the region of WM. On the other hand, the most acute conflicts can be observed between local stakeholders and stakeholders that can affect the decision-making process. More specifically, the citizens, employees in the energy mining sectors, labour unions and the transition governance and large-scale energy and mining companies. Additionally, it includes conflicts between local and regional stakeholders (citizens, employees, land owners, NGOs) and regional and local governments because of the lack of trust between the two groups. Finally, there are conflicts between knowledge institutions (Universities, NGOs) and transition governance because of the lack of inclusion in technical committees.

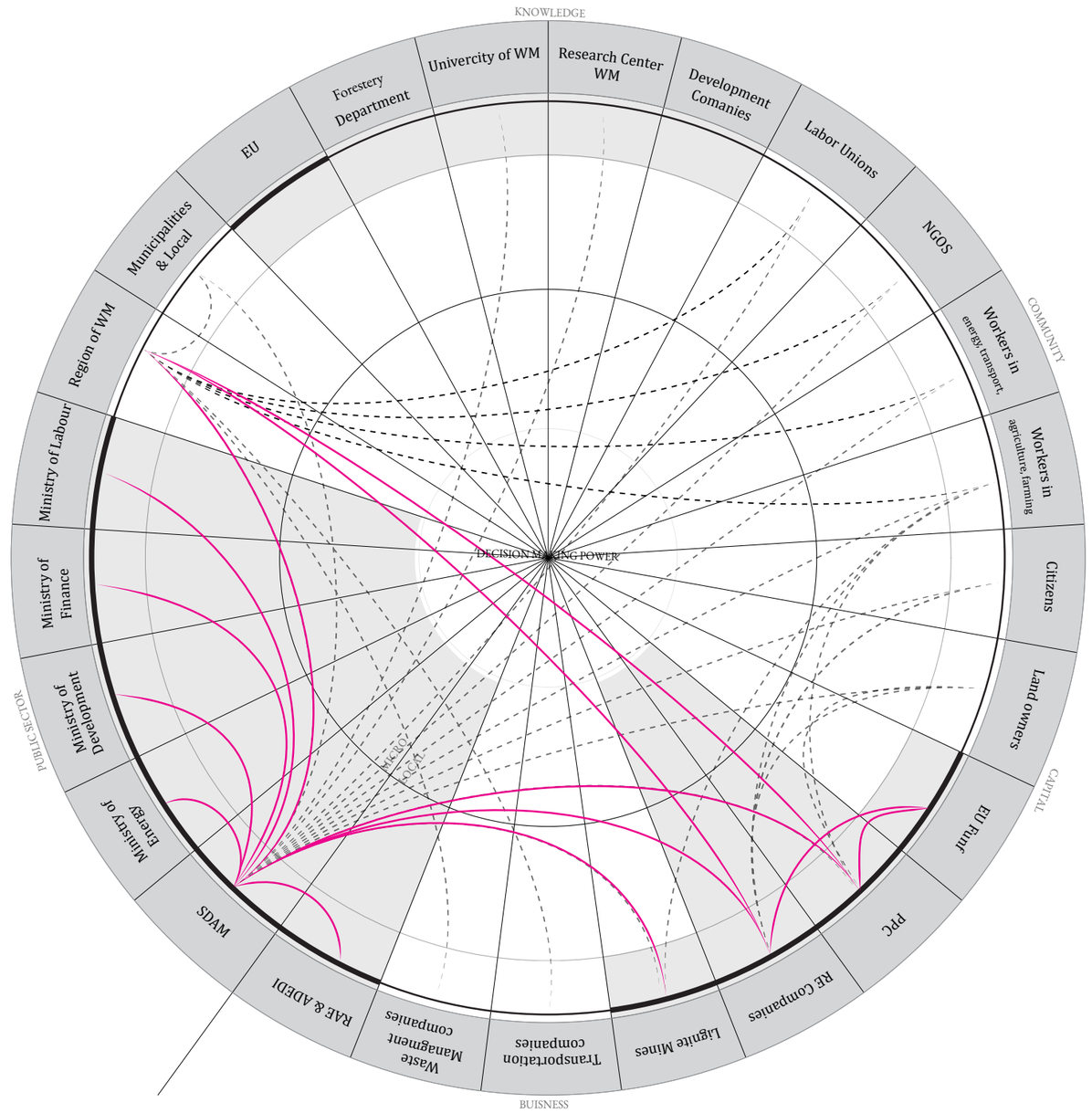


Figure 57. *Stakeholder Synergies and Conflicts Diagram*
Source: author

THE POWER STRUCTURE | POWER & INTEREST

Stakeholder Power - Interest Diagram

By placing the stakeholders in the Power Interest Diagram, different groups and actions per group can be identified. More specifically, region-local governance stakeholders must be included in the transition governance mechanism. Additionally, local stakeholders must be empowered by integrating into the participatory and monitoring process. Local and regional stakeholders in the knowledge sectors must be integrated into the governance mechanism, either in the monitoring or technical committees. Finally, Energy companies need to be controlled through the adjustment of current policies related to energy infrastructure.

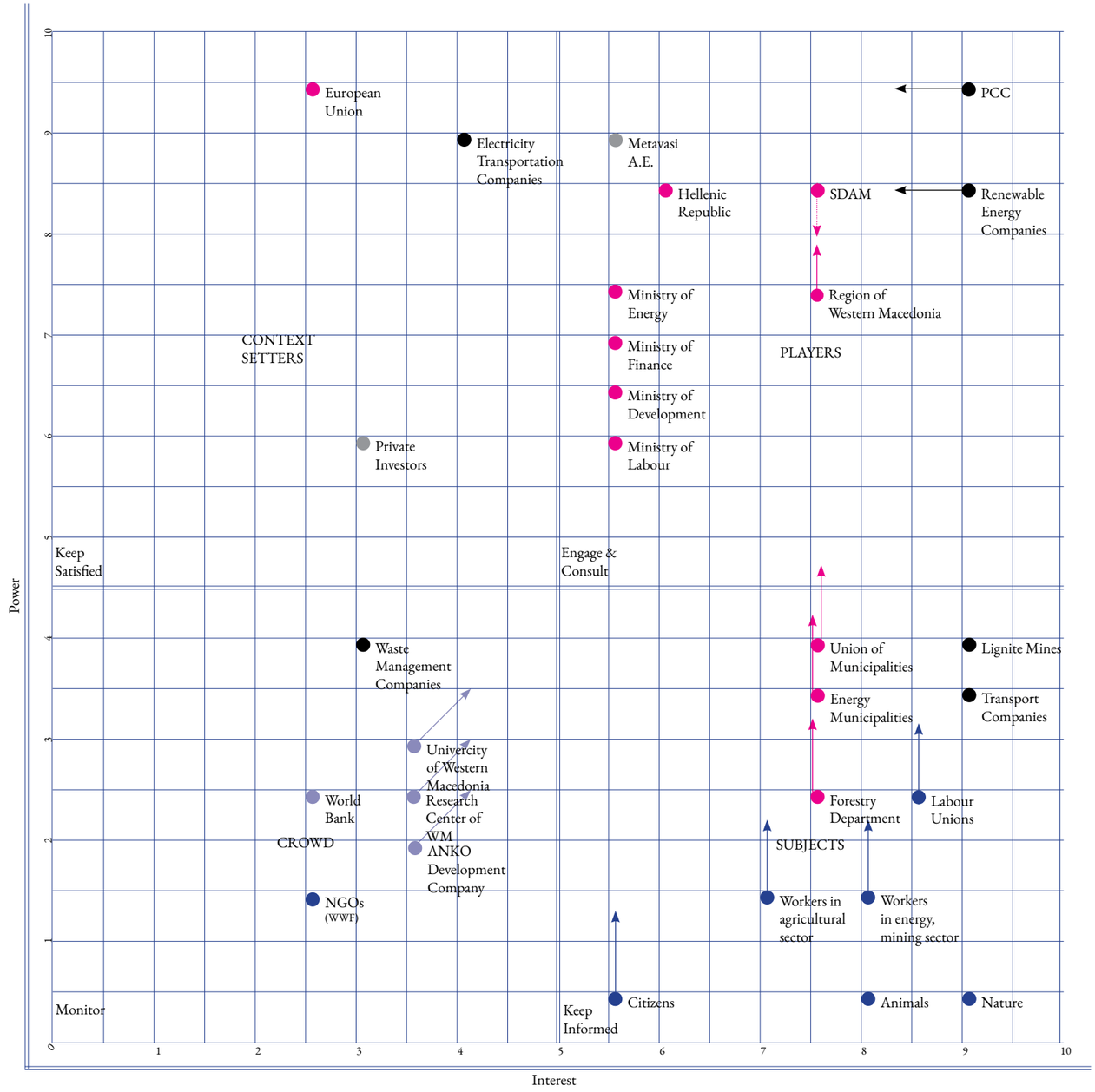


Figure 58. *Power Interest Matrix Diagram*
Source: author

JUST TRANSITION GOVERNANCE MECHANISM | SDAM-PDAM

In September 2019, Greece pledged to phase out all coal-powered electricity production by 2028. This commitment is enshrined in the **National Energy and Climate Plan (NECP)** submitted by the Greek government to the European Commission in December 2019. Three months after the announcement of the decision to phase out lignite, the first governance structure came to the fore under the title Government Committee for Just Development Transition in the context of a Ministerial Council Act. The Committee is comprised of representatives of competent Ministries, empowered to politically oversee the overall transformation in lignite regions and coordinate the utilisation of the available funding resources.

It is worth noting that there was the possibility of choosing other bodies, such as regional-local authorities, public organisations, agencies, environmental NGOs, and even any other person considered capable of assisting on a case-by-case basis (without the right to vote). Notably, the Committee has no expiration date, implying that it will operate throughout the transition.

In parallel with the Government Committee, a Steering Committee was established with the mandate of preparing and implementing a Just Development Transition Program and the corresponding **Territorial Just Transition Plans** required for accessing funds from the EU Just Transition Fund. The members of the Steering Committee Are Secretary Generals of several ministries relative to transition, the Governors of the lignite regions, the CEO of the Public Power Corporation (PPC), and the Director of the Greek. manpower employment organisation (OAED). The Steering Committee operates within the context of the Regulations of the European Structural and Investment Funds and reports to the Government Committee. On top of all that, a Technical Secretariat was set up to provide technical support to the Steering Committee in the planning, drafting and monitoring of the implementation of the **Just Development Transition Program (general masterplan)** and the **Territorial Just Transition Plans** (regional plans). The Technical Secretariat is also authorised to provide scientific, technical, and legal support.

The Just Development Transition Plan (masterplan) was drafted in August 2020, and the Territorial Just Transition Plans that followed. In compliance with the rules of the Just Transition Fund Regulation, they alluded to the promotion and inclusion of various stakeholders, including local partners, aiming to strengthen social dialogue and inclusive participation. The adopted governance setting, however, as illustrated in Figure 63 to the right, reflects a complecated mechanism with several ambiguities in the duties and roles of the eleven different structures (Green Tank, 2021).

To conclude, apart from the **managerial intricacy** of the above governance mechanism, it is obvious that this governance mode is clearly applying a t**op-down approach**. It is worth mentioning, for instance, that **decision-making does not even include the mayors of the transition regions**, ignoring their decisive role as advocates of the lignite areas' transition issues. In addition, **several key stakeholders, representatives of local communities, and NGOs are missing** from the proposed structures, thus reflecting inadequate inclusiveness andrepresentation (The Green Tank, 2021).

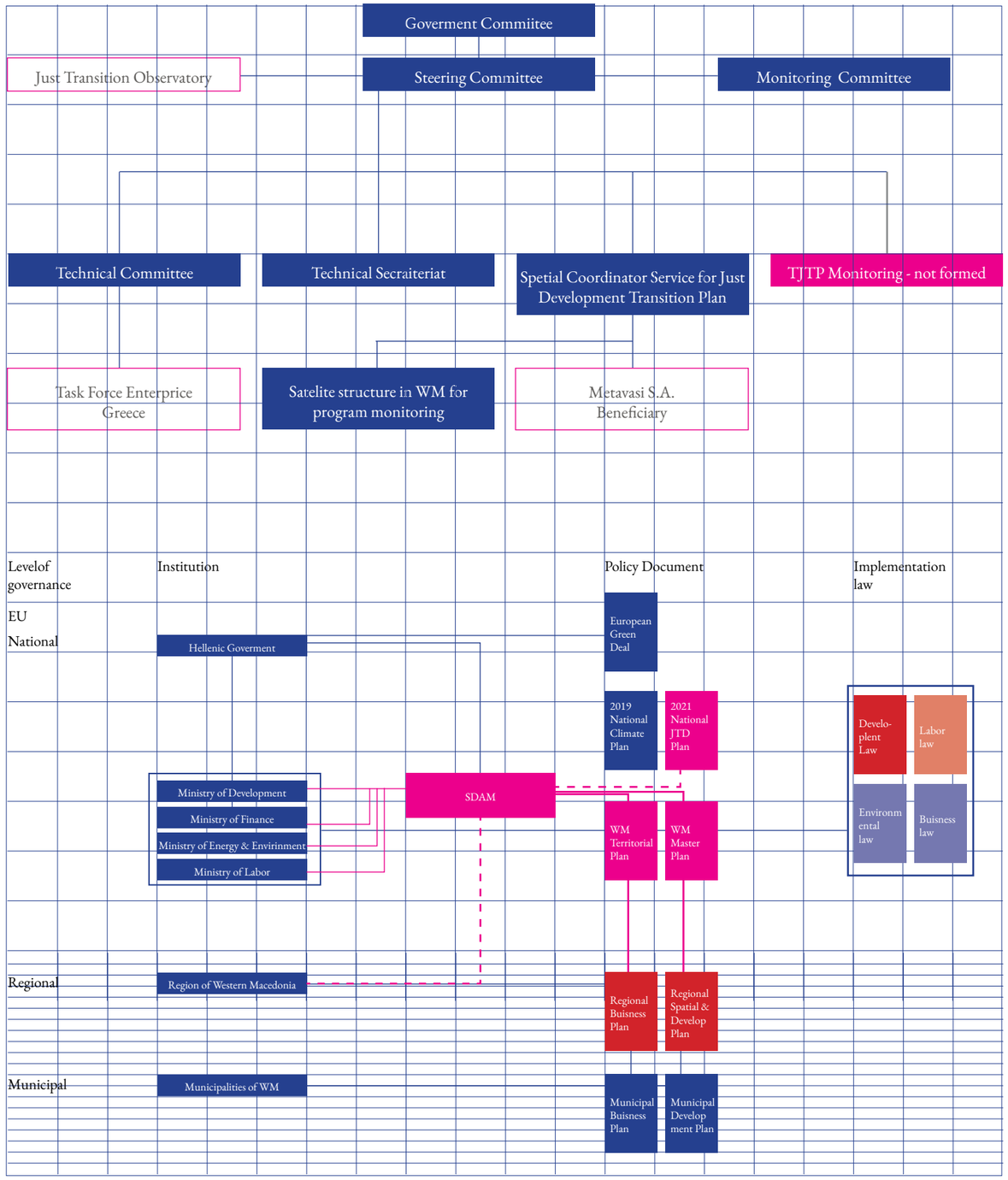


Figure 59. *The Structure of SDAM*
Source: Topaloglou (2021)

SCENARIOS

We are all within our future

Andreas Empirikos, Blast Furnace

(Empirikos, 1935)

SCENARIO CONSTRUCTION

Logic of construction

Based on the previous analysis, it becomes clear that the current plans for the region and the territory are clearly oriented to transforming it into an energy powerhouse but, at the same time, lack serious considerations of environmental and social aspects of this transition and are primarily focused on maximising energy production.

Mapping Technique

To depict the scenarios on the scale of the territory, space was reduced to a spatial grid of 1km to 1 km, and spatial data (land uses, water structure, energy potential, etc.) were simplified according to this grid. For the construction of the scenarios, specific strategies are applied to each scenario. Each strategy is applied according to the scenario narrative on specific land uses.

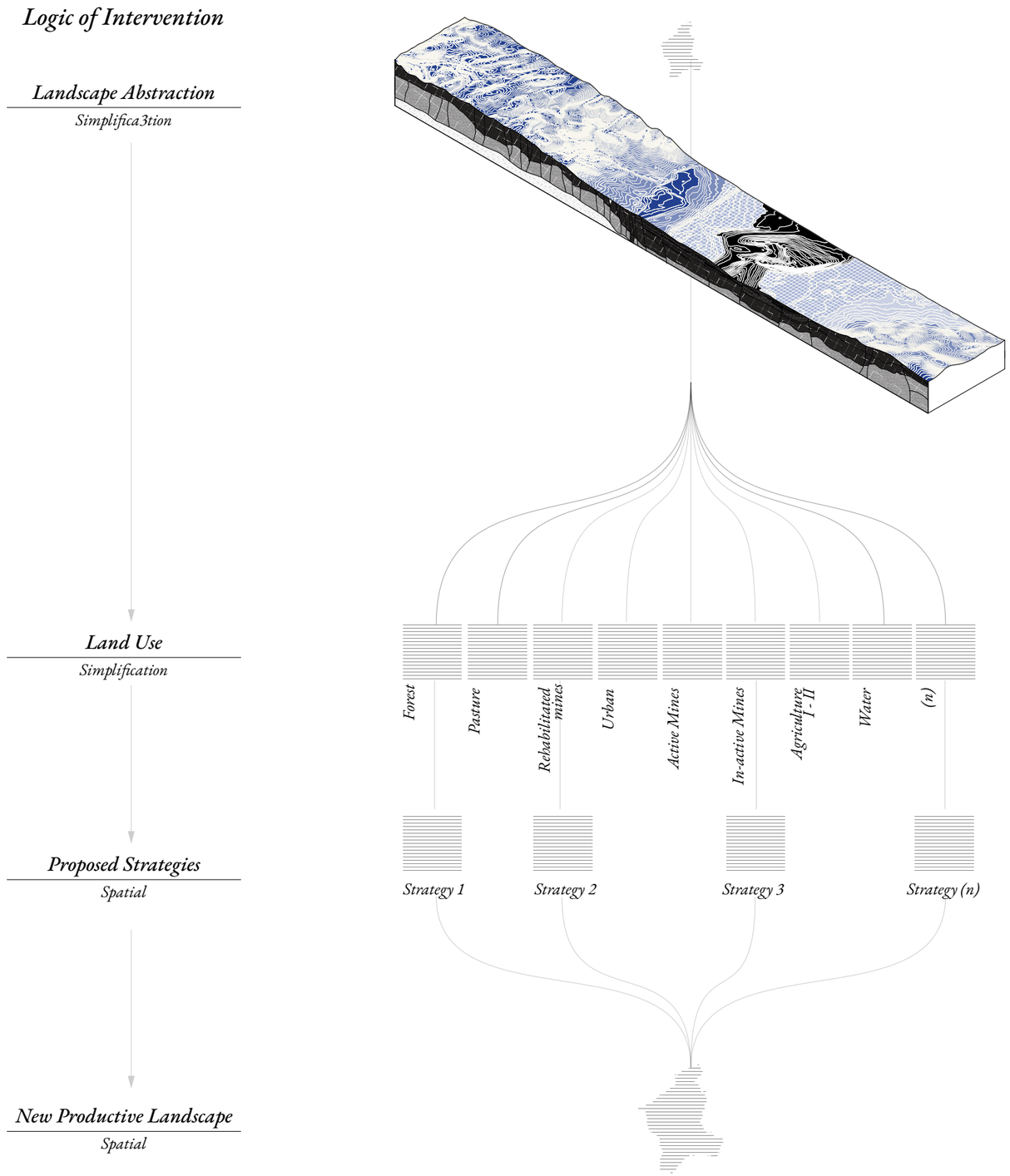


Figure 60. *Scenario Construction Logic*
Source: author

SCENARIO CONSTRUCTION

The four scenarios

According to the previous analysis, two key dimensions are defined and used to construct four scenarios: regeneration – degradation and transformation - preservation. These values will be used to create four different scenarios that explore extreme possibilities of development for the territory. Through examining these scenarios, we can envision how the planning process could take place in different ways by identifying different objectives and asses their potential impact on the ecology, society, economy and, finally, energy production of the area.

Scenario: Solaria

This scenario explores the development of the territory as a new energy production centre focused exclusively on wind and solar energy. It follows the current spatial patterns of development in the region, following an extractive logic, in which the landscape itself is radically transformed to produce energy with mostly negative impacts on the local communities. The goal is to radically increase the energy production of the territory.

Scenario: Modernisation

This scenario envisions the development of the territory as a diversified energy production centre. It follows the current patterns of spatial patterns of development but tries to invert the extractive logic by proposing the transformation of the primary and secondary sectors through the use of energy. More specifically, it proposes the industrialisation and intensification of the primary and secondary sectors and the diversification to have a positive impact on local communities. The goal is to promote economic and social growth through the diversification of the economy.

Scenario: Bio-fuels

This scenario proposes the development of the territory as a diversified energy production centre focused exclusively on biofuels and energy forestry. It mostly follows spatial patterns of development and follows an extractive logic. It proposes the large-scale transformation of the mines, pastures, low vegetation zones and deposits in biofuels and energy forestry plantations, and the re-use of industrial areas in the new productive model.

Scenario: De-growth

The final scenario explores the development of the territory as an ecological reserve. This scenario accepts current trends of socio-economic shrinkage and proposes the ecological regeneration of the territory. It focuses on the regenerative strategies aiming at the ecological restoration of the water network, the rehabilitation of mining areas and the afforestation of pastures and low vegetation areas.

Expected outcome

The expected outcome of this section of the thesis consists of evaluating the aforementioned scenarios that will hopefully determine the logic behind the final proposed vision and strategy for the territory.

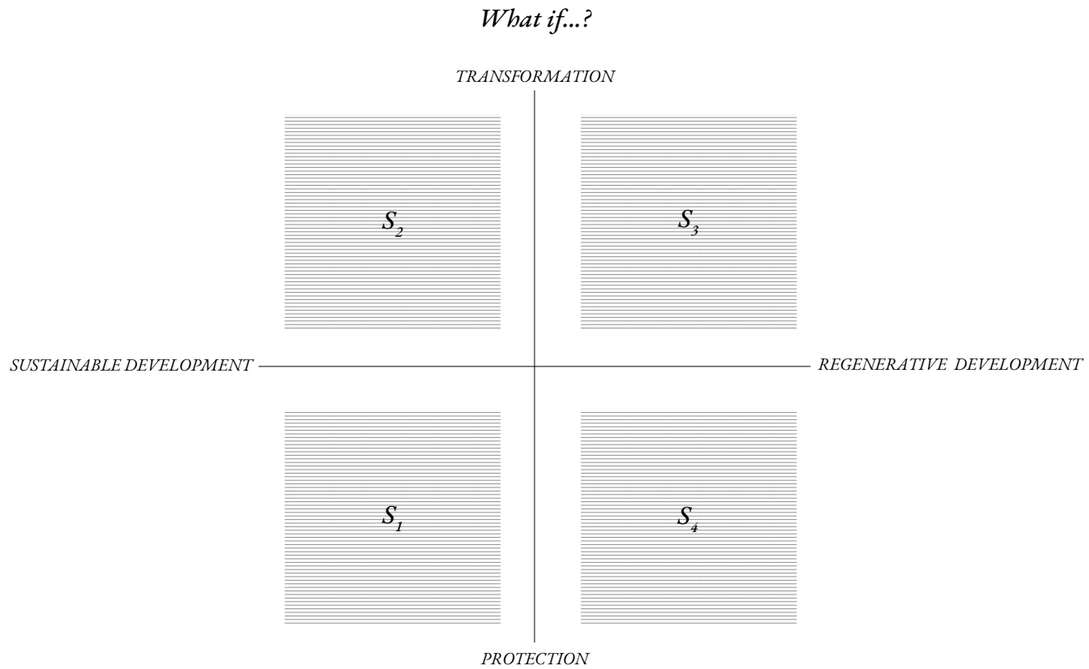


Figure 61. *Scenario Matrix*
Source: author

SCENARIO SOLARIA | INTRODUCTION

Principle Logic

It is based on a strong partnership between the region of WM, private and public energy companies, and local landowners.In addition, it abides by trends of social and economic shrinkage.

Legend

Wind park
Large scale solarpastures
Large scale solar mines

N
0 10 km

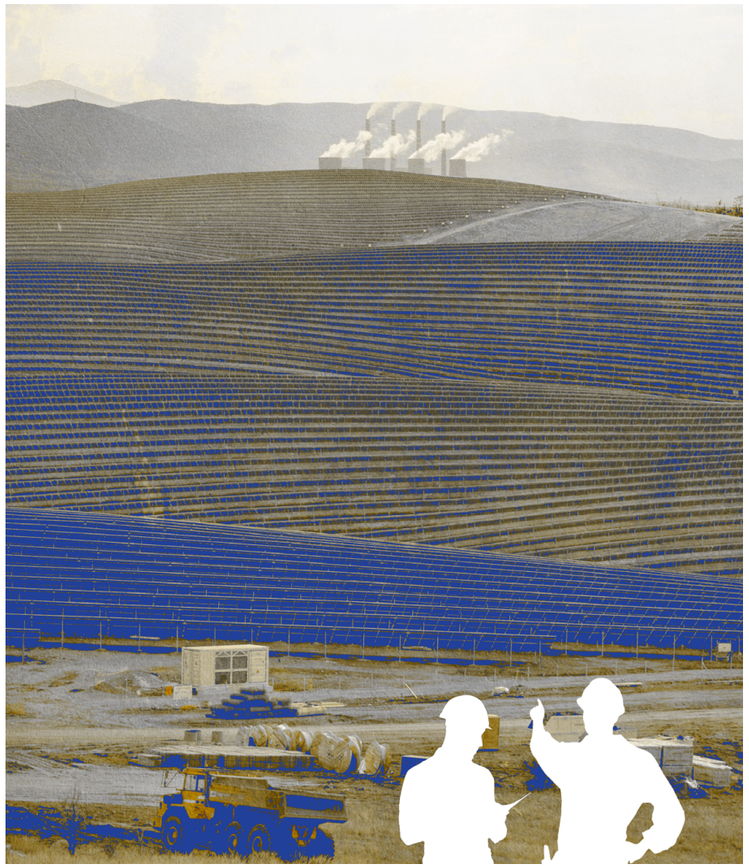


Figure 62. *Collage Solaria*
Source: author

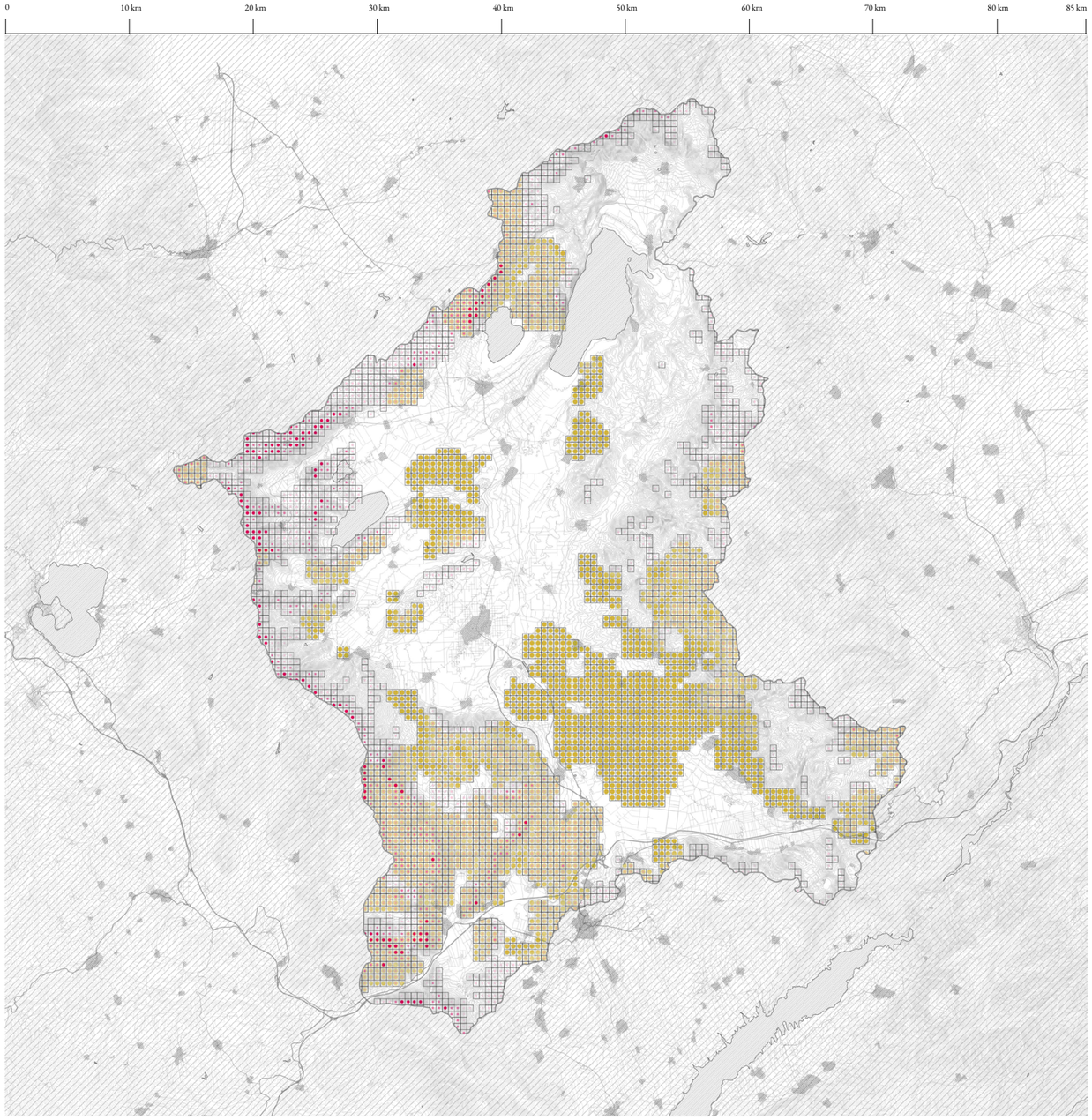


Figure 63. *Scenario 1 Basin Map*
Source: author

SCENARIO SOLARIA | STRATEGIES

Strategies

The principle strategies that are applied foresee the intensification of energy production in the territory and follow a logic of no restriction. As a result, this scenario proposes the large-scale instalment of wind parks in protected areas and forests, the large-scale instalment of photovoltaic panels in areas of deposits and mines and lastly, the instalment of photovoltaic panels in pastures, low vegetation zones and barren land.

Impact

Even though this scenario focuses on maximising the renewable energy production of the territory, it presents crucial drawbacks. The large-scale instalment of photovoltaics utilises space used for other economic activities and does not create ample employment opportunities for members of the local community. As a result, this mono-centric scenario will lead to the economic De-growth of the territory. In addition, spatially blind logic will result in the loss of vegetation in pastures and forest areas and the disturbance of local ecosystems.

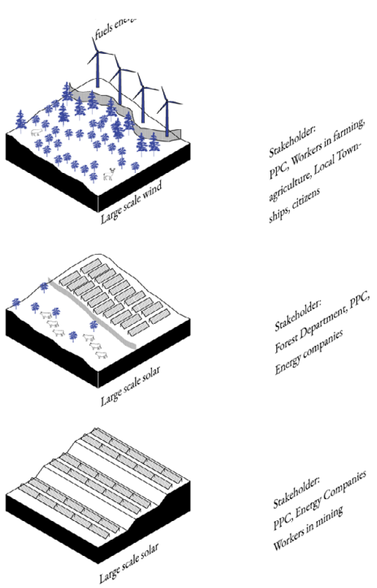


Figure 64. *Scenario Solaria |Proposed spatial strategies (source: author)*

Scenario 1 | Axonometric Depiction

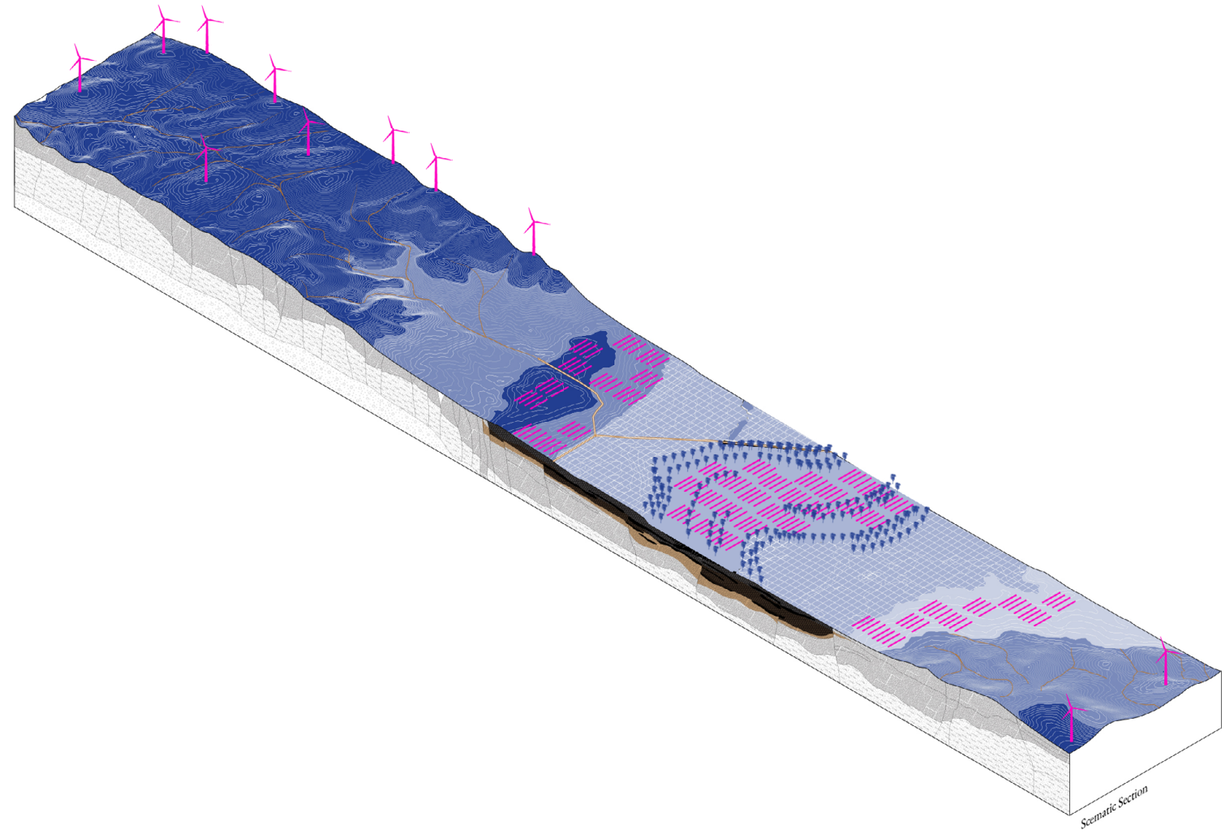


Figure 65. *Scenario Solaria | Axonometric Diagram Source: author*

SCENARIO MODERNISATION | INTRODUCTION

Principle Logic

This scenario envisions the development of the territory as a diversified energy production centre. It follows the current patterns of spatial patterns of development but tries to invert the extractive logic by proposing the transformation of the primary and secondary sectors through the use of energy.

In terms of the implementation, it foresees the development of a strong partnership between the region of WM, farmers, private and public energy companies, local land owners and research institutions to achieve a large-scale transformation of the productive landscape. Additionally, it tries to invert current trends of socio-economic shrinkage.



Figure 66. *Scenario Modernisation | Collage*
Source: author

Legend

- Large scale solarpastures
- Large scale solar mines
- Small scale solar agriculture
- Industrialised agriculture
- Intergration biofuels agriculture
- Hydrogen TPP
- Biofuels CTP

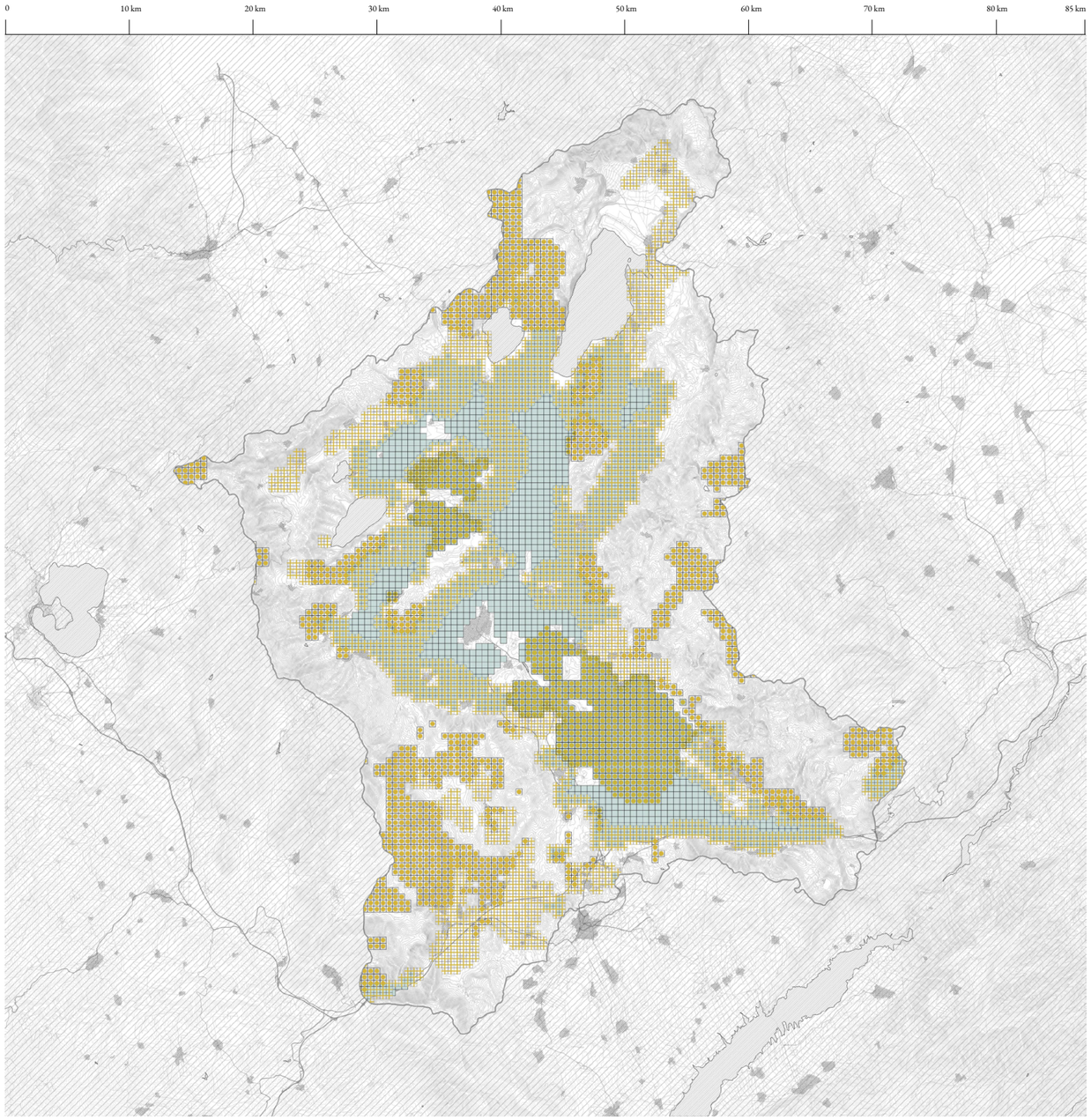


Figure 67. *Scenario Modernisation | Territorial Map, Source: author*

SCENARIO MODERNISATION | STRATEGIES

Strategies

The principle strategies applied foresee the modernisation and re-use of industrial areas such as Green Hydrogen facilities, the instalment of solar panels in mining areas and pastures and wind parks on forests and finally, the vast deployment of small-scale solar grids in agricultural and residential areas.

Impact

Even though this scenario aims to improve and diversify the productivity of the primary and secondary sectors, it presents certain drawbacks. Firstly, the increase in productivity, especially in the primary sector, will have a high water consumption rate, which may lead to the further deterioration of the aquifer. Secondly, there is a high risk of increased nitrogen and heavy metals pollution in the soil and water structure. Thirdly, the expansion of photovoltaic parks will antagonise other economic activities like farming.

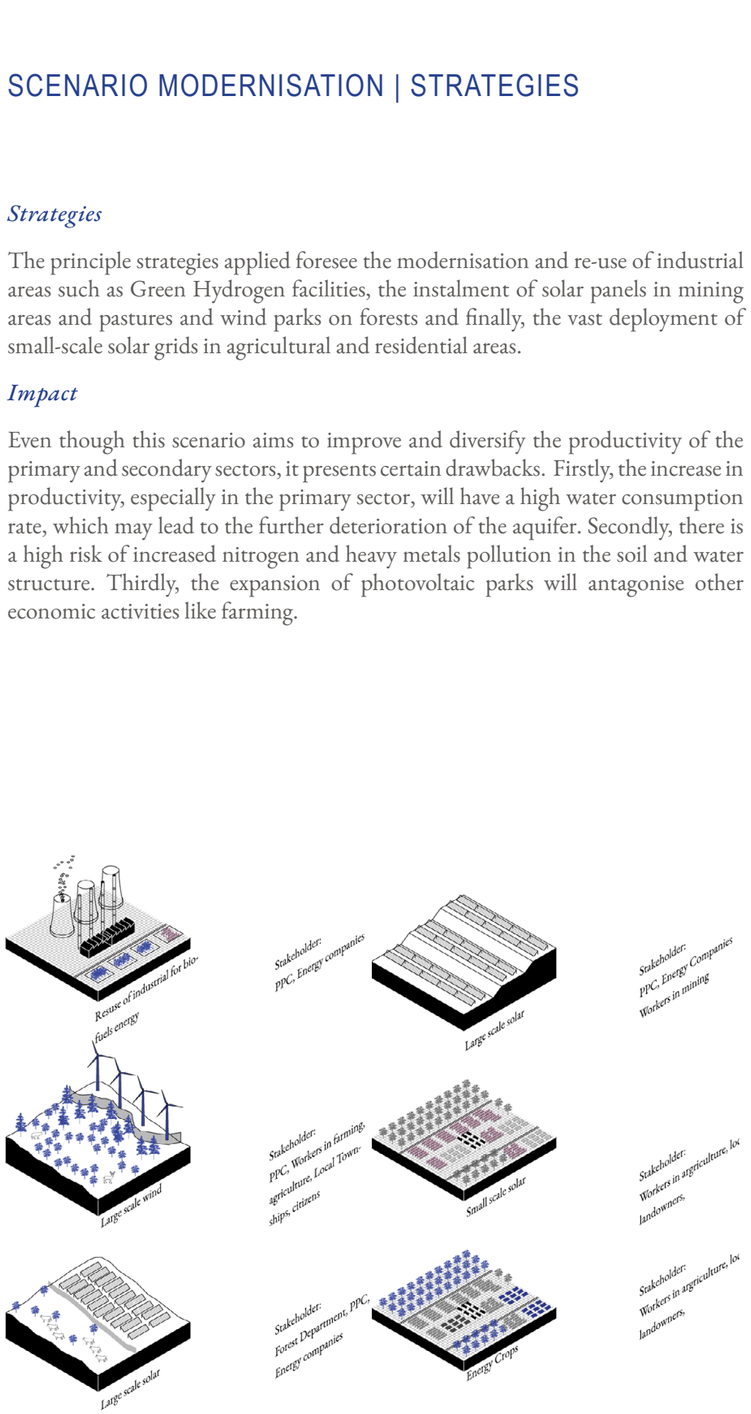


Figure 68. *Scenario Modernisation | Proposed Spatial Strategies, Source: author*

Scenario 2

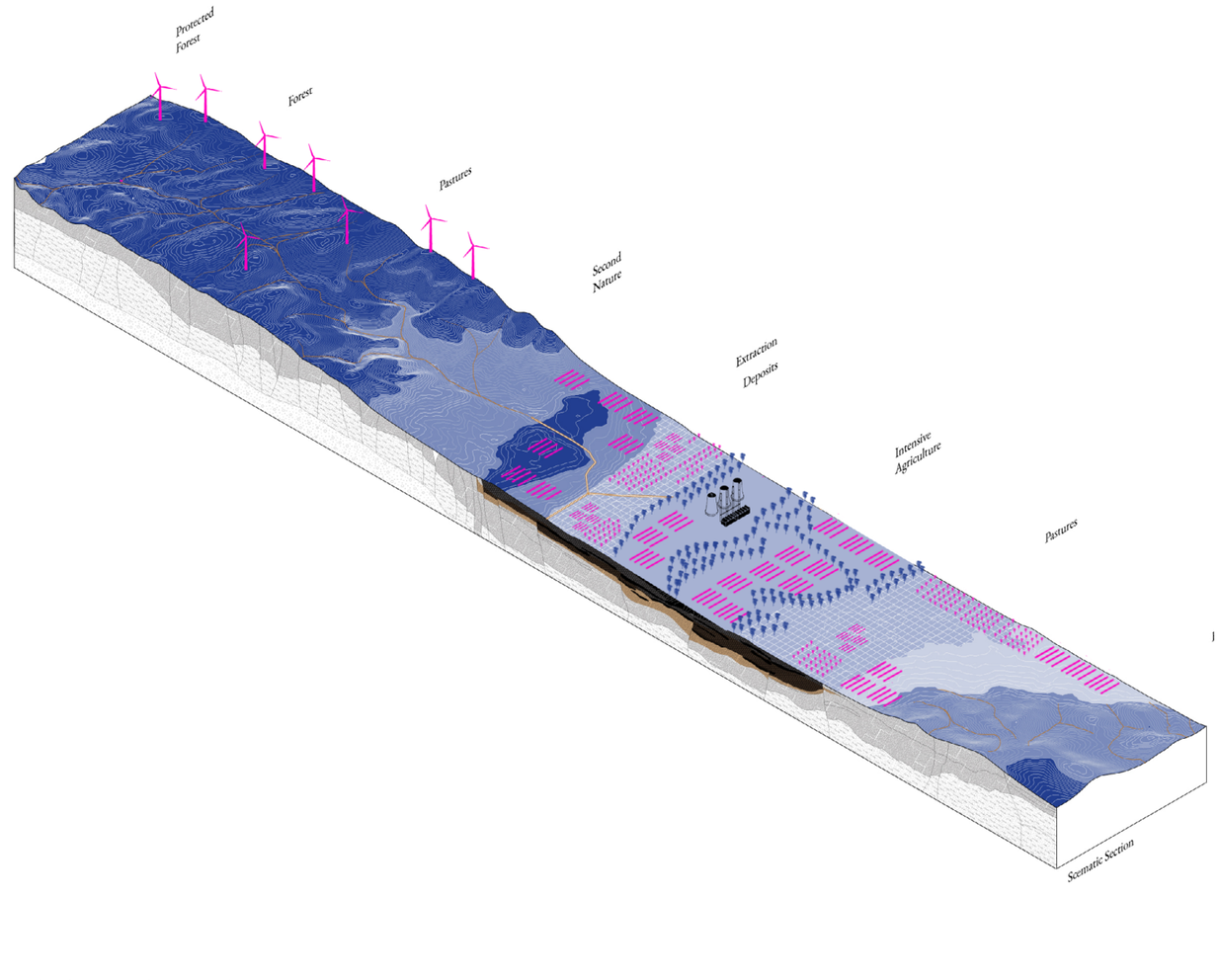


Figure 69. *Scenario Modernisation | Axonometric Diagram, Source: author*

SCENARIO BIO-FUELS | INTRODUCTION

Principle Logic

The scenario biofuels are focused on the transformation of the productive landscape by the incorporation of bio-fuels and energy forestry. In terms of the implementation, it requires a strong partnership between the region, PPC, local communities, local land owners, farmers and the forestry department of WM. Additionally, it follows the patterns of social and economic shrinkage in the region.

Legend

Large scale solarp astures
Energy Forestry in pastures and mines
Intergration biofuels agriculture
Biofuels CTP

N
0
10 km



Figure 70. *Collage Biofuels*
Source: author

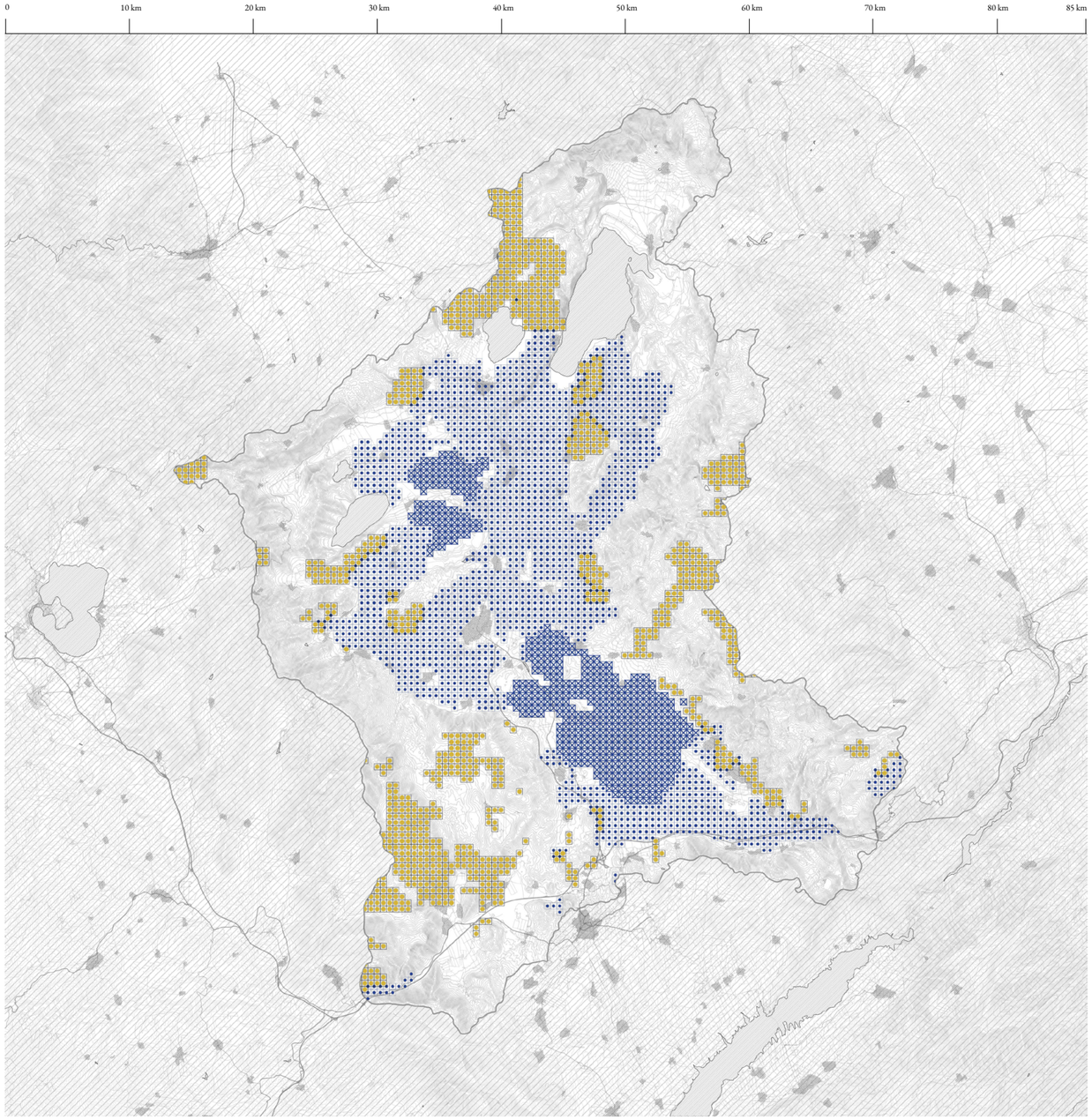


Figure 71. *Scenario Biofuels | Territorial Map*
Source: author

SCENARIO BIO-FUELS | STRATEGIES

Strategies

The principle strategies applied in this scenario are the development of energy forestry and bio-fuels in the mining areas and pastures and the transition of industrial areas into biomass factories.

Impact

It is crucial to emphasise that this scenario comes with significant disadvantages. More specifically, the scenario does not create ample job opportunities as it does not propose a radical transformation of the productive model. Additionally, the vast creation of biofuels will antagonise other production and might have a negative impact on the water reserves.

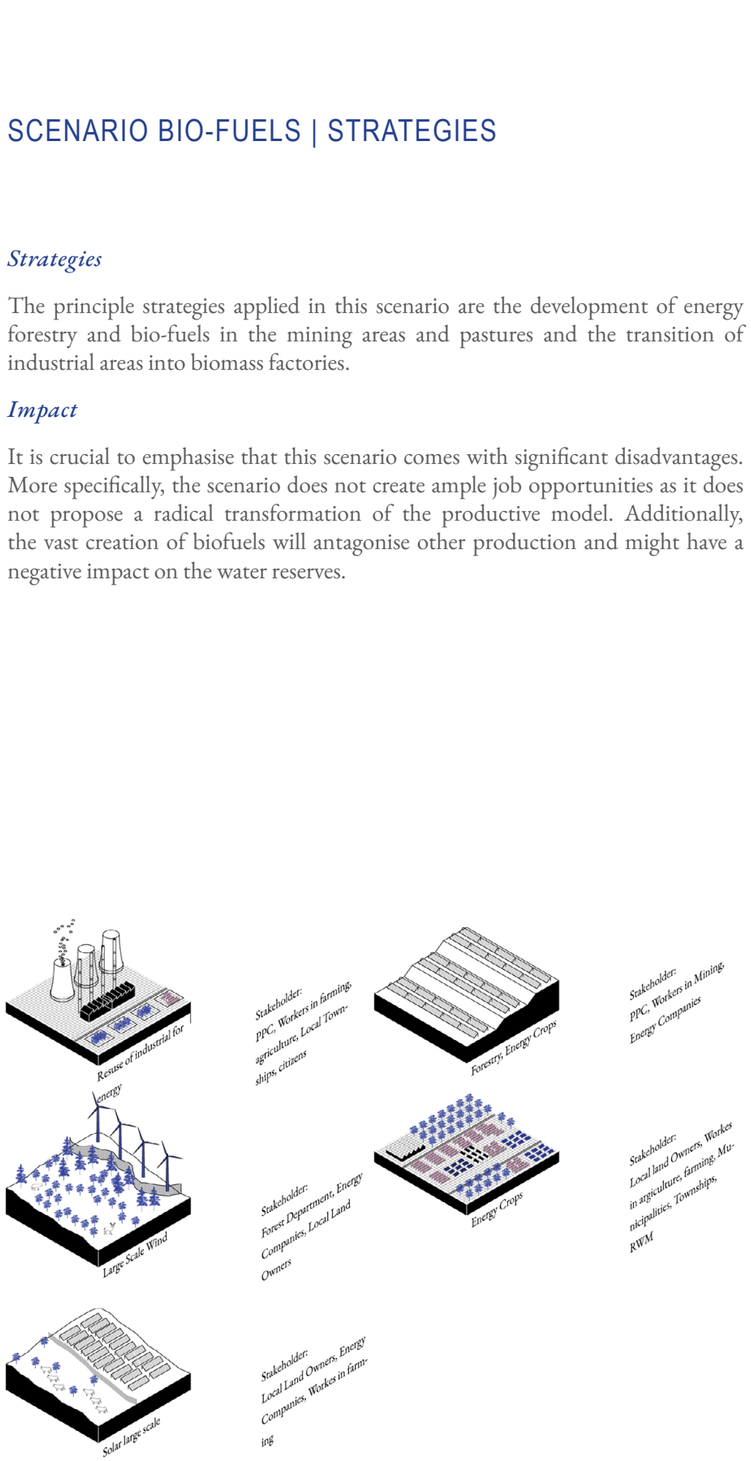


Figure 72. *Proposed spatial strategies*
Source: author

Scenario 3

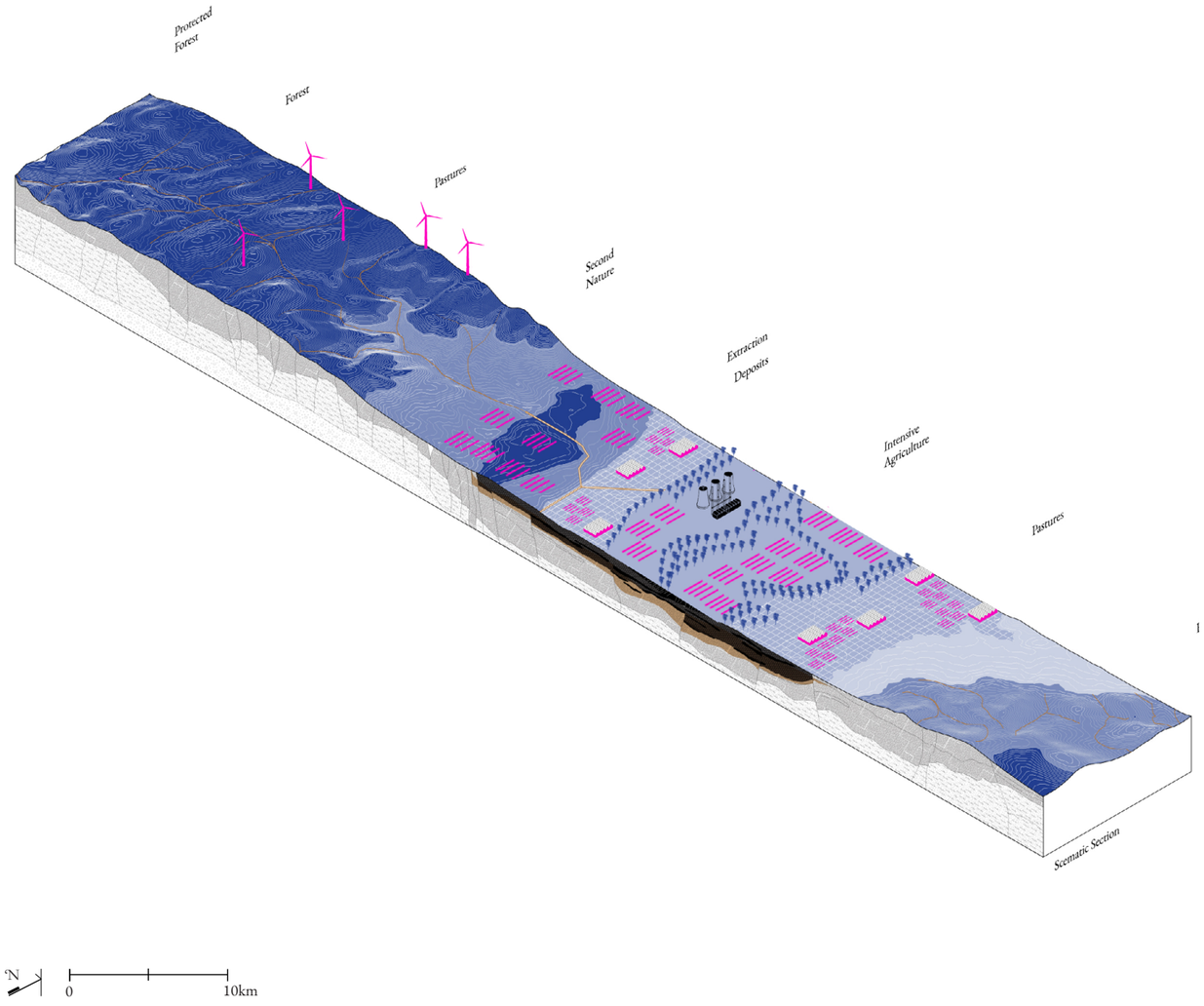


Figure 73. *Scenario Biofuels | Axonometric Diagram,*
Source: author

SCENARIO DE-GROWTH | INTRODUCTION

Prinple Logic

The scenario forestry focuses on the transformation of the productive landscape through the incorporation of forestry. It requires the development of a strong partnership between the region, the townships, the forestry department of WM, research institutions and farmers interested in forestry. Finally, it embraces the patterns of socio-economic shrinkage.

Legend

- Energy Forestry in pastures and mines
- Water reservours
- Biofuels agriculture
- Biomass Power Plant

N

0 10 km

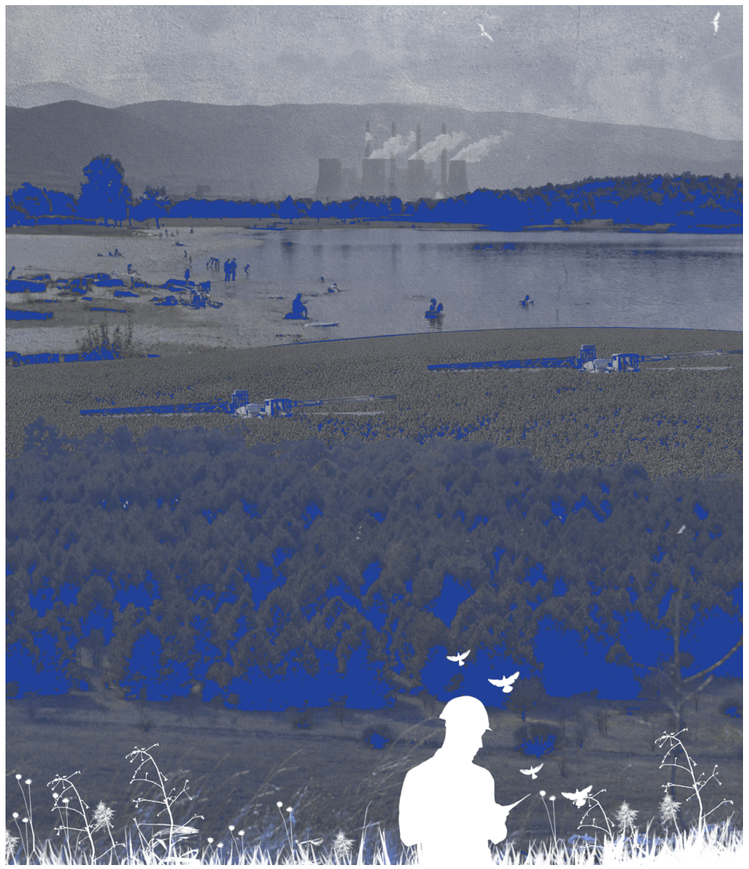


Figure 74. *Collage Scenario De-growth*
Source: author

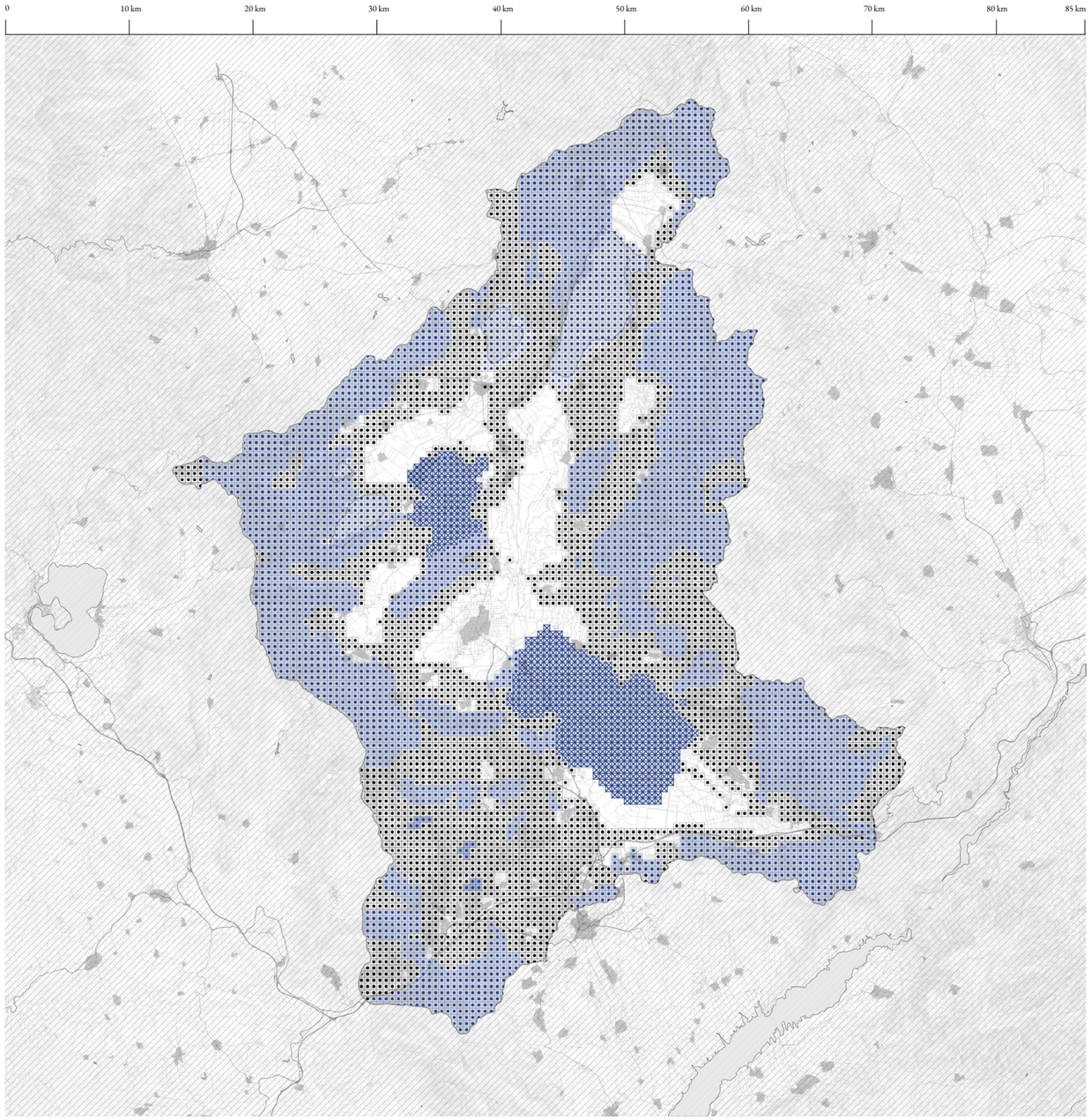


Figure 75. *Scenario De-growth | Territorial Map*
Source: author

SCENARIO DE-GROWTH | STRATEGIES

Strategies

The principle strategies applied in this scenario are focused on ecological regeneration. Therefore, forest areas are protected, pastures and low vegetation zones are afforested, and the mines turn into energy forests and lakes. Additionally, crop rotations are integrated into the intensive agriculture surrounding the mines. Finally, industrial areas are transformed into biomass plants or are used for recreation.

Impact

It is important to acknowledge that this scenario presents serious drawbacks. Even though it prioritises ecological regeneration at a very large scale, it will result in a decrease in the productivity of the territory and its social and economic shrinkage. As a result, there will be a reduction in job opportunities in the smaller settlements, potentially leading to the centralisation of the population in the larger cities.

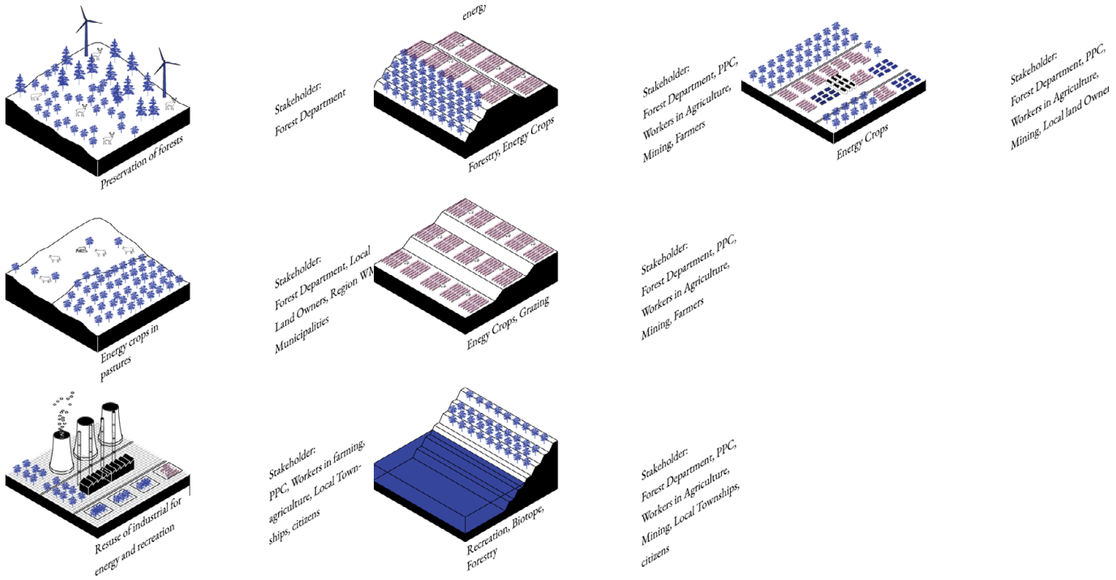


Figure 76. *Scenario De-growth | Proposed Spatial Strategies, Source: author*

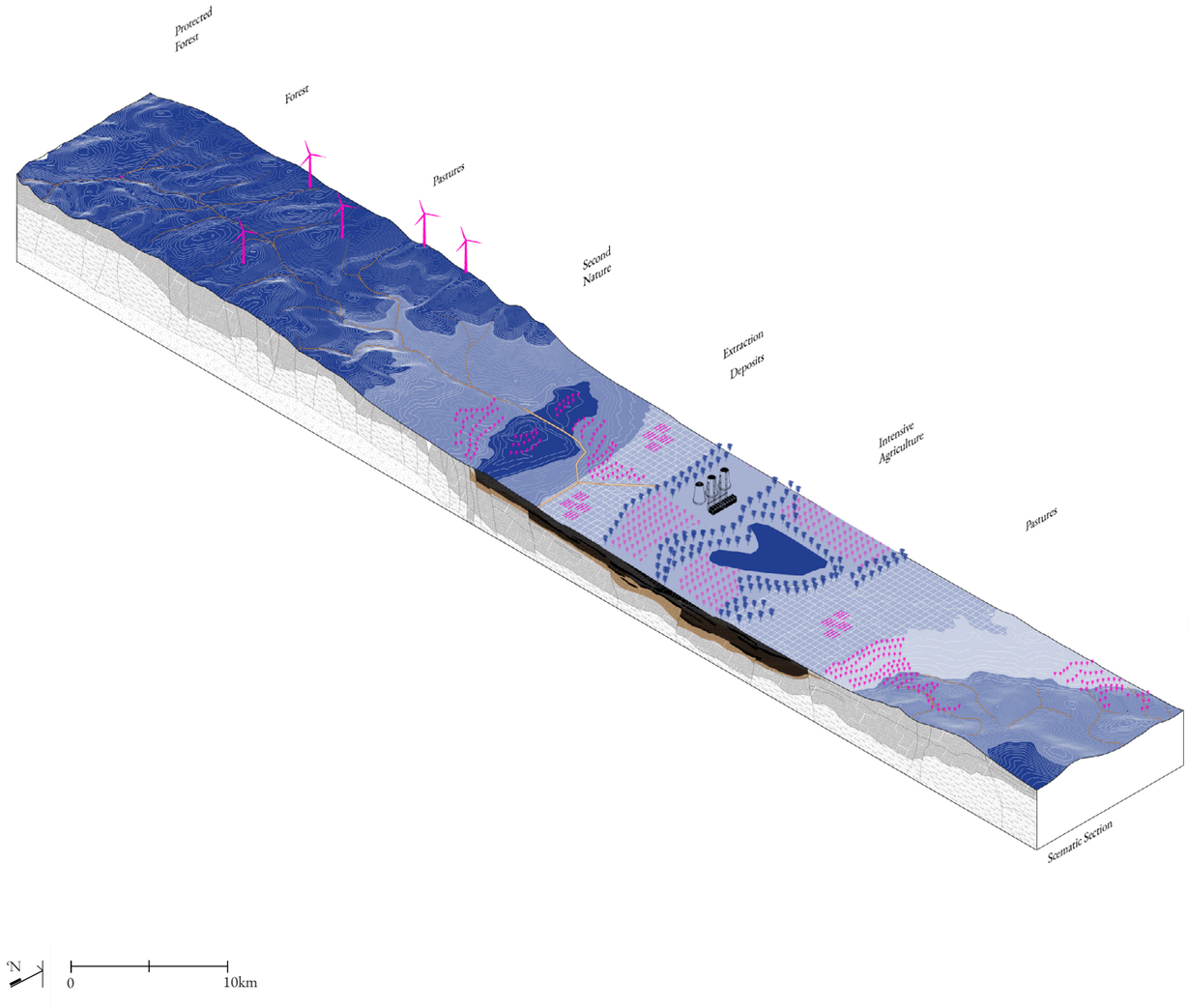


Figure 77. *Scenario De-growth | Axonometric Diagram, Source: author*

SCENARIO EVALUATION

Intro

A comprehensive comparison is conducted to evaluate the performance of each scenario in terms of ecological impact, socio-economic impact, and energy production. By analysing the outcomes and impacts of the scenarios within these three axes, the comparison facilitates the drawing of an overall conclusion that assesses the scenarios in a holistic manner. This analysis will provide valuable findings and inform decision-making processes, theoretically facilitating the identification of the most favourable scenario for the territory.

Ecological Impact

In order to assess the ecological impact, six parameters were considered: water usage, water contamination, vegetation destruction, vegetation regeneration, soil contamination and soil regeneration. On the following page, the four later parameters are mapped on the grid in a series of diagrams.

Scenario 1

Scenario solaria prioritizes energy production in pastures and mines. As a result, it presents a high degree of vegetation destruction and limited regeneration. Additionally, it falls short on regeneration and de-contamination of the polluted soils.

Scenario 2

Scenario modernisation prioritises the productivity of the primary and secondary sectors and, as a result, has a large ecological impact. It has a high degree of vegetation destruction, high water usage, water contamination and limited regeneration. Additionally, it falls short of regeneration and de-contamination of the polluted soils. The areas that retain some ecological functions are primarily the existing water network.

Scenario 3

Similarly, scenario biofuels proposed an increase in the production of the primary sector and have high water usage and water contamination.

Scenario 4

Lastly, scenario De-growth has a positive impact as it proposes large-scale regeneration of vegetation and soil and has a smaller degree of water usage and water contamination in relation to other scenarios. As a strategy, it prioritises regeneration and de-contamination of the soil.

In conclusion, Scenario De-growth presents the most positive impacts on the ecological network and is, therefore, the most favourable scenario regarding water storage, vegetation preservation and minimising contamination.

Legend

- Point of pollution
- Ecological conservation
- Ecological restoration
- Ecological disruption

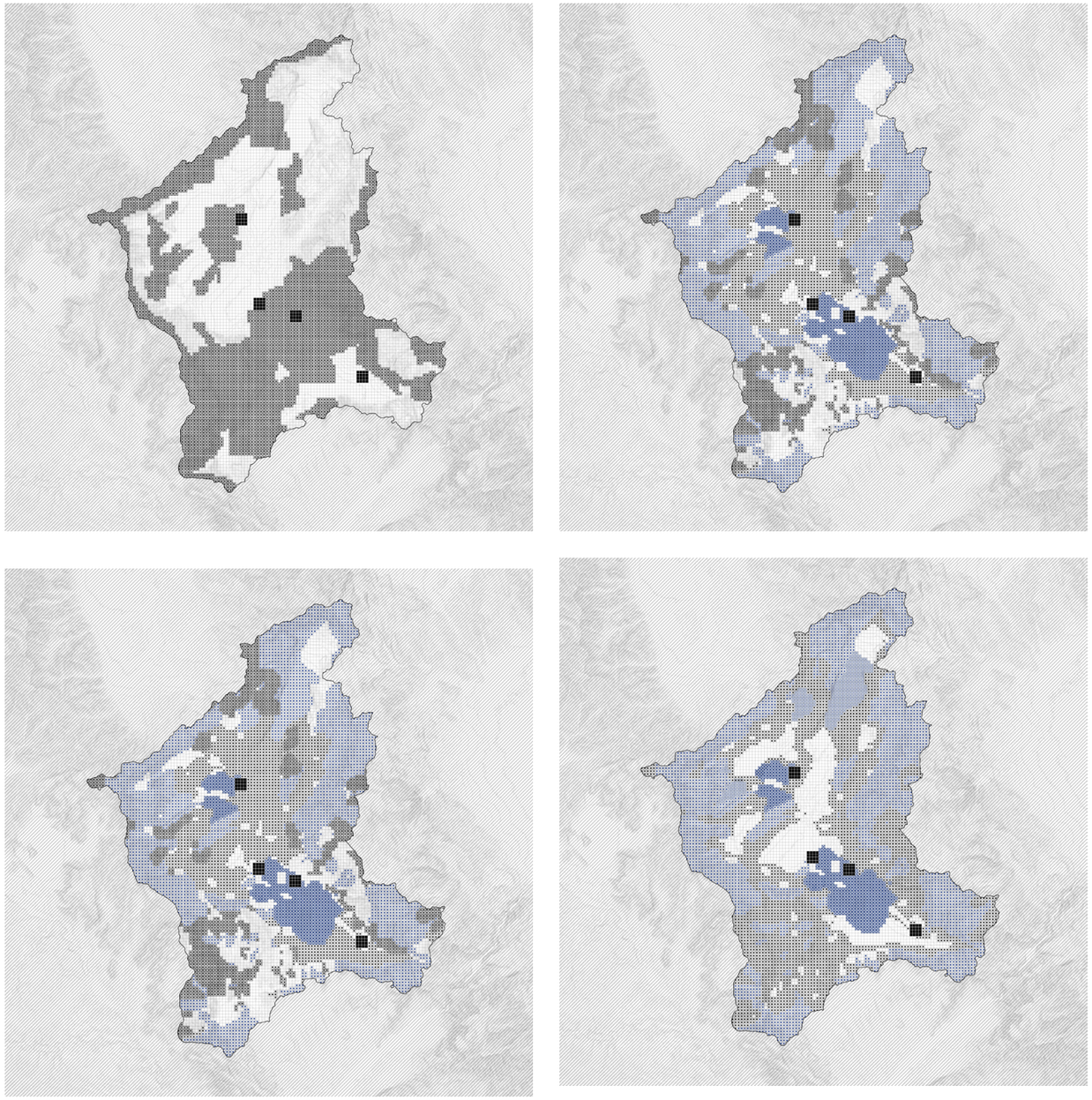


Figure 78. *Evaluation | Ecological Impact Diagrams*
Source: author

SCENARIO EVALUATION

Socio economic Impact

In order to assess the impact on the socio-economic structure of each scenario, four parameters were considered: new employment opportunities, economic growth, need for re-skilling, and population growth. The following page presents the socioeconomic structure of the territory.

Scenario 1

In scenario Solaria, the production is focused exclusively in renewable energy, without a rapid transformation of the socio-economic structure. This results in a similar structure, with the shrinkage of remote settlements

Scenario 2

In scenario Modernisation, intensive primary and secondary sectors dominate the basin. This results in the retention of this dispersed structure of urbanisation, in witch secondary villages retain economic activities related to agriculture, while the primary settlements have a diversified economy and concentrate functions.

Scenario 3

In the scenario Biofuels, propose an intensive primary sector. As a result, we can see a similar dispersed structure to scenario Modernisation, but at the same time, we see the shrinkage of remote settlements.

Scenario 4

In scenario De-growth focuses on a slower production model. As a result, the socio-economic structure is preserved, but with a shrinkage of the primary settlements and a diversification of secondary settlements.

In conclusion, scenario modernisation is the one that presents the largest economic growth in terms of job creation and is most favourable under a logic of growth, and scenario forestry presents the most economic growth under a logic of de-growth and is, therefore, the most favourable scenario under a logic of de-growth.

Legend

- population shrinkage
- population growth

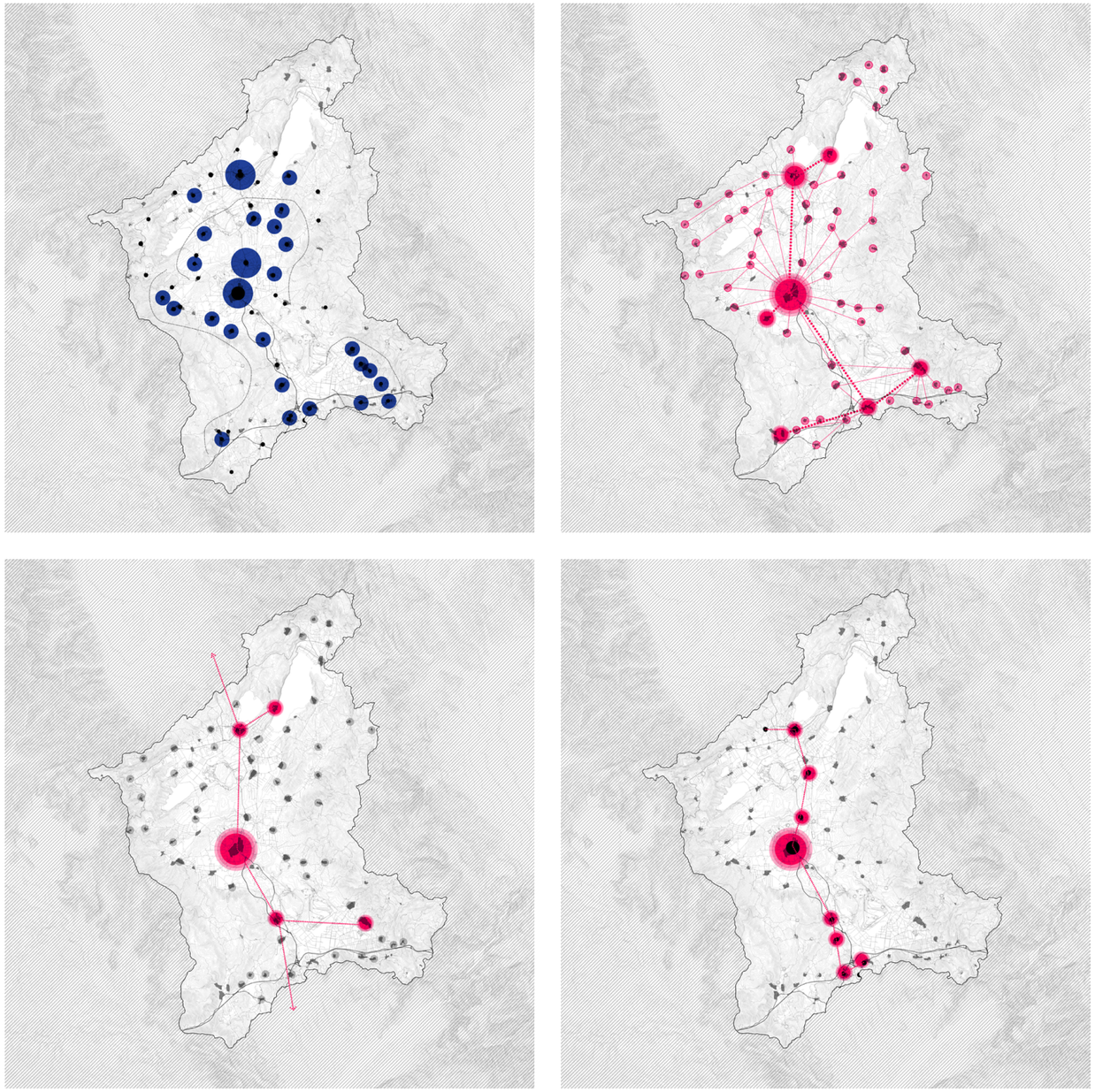


Figure 79. *Evaluation | Socioeconomic Structure Diagrams*
Source: author

SCENARIO EVALUATION

In order to access the energy production capacity of each scenario, the approximate area and energy produced was calculated. On the following page, the presence of energy production infrastructure or plantations is marked on the grid with the corresponding colour.

Scenario 1

In the Solaria scenario, energy production primarily relies on extensive solar and wind infrastructure, strategically positioned in centralized locations within the mining and pastoral zones of the basin.

Scenario 2

In the Modernisation scenario, energy production incorporates solar, wind, and biofuels, and is dispersed across mining, agricultural, and pastoral areas spanning the entirety of the basin.

Scenario 3

Within the Biofuels scenario, energy production predominantly centers on biofuels and energy forestry, with a particular focus on mining and agricultural regions.

Scenario 4

The Forestry scenario envisions energy production predominantly rooted in energy forestry, with a concentrated presence in mining areas and the pastoral regions of the basin.

In summary, it is discernible that Scenario Solaria exhibits the highest magnitude of energy production, while Scenario Modernisation demonstrates comparable levels, albeit with a diversified energy production paradigm. Conversely, both Scenario Biofuels and Scenario Forestry manifest comparatively lower levels of energy production.

Legend

Wind
Solar
Biofuels
Energy Forestry

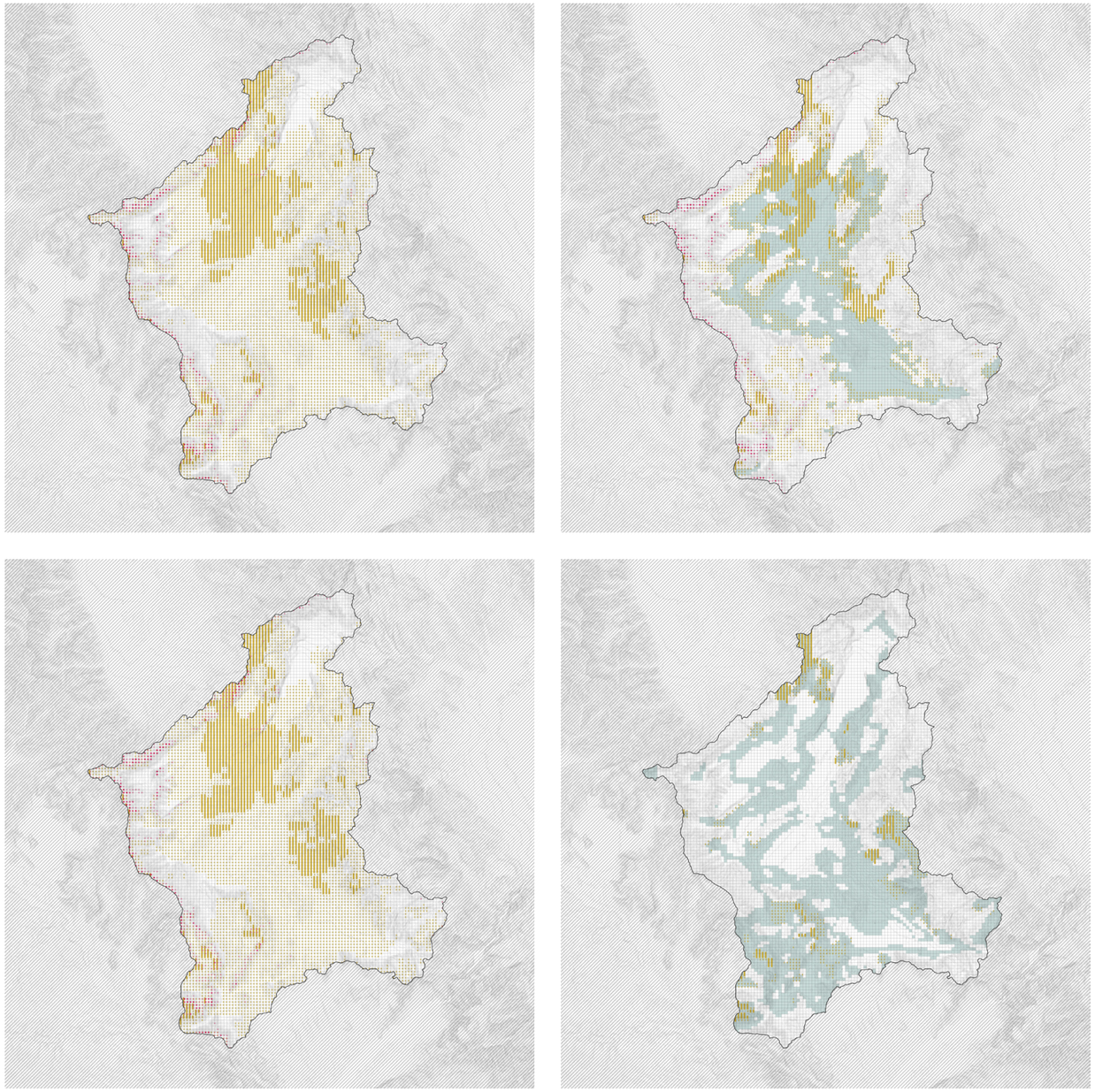


Figure 80. *Evaluation | Energy Production Diagrams*
Source: author

SCENARIO EVALUATION

Parameters of evaluation

On the following page, a comprehensive synthesis is presented, encompassing all parameters expounded upon in the preceding three sections of our evaluation. To ensure a thorough assessment, each scenario has been meticulously evaluated by assigning a score within the range of 1 to 4 for each individual parameter. This meticulous scoring process ultimately culminates in deriving a final composite score for each scenario. This approach allows us to holistically gauge the relative merits and drawbacks of each scenario under consideration, thus facilitating a well-informed and nuanced decision-making process.

The final finding of this analysis is the absence of a definitive superior scenario among those under examination. It appears that there is no unequivocally optimal scenario for the territory.

Conclusions

At the present point, it is imperative to recognise the necessity of establishing a clear set of values as a prerequisite for advancing from the current scenario phase to the subsequent vision phase. These specified values will serve as a foundational framework that facilitates a seamless transition and alignment of objectives, ensuring coherence and purpose in the development of the vision. For this, the projects go back and consult the conceptual framework.

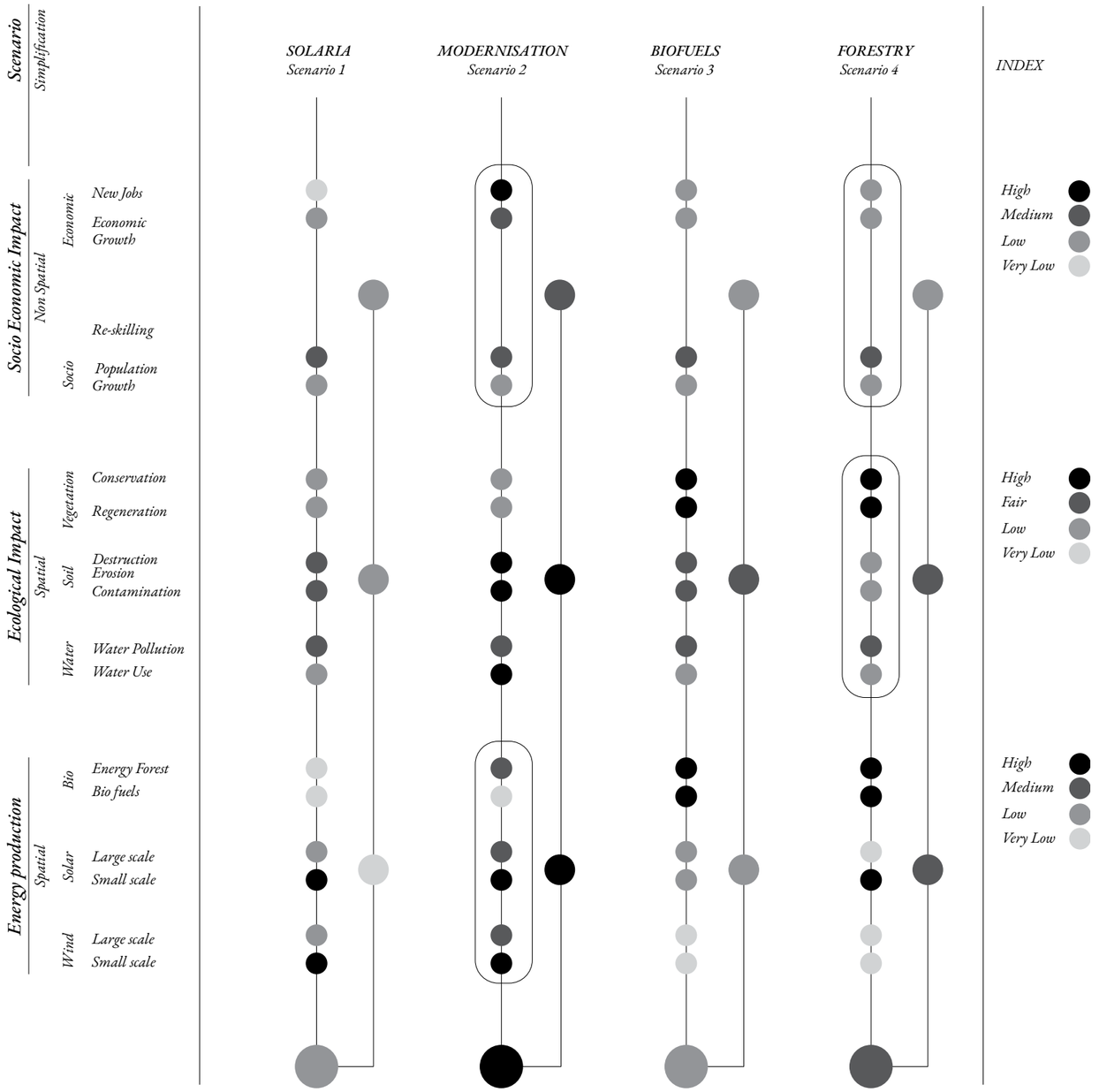


Figure 81. *Scenario Evaluation*
Source: author

TERRITORIAL VISION

VISION | MAIN OBJECTIVES AND PRINCIPLES

Objectives

The project revisits the problem statement and the conceptual framework, re-establishing the five specific sectors of energy, ecology, heritage, society and governance, with each sector being associated with specific goals and principles.

1. *Regenerative ecological system*
2. *Flexible renewable energy system*
3. *Re-valorised heritage*
4. *Inclusive energy transition*
5. *Collaborative governance*

Regenerative ecological system

The new energy landscapes should reverse, restore and regenerate the energy landscape of the old. Thereby, special care must be give to rehabilitation of the mining landscape and the design of the new ecological territorial structure.

Flexible renewable energy system

The renewable energy landscapes should possess a high degree of flexibility and the ability to adapt to possibly energy transitions of the future. Thereby, multiple different energy infrastructure must by enforces and work synergistically on different levels. This diverse new energy landscape will result in systemic adaptability and acceptance by local stakeholders.

Re-valorised heritage

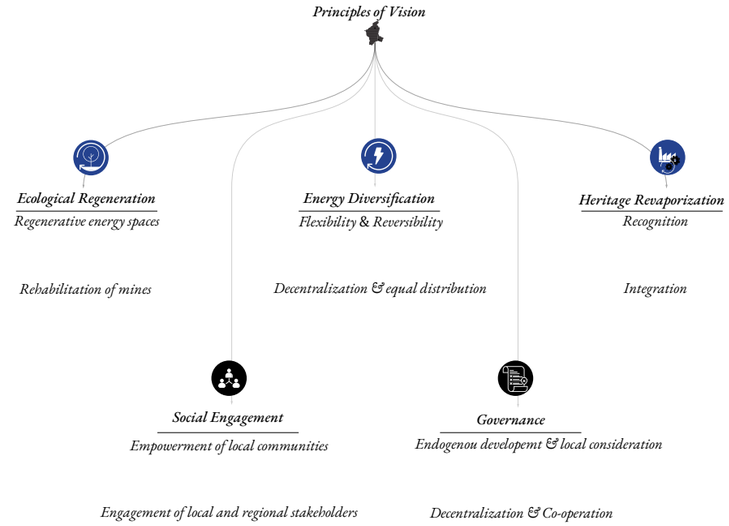
The new energy landscapes should intergrate and re-invent spaces of the old energy landscape, utilising principles of adaptive re-use. In this way new meaning is given to obsolete infrastuctue, and obsolete space are transforemed in places.

Inclusive energy transition

The new energy landscapes should be created by means of inclusive participatory process, with spatial consideration to local stakeholders. This approach will enable local actors to participate in the re-formation of the energy landscapes and increase social acceptance of the transition.

Collaborative governance

The transition governance should align its goals with regional and local urgencies and consider local issues. Additionally, it must decentralise various aspects an co-operate with regional and local governance entities.



Principles

The principles of the project, diriving from the goals above, can be summarised as such:

- Flexibility & Reversibility of energy system
- Decentralization & equal distribution of energy infrastructure
- Regenerative & respective ecological structure
- Restoration of mines
- Recognition and integration of heritage places
- Accessibility of heritage places
- Empowerement of local communities
- Engagement of local and regional actors
- Decentralization and cooperation of transition governance
- Endogenous development & local consideration in policy

At this point, the goals, values and principles defined in the final positioning of the project act as normative guidelines for the development of the final territorial design. The vision also plays an important role in ensuring that flexibility, regeneration, re-valorisation, inclusivity and collaboration are embedded in every stage of project development. In this way, the transition to renewable energy can be accomplished as a way for the just socio-economic development of the territorial overall.

Figure 82. *Principles Diagram*
Source: author

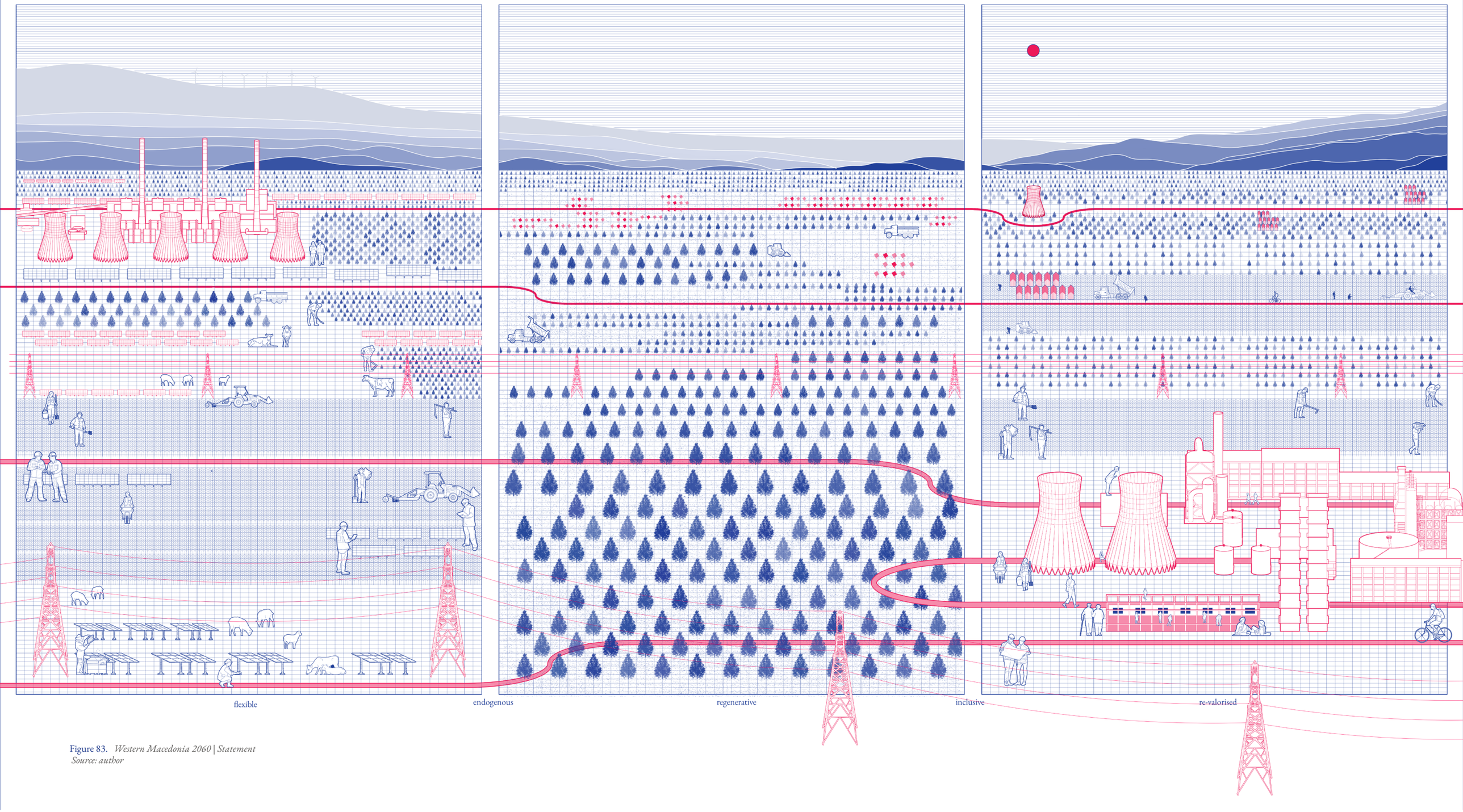


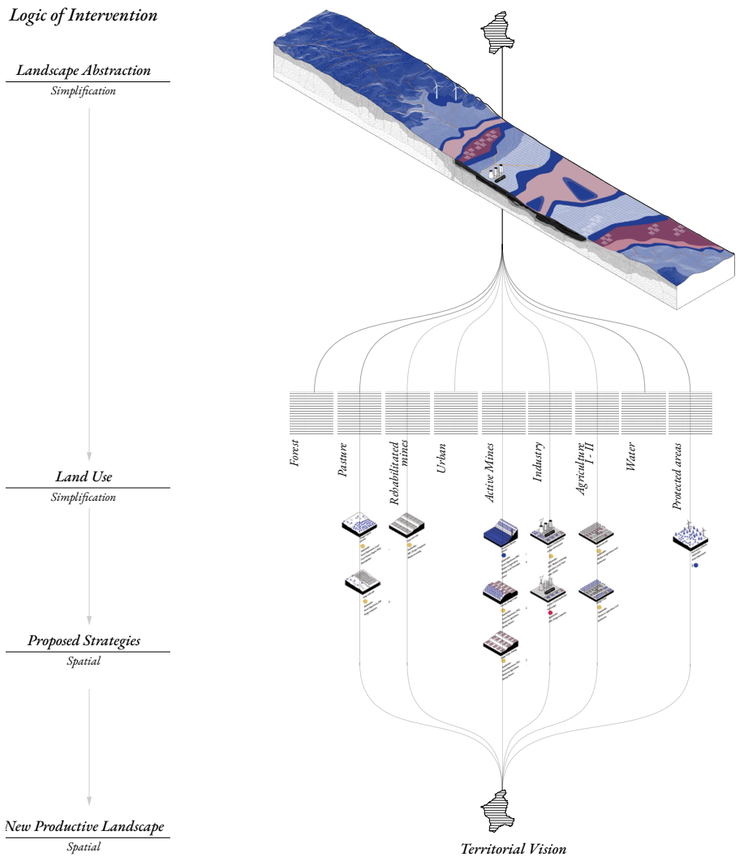
Figure 83. *Western Macedonia 2060 | Statement*
Source: author

VISION | INTRODUCTION

Statement

This project proposes to redefine the identity of the territory of Western Macedonia as a diversified energy landscape while strengthening the significance of the role of the mines as an energy hub.

By restoring the ecological systems and decentralising and diversifying the energy production system within the territory, the project aims to propose a series of synergies between different landscape components. Therefore, in 2060, the thesis project envisions the holistic transformation of the territory of Western Macedonia through the transition into a regenerative, flexible and revalorised energy production system based on regenerative ecologies and integrated heritage that is produced in an inclusive and endogenous manner.



Legend

Ecology
- Mine Restoration
- Riparian Zones
- Restoration of Barren Land

Energy
- Biomass power plant
- Transmission network
- 400v
- 100v
- 100v extension
- Storage
- Small scale agriculture solar
- Large scale solar
- Small scale bio-fuels
- Energy Forestry

Heritage
- Shrinking Settlements
- Energy Settlements
- 10km Buffer
- Heritage center
- Road Network
- Large scale energy forestry

N
0 10 km

Figure 84. *Vision Axonometric*
Source: author

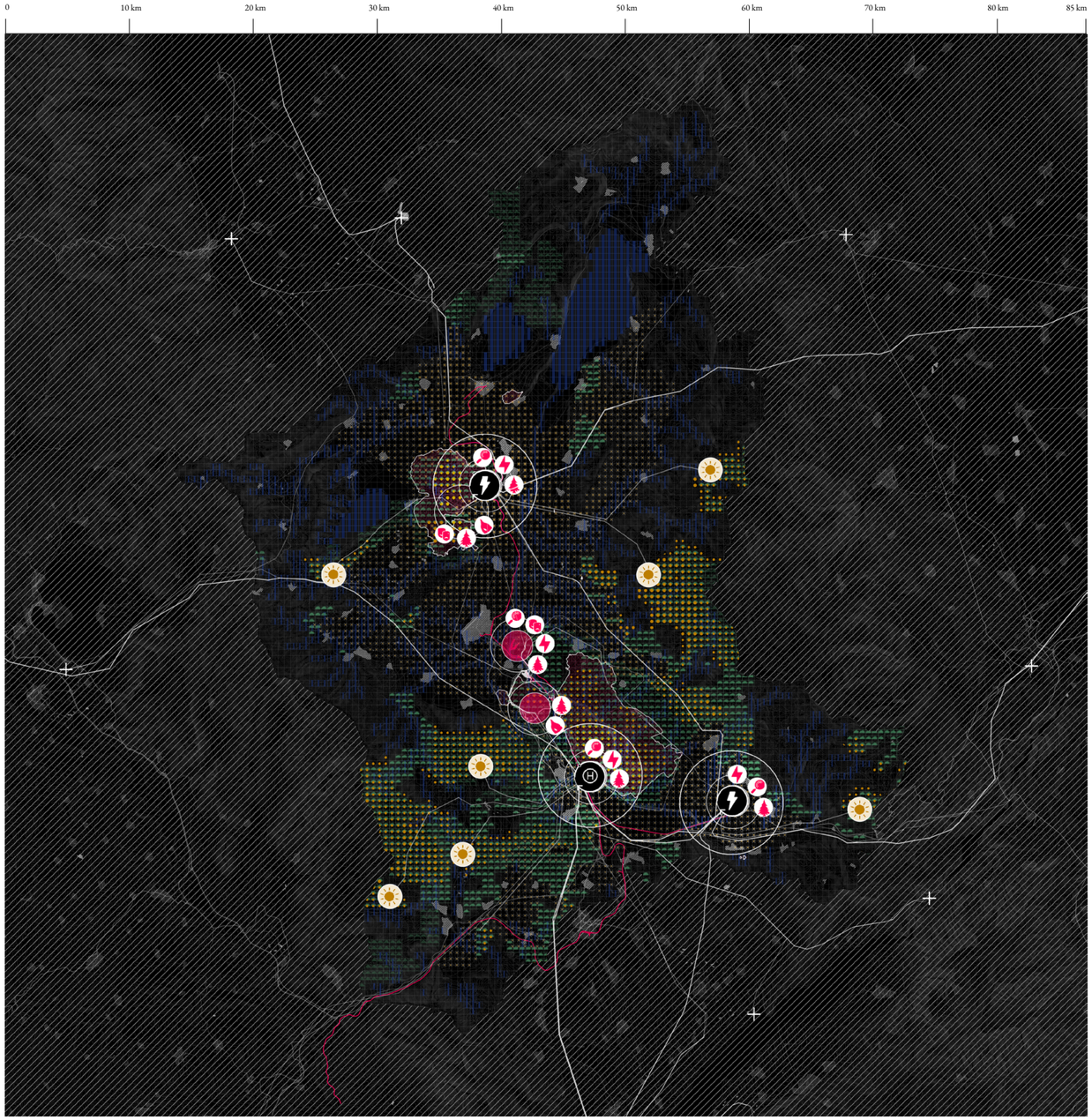


Figure 85. *Vision Map*
Source: author

STRATEGIES

The Five Strategies

Drawing from the previously elucidated conceptual framework, a set of four primary objectives and their corresponding values are established:

(i) Ecological rehabilitation,
(ii) Energy diversification,
(iii) Heritage revalorisation
(iv) Social Inclusion, and
(v) Transition Governance

These objectives are encapsulated by the principles of regeneration, flexibility, re-valorisation, inclusivity, and collaboration. Building upon these values and objectives, a series of design strategies and principles are introduced from Scenario 2 and Scanrio 4. Throughout the transition process, these strategies are progressively implemented in four distinct phases, gradually affecting the transformation of the productive landscape in an inclusive and collaborative manner.

In the next section of the report, the project focuses on the township of Ptolemaida, chosen as a demonstrative case for illustrating the practical application of these spatial strategies.

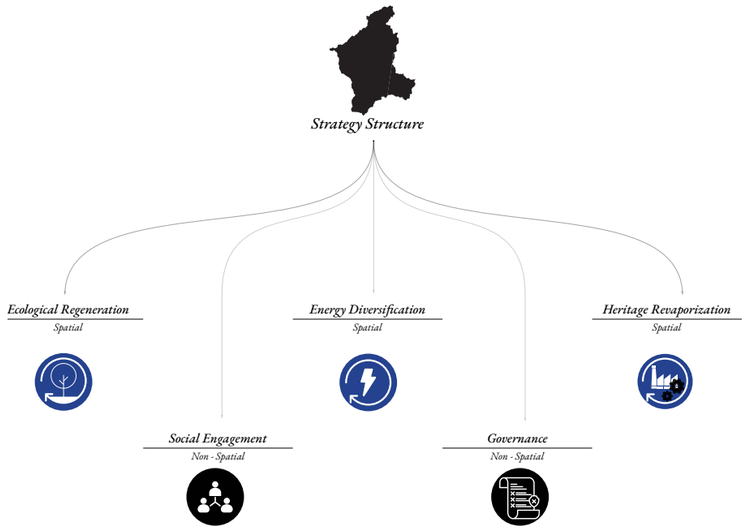


Figure 86. *Simplification of Strategies*

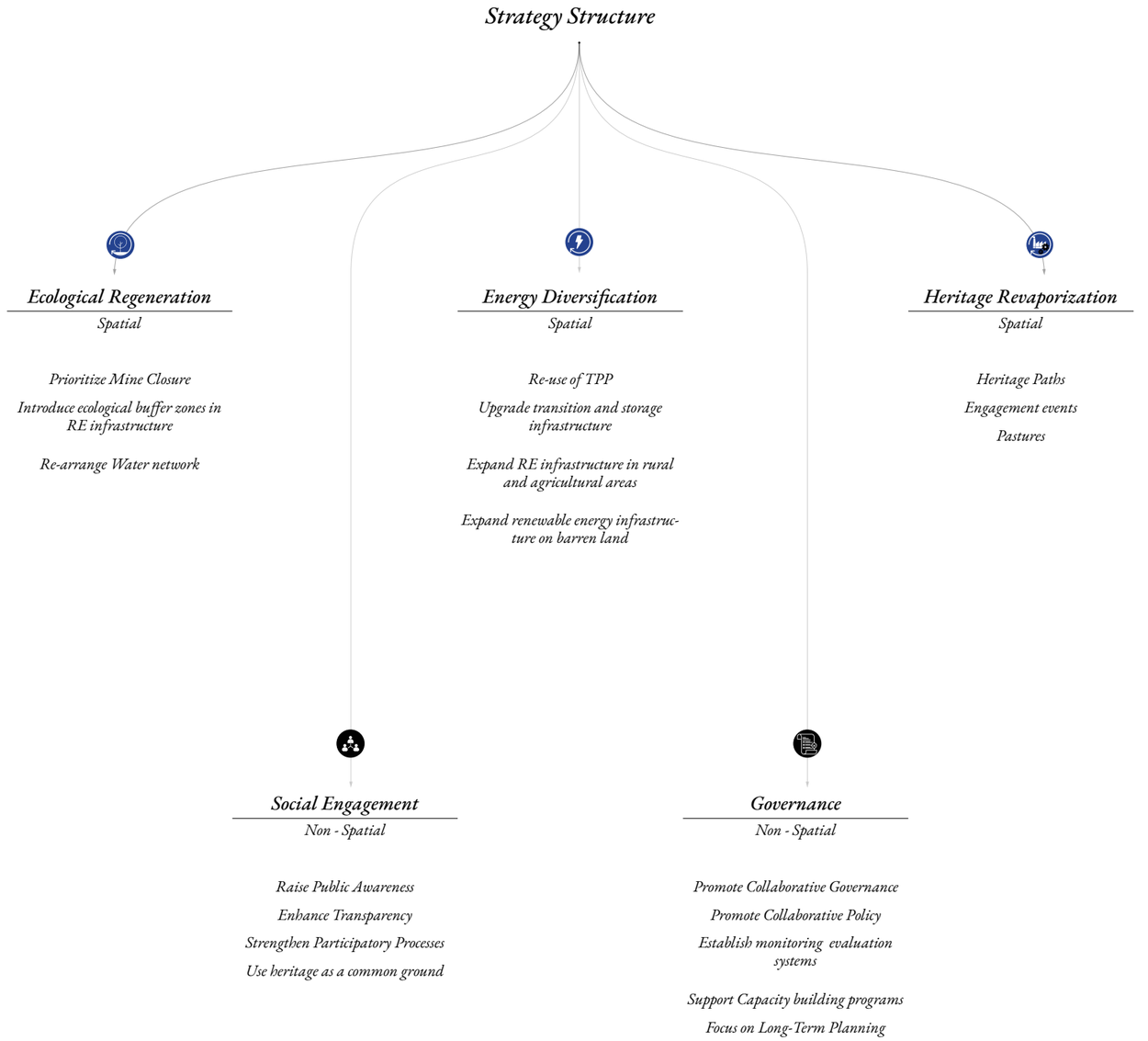


Figure 87. *Expansion of Strategies*

VISION | ECOLOGY

(i) Ecological rehabilitation

The first strategy of this project is ecological restoration, which serves the dual purpose of mitigating the ecological ramifications of mining activities and enhancing ecological connectivity in the area. This approach entails the delineation of protected areas, with a concurrent focus on the restoration of water reservoirs and the creation of a contentious green network, thus contributing to the overall ecological revitalisation of the area.

E.1. Prioritisation of Mine Closure

Prioritising mine closure in the territory of Eordaia is paramount for environmental sustainability and local community well-being. As mining activities cease by 2030, the proper closure ensures the safe and stable rehabilitation of mine slopes, soil rehabilitation and slope stabilisation. Slope formation and stabilisation mitigate the risk of landslides and erosion, safeguarding both the environment and nearby communities from potential disasters. Additionally, topsoil rehabilitation promotes the restoration of fertile land, vital for agriculture and local livelihoods. A well-executed mine closure plan minimises environmental degradation and supports the region's transition to alternative economic activities.

E.2. Introduction of ecological buffer zones in RE infrastructure

The strategy to restore the ecological network emphasises the implementation of two key measures: the introduction of buffer zones within renewable energy (RE) infrastructure and the restoration of green connections. Buffer zones act as protective barriers around RE installations to mitigate potential environmental impacts, preserving natural habitats. Simultaneously, the restoration of green connections aims to reconnect fragmented ecosystems, enhancing biodiversity and facilitating species movement. This strategy underscores the imperative of balancing renewable energy development with ecological conservation, promoting a harmonious coexistence between renewable energy initiatives and the conservation of the natural environment.

E.3. Regenerative Water Network

Implementing a strategy to replenish the aquifer and the open water structure in a post-mining landscape is crucial. It involves rehabilitating and connecting existing water reservoirs, creating new ones, and enhancing water treatment infrastructure. Additionally, re-establishing riparian zones is imperative for preserving aquatic ecosystems and water quality. This approach ensures sustainable water management, benefiting both the environment and local communities in the post-mining landscape

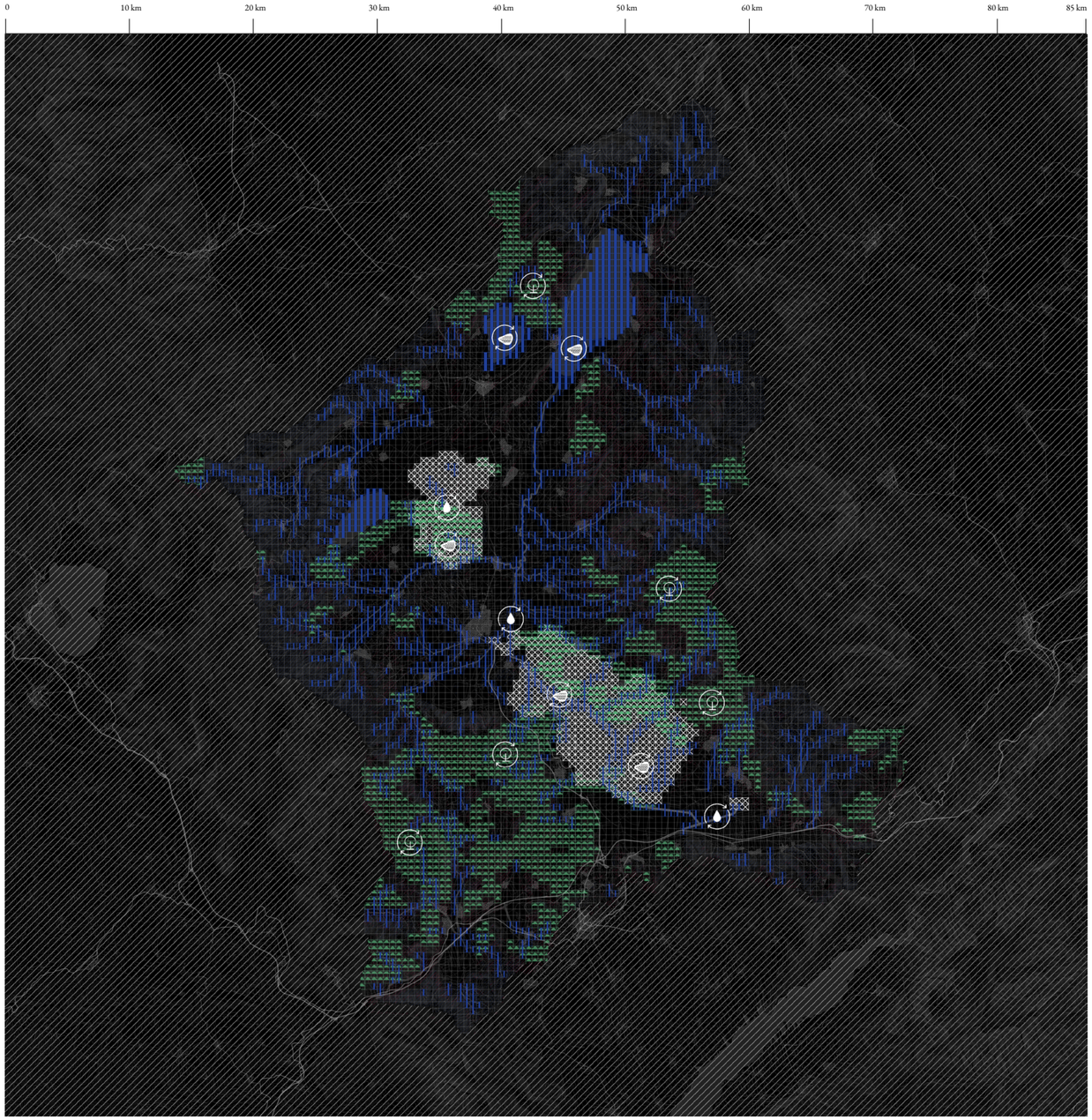


Figure 88. *Vision Map | Ecological rehavilitation*

VISION | ENERGY

(ii) Energy diversification

Building off the foundation of ecological regeneration, this strategy of energy diversification seeks to address the challenges posed by the rapid growth of renewables in the territory of Eordaia, which is currently leading to rapid landscape transformations. Thereby, this strategy emphasises the need for a re-structuring of the renewable energy infrastructure within the territory that utilises local potential while respecting local communities and natural areas.

E.1. Re-use of TTP

Repurposing fossil fuel infrastructure stands as a prominent and widely discussed action for the energy transition within the region of Western Macedonia. This strategy involves the reutilization of the Thermal Treatment Plants (TTP) with a dual-purpose approach. Firstly, it proposes repurposing the facilities as a biomass power plant, tapping into renewable energy sources to generate electricity. Secondly, it aims to transform specific TTP into a green hydrogen research hub, fostering innovation and research in clean energy technologies. This strategy reflects a proactive effort to repurpose existing infrastructure, aligning it with renewable energy objectives and promoting a diversified and sustainable energy landscape.

E.2. Upgrade transition and storage infrastructure

The transition from centralised energy production to a decentralised and diversified paradigm exhibits an entirely distinct spatial footprint. However, the imperative lies in the expansion of energy transition and storage infrastructure dedicated to renewable energy sources.

E.3. Expand renewable energy agricultural areas

The expansion of renewable energy, particularly solar energy, within agricultural areas necessitates a multifaceted approach. Firstly, the creation of energy communities aligned with municipal boundaries fosters localised energy production, engendering a sense of ownership and cooperation among local stakeholders. Additionally, the development of zoning regulations tailored to renewable energy installations within agricultural zones ensures efficient land use and minimises conflicts. Moreover, the incorporation of multifunctional solar panels in these agricultural areas not only generates clean energy but also offers the potential for dual land use, such as providing shade for crops. Together, these strategies facilitate the harmonious integration of solar energy into agriculture.

E.4. Expand renewable energy infrastructure on pastures and deposits

The expansion of renewable energy, specifically solar energy within pastures and mining areas, is a strategy that is already enforced; however, strategic improvements are proposed. Firstly, zoning regulations tailored to renewable energy installations facilitate efficient land use planning, identifying suitable areas for clean energy development. Additionally, incorporating buffer zones around solar facilities helps mitigate environmental and aesthetic impacts, preserving the integrity of the surrounding ecosystem. Furthermore, the utilisation of versatile solar panels not only enhances energy production but also allows for dual land use, such as providing shade in pastures.

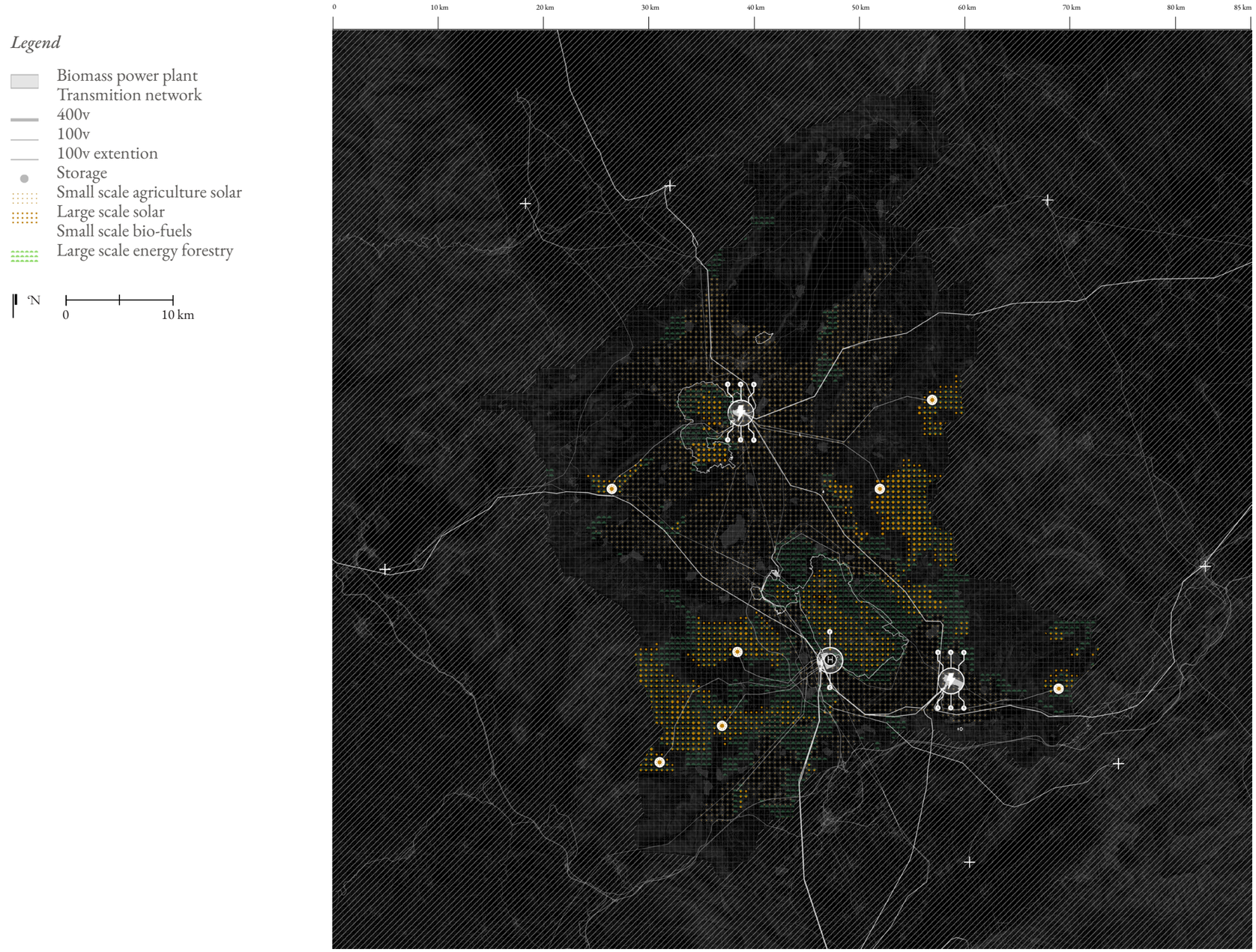


Figure 89. *Vision Map | Energy Diversification*

VISION | HERITAGE

(iii) Heritage revalorisation

The "Revalorizing Heritage" strategy encompasses four distinctive components. Firstly, the "Heritage Paths" initiative seeks to establish curated routes that showcase the historical significance of the mining heritage, offering visitors an immersive experience. Secondly, the "Open Mines" Engagement events endeavour to engage the community in dialogues and activities aimed at fostering an appreciation for the mining legacy. Thirdly, the "Mining Archaeology Museum" intends to preserve and exhibit artefacts, providing a deeper insight into the region's mining history. Lastly, "Reuse of mining infrastructure in the new production" represents a forward-looking approach, repurposing disused mining structures and integrating them into contemporary production processes. This multifaceted strategy bridges the past and future, celebrating heritage while embracing progress.

Legend

- Co-operation Settlements
- Shrinking Settlements
- 10km Buffer zone
- Settlement Network
- Rail Heritage Network
- Energy Production
- Rehabilitation
- Water Storage
- Research
- Recreations

'N

0 10 km



Figure 90. Industrial Complex



Figure 91. Industrial Complex AEVAL



Figure 92. Industrial Complex KARDIA



Figure 93. Industrial Complex LIPTOL



Figure 94. *Settlement relics MAVROPIGI*



Figure 95. *Settlement relics KOMANOS*

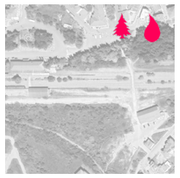


Figure 96. Railway PTOLEMAIDA



Figure 97. Railway PTOLEMAIDA



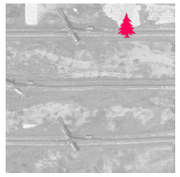
Figure 98. *Abandoned electricity network*



Figure 99. Abandoned electricity network



Figure 100. Abandoned mining infrastructure



Figures 93-107: Satelitte Images of Industrian and Mining Heritage Sites
Source: Google Maps

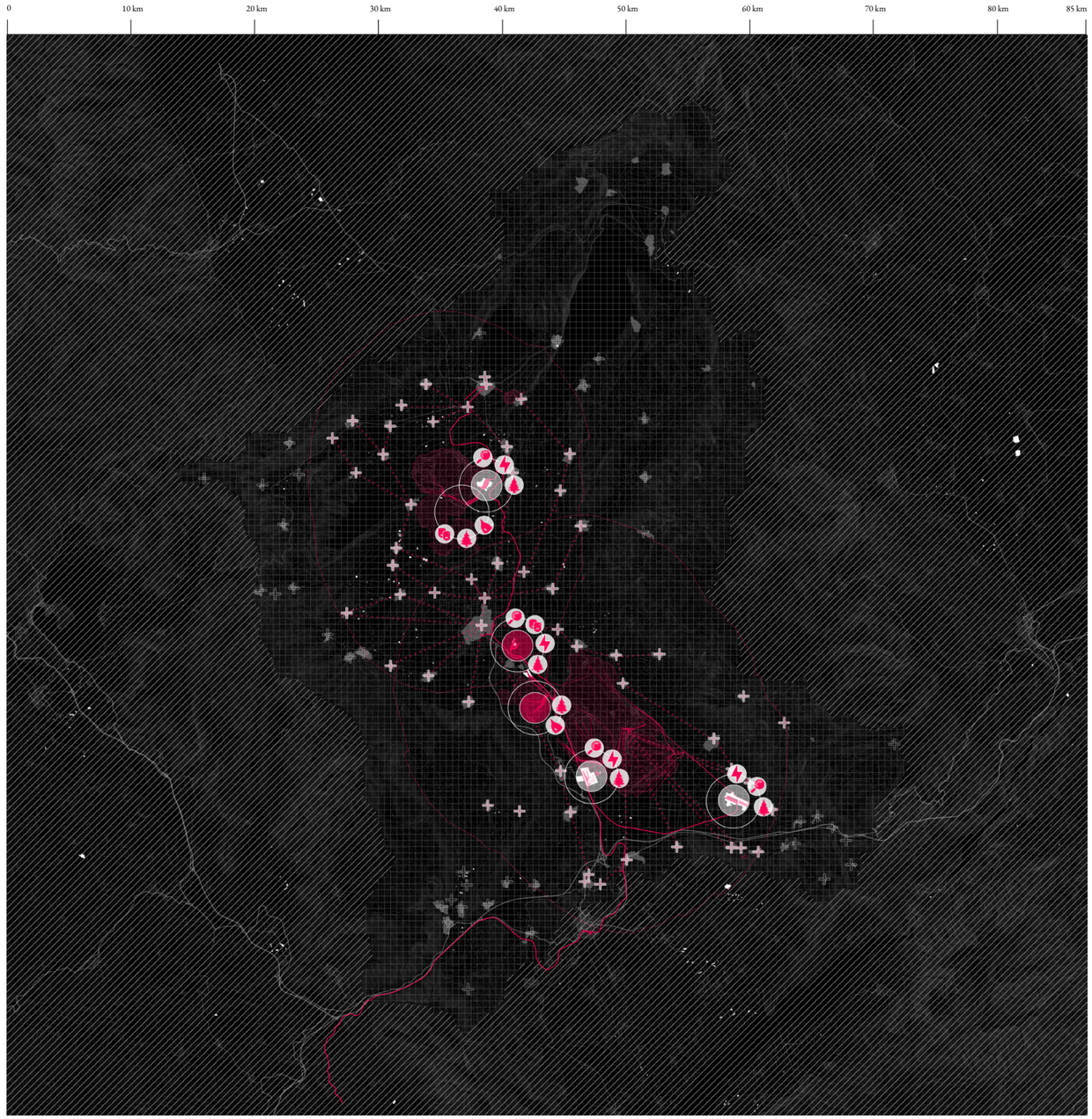


Figure 101. *Vision Map | Heritage revalorisation*

STRATEGY | PHASING

The implementation of this project can be organised in 4 phases to facilitate the transition from carbon to renewable energy production while simultaneously transforming the mining landscape and the productive landscape of the Territory in general.

Phase 1: Preparation (2023-2025)

The first phase of this project is dedicated to developing and finalising the strategic design of the transition for the region. It involves discussions between interested stakeholders, reaching out to potential investors and the formation of policies for the transition. Additionally, in this phase the foundations are laid and collaborations are established e between various planning and governance agencies. It also includes the efforts for the engagement of the local communities that are integral to the transition process.

Phase 2: Intergration (2025-2030)

The third phase of the project is dedicated to the large-scale transformation of the energy sector, through the integration of new renewable energy projects in the agriculture and pastures areas, the conversion of TPP into CPP or Hydrogen research facilities, in a new productive heritage network. At the same time, the restoration projects continue, and the afforestation of the mines with energy forestry and biofuels is starting. The retraining of the workforce is continuing, as progressively, more people are

Phase 3: Synergies(2030-2040)

The third phase of the project is dedicated to the large scale transformation of energy sector, through the integration of new renewable energy projects on the agriculture and pastures areas, the conversion of TPP into CPP or Hydrogen research facilities, in a new productive heritage network. At the same time, the restoration projects continuing, and the afforestation of the mines with energy forestry and biofuels is stating. The retraining of the workforce is continuing, as progressively, more people are needed at maintenance of forestry, biofuels and RE infrastructure and less for mining operations.

Phase 4: Establishment (2040-2050)

The final phase of the project sees the completion of the restoration of mines and the maturing of various energy diversification projects. Additionally, restoration projects are completed, with the completion of the water network.

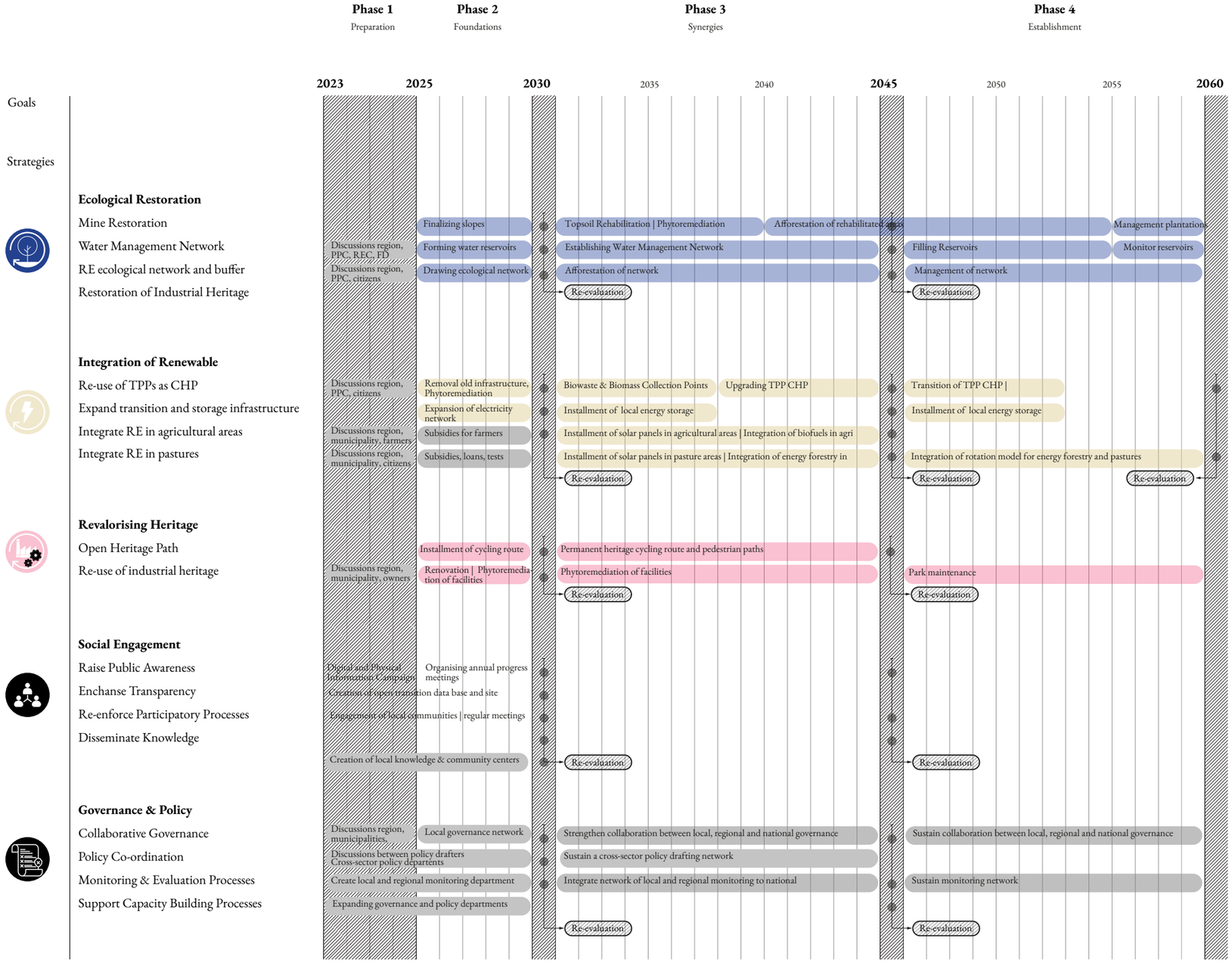


Figure 102. *Strategy timeline*
Source: author

STRATEGY | STAKEHOLDER SYNERGIES

As explained at the beginning of this chapter, for the transition to be implemented, numerous collaborations need to be implemented along the process. Currently, there is some financial help provided by the government, the Just Transition Fund and other EU funding programs to facilitate the decarbonisation of the coal-intensive regions and the implementation of renewable sources. However, in the case of Greece and specifically Western Macedonia, much of the funding has not been equally accessible to all interested stakeholders, (Green Tank, 2023) and much of the funding remains underutilized (Krithari, 2023). More specifically, according to Green Tank, there has been a clear neglect of the integration of local communities and SM companies in the planning and evaluation process of the first drafts of "Just Transition" policies and constant overlooking of local potential with a unilateral development logic revolving around large scale energy projects (Green Tank, 2023). As a result, these funding, subsidies and loans are not enough to achieve a socially just, inclusive transition, since they are not taking into account numerous local difficulties. Since this project proposes the reaction of synergies between different stakeholders in the re-structuring of the energy landscape of Eordaia operating at different scales, it is important to establish similar synergies between the corresponding stakeholders.

Prioritising their collaboration between local, regional and national stakeholders and creating multi-scalar networks of syneries is essential for the completion of this transition of the territory .

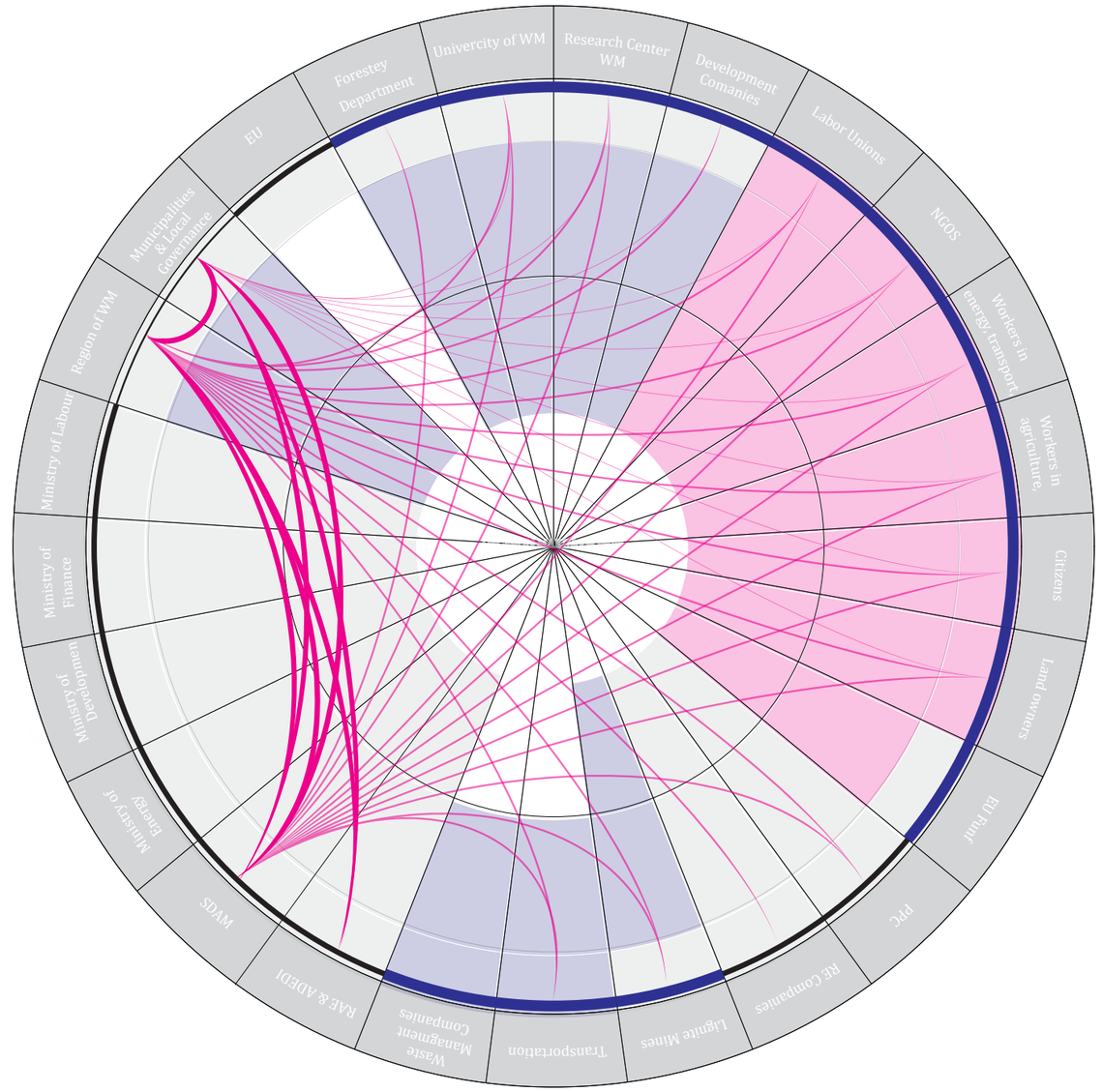


Figure 103. *Main Stakeholder Synergies*
Source: author

STRATEGY | STAKEHOLDER SYNERGIES | STRATEGY

(i) Ecological rehabilitation

Firstly, in regards to the ecological restoration strategy, numerous collaborations need to be establish e between public and private stakeholders. The most prevalent is between PPC, the PUBLIC Forestry Department of WM and municipalities regarding the large-scale rehabilitation of mines and riparian zones. Additionally, synergies between workers in the agriculture, mining sectors and the aforementioned PPC and FDWM need to be established in order to retrain part of the workforce in these new practices.

(ii) Energy diversification

In relation to the energy diversification strategy, it is important to establish collaboration between local communities, energy companies and energy planning agencies, in order to ensure a just spatial transformation. More specifically, synergies between different planning agencies (energy, forestry, municipalities) need to be established for the development of a comprehensive energy zoning of pastures and mines. Additionally, synergies between local land owners, SMC and large energy companies and energy planning agencies need to be establishe for the co-ordinated expansion of RE infrastructure in agricultural areas. Lastly co-ordination between municipalities, the forestry department and energy companies planning needs to organise the updating and maintaining road infrastructure.

(iii) Heritage revalorisation

In relation to the heritage strategy, numerous actions need to be established, between landowners, investors and local communities. Firstly, synergies between the owners of heritage sites (Municipality of Eordaia (former Ptolemaida), PPC, Municipality of Kozani, HT) and investors in order to develop plans for the re-use of heritage sites. Secondly, synergies between owners and future occupants of the heritage areas, such as research institutions, energy companies, local communities, in order to plan the future management of the sites.

(v) Governance re-form

Lastly, the creation of collaboration between different planning institution, more specifically, the “Just Transition committee, the Regional spatial planning agency (name), the municipal planning agencies (name) in crucial for a number of reasons. Firstly, the inclusion of aforementioned planning committee and corresponding communities in the planning process, the alignment of planning goals, the alignment of spatial footprint of said goals.

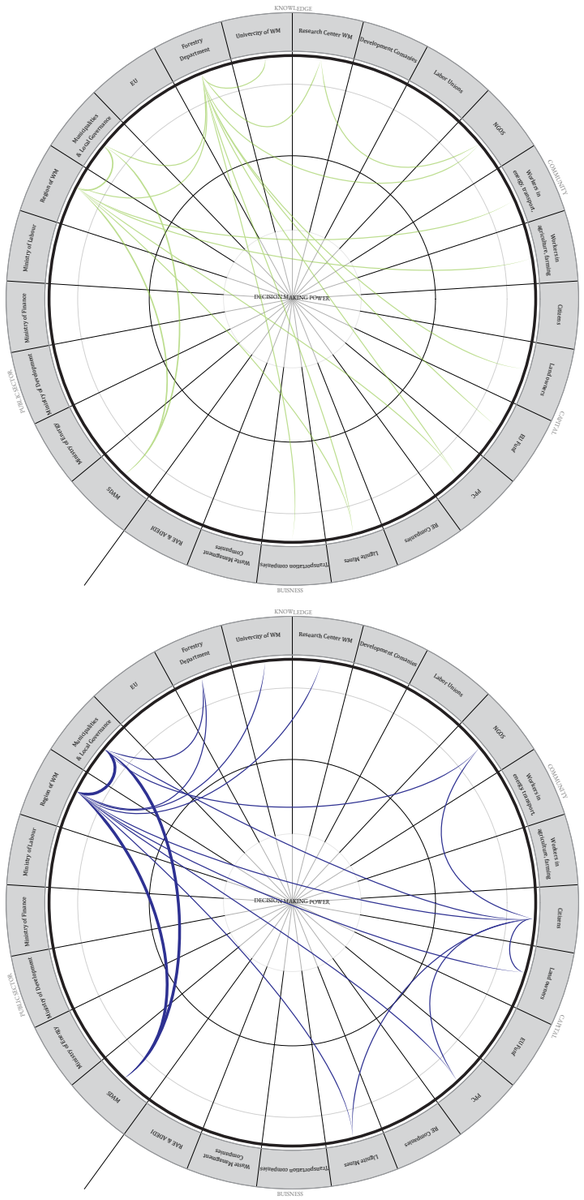


Figure 104. *Ecological Regeneration | Synergies*
Source: author

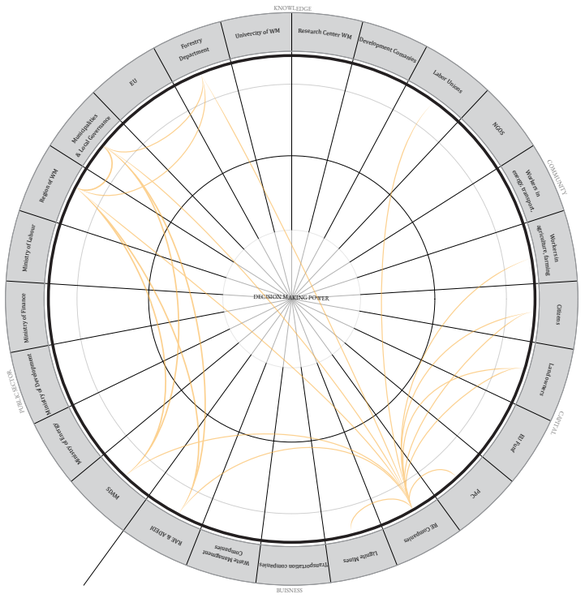


Figure 105. *Energy Diversification | Synergies*
Source: author

Figure 106. *Heritage Revalorisation | Synergies*
Source: author

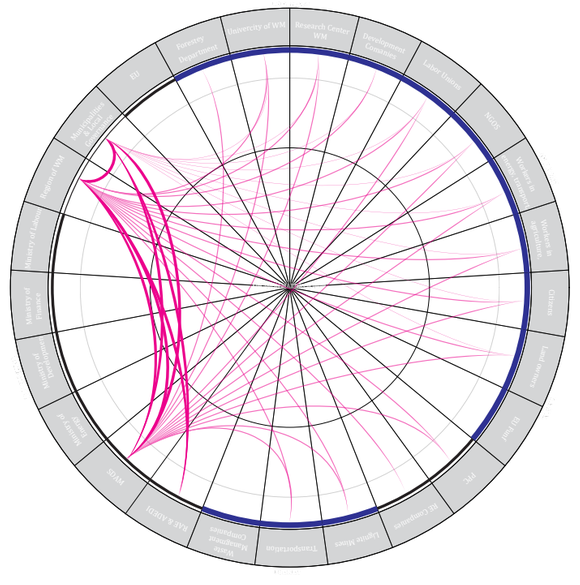


Figure 107. *Energy Diversification | Synergies*
Source: author

STRATEGY | SOCIAL ENGAGEMENT

In order to increase the inclusivity during the transition process, it is important to intervene during deferent phases of the process with different Engagement strategies. In this project, four groups of strategies are proposing to establish a societal transformation.

S.1. Strengthen Participatory processes

Participatory processes in transition planning serve to promote the active involvement of local stakeholders in the planning phase, fostering the integration of their local knowledge and perspectives into future policy formulation. It is worth noting that, as previously mentioned, there is a notable deficiency in participatory processes when it comes to the development of "just transition" policies. Furthermore, Greece currently lacks a well-established "participatory planning culture. Thereby, this strategic action focuses on creating this culture through organising local community meetings and workshops, to encourage citizens to provide their views. Additionally, this action proposes the integration of stakeholders from different sectors and levels in an effort to combine knowledge and perspective on future proposals.

S.2. Raise public awareness

Raising public awareness constitutes an action that refers to increasing the awareness of local stakeholders of the transition process, aiming to increase their contribution to participatory processes. To illustrate, the organisation of annual conferences focusing on Renewable Energy (RE) technology serves as a platform wherein local stakeholders can engage in the open exchange of knowledge and ideas. Furthermore, the orchestration of annual heritage festivals provides an avenue for local stakeholders to deliberate upon potential repurposing opportunities for historical spaces.

S.3. Enhance Transparency

This action focuses on increasing information transparency within the transition process. Currently, governmental documents regarding the transition process are scattered on various websites, with different types of information being published from different sources on different websites. This action calls for the creation of an easily accessible central website that compiles information from different sources, originating from different levels, providing users with multisector and multi-scalar information and data. Additionally, this strategy calls for the creation of local "Just Transition" observatories that collect data on the local level and assist in monitoring and evaluation processes. Lastly, this strategy calls for the organisation of information centres, which bridge knowledge gaps relating to technology in local communities.

S.4. Disseminate Knowledge

Disseminating knowledge constitutes an action centred around the broad dissemination of information pertaining to renewable energy production and silviculture. Specifically, this action aims to accomplish the retraining of the workforce in the domains of renewable energy technologies and silviculture. Furthermore, it entails the conceptualisation and implementation of a series of open pilot projects designed to function as training initiatives for interested stakeholders.

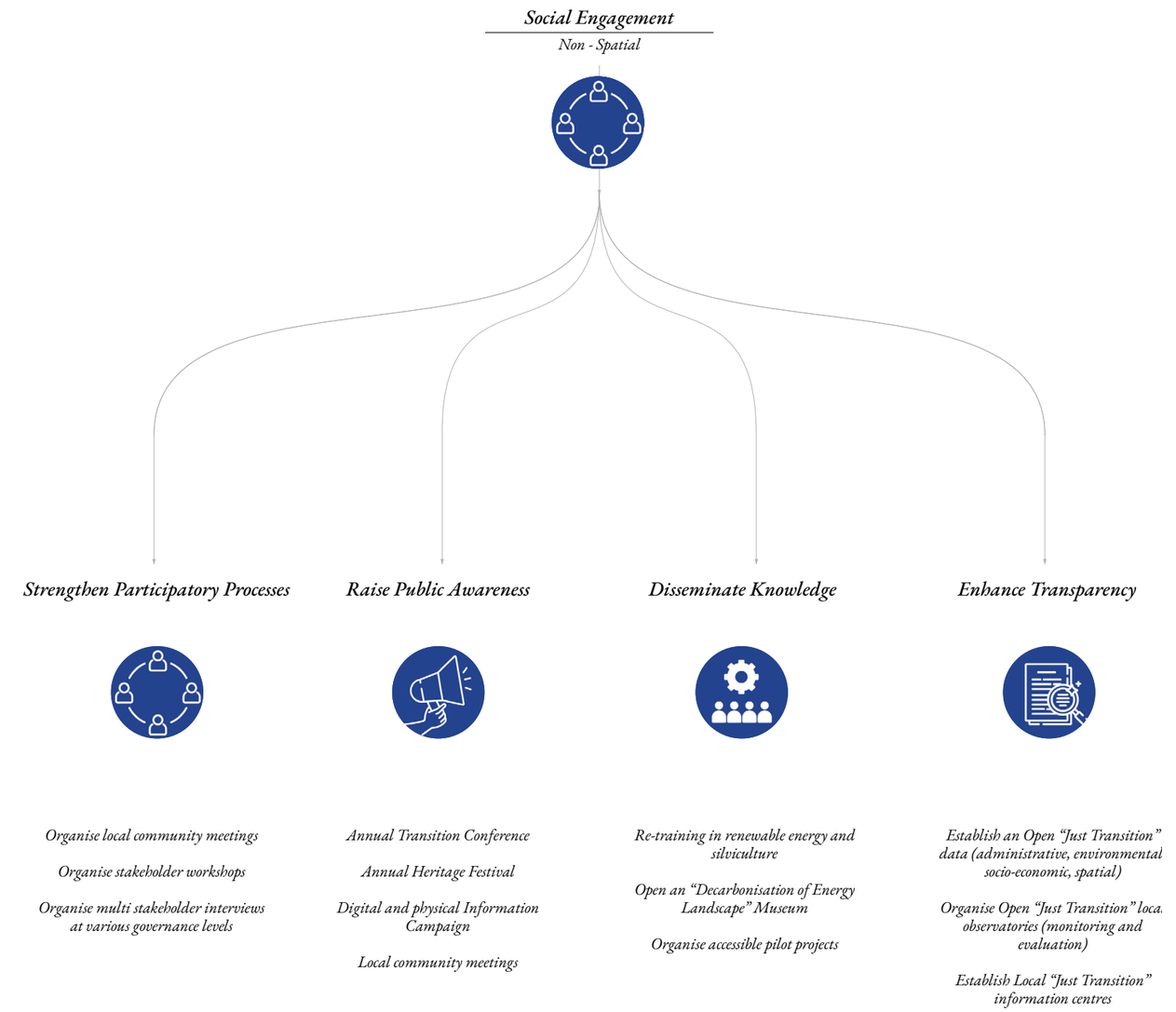


Figure 108. *Social Engagement Strategies Diagram*
Source: author

STRATEGY | GOVERNANCE REFORM

To optimise the efficacy of transition governance and policy formulation, it is imperative to re-evaluate current practices and promote seamless collaboration among government institutions operating at different administrative levels. Within this strategy, three distinct sets of actions are delineated to fortify institutional synergy.

G.1. Promote collaborative policies

Aligning policies and goals for the "Just Transition" of Western Macedonia is crucial due to the existing disconnect among various governmental agencies directly and indirectly involved in the 'Just Transition.' Bridging the gap between different governmental agencies and supporting collaboration is imperative both between different agencies and different scales. A collaborative renewable energy policy and just transition policy should encompass environmental, and social aspects in order to pre-empt potential conflicts and foster beneficial changes in the transition process.

G.2. Establish monitoring and evaluation systems

Establishing a robust monitoring process is a pivotal component of the "Just Transition" for energy transition and decarbonisation in the region of Western Macedonia. Crucially, these processes encompass several essential steps. First, define clear and quantifiable metrics to measure progress toward set goals, such as reduced carbon emissions and increased employment in renewable energy sectors. Second, data collection and analysis are imperative to assess the effectiveness of policies and strategies. Third, stakeholder engagement ensures that local voices and concerns are heard, fostering transparency and accountability. The benefits of such monitoring processes are multifaceted. They enable evidence-based decision-making, helping to adjust strategies for optimal outcomes. Moreover, they build trust among local communities by demonstrating a commitment to their long-term well-being.

G.3. Promote Long-term planning

Promoting long-term planning for energy transition and decarbonisation in the region of Western Macedonia is of paramount importance. Long-term planning entails aligning policies, investments, and infrastructure development with renewable energy adoption, retraining the workforce and long-term environmental rehabilitation. Furthermore, it encompasses the active engagement of local stakeholders, the cultivation of innovation ecosystems, and the establishment of an enabling environment conducive to renewable energy initiatives. By prioritising such planning, Western Macedonia can effectively navigate the complex path toward a greener, more sustainable future.



Figure 109. *Governance Re-structure Diagram*
Source: author

STRATEGY | LOCAL INTERVENTION

For the final phase of the design segment of this thesis focuses on the township of Eordaia (former Ptolemaida) and illustates a smaller s scale design of the strategic vision.

Legend

Ecology
- Mine Restoration
- Riparian Zones
- Restoration of Barren Land

Energy
- Biomass power plant
- Transmission network
- 400v
- 100v
- 100v extension
- Storage
- Small scale agriculture solar
- Large scale solar
- Small scale bio-fuels
- Energy Forestry

Heritage
- Shrinking Settlements
- Energy Settlements
- 10km Buffer

N

0 10 km



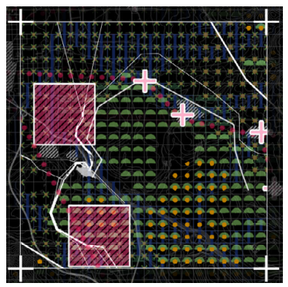


Figure 110. *Local Intervention Diagram*
Source: author

DESIGN INTERVENTION

PTOLEMAIDA | CURRENT CONDITIONS (I)

The local intervention focuses on the township of Eordaia (former Ptolemaida) located in between the two mining areas, more specifically at the edge of the urban fabric and the mining operations. It is chosen as one of the central sites that will initiate the transition process.



Figure 111. *Satellite Image of 2009*
Source: Google Earth



Figure 112. *Satellite Image of 2014*
Source: Google Earth



Figure 113. *Satellite Image of 2020*
Source: Google Earth

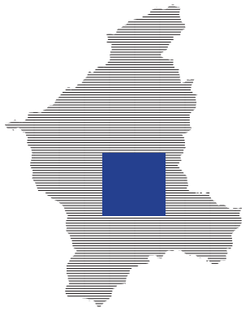


Figure 114. *Key*



Figure 115. *Satellite Image of area*
Source: Google Earth

PTOLEMAIDA | 2023

Current Condition

Looking at the current land conditions, it is clear that the site is in a transitional phase. The site contains a series of small settlements, an intensive agricultural area, industrial areas and an extensive area of mining deposits (Deposits II) and the still active Main Field mine.

Looking more closely at industrial space, three industrial complexes are located in close proximity to the mines. The semi-abandoned A.E.V.A.L. Industrial Complex, the recently de-commissioned Thermal Power Plant of LIPTOL I and the attest Thermal Power Plant Ptolemaida V. Additionally, we can see several abandoned agricultural areas in adjacency to the mines and areas of deposits. Finally, we can see the mining and deposits area at various stages, ranging from abandonment to rehabilitation.

The withdrawal and shrinkage of the energy sector in the site, in relation to the proximity to the residential areas, makes the site the ideal area for the expansion of renewables.

Legend

- Abandoned Industrial Areas
- Active TPP
- Abandoned rail infrastructures
- Conveyor belts
- Structural green
- Residential
- Abandoned agriculture

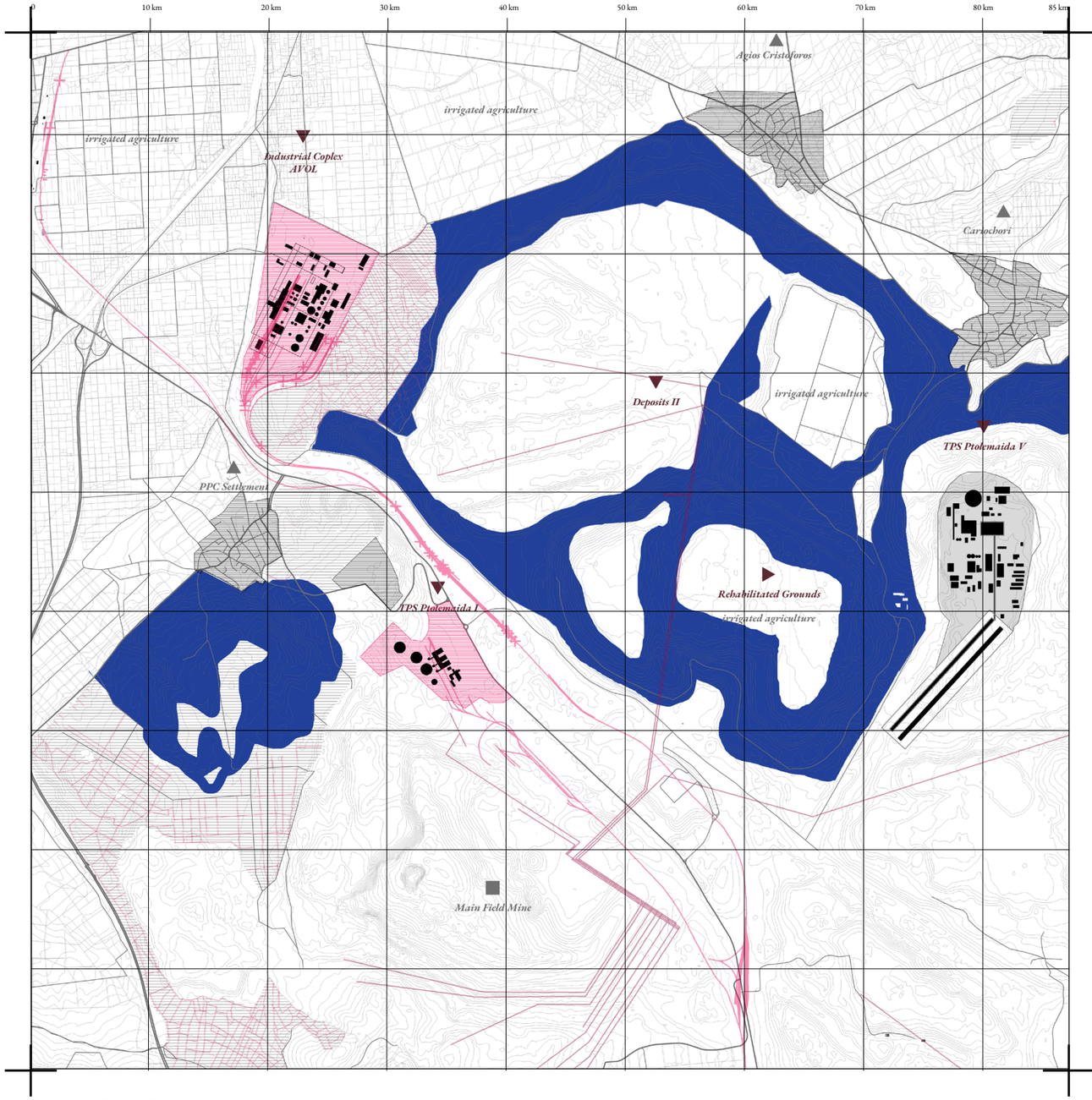


Figure 116. *Current Conditions of area*
Source: Google Earth, Geofabric, EEA (2020)

PTOLEMAIDA | CURRENT CONDITIONS (II)

Layers (i)

Administration-Urban

The study area is divided between four different NUTs 4 townships.

Road Network

The road network includes different types of roads. The area is accessible by highway, connected to the primary and secondary road network.

Industrial Heritage

The township of Eordaia was the area from which extraction began in 1958. For this reason, the area concentrates on numerous industrial heritage sites in various states. In short, in the area located in active Thermal Power Plant {Ptolemaida V}, remnants of the railway network that connected the urban settlements, industrial sites and the mines, and other important industrial spaces, such as the AEVAL industrial complex. It is important to mention that most of the aforementioned infrastructure is in a state of abandonment or neglect due to either complicated ownership states or because of the lack of funding for its re-use.

Extraction System

In the study area, there are three major extraction areas: the still active Main Field Mine, the Kardia Mine, and the mining deposits in Deposits II.

Energy Infrastructure

Regarding energy infrastructure, the case study area is home to two Thermal Power Plants (TPP), one of which is currently operational while the other lies dormant. As a result, the region is interconnected with both high and low voltage electricity transportation systems, complete with the requisite substations to facilitate power distribution.

Water Structure

The water systems in this area pose significant challenges due to their disconnected and open layout. With limited retention areas, there is an elevated risk of flooding, which can impact the surrounding environment.

Ecological Structure

The ecological structure in this landscape is rather restricted, mainly confined to specific riparian zones and rehabilitated areas.

Topography

The topography of this area is characterized by steep slopes, primarily resulting

Legend

Solar

- administrative boundary
- residential area
- primary road
- secondary road
- residential road
- conveyor belt
- abandoned rail network
- open water network
- water extraction points
- irrigation points
- high degree of flooding
- electricity pylon
- electricity cable
- pine vegetation
- riverine vegetation
- contours
- slope 0-100

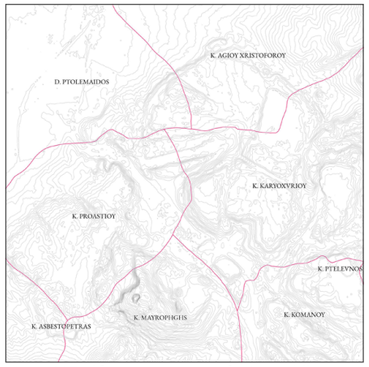


Figure 117. *Administrative Boundaries NUTS 4*

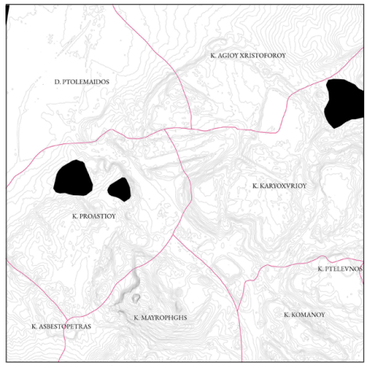


Figure 118. *Settlemets*

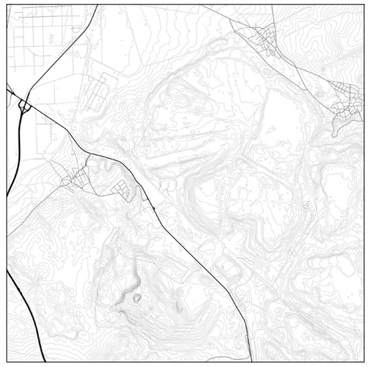


Figure 119. *Road Network*

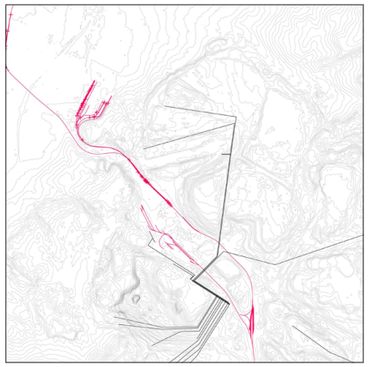


Figure 120. *Industrial and mining Heritage*

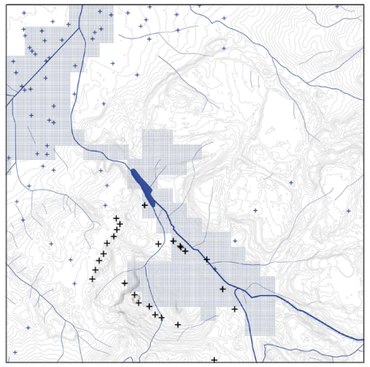


Figure 121. *Water Structure*

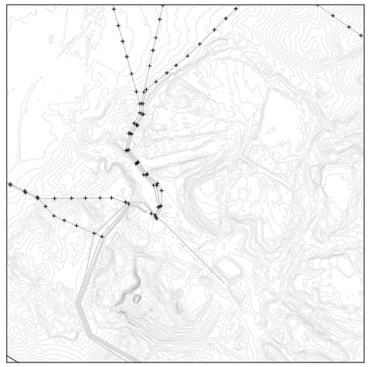


Figure 122. *Energy Infrastructure*

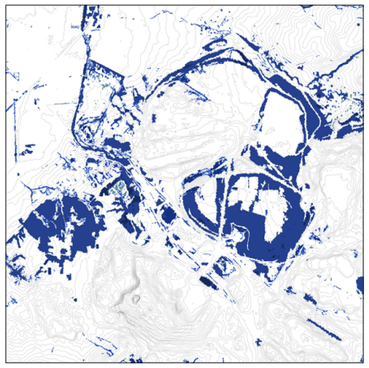


Figure 123. *Vegetation*

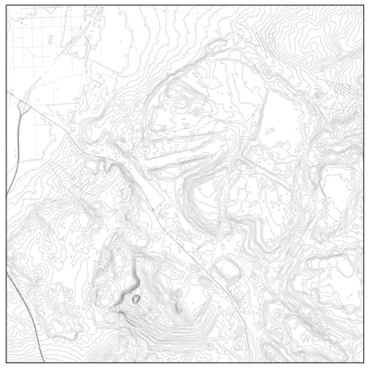


Figure 124. *Topography*

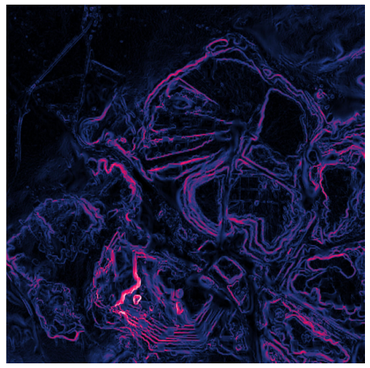


Figure 125. *Slope*

Figures 125-133. Layers
Source: Google Earth, EEA (2020)

PTOLEMAIDA | 2060

Proposal

The strategic design integrates strategies across three key spatial categories: ecological rehabilitation, energy diversification, and heritage valorization. This holistic application of strategies orchestrates a profound transformation within the site. Mining and deposit regions undergo a significant shift, transforming into diverse energy production landscapes where electricity is generated directly through solar panels or via the cultivation of energy forestry and biofuels. Simultaneously, abandoned industrial zones find adaptive reuse, serving as versatile community spaces or contributing to energy production through biomass utilization. Moreover, agricultural areas incorporate small-scale energy infrastructure, encompassing elements such as small-scale solar systems, energy storage, and energy crop cultivation. Ultimately, this comprehensive approach leads to the evolution of the former extractive landscape into a revitalized and diverse terrain.

In the next pages, the project focuses a phasing of the design and on two key components of the new energy production landscape:

- the adaptive re-use of the AEVAL Industrial Complex and
- the rehabilitation of the Kardia mining field.

Legend

- Heritage Path
- Community Center
- Biomass Power Plant
- Solar | Large scale
- Biomass plantation
- Biofuels plantations

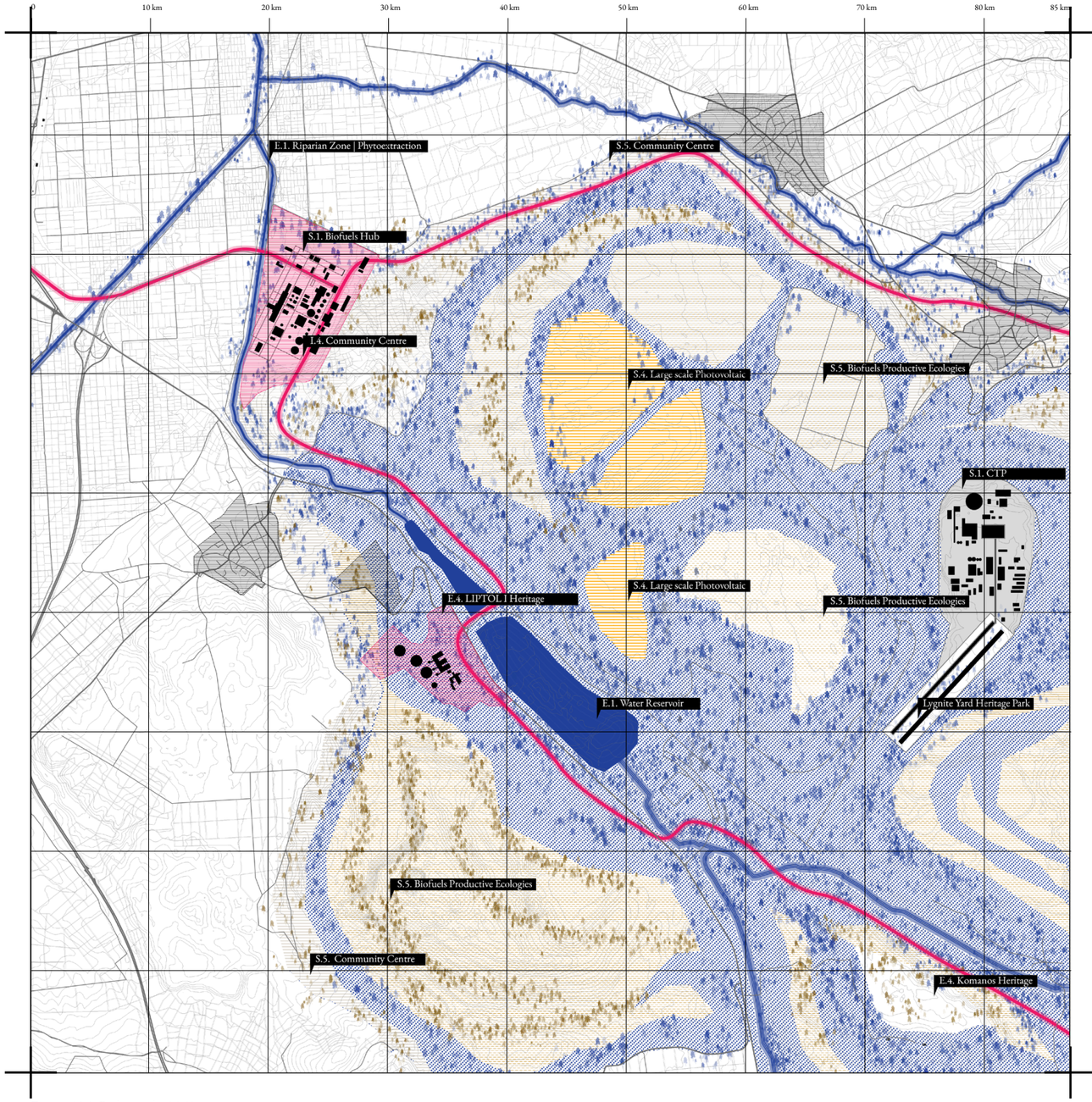


Figure 126. *Ptolemaida 2060*

PTOLEMAIDA | 2060

The phrasing of the strategic design is structured in four different phases.

Phase 1: Preparation (2023-2025)

As previously mentioned, in the initial phase, the project is dedicated to developing and finalising spatial plans and engaging local communities. For this reason, in the first phase, the site is used in order to engage the local communities. Heritage paths are set up, and dedicated areas within the industrial sites, the mining areas and other landmarks are organised in one open exhibition, like an industrial heritage museum. The goal is to engage local communities, show them their importance in the process and attract them. At the same time, intangible strategies, such as the heritage paths platform and heritage path, are taking place. Additionally, within this phase, rehabilitation projects centred on areas of deposits are completed.

Phase 2: Integration (2025-2030)

The second phase of the design focuses on energy diversification and mine restoration. More specifically, it proposes the integration of renewable energy infrastructure in rehabilitated deposit areas and small-scale energy infrastructure in agricultural areas. Additionally, the ecological rehabilitation of the main field and cardia field is initiated with the end of the mining operations. At the end of this process, an evaluation of these projects is conducted.

Phase 3: Synergies (2030-2040)

The third phase of this project is dedicated to large-scale transformations in the energy sector. Renewable energy infrastructure is integrated in the rehabilitated mining areas of the Main field and Kardia field. Additionally, feedback loops from previous energy strategies are carried out. Again, at the end of this phase, the evaluation process regarding the implementation of the proposed strategies is carried out

Phase 4: Establishment (2040-2050)

The final phase is dedicated to finalising the connection of small-scale energy projects to the grid and establishing the final synergies between different landscape components. The energy production landscape in the mining areas is finalised. Industrial areas are being re-used and connected to the national electricity grid. The agricultural energy landscape is also connected to the national energy grid. Finally, the water reservoirs are in the process of water accumulation and rehabilitation of the local depleted aquifer.

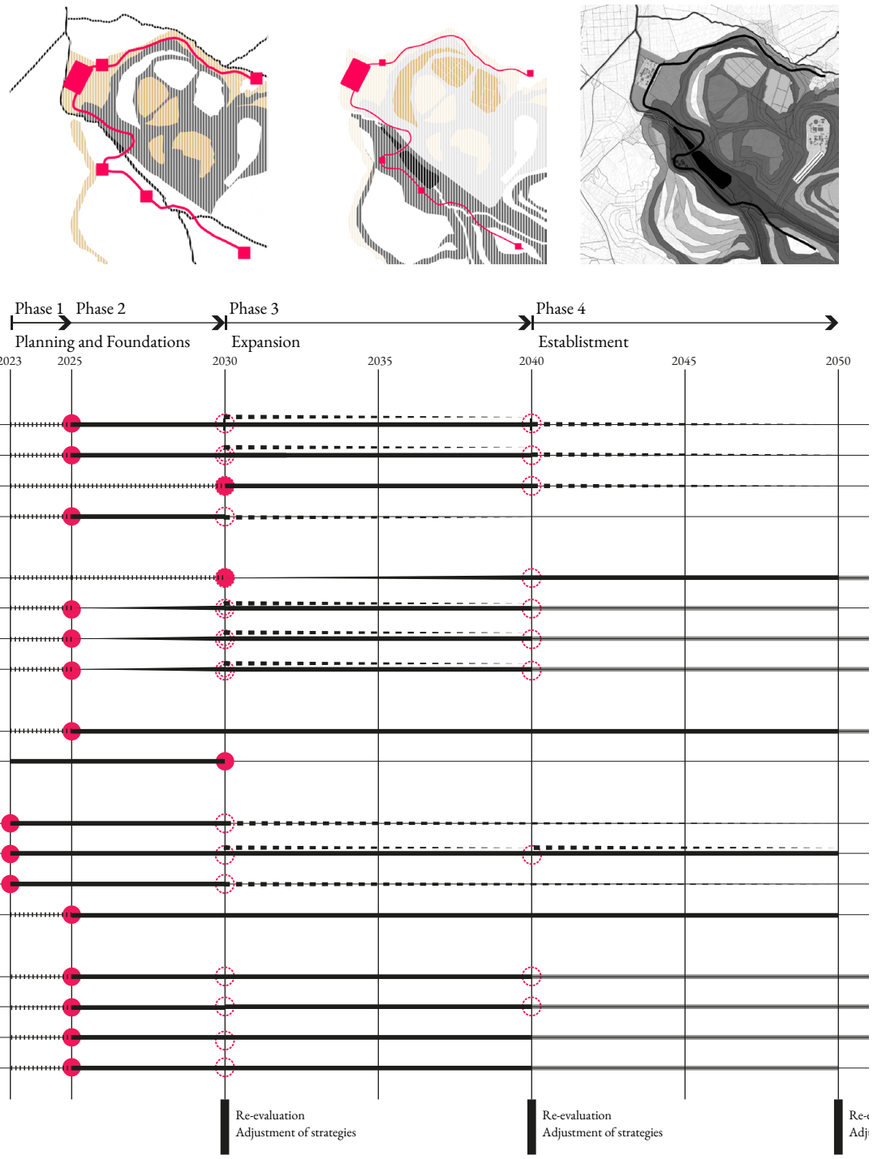


Figure 127. *Design intervention Phasing*

AEVAL INDUSTRIAL COMPLEX | INTRODUCTION

The zoom-in analysis centres on the AEVAL industrial complex, which represents a semi-abandoned industrial facility historically engaged in the production of fertilizers utilizing by-products derived from mining operations. The AEVAL industrial complex has remained dormant for 40 years and has deteriorated into a state of abandonment since the year 2006. It maintains connections to neighbouring settlements through a network of roadways and maintains a semi-abandoned rail infrastructure linking it to the mining sites. In 2011, the entire site was acquired by the municipality of Eordaia (formerly known as Ptolemaida), using funds sourced from the "lignite fee." The primary objective behind this acquisition was to facilitate the adaptive re-purposing of the complex into an industrial heritage park.

The strategi design proposes the adaptive re-use of th industrial complex as a administrative headquartes for the transitio, heritage museum, and storage space for some of the energy crops.

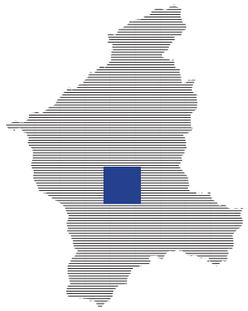


Figure 129. *Key | Aeval Industrial Complex*



Figure 128. *Aeval | Gas Structures*
Source: Modica (2014a)



Figure 130. *Aeval | Cooling Towers*
Source: Modica (2014a)



Figure 131. *Aeval | Industrial Water*
Source: Modica (2014a)



Figure 132. *Cooling Towers and gas infrastructure*
Source: Modica (2014a)



Figure 133. *Satellite Image of AEVAL Industrial Complex*
Source: Google Earth

AEVAL INDUSTRIAL COMPLEX | 2023

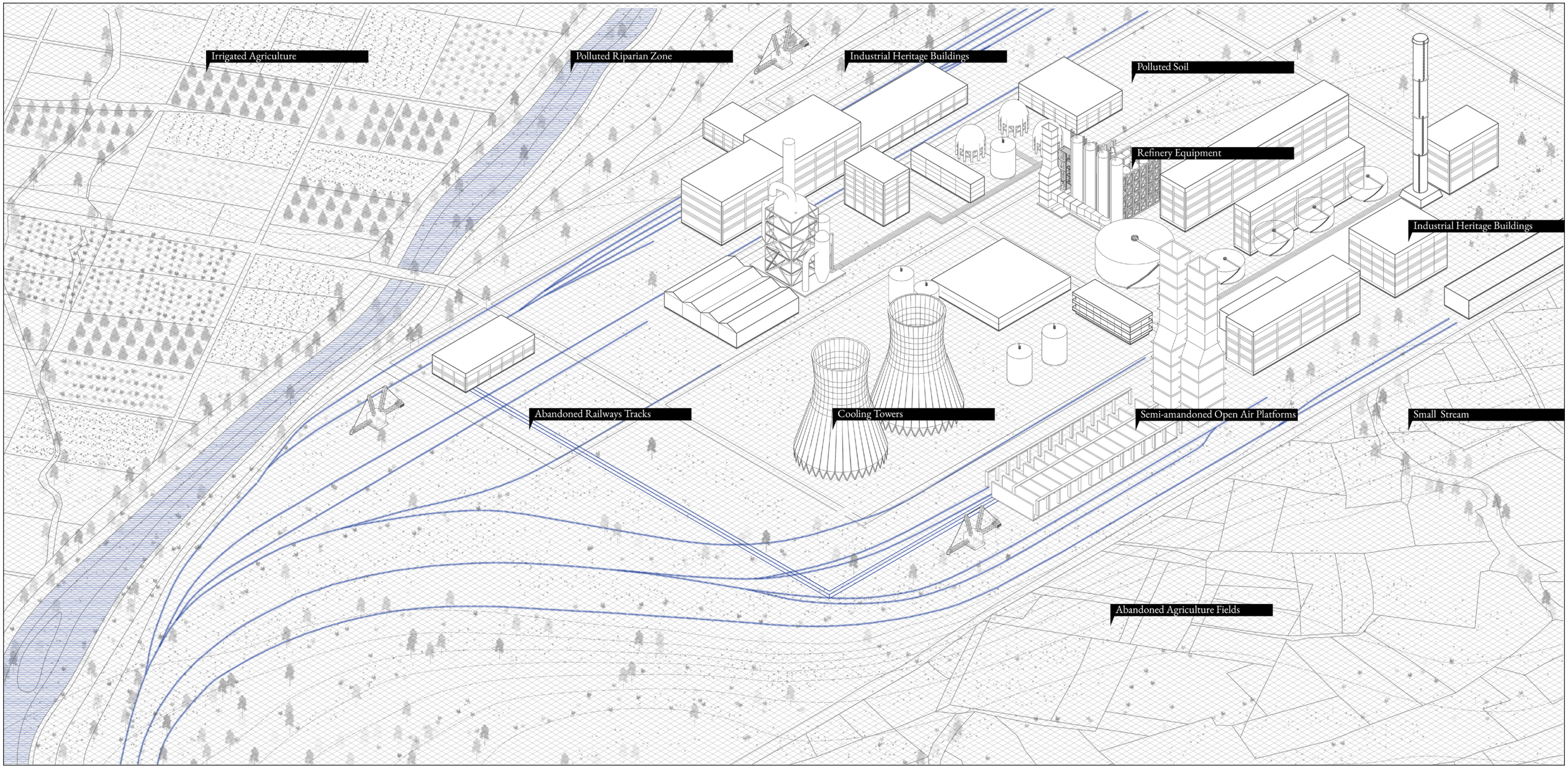


Figure 134. *Axonometric of the AEVAL industrial park*
Source: author

AEVAL INDUSTRIAL COMPLEX | 2060

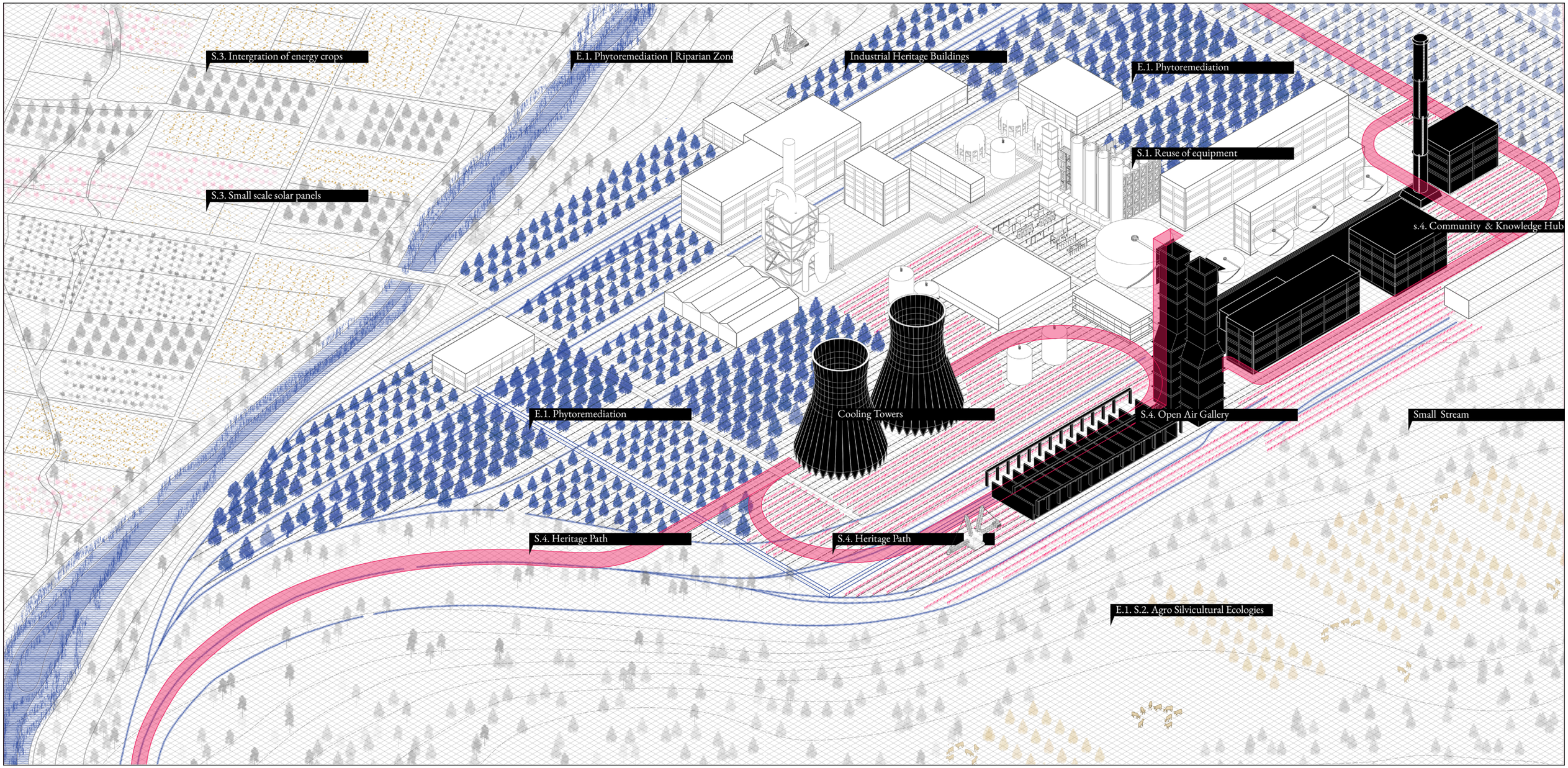


Figure 135. *Axonometric of the new community center and community heritage park at AEVAL industrial complex*
Source: author

AEVAL INDUSTRIAL COMPLEX | REFERENCES PROJECTS

STRATEGY 3 | *Revalorising Heritage - Ecological Restoration*
REFERENCE PROJECT | *Landscape Park Duisburg Nord*

- Intergration of visitor paths with rehabilitation of contaminated ground
- Social awarenes events
- Design choises : vegetation types

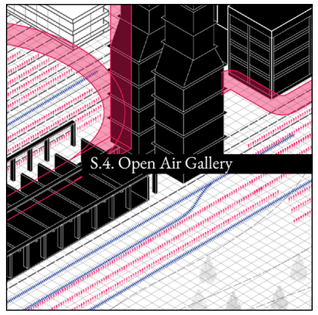


Figure 136. *Key of reference*

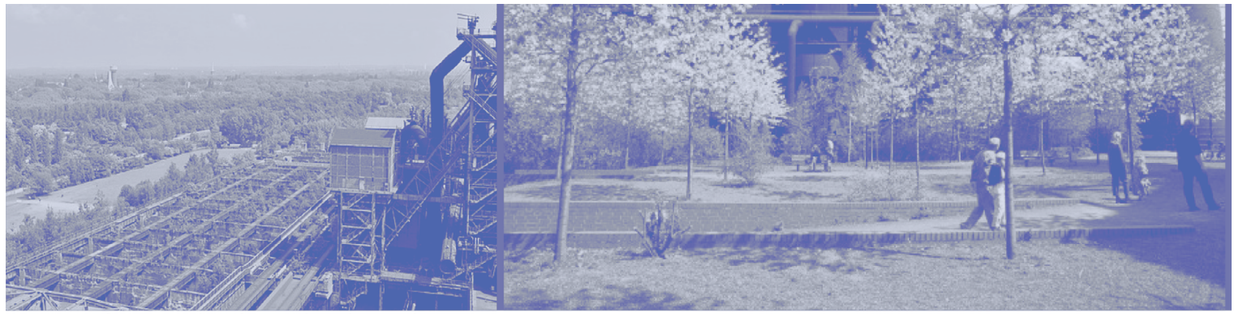


Figure 139. *Reference Project | Landscape Park Duisburg Nord*
Source: Landscape Park Duisburg-Nord | Urban Green-blue Grids, n.d.)

STRATEGY 3 | *Revalorising Heritage*
REFERENCE PROJECT | *Industrial Heritage Trail in Ruhr Area*

- Recreation network centered on post industrial and mining areas
- Intergration of different mobility networks (cycling, pedestrian)

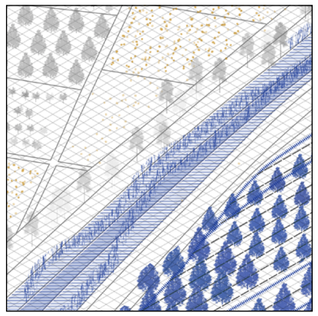


Figure 137. *Key of reference*



Figure 140. *Reference Project | Industrial Heritage Trail*
Source: (Cycle Routes in the Ruhr Area: The Industrial Heritage Trail, 2023)

STRATEGY 1 |*Ecological Restoration*
REFERENCE PROJECT | *Quzhou Luming Park* |

- Intergration of visitor paths with rehabilitation of contaminated ground
- Social awarenes events
- Design choises : grid, vegetation types

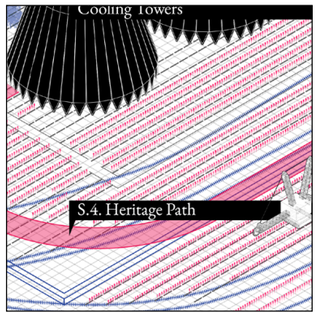


Figure 138. *Key of reference*



Figure 141. *Reference Project |Quzhou Luming Park*
Source: Architecture_Built (2023)

AEVAL INDUSTRIAL COMPLEX | DETAIL

The proposed detailed converges two essential strategies: ecological regeneration and the revalorization of heritage spaces. To be more specific, this plan advocates the revitalization of contaminated industrial heritage sites by establishing accessible heritage paths.

Regarding material selection, the project recommends the utilization of locally sourced materials derived from mining by-products. This includes the construction of rammed earth paths and the incorporation of gabion elevated pathways.

Furthermore, the project emphasizes the importance of vegetation, suggesting a blend of indigenous species, such as beech and helianthus, for phytoremediation purposes, effectively rehabilitating and remediating the contaminated ground.

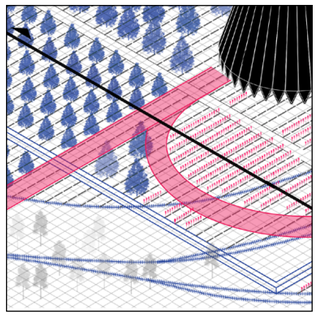


Figure 144. *Key of detail*

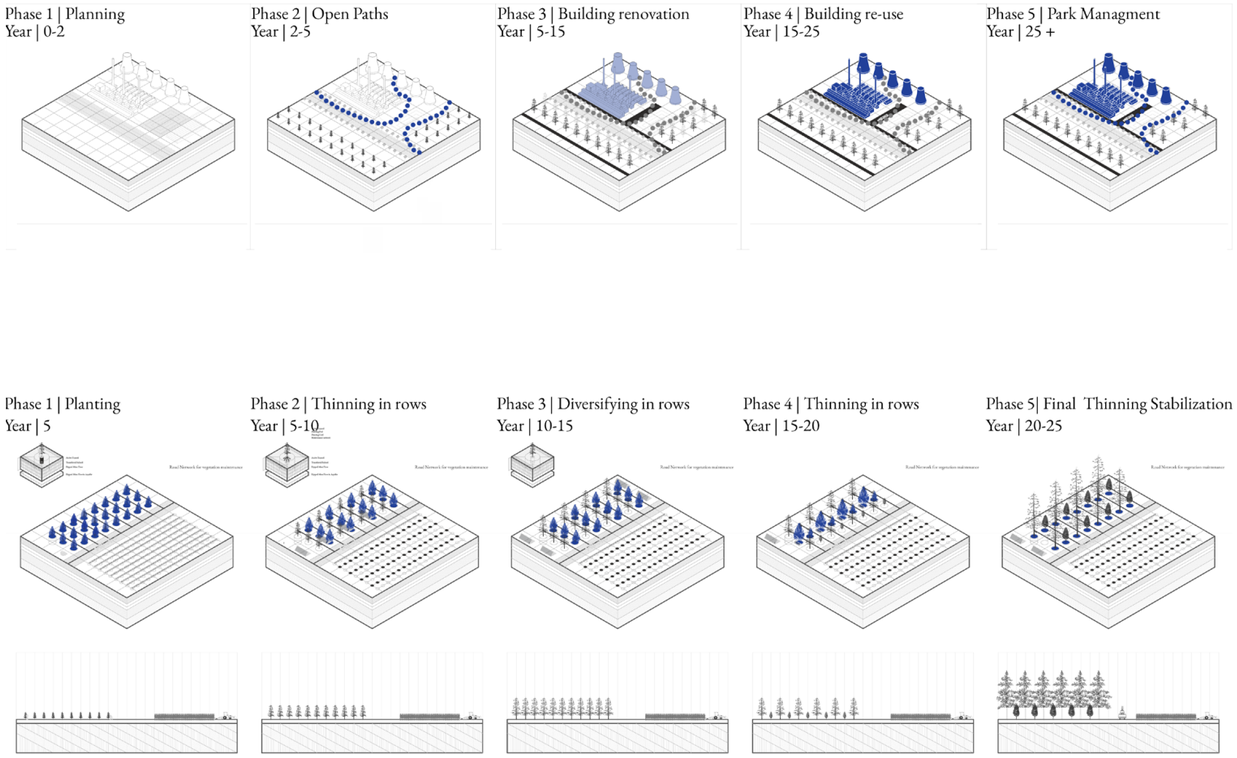
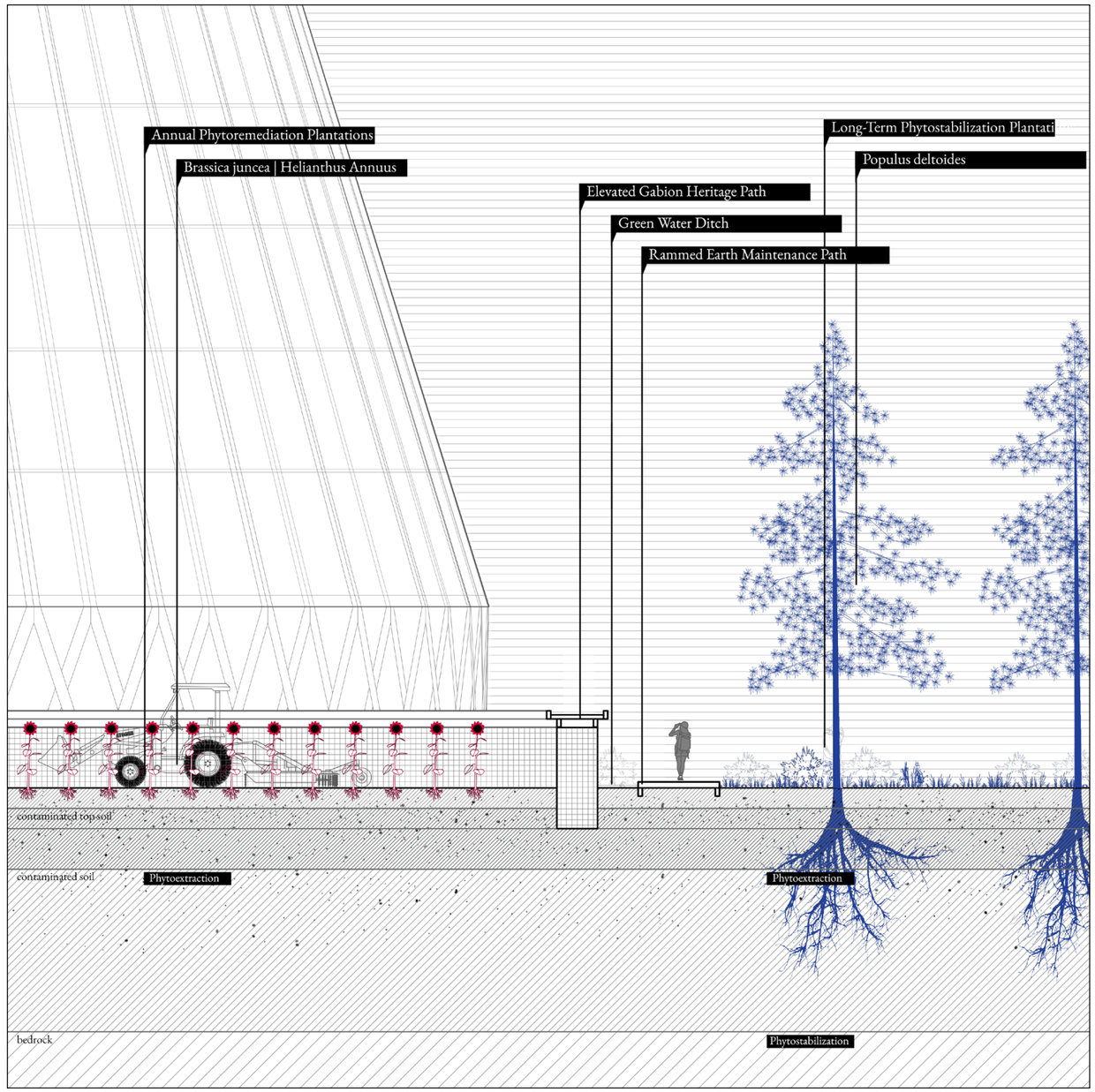


Figure 142. *(top) Phasing of eIndustrial complex rehabilitation and re-use processes*
Source: author

Figure 143. *(bottom) Phasing of phytremediation*
Source: author



Detail of phytoremediation in AEVAL Industrial Complex
Source: author

AEVAL INDUSTRIAL COMPLEX | SPATIAL IMPRESSION



Figure 145. *2020 | Perspective of AEVAL industrial complex*
Source: author

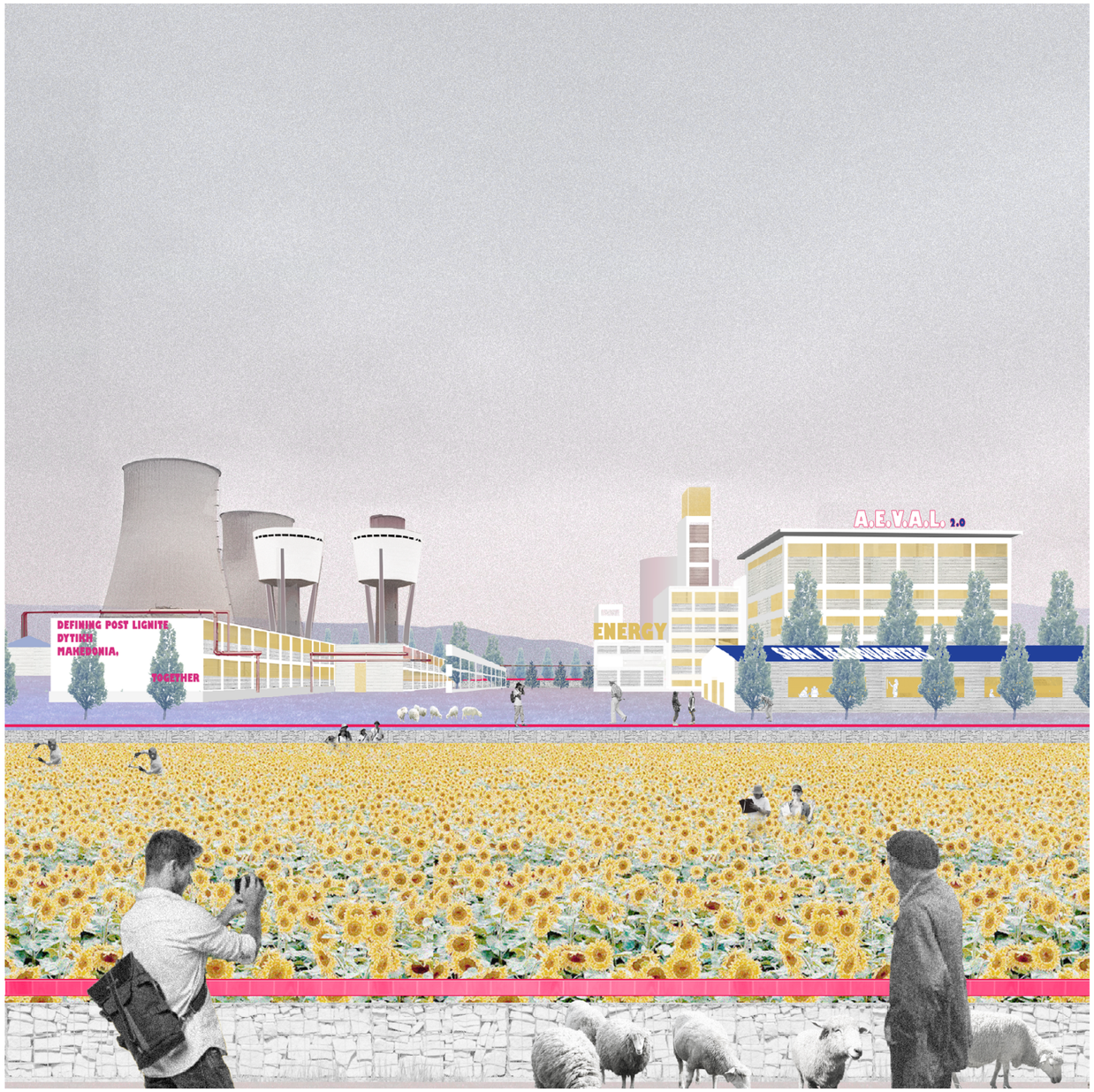


Figure 146. *2050 | Perspective of AEVAL industrial complex*
Source: author

KARDIA FIELD | INTRODUCTION

The second local intervention focuses of the decommissioned lignite mine Kardia and the remnants of Komanos settlement, one of the transferred lignite settlements. In this local intervention we can see the application of strategies centered on ecological restoration and energy diversification. The Kardia mining field has been abandoned since 2019, since lignite mining was deemed unprofitable. Currently the mine is slowly being filled with deposits from excavations from the south field and main field mines.

The design proposes the transition of the mining field ina solar and biomass production landscape, and the use of the mennants of mining and cultural sites in the heritage network.

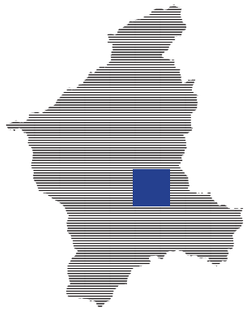


Figure 149. *Kardia Key*



Figure 147. *Komanos church and Kardia mine*
Source: Modica (2023)



Figure 150. *Tops soil removal kardia mine s*
Source: Modica (2023)



Figure 148. *Kardia field extraction site*
Source: Modica (2023)



Figure 151. *Internal deposits site*
Source: Modica (2023)

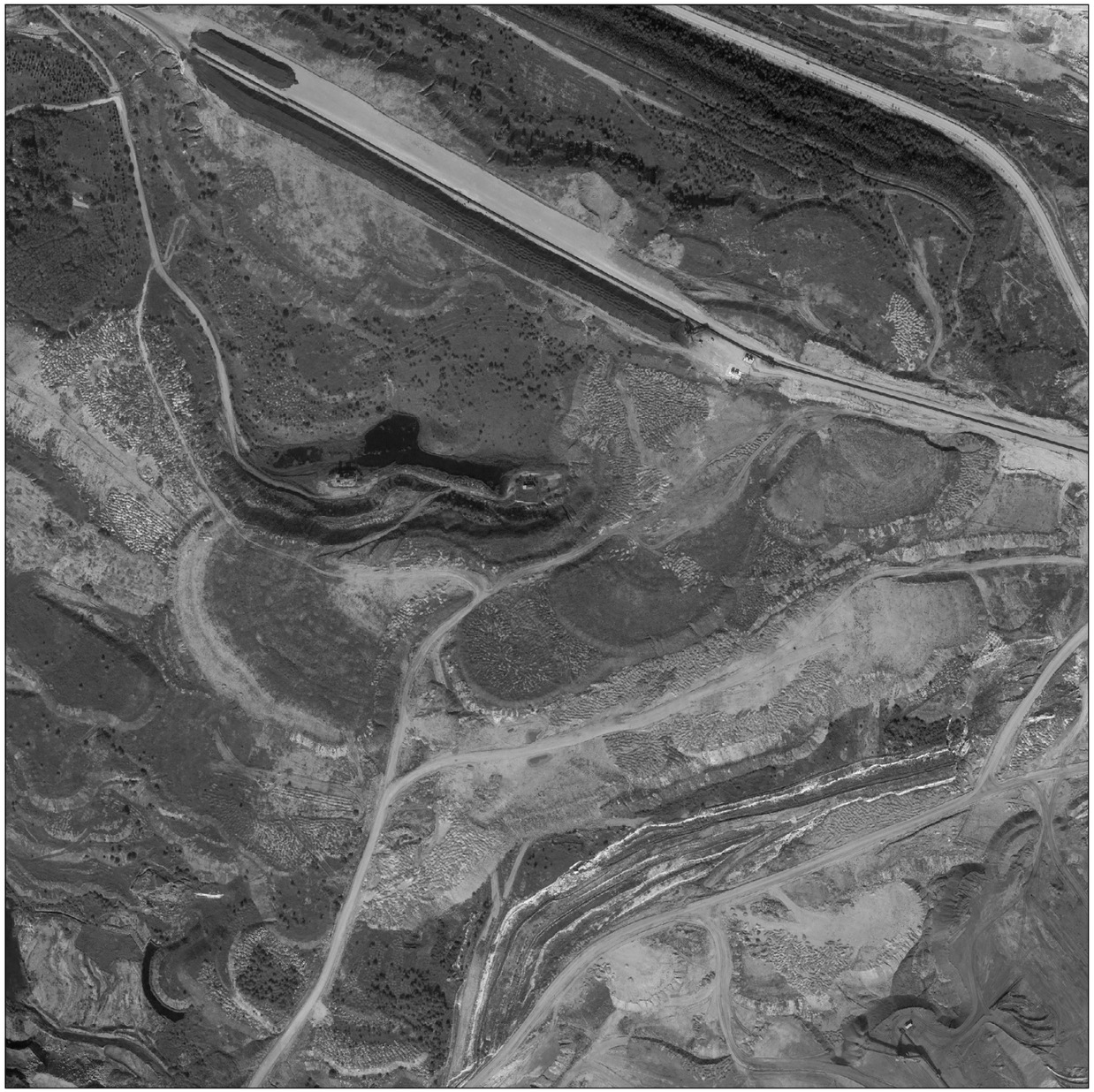


Figure 152. *Satellite Image of Kardia mine and Komanos village*
Source: Google Earth

KARDIA FIELD | 2023

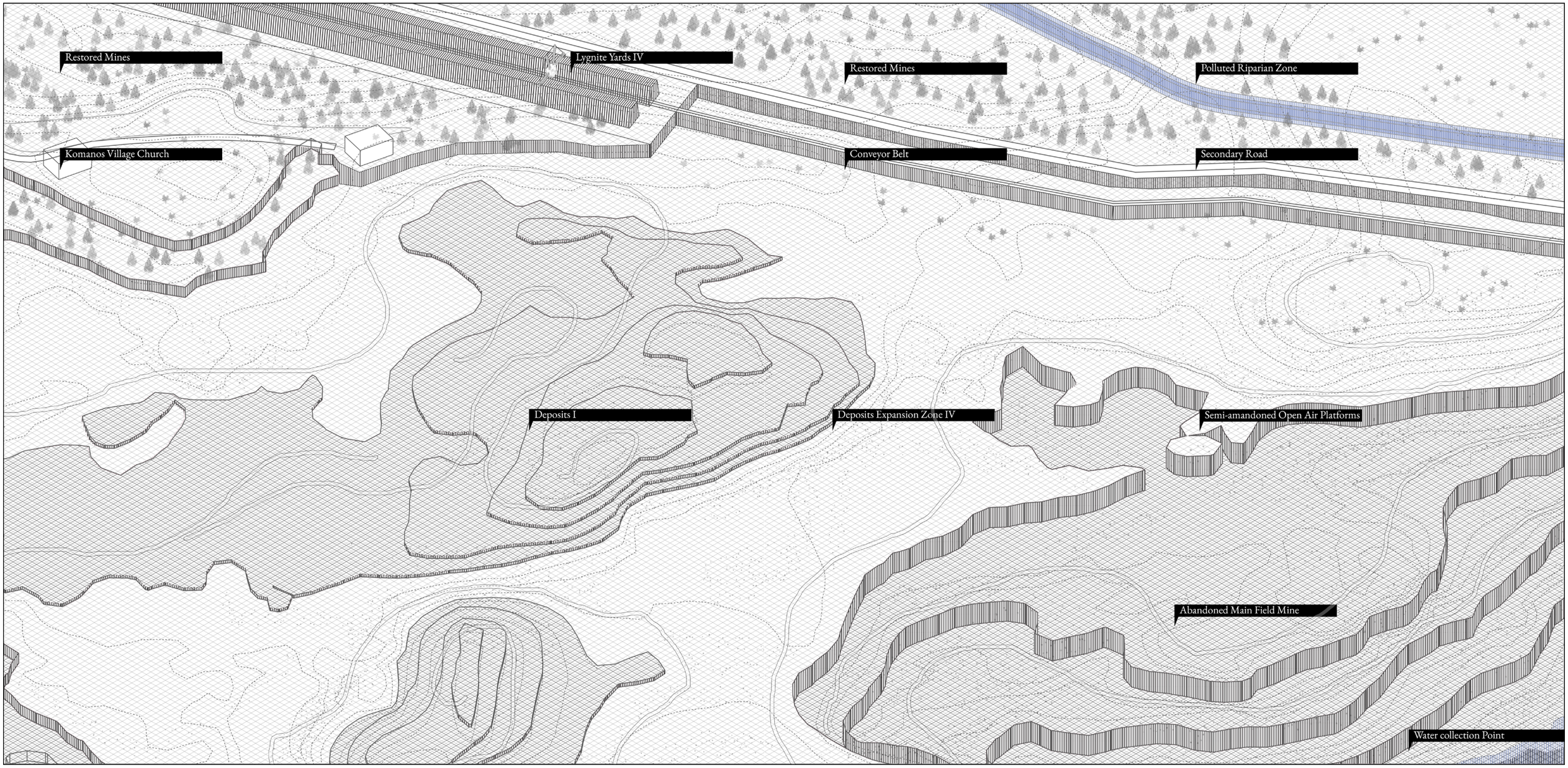


Figure 153. *Axonometric of the Kardia mining field*
Komanos village remails
Source: author

KARDIA FIELD | 2060

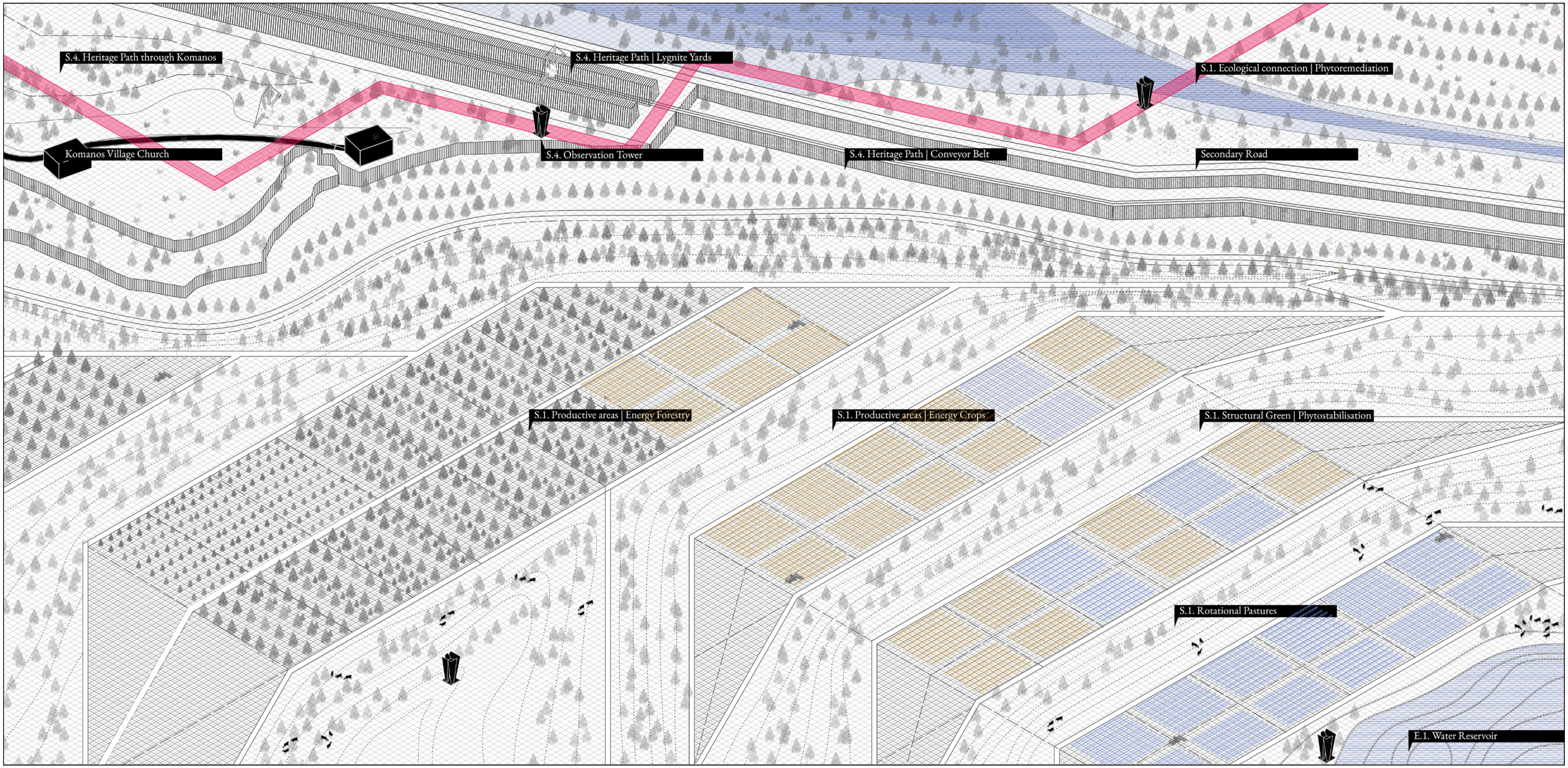


Figure 154. *Axonometric of the Kardia mining field*
Komanos village remails
Source: author

KARDIA FIELD | REFERENCE PROJECTS

STRATEGY 1 |*Ecological Restoration*
REFERENCE PROJECT | *Landscape restoration of the Vall d'en Joan | Catalonia, Spain*

- Open water network for rainwater collection
- Integration of recreation paths to productive areas

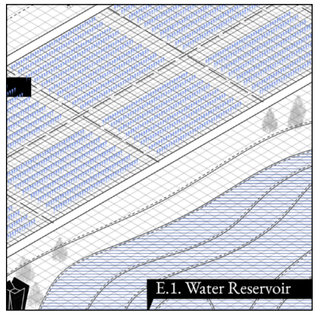


Figure 155. *Key of reference*

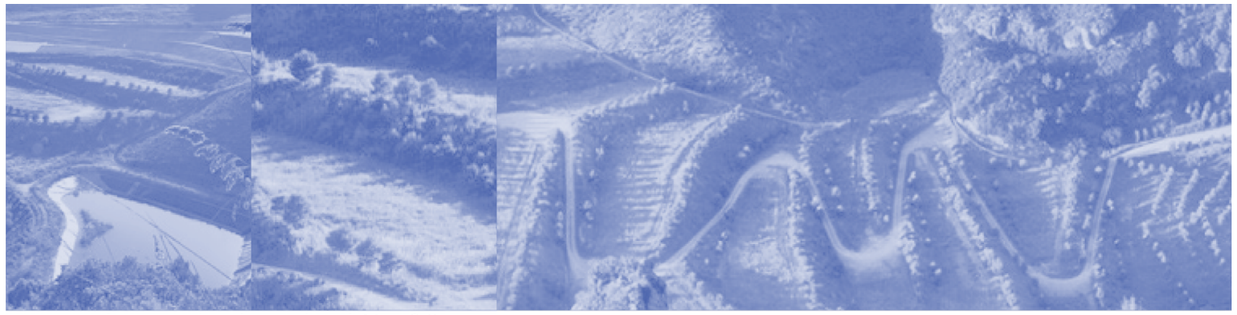


Figure 159. *Reference Project | Landscape restoration of the Vall d'en Joan*
Source: Landscape Restoration of the Garraf Controlled Waste Landfill in Barcelona « Landezine International Landscape Award LILA, n.d.)

STRATEGY 3 | *Ecological Restoration*
REFERENCE PROJECT | *Quzhou Luming Park*

- Method for drawing awareness to previously negleted heritage sites
- Digital platform for heritage sites
- Digital and printed Heritage Path Guide
- Co-operation of local stakeholders for outcome

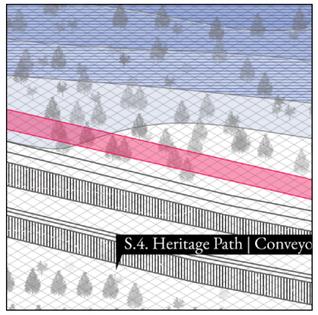


Figure 156. *Key of reference*

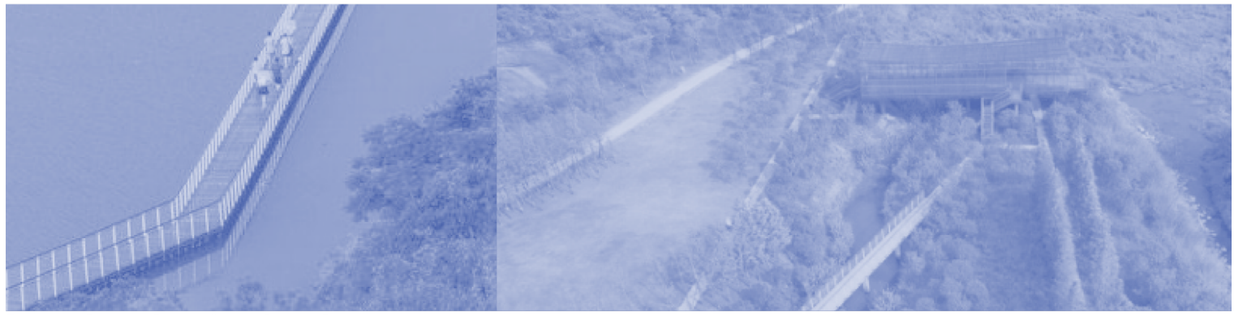


Figure 158. *Reference Project | Quzhou Luming Park*
Soy=urce: Architecture_Built (2023)

STRATEGY 3 |*Revalorising Heritage*
REFERENCE PROJECT | *Blue routes: Alicante's Hydrogeological Heritage | Alicante Province, Spain*

- Method for drawing awareness to previously neglected or unrecognised heritage sites
- Digital platform for heritage sites
- Digital and printed Heritage Path Guide
- Co-operation of local stakeholders for outcome

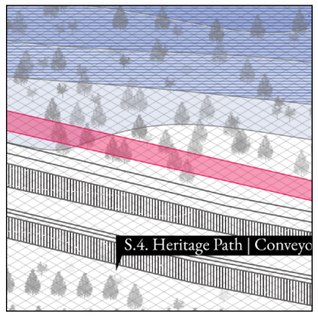


Figure 157. *Key of reference*



Figure 160. *Reference Project | Blue routes: Alicante's Hydrogeological Heritage*
Source: Rutas Azules vol1, (2021)

KARDIA FIELD | DETAIL

The proposed detailed plan integrates two fundamental strategies: ecological regeneration and energy diversification. In the context of mine restoration, the project advocates the establishment of multifunctional platforms featuring diverse productive ecologies.

Furthermore, it proposes afforestation using native species, carefully selected to either mitigate the presence of specific contaminants in the deposited soils, adjust nutrient levels, or generate biomass by-products.

Additionally, the strategy entails the incorporation of biofuels and solar panels within long-term rotation cycles. This approach aims to facilitate the rejuvenation of nutrients within polluted grounds, emphasizing a sustainable and restorative approach to land reclamation and energy generation.

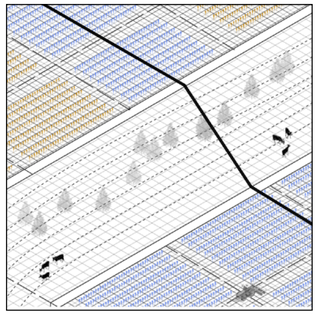


Figure 163. *Key of detail*

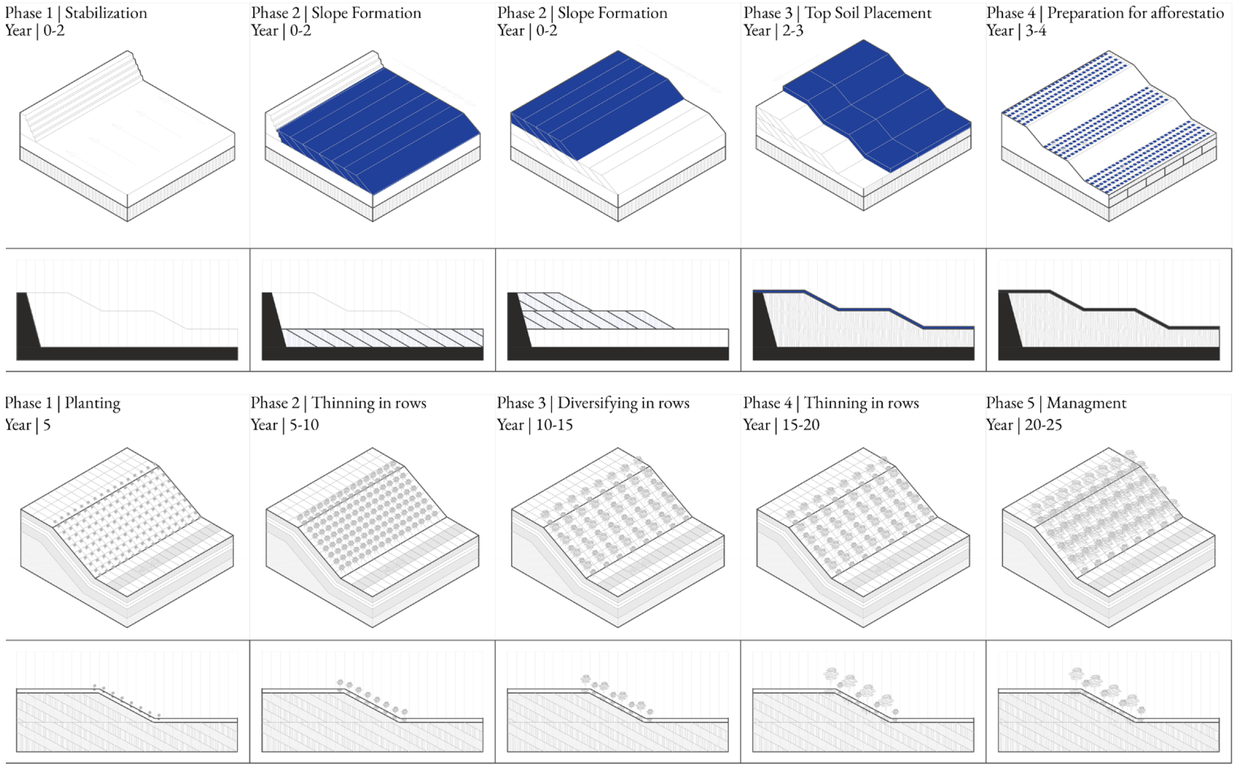


Figure 161. *(top) Phasing of mine closure*
Source: author

Figure 162. *(bottom) Phasing of afforestation*
Source: author

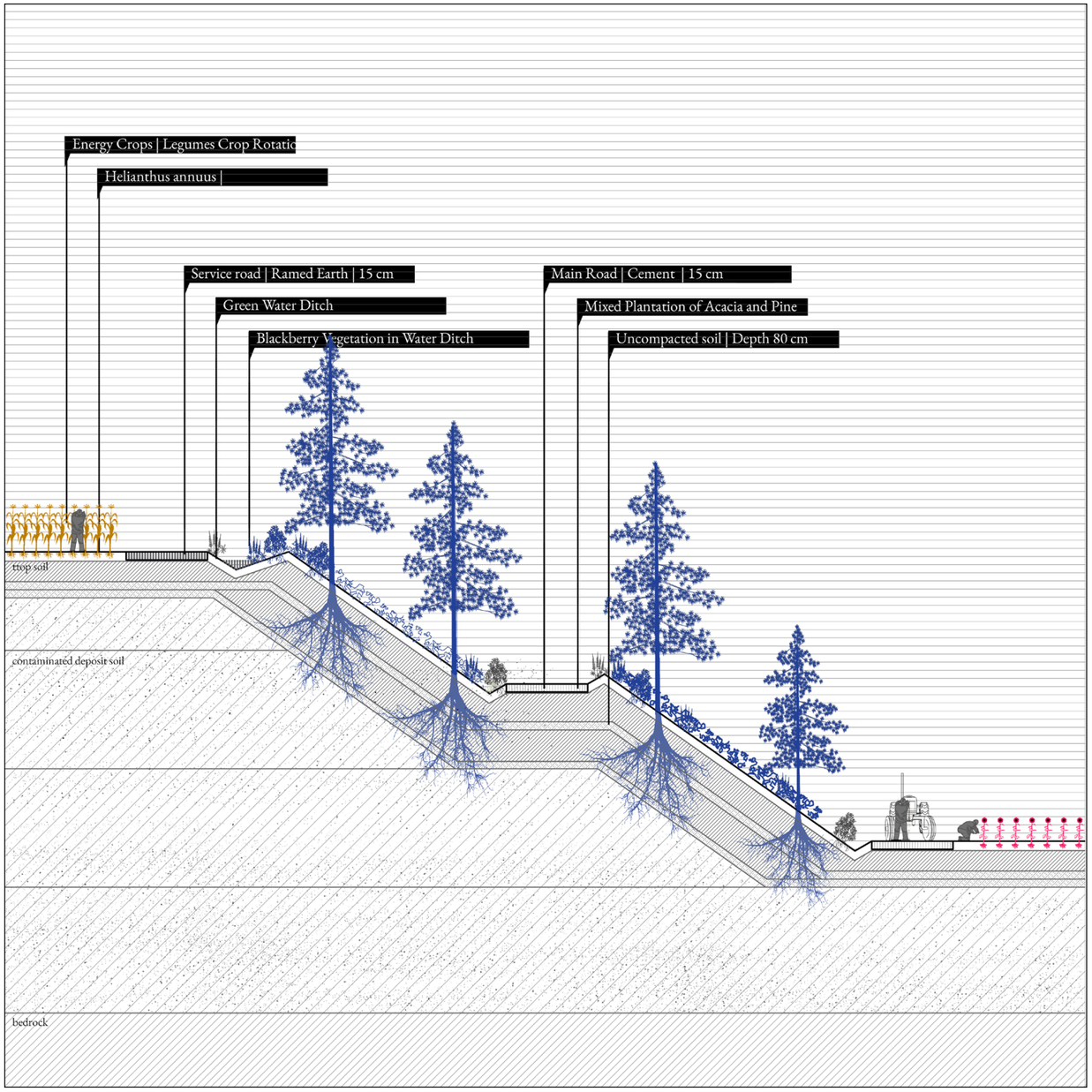


Figure 164. *Detail of rehabilitated mines and new energy landscape in Kardia Field mine*
Source: author

KARDIA FIELD | SPATIAL IMPRESION



Figure 165. *Perspective of abandoned settlement in mines*
Source: Stavrakis (2022)

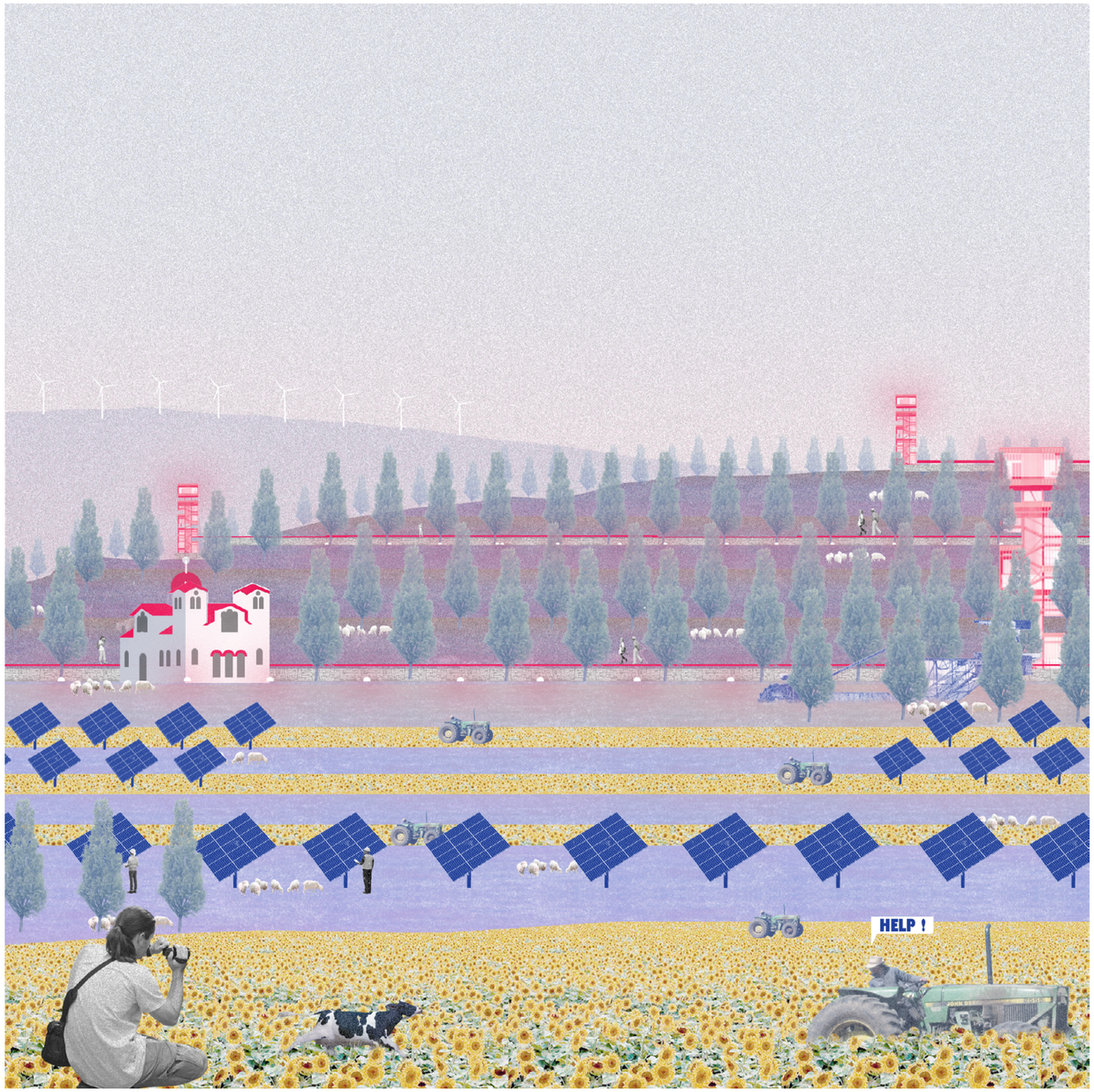


Figure 166. *2070 | Perspective of new productive ecologies and heritage areas*
Source: author

ON SCALING UP

In this final section, the project explores the applicability of the vision and its strategies on the scale deyond the region. For this to happen, the integral elements of depleted ecological systems, energy receptive land uses and industrial areas must be defined. Firstly, as the mining activity is concentrated on the east part of the territory, environmental rehabilitation strategies can be primarily concentrated there. Secondly, looking at the agriculture and pasture areas, patterns must be identified to see in witch of these areas RE diversification can happen. Finally, heritage sites must be identified, evaluated and integrated in the new productive network.

The key takeaway from this scaling-up process is to assess the suitability of each strategy for other areas beyond coal regions. While the highlighted agriculturan and pastural ans mining areas may share certain characteristics, local conditions are also distinct. Therefore, any endeavour to implement the aforementioned strategies necessitates a thorough examination of the sites to evaluate its unique micro-conditions. Ultimately, the goal of this strategy is to initiate a discussions about the energy transition, and its implications for the landscapes left behind by mining, which will impact both coal region and their communities. While all the steps within the strategy are open to negotiation with stakeholders, the underlying concept driving these steps is the creation of a jyst, inclusive and collabrative transition as an integral part of the development coal regions.

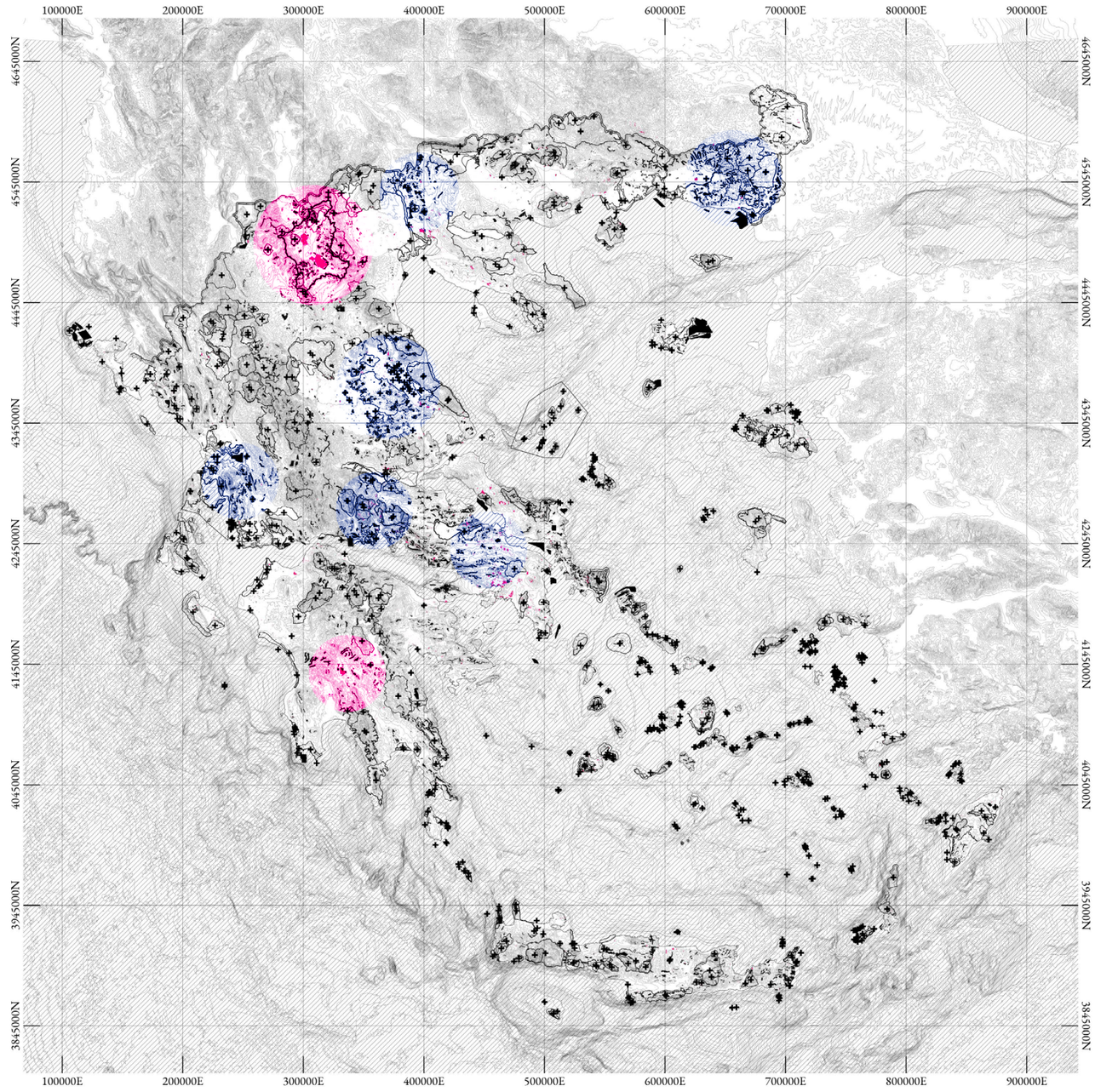


Figure 167. *Western Macedonia scale up*
Sources: ELSTAT, EEA (2020)

ON COLABORATION

As elaborated on the analysis segment of this report, the current decision making and policy drafting processing Greece associated with the transition, is suffering from may misgivings, briefly summarized as follows: the lack of co-ordination between different planning instruments, the exclusion of lower scales of planning and the lack of a spatial scope in the management of the energy transition.

In this segment, the project gives ore information regarding the creation of synergies between specific planning instruments and the corresponding policies that are produced. More specifically, the project proposes the coordination of differ policies in the fields of energy planning, spatial planning and transition planning, on the national, territorial and finally local scale. This aims at firstly the alignment of objectives in different policies documents associated with the de-lignification od the energy sector and the energy transition and the creation of networks of synergy between the corresponding planning bodies. Additionally, as a result of this collaboration could be a final integrated cross sectoral spatial energy transition plan for the territory of western Macedonia, addressing and giving spatial consideration to both the spatial and social aspects of the energy transition. In this way the final outcome will be a collaborative, co-ordinated and inclusive spatial territorial master plan.

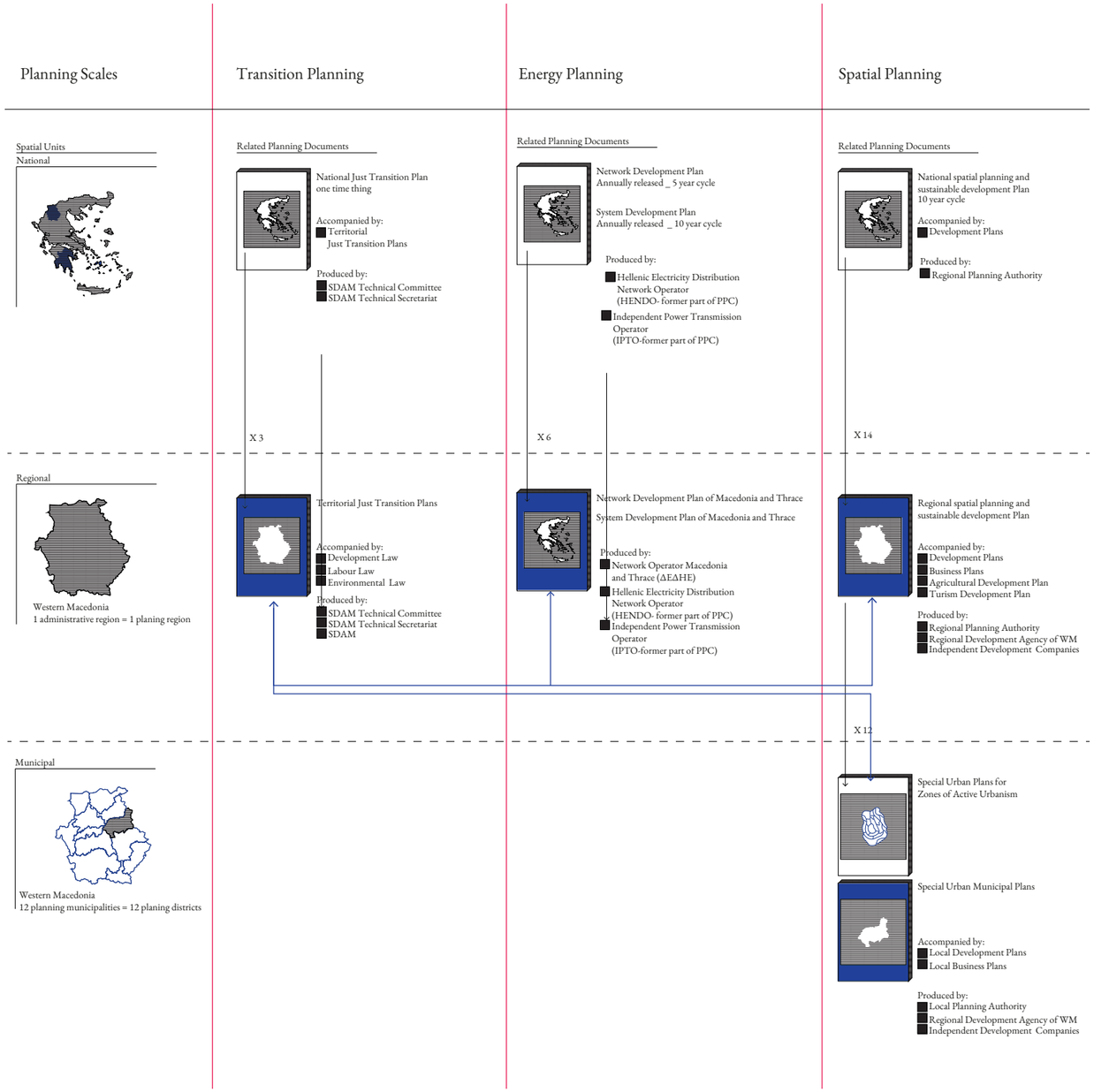


Figure 168. *Western Macedonia| Policy Collaboration*

CONCLUSION

“Everything is lost. Everyone’s time comes.

Everything remains. I am leaving. We’ll see about you.”

Odýsseas Elýtis, Diary of invisible April

(Elytis, 1984, p. 52)

CONCLUSION (*i*)

This section is dedicated to the re-evaluation of the principaland secondary research questions subsequent to the culmination of the research and design phases of the thesis.

MQ | How can the re-configuration of the energy landscape of Western Macedonia establish a more environmentally and socially sustainable region while ensuring spatial, distributive and procedural Justice?

This thesis sets out to investigate alternative narratives for the post-carbon era of energy production in the coal intensive region of Western Macedonia in Greece. After investigating the current productive landscape, local conditions, transition governance, the social impacts, it proposes the re-structuring of the energy production model, in a way that can foster socio-economic growth and ecological regeneration. In that context, it frames the energy production landscape with the boundary of the hydrological basin and introduces four scale of operation: The region of western Macedonia, the Basin of Eordaia, the energy production cluster of Ptolemaida and local components. By using a systemic approach, it creates a territorial vision and introduces interventions based on case studies, aiming to restructure the energy production system.

The most valuable outcome of this thesis project is the initiation of a discourse for the post-coal era, by bringing awareness for local communities, questioning current governance practices and current plans. The industrial relics of the coal based energy production systems along with the mining landscapes and the depleted communities demand a new multidimensional strategy that combines environmental and social values and tries to regenerate and find alternative paths for the coal intensive region. The design outcome of this thesis supports this line of positioning by building a set of exploratory scenarios and providing a final territorial vision and design interventions, that explore alternative paths for the site.

RQ1 | How did the increasing demand for energy supply shape the energy landscape of Western Macedonia?

Researching and understanding the relation between local transformations and national/global trends and needs is of crucial importance when studying remote operationalised landscapes, such as the energy landscape of Western Macedonia, in order to imagine possible future trajectories. The increasing demand for energy supply in Greece significantly shaped the energy landscape of Western Macedonia. The energy production landscape in this region was primarily influenced by the continuous rise in energy demand within Greece after the second world war, driven by rapid urbanization and industrialization processes. This necessitated the development and expansion of energy infrastructure and an extractive landscape in sites with large lignite reserves within Western Macedonia.

RQ2 | How was the land operationalized to sustain the energy system? What were the negative impacts on the social and natural systems?

The expansion of the extractive energy landscape involving lignite in Western Macedonia led to the operationalization of the land. The negative impacts of this operationalization can be summarized as follows:

Monoculture Economy: It resulted in the creation of a one-dimensional economy primarily focused on the extraction, energy, and transportation sectors, with inadequate development in other secondary production areas like manufacturing or modernizing the primary sector. Various local, regional, and national stakeholders, driven by diverse interests, contributed to the neglect of economic diversification. This monoculture development has led to negative social impacts, intensified with the gradual decline of these sectors following the Paris Agreement.

Population Shrinkage: The aforementioned economic structure has contributed to a gradual population decline, a phenomenon exacerbated since the Paris Agreement. This has also resulted in high unemployment rates and limited skills distribution within the region.

Extensive Soil and Water Pollution: The energy and mining sectors have had a significant adverse impact on the ecological integrity of the area, including the destruction of open water bodies and widespread soil contamination. These impacts need to be considered in discussions regarding potential post-mining land uses and economic alternatives.

Depletion of Water Bodies: One of the most critical consequences of mining in the region is the depletion of available water resources. Specifically, since mining commenced, local water resources have decreased by 40%, and aquifers have shrunk by 60%. This becomes especially significant when considering factors like climate change and shifting water patterns.

In summary, the expansion of the extractive energy landscape in Western Macedonia led to various negative consequences, including economic monoculture, population decline, extensive environmental pollution, and the depletion of vital water resources, all of which require careful consideration and mitigation efforts. Understanding the multilayered impacts of the extractive energy landscapes is crusial in discussions of sustainability transitions, in spite of the path of development, away from fossil fuels.

RQ3 | What is the structure of the current governance mechanism of the energy transition and what are the social bad institutional challenges that arise?

The current governance mechanism for just transition and the planning systems is of paramount importance, especially in the context of large-scale sustainability transitions like decarbonizing the energy sector. This significance is amplified in Greece, a country new to such transformations. The structure of this governance mechanism of the “just transition” (SDAM-PDAM) faces several social and institutional challenges concerning procedural justice:

Stakeholder Inclusion: A notable challenge is the insufficient inclusion of diverse stakeholders in decision-making processes. This exclusion can lead to marginalized voices and a lack of representation, potentially undermining procedural justice by not adequately considering the needs and perspectives of all affected parties.

Multi-Level Decision Making: The absence of robust multi-level decision-making processes, which actively involves regional and local governance entities, poses a challenge. This deficiency may hinder effective coordination and cooperation across different administrative levels, potentially resulting in injustices and unequal distribution of resources.

Transparency Deficit: Another critical challenge is the lack of transparency in decision-making, particularly during participatory processes held during the COVID-19 pandemic. This "opacity' can erode trust between actors, raise questions about fairness, and impede procedural justice by limiting public access to information and involvement in the decision-making process.

In conclusion, the governance mechanism for the just transition, particularly in the context of Greece, confronts social and institutional challenges related to procedural justice, including stakeholder inclusion, multi-level decision making, and transparency. Addressing these challenges is essential to ensure fair and equitable outcomes in the pursuit of sustainable energy transitions.

RQ4 | How can a transition from an extractive energy system to a sustainable energy system be successfully realized in a period of uncertainty?

Despite the ongoing energy transition and the decarbonisation of the energy sector through the deployment of renewables, coal regions continue to grapple with uncertainty stemming from current geopolitical conditions. Consequently, the decommissioning of fossil fuel-related infrastructure and the subsequent retraining of the local workforce are continuously postponed. To address this issue, this thesis project applies and develops two outcomes. Firstly, it develops a series of exploratory scenarios, and secondly, it focuses on the development of a series of non-spatial strategies and recommendations, focusing on the creation of social engagement and governance collaboration. By focusing on developing a culture of cooperation between local, regional and national actors and different planning authorities, the thesis highlights the importance of the process rather than just the outcome. By proposing a specific set of strategies focusing on social engagement and transition governance, this thesis project highlights the importance of tools that focus on the re-evaluation and monitoring sustainability transitions on the local scale, opening up these processes to local and regional actors. By integrating these strategies and processes of monitoring and re-evaluating the spatial planning, this thesis project highlights the vital importance of increasing the coping capacity to increase the overall adaptability of the transition. Thereby, the importance of developing tools that help the actors navigate uncertainty together in periods of uncertainty is highlighted.

RQ5 | Which alternative scenarios could we be envisioning and designing for this territory?

The method of scenario construction is commonly employed by urban and regional planners when confronted with high levels of uncertainty. It is widely accepted as a methodology and offers various approaches to construction, including visioning, back casting, exploratory, planning, and combinations thereof. Scenarios can be applied in diverse ways, either within interdisciplinary research or by involving local stakeholders to derive conclusions.

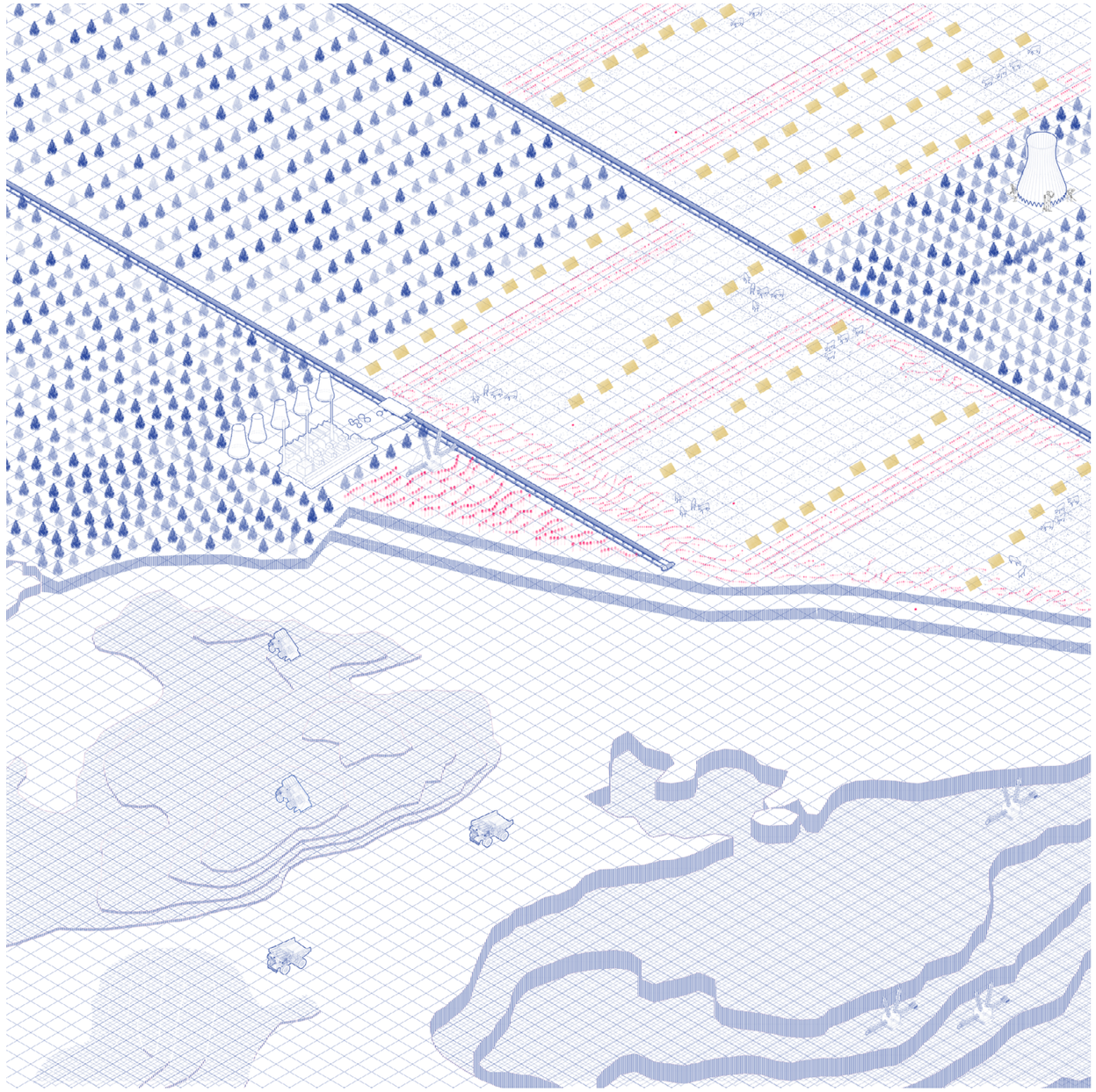


Figure 169. *Elements of the productive landscpe*
Source author

REFLECTION

"I'm jus' pain covered in skin."

John Steinbeck, The Grapes of Wrath

(Steinbeck, 2000)

RELATION (*s*)

1. What is the relation between your graduation project topic, your master track (Urbanism), and your master programme (MSc AUBS)?

Between topic and studio

The topic of this thesis focuses on the energy transition and investigates how that could possibly be altered by applying principles of regenerative design to achieve an environmentally and socially just transition that leads to a sustainable, productive landscape in the region of Western Macedonia. The topic of the studio Metropolitan Ecologies of Place -specifically the section Circular Urban and Territorial Metabolism- thematically encompasses issues such as resource scarcity and energy transition, aiming to utilise a systemic approach to establish regenerative interactions of people and resource flows in urban agglomerations and territories. As such, the thesis's overarching theme and primary methodology directly align with the studio's focal subject matter and approach.

Between topic and Urbanism

The thesis project "Landscapes of Power" focuses on the duality of the spatial transformation that is currently happening because of the energy transition and the negative socio-economic impacts of de-carbonisation of the economy of the coal-intensive region of Western Macedonia by proposing an alternative energy production system, better aligned with environmental and social factors.

Regarding the MSc track Urbanism, which traditionally tends to focus on the issues of the urban space, the project looks at the opposite space, shaped by the process of urbanisation, namely, the "operationalised landscapes" (Brenner & Katsikis, 2020) of coal extraction. If urbanisation processes shape these spaces, should they not be a research object of the discipline of Urbanism? Additionally, by focusing on the socio-economic impacts of the energy transition in the coal-intensive region of WM, the project ultimately places people, and more specifically exposed or marginalised communities, at the very centre of its problematisation.

The transition of these extractive landscapes into new productive zones marks a paradigm shift towards a new post-fossil fuel era in energy production, in which the associations between human and non-human entities can be re-determined. Under the scope of this large-scale systemic transition, the role of urbanists is to anticipate the spatial transformation and try to imagine and coordinate the productive landscape that will eventually result in a new socio-economic model.

Between topic and master programm

Finally, concerning the overall MSc AUBS program of the Faculty of Architecture and the Built Environment, this master thesis aims to act as a producer of knowledge to present alternatives to an existing plan of "sustainable development" through utilising research and design methods.

METHOD (*ology*) I

2. How did your research influence your design/ recommendations and how did the design/ recommendations influence your research?

This thesis's relationship between research and design was a dynamic and cyclical process. The research phases influenced design investigations, and the design and reflection phases, in turn, influenced further research. Specifically, the analysis phase strongly influenced the scenario construction phase, and its outcomes shaped the final territorial vision. This approach involved a combination of various methods and disciplines, employing a research-by-design methodology where data collection and analysis were integrated with design elements. The project used a layered approach during the research phase to unravel the productive landscape, utilising representation techniques like maps, sections, and axonometrics to provide a holistic understanding of the landscape's complexity, from mines to inhabitants. However, achieving the desired continuity and integration between the research, design, and reflection phases was challenging due to time constraints, and further work was needed for a more comprehensive and informed final design output.

METHOD (*ology*) II

3. How do you assess the value of your way of working (your approach, your used methods, used methodology)?

Reflecting on approach and methods

The analysis phase of the thesis entailed the development of an approach to comprehend the context comprehensively. Initially, it involved the meticulous selection of a range of themes and theories, aiming to cultivate a holistic understanding of the implications of the coal phase-out and the energy transition. Additionally, it employed methods of representation that enabled a comprehensive overview of the intricacies of the productive landscape, all while simultaneously navigating the challenges posed by data scarcity. Specifically, techniques such as mapping were utilised to gain insight into the productive landscape and identify the components of the proposed system, along with policy reviews to decipher the transition process. Throughout this process, issues associated with data scarcity and differing viewpoints of stakeholders emerged.

To overcome these data limitations, the research incorporated fieldwork, focusing on collecting photographs, local data, and other relevant materials. Furthermore, the research conducted interviews with numerous local stakeholders to comprehend the challenges local communities face.

The research phase concluded, leading to the design phase, encompassing scenario construction and territorial vision. Scenario construction involved the exploration of four distinct development paths for the site. Throughout this process, the project aimed to adopt a grounded approach, considering current trends in economic contraction and expansion within the energy sector rather than extreme scenarios. The scenario evaluation phase entailed a threefold assessment, culminating in integrating elements from two more favourable scenarios into a final vision. This research-by-design approach allowed for the exploration of diverse trajectory options, offering responses to the inherent uncertainties associated with the site.

The design phase was divided into two sections: scenario construction and territorial vision. The analysis phase of the project significantly influenced the scenario construction. Additionally, reflection on the four design outputs (the four scenarios) shaped the final design output of the thesis.

I acknowledge that the methodology could have been further enriched by incorporating a more extensive qualitative data collection, specifically ethnographic data and testimonies. Furthermore, collaborative scenario development with local stakeholders could have fostered a more productive dialogue and potentially yielded more intriguing results. Finally, dedicating additional time to theoretical readings and concepts could have strengthened further the foundational aspects of the project.

Limitations of methods

The research laid a solid foundation for the design aspect of this thesis. However, specific limitations imposed constraints on conducting a more comprehensive and multifaceted analysis and developing a detailed design proposal. To elaborate, the absence of spatial data regarding the current state of the mining areas and their rehabilitation timelines hindered a thorough assessment of contaminated soils and a comprehensive water management system. Consequently, the territorial vision lacked an extensive plan for the phased restoration of the mining sites. Furthermore, the unavailability of spatial ownership data prevented the creation of a comprehensive stakeholder list related to spatial planning coordination. Lastly, the challenge of obtaining updated and recent spatial information on demographics hindered a profound understanding of the local-scale impact of the energy transition. For instance, evaluating the effects of the energy sector's shrinkage over the past decade in the region was impossible without access to annual data on employment sectors and local community unemployment rates.

Due to the overall scarcity of data, the design outcomes were primarily based on global or European datasets, assuming their suitability for this project's purposes. However, should this venture go beyond a theoretical proposal, it becomes imperative to acquire precise and reliable data from local stakeholders such as regional authorities, municipalities, and the forestry department, as well as from sensors measuring factors like water levels and atmospheric conditions.

RELEVANCE

4. How do you assess the academic and societal value, scope of your project?

Scientific and Academic Relevance

This thesis holds academic value within the context of accelerating climate change and the global transition to renewable energy sources. As our society becomes increasingly concerned with the growing footprint of human activities, environmental justice and the appropriation of nature during the decarbonisation of the energy sector, there is an increasing need for academic research that addresses these issues. In this regard, this thesis contributes to the expanding body of knowledge concerning the energy transition in a way that brings together different theories. More specifically, by combining the approaches of spatial justice and landscape, this thesis brings out the interplay between our understanding of the space we inhabit, how it is produced (justice) and how it is perceived (landscape). It underlines that during the process of the decarbonisation of the energy system, which demands large-scale landscape transformations, consideration of how the new landscape will be produced is of equal importance to the transition itself, highlighting the significance of social inclusion (distributive justice) and collaboration between planning bodies (procedural justice). It thereby contributes to bodies literature like "Landscape and Energy: Designing Transition. " by Sijmons at al, "Power Density: A Key to Understanding Energy Sources and Uses." by Smil. Additionally, by combining theories of heritage and justice, this project highlights a development path which could facilitate the inclusion of local, marginalised communities in the development of the "Just Transition Development Plan" plans.

Social Relevance

This thesis holds significant societal value as it exposes critical issues arising from the energy transition in the region of Western Macedonia. The ongoing decarbonisation of the energy system amidst an energy crisis, coupled with the complicated governance system and negligence towards understanding the socio-economic repercussions, has led to polarisation and conflicts among stakeholders in the region and the exposure of local communities. In response, this thesis aims to expose aspects of social injustice prevalent in many parts of this transition. It seeks to expose the injustices endured by local communities and propose some solutions.

Professional Relevance

The thesis project contributes to the field of urbanism in Greece by emphasising the often-overlooked spatial aspect of the energy transition and the value of heritage in relation to the "Just Transition" of WM. More specifically, the thesis proposes adjustments with regard to the "Just Transition Development Plan" and the "Territorial Plan of Western Macedonia", focusing on both content (spatial aspect, heritage re-valorisation) and procedures related to collaboration and inclusivity. Firstly, while urbanism and spatial planning practice in Greece typically prioritise policy, this project offers a nuanced spatial approach by focusing on spatial analysis, experimentation, and evaluation within the context of renewable energy expansion. Additionally, the project proposes heritage as a means of development, trying to introduce a new (for Greece) approach to considering heritage in development planning and trying to align it with local development practices by integrating heritage into a new productive economy. Overall, this approach introduces a fresh dimension to urbanism discussions in Greece, promoting an interdisciplinary approach, prioritising space and heritage, establishing interplays between the two.



Figure 170. *Miner and Excavator in the Kardia Mining Field*
Source: Oikonomopoulos (1998)

TRANSFERABILITY

6. How do you assess the value of the transferability of your project results?

Output-Based Transferability

This thesis project examined the energy production footprint, the spatial impacts of the de-carbonisation of the energy sector and the deployment of renewables. It developed an approach in which it combined a number of methods, including literary research and analytical and speculative mapping, in order to highlight a series of conditions that shaped a scenario construction and an eventual design proposal. This process could be systematised into a coherent methodology and re-applied to other regions that are undergoing similar transitions away from extractive systems associated with fossil fuels, like gas, peat, coal, iron, or even oil. It could even be applied in future sustainability transitions, like the decommissioning of renewable energy infrastructure (solar panels, wind turbines, biofuels, algae refineries), when these economies are deemed unsustainable.

Transferability Index

As a final step, the regions with similar socio-economic and spatial structures in the EU were identified. On the page to the right, a series of maps examine three factors: socio-economic shrinkage, regions with an economy associated with fossil fuels and spatial structure of European NUTs 2 regions. On the final map (Figure 153), regions with a high similarity index to WM are depicted.

Legend

Population Shrinkage
5-10
10-15
15+

Coal intensive regions
Recognised coal regions
Regions engaged in unsustainable

Degree of Urbanisation
Rural
Urban

Overlap
Regions with High Similarity to WM
Rural
Urban

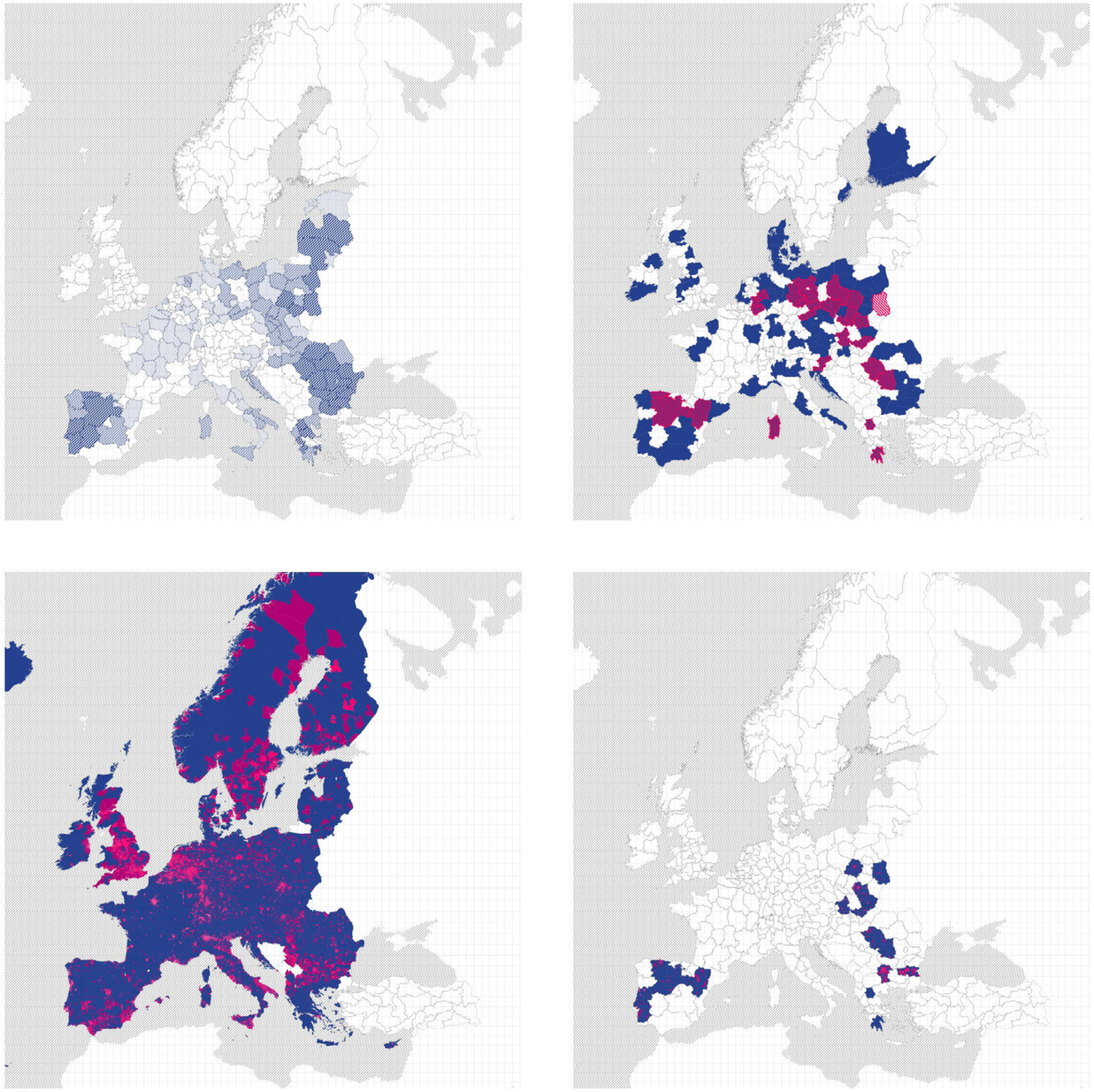


Figure 171. *Transferability Matrix | Area Based*
Sources: EEA (2020), Patricia et al. (2018)

LIMITATIONS

7. What are some exclusions you intentionally left out?

Framing the lack of "Inclusivity"

In addition to the aforementioned limitation regarding extensive cost analysis of the scenarios, the current academic project presents the following limitations:

Firstly, the thesis project takes steps in the creation of alternative scenarios based on current trends and feedback from interviews on the field trip but does not actively engage any of the stakeholders in the process of scenario construction. Secondly, the project talks about the urgent need for inclusivity during the design process but does not actively include stakeholders either in the scenario construction, the vision or the local intervention. Thirdly, the project does not develop an output, such as a co-creation tool, in order to bridge the gap in the lack of inclusive design/planning that has been established as a critical issue as early as the problem statement.

The primary reasons why the project left out both the active inclusion of stakeholders and the development of a co-creation tool were because of perceived time constraints, the difficulty in reaching out to stakeholders in a digital way in the initial phase of the project (before P2) and the inability to test the co-creation tool with stakeholders at later phases of the project. On the contrary, in order to make up for the lack of inclusivity, the project opted to try to develop an evaluation tool for the scenarios instead, which could be utilised in participatory processes.

Framing the limits of the local intervention

The design outputs of this thesis focus on the territorial scale and, more specifically, the landscape transformation through the energy transition and the establishment of a new productive economy and territory. Due to the time constraints and limited availability of small-scale data (as previously mentioned), on a smaller scale, the project actively chooses to focus on key components of the old productive landscape and their integration with new uses. The project opts to focus more on the spatial impact of the strategies in the transformation of the territory and shift away from an in-depth design of mining fields, industrial complexes, heritage sites and the urban fabric. Instead, the project opts to focus on components that can be reproduced and replicated either within the territory or in a similar project, providing a clear approach axis and a continuity between scales but, at the same time, allowing for possible adjustments that could be made in a participatory process.

Understanding the scales of the project

Working on different scales was an important component of this thesis project, from the scale of the nation to the territorial and finally to the small-scale interventions. Because of the environmental significance of the mining operations, in an effort to constrain and territorialise the transformation, the focus shifted from the region of Western Macedonia to the hydrological basin, and the mappings, evaluations and final territorial vision were conducted on this scale. This could be done differently if the project opted to exclude the environmental impact and focused more on planning and administrative boundaries, in which the regional spatial boundary would have been preferred.

Framing "Heritage"

In this thesis project, heritage is highlighted as a development tool that has the potential to attract local stakeholders and possibly result in a more inclusive transition. However, how the project frames heritage is important. For this thesis project, because of the time constraints, the project decided to follow a development approach of heritage as a "Factor "(Janssen et al.,2017). It can be argued that heritage as a "Vector" approach is more suitable as it could enable a larger degree of inclusion, as it highlights and integrates intangible heritage values by bringing forward other aspects of local communities as a means of local development. However, because of the time constraints, the lack of a bibliography on this particular subject in this region, the aforementioned distance from local stakeholders and finally, the already adopted systemic approach of the thesis project, the project followed the "Factor "approach, by focusing on the integration of physical industrial and mining heritage and infrastructure in the systemic change. Adopting the "Vector" approach would require implementing different methodologies, like interviews and questionnaires, which exceeded my field of experience as an urban designer and architect and would thereby require a degree of generalisation, which would degrade the scientific integrity of the project. At this point, it is important to state that if heritage is indeed integrated into a revision of the "Just Transition Development Plan" (Master plan) or the "Just Transition Territorial Plan for Western Macedonia", further research on identifying and integrating intangible heritage values is vital.

FIELD TRIP

8. How did the fieldwork affect the project and alter your perception?

Having spent the majority of my life in Greece, my most recent visit focused on the fieldwork phase of this thesis project, which proved to be an incredibly valuable experience. The visit to the mines, the interviews and the photographic depiction provided invaluable insights into the territory, reinforcing the significance and urgency of an immediate alternative proposal. This visit enabled me to perceive certain aspects (both positive and negative) of the territory that I had previously overlooked, namely the rapid land-use transformation because of renewable energy infrastructure. Visiting Western Macedonia with the lens defined by the thesis revealed the reality of the spatial transformations I had initially depicted was more severe than I had anticipated.

RECOMMENDATIONS

9. What are some future avenues that you envision for the project?

One potential future direction involves opening up the project to the public and conducting a more in-depth examination of co-design for the scenarios chapter and vision chapter. This investigation would entail creating a tool for co-creation, such as a pattern language, and conducting co-design experiments with members of the stakeholders. The output of this process would be a new adjusted set of scenarios and a territorial vision, including adjusted or new strategies.

ETHICAL CONSIDERATIONS

10. How do you asses the implications of your project, including ethical aspects?

Ethical issues during research

In undertaking this research project, I have found that oftentimes, the scope of the project exceeded the fields of my pool of knowledge and my academic expertise in topics such as mining rehabilitation, regenerative agriculture, industrial water management, energy potential mapping, and socio-economic studies. In these instances, instead of proposing concrete solutions, in order to try to bridge this knowledge gap, the thesis project took a step back and aimed to adopt a holistic approach that focused on territorial and system relations instead of small-scale solutions. An example of such a moment is the scenario construction, evaluation and vision sections of this thesis project.

Ethical issues during design elaboration

During the design phase of the thesis project and the construction of the territorial vision, numerous decisions had to be made in regard to land use transformations. These decisions, though made by taking into account scientific knowledge, local conditions and wishes of the involved stakeholders, raised some ethical considerations regarding my role as an urbanist and a designer and my authority in making these decisions. Additionally, for the implementation of the vision, various stakeholders need to be involved, actively collaborate, and adapt their practice and specialisation. This large-scale re-skilling of the local workforce again raises the issue of the role of the urbanist in relation to authority.

To conclude, reflecting on the design process, I often found myself doubting my authority, and oftentimes, I found myself limited either by the tools at my disposal or the inability to reach out to stakeholders.

Ethical issues form potential implementation in practice

Proposals for decarbonising the energy systems are currently underway, and several communities are left exposed to the socio-economic impacts of this transition, trying to navigate complicated policies and (sometimes) corrupt governance structures. This thesis project did the unimaginable for Greek standards of prioritising ecological and social aspects in its consideration of this transition. By doing so, this thesis tries to challenge or at least question current practices stemming from the profit-oriented development approach which dominated Greece, which prioritises profit over people and nature. By doing so, this thesis tried to explore alternative ways of thinking which fostered synergetic relationships between different social and natural components.

Nevertheless, in the potential implementation of this thesis project, the current development approach would need to be considered, and spatial care would have to be directed towards the adoption of a holistic understanding of the energy transition.

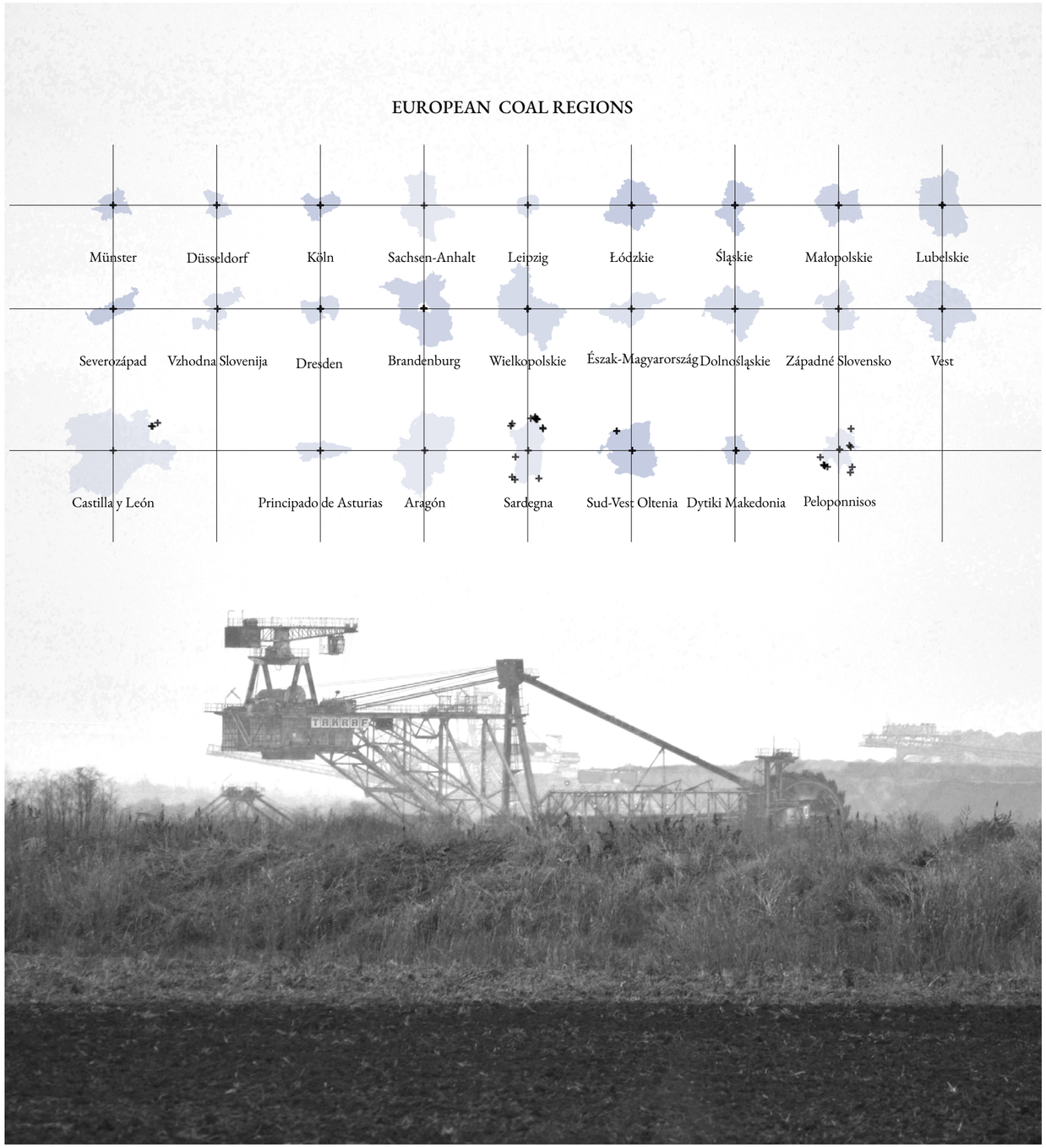


Figure 172. *Coal Intensive Regions of Europe*
Source : author

EPILOGUE

The "void" exists as long as you don't fall into it.

Odýsseas Elytis | Sximatologio

(Elýtis, 2001)

ON THE JOURNEY | *A REVISION*

This section is dedicated to a personal reflection on the process of this thesis.

The report will conclude with Kavafis's poem, "Ithaka." In the context of coal regions in transition, this poem resonates profoundly as a metaphor. Analogous to the journey described in the poem, coal regions have embarked upon a transformative path, manoeuvring through the intricacies of economic diversification and ecological restoration. The poem "Ithaka" underscores the significance of the journey itself, emphasising the acquired wisdom and experiences gained along the way. The current energy transition will undoubtedly be a journey that ultimately implicates all stakeholders, each commencing from distinct points of origin, propelled by different objectives and motivations. Regardless of the efforts from the academic, governance and professional sectors for a pre-calibrated "optimal" path, there invariably exists the possibility that all fail.

In "Ithaka," Cavafy -taking inspiration from the epic poems of Homer and the voyage of Odysseus as he returns from Troy to Ithaca- constructs an allegory for each individual embarking on a new journey. In the poem, Cavafy wishes that the journey be long, filled with new experiences and revelations so that upon arrival, one emerges richer. Consequently, "Ithaka" essentially serves as an incentive for embarking on a journey, encouraging individuals to dare, experiment, and aspire. This allegory may similarly be applied to the endeavour of decarbonising the energy sector. This journey will undeniably be long and akin to the journey of Odysseus; numerous stops, delays, adversities, and unforeseen situations will punctuate it. Nevertheless, the objective must remain the same, necessitating the perpetual recalibration of the path leading home. Ultimately, achieving one specific goal will not be our sole accomplishment; rather, it is the aptitude to navigate unforeseen challenges collectively together.

"Ithaka" serves as a reminder that it is the journey, with all its adversities and revelations, that forges our character and offers the most valuable insights.

Figure 173. ***RIGHT PAGE*** | *Source: Cavafy (1992)*

ITHAKA

Σὰ βγεῖς στὸν πηγαιμὸ γιὰ τὴν Ἰθάκη,
νὰ εὔχεσαι νἄναι μακρὺς ὁ δρόμος,
γεμάτος περιπέτειες, γεμάτος γνώσεις.

Τοὺς Λαιστρυγόνας καὶ τοὺς Κύκλωπας,τὸν
θυμωμένο Ποσειδῶνα μὴ φοβᾶσαι,
τέτοια στὸν δρόμο σου ποτέ σου δὲν θὰ βρεῖς,
ἂν μέν' ἡ σκέψις σου ὑψηλή, ἂν ἐκλεκτὴ
συγκίνησις τὸ πνεῦμα καὶ τὸ σῶμα σου ἀγγίζει.

Τοὺς Λαιστρυγόνας καὶ τοὺς Κύκλωπας,
τὸν ἄγριο Ποσειδώνα δὲν θὰ συναντήσεις,
ἂν δὲν τοὺς κουβανεῖς μὲς στὴν ψυχή σου,
ἂν ἡ ψυχή σου δὲν τοὺς στήνει ἐμπρός σου.

Νὰ εὔχεσαι νά 'ναι μακρὺς ὁ δρόμος.
Πολλὰ τὰ καλοκαιρινὰ πρωϊὰ νὰ εἶναι
ποὺ μὲ τί εὐχαρίστηση, μὲ τί χαρὰ
θὰ μπαίνεις σὲ λιμένας πρωτοειδωμένους·

Νὰ σταματήσεις σ' ἐμπορεῖα Φοινικικά,
καὶ τὲς καλὲς πραγμάτειες ν' ἀποκτήσεις,
σεντέφια καὶ κοράλλια, κεχριμπάρια κ' ἔβενους,
καὶ ἡδονικὰ μυρωδικὰ κάθε λογῆς,
ὅσο μπορεῖς πιὸ ἄφθονα ἡδονικὰ μυρωδικά.
Σὲ πόλεις Αἰγυπτιακὲς πολλὲς νὰ πᾶς,
νὰ μάθεις καὶ νὰ μάθεις ἀπ' τοὺς σπουδασμένους.

Πάντα στὸ νοῦ σου νἄχῃς τὴν Ἰθάκη.
Τὸ φθάσιμον ἐκεῖ εἶν' ὁ προορισμός σου.
Ἀλλὰ μὴ βιάζῃς τὸ ταξεῖδι διόλου.

Καλλίτερα χρόνια πολλὰ νὰ διαρκέσει.
Καὶ γέρος πιὰ ν' ἀράξῃς στὸ νησί,
πλούσιος μὲ ὅσα κέρδισες στὸν δρόμο,
μὴ προσδοκώντας πλούτη νὰ σὲ δώσῃ ἡ Ἰθάκη.

Ἡ Ἰθάκη σ' ἔδωσε τ' ὡραῖο ταξίδι.
Χωρὶς αὐτὴν δὲν θἄβγαινες στὸν δρόμο.

Ἄλλα δὲν ἔχει νὰ σὲ δώσει πιά.
Κι ἂν πτωχικὴ τὴν βρῇς, ἡ Ἰθάκη δὲν σὲ γέλασε.
Ἔτσι σοφὸς ποὺ ἔγινες, μὲ τόση πεῖρα,
ἤδη θὰ τὸ κατάλαβες ἡ Ἰθάκες τί σημαίνουν

As you set out for Ithaka
hope your road is a long one,
full of adventure, full of discovery.

Laistrygonians, Cyclops,
angry Poseidon—don't be afraid of them:
you'll never find things like that on your way
as long as you keep your thoughts raised high,
as long as a rare excitement stirs your spirit and your body.

Laistrygonians, Cyclops,
wild Poseidon—you won't encounter them
unless you bring them along inside your soul,
unless your soul sets them up in front of you.

Hope your road is a long one.
May there be many summer mornings when,
with what pleasure, what joy,
you enter harbors you're seeing for the first time;

may you stop at Phoenician trading stations
to buy fine things,
mother of pearl and coral, amber and ebony,
sensual perfume of every kind—
as many sensual perfumes as you can;
and may you visit many Egyptian cities
to learn and go on learning from their scholars.

Keep Ithaka always in your mind.
Arriving there is what you're destined for.

But don't hurry the journey at all.
Better if it lasts for years,
so you're old by the time you reach the island,
wealthy with all you've gained on the way,
not expecting Ithaka to make you rich.

Ithaka gave you the marvelous journey.
Without her you wouldn't have set out.

She has nothing left to give you now.
And if you find her poor, Ithaka won't have fooled you.
Wise as you will have become, so full of experience,
you'll have understood by then what these Ithakas mean.

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This is the way the world ends

This is the way the world ends

This is the way the world ends

Not with a bang but a whimper.

T.S. Elliot, Hollow Men

(Eliot, 1925)

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APPENDICES

“Is it morning or is it getting darker?”

Odýsseas Elýtis, Diary of Invisible April

(Elytis, 1984)

NATIONAL SCALE | EMERGING ENERGY LANDSCAPES

Investigations | National scale

This series of maps investigates the spatial dimension of the deployment of renewables on the national scale of Greece. The map on the right highlights all of the RE projects currently taking place in Greece. Various agglomerations can be detected in different areas in Greece with different spatial conditions. Future research in renewable energy landscapes can utilise this map to focus on referent regions within the country.

In addition, the maps below investigate the conflicts between synergy production and energy consumption and energy production potential and protected sites.

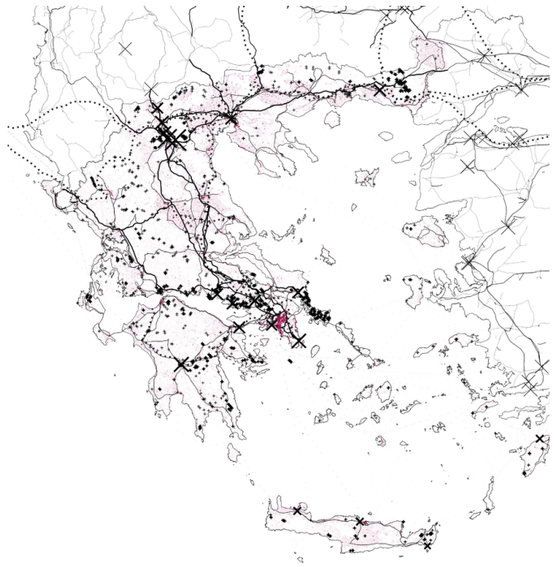


Figure 174. *Energy Infrastructure | National scale*
Source EEA (2020), Global Energy Monitor (2022a), Global Energy Observatory et al. (2020)

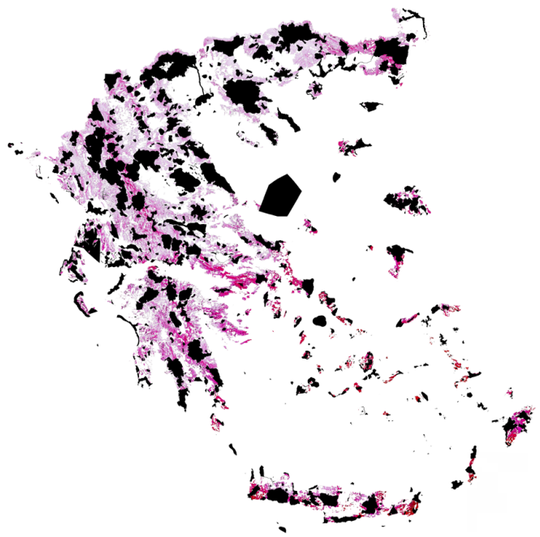


Figure 175. *Energy potential vs protected areas | National scale*
Source EEA (2020), RAE (2022)

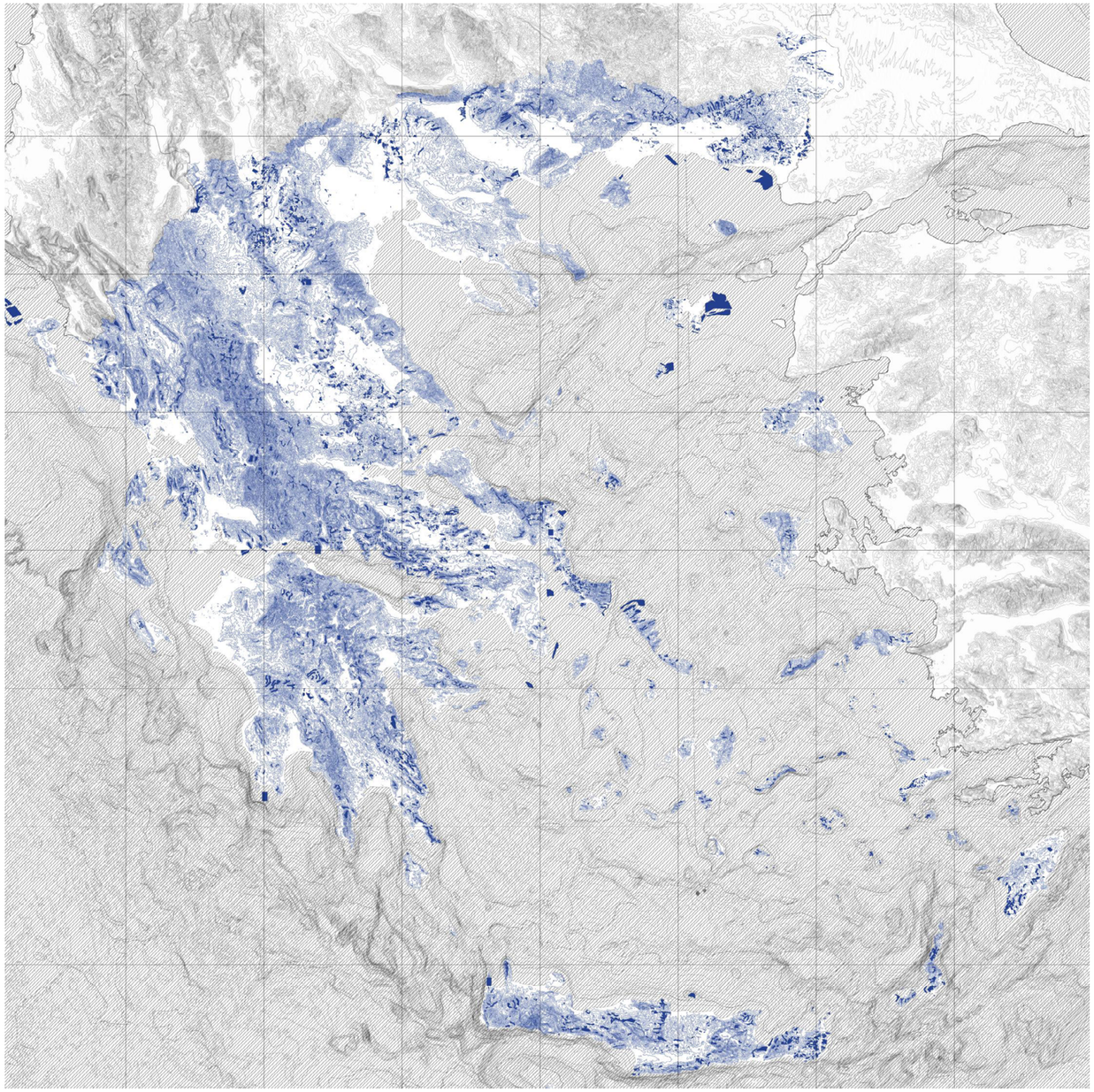


Figure 176. *Renewable energy projects | National scale*
Source EEA (2020), RAE (2022)

FINAL OUTPOUTS OF GU INTENSIVE

Investigation | National scale

The axonometric on the right is an abstraction of the energy production system in Greece, In this axonometric, space is reduced to a grid, and each point of the grid is extruded according to the energy that is produced there.

SPACE / MJ

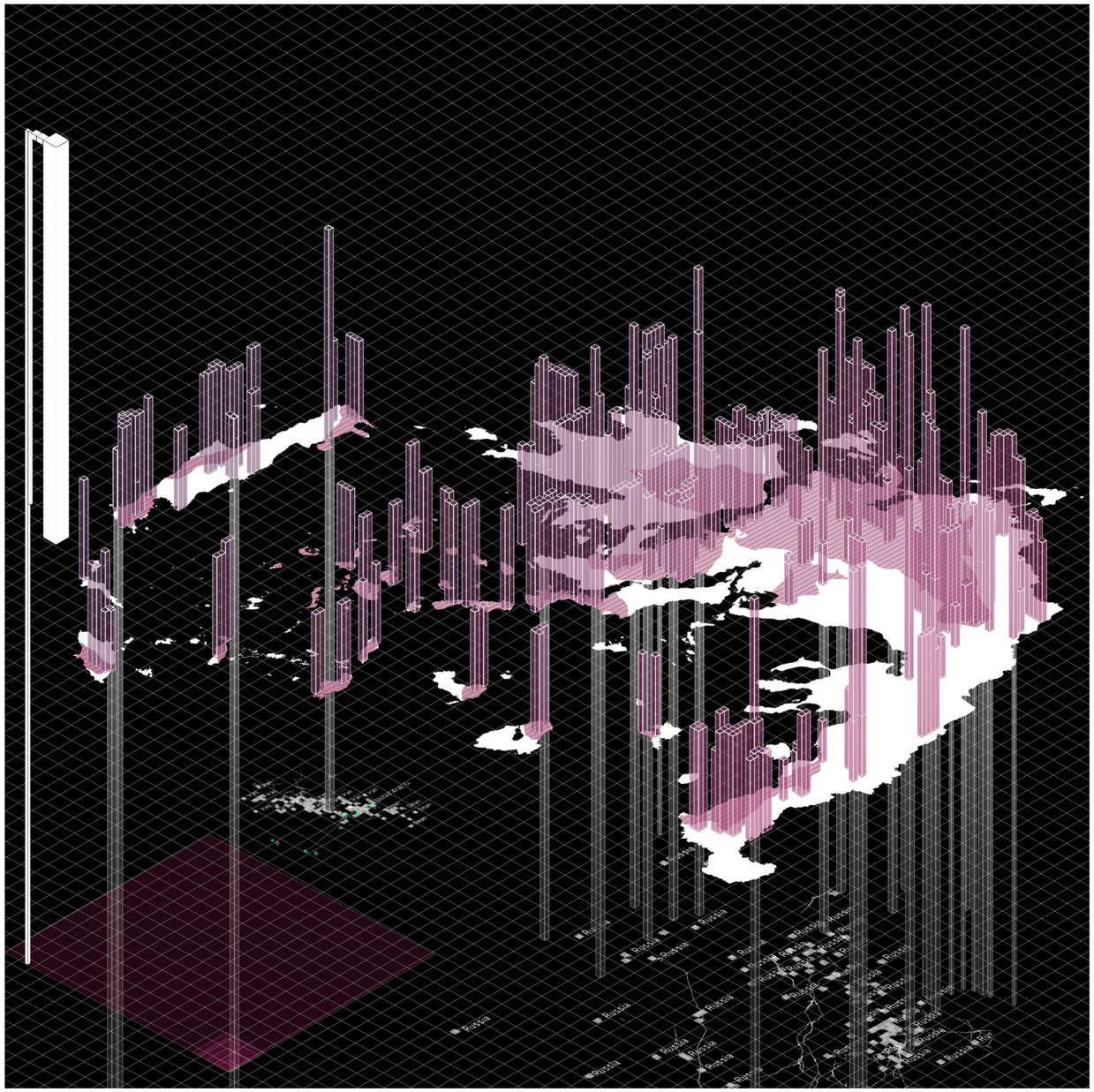


Figure 177. *Km^2=x MJ | National scale*
Source authour

INTEVIEWS (i)

ENERGY |Energy & Mining	Interviewe
1. Rushed Mine closure	1|2|3|4|6|
2. Exposure of Workers (Pcc, Indipendent Contractors)	1|2|3|6|
3. Insuficient time for restoration of minning fields	1|2|6|
LANDSCAPE| land-use alterations	
1. Alteration of the "KAMPOS" because of minning	5| 7
2. Alterarion of the "Hills" because of solar parks	1|5| 7
3. Loss of pastures and habitats	5| 7
JUSTICE | Sdam | Planning Process	
1. Rushed Planning process during Covid Lockdown	1|2|3|4|5|6|7|
2. Inability of many minor communities to participate	3|4|5|7|
3. Insufficient time for communities to prepare. Lack of knowledge and ways to communicate with experts	3|4|5|
4. Lack of inclusion of local actors (mayors, knowledge institutions, union representatives) in most of the committees	3|4|5|
5. Widespread belief that the planning committee had formulated plans prior to planning procedures and local actors were not heard	1|2|3|4|5|6|7|
JUSTICE | Governance & Implementation of plans	
1. Implementation of plans is uncoordinated	1|2|3|4|
2. Development law is insufficient	3|4|5|6|
3. Labor Law in insufficient	3|4|5|6|
4. Forest protection Law is insufficient/contradictive with protection laws	3|4|5|6|7

The accounts of the interviewees have been summarized above in 4 themes, in relation to the pillars of Energy, Landscape and Justice. In short, there is a concensous that the switch from lignite to renewables is too rushed, the landscape of the area is altered and finally, the procedure in which the transition is happening is unjust.



Figure 178. *A resident of the semi-abandoned Pontokomi settlement*

AXIS OF QUESTIONS

Past |

1. How has the presence of the energy sector affected the region/ your professional sector / the quality of life?

Present | Delignification

2. Will the delignification of the region of WM positively or negatively impact the region/ your professional sector / quality of life?

3. What is the greatest challenge in your professional sector (governance, mining, electricity) in this period of delignification?

Present | Just transition

4_ Are you informed about the current JTD Plans? Do you perceive the as or just?

5. Did your institution actively participate (to your knowledge) in the formulation of the plans?

6. Do the plans have a positive or negative impact on your sector (Electricity, mining, forestry, knowledge sectors)?

Interviewes

1_ Private Sector- PCC _ Director of Environmental & Land Use management

2_ Private Sector- PCC_ Director of South-Field & Main Field Mine

3_ Public Sector_ Municipality of Kozani_ Mayor of Kozani & Representative of Energy Municipalities

4_ Knowledge Sector_ University of Western Macedonia_ Spatial Planning Department

5_ Civic Society _ Residentsof Pontokomi

6_ Civic Society _ Worker in Transportation Sector _ Subcontractor in PCC

7_ Forestry Department_ Second Director in Mapping Department_



TU Delft
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