Repurposing Land and Assets for Western Macedonia

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Presented to:
The European Commission, Ministry of Environment and Energy, the Governor of Western Macedonia and the Coal Regions in Transition Working Group for Western Macedonia.
1. Land Repurposing is an important enabling and supporting factor for coal transition in a variety of contexts. To neglect former mining lands and their scope of development options would be an important missed opportunity, both economically and as contribution to post-mining environmental and social sustainability. Land repurposing can enable and contribute significantly to the stimulation of post-coal economic activities and growth. Well planned repurposing makes land available for a number of purposes with benefits to climate change mitigation and improvements of environmental conditions. Positive impacts of land repurposing often reach well beyond the mines’ original footprints.

2. The Figure below depicts the range of potential contributions and benefits of land repurposing and spatial planning to three major pillars of coal transition: (i) climate change mitigation; (ii) a diversified post carbon economy and energy production; and (iii) the environmental regeneration of mining lands. All of these measures and activities would be tied to former mining lands and both dependent on, and contributing to their reclamation, remediation and repurposing.

Table 1 provides additional detail to the information contained in Figure 4.

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<tr>
<th>Activity / Measure</th>
<th>PCE</th>
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<tr>
<td><strong>Land Swapping:</strong> this can unlock economic opportunities where there are regulatory or spatial restrictions on construction lands. Mines are often located in remote areas, distant from urban centers. In such situations their land value would be low and redevelopment potential quasi nil. However, the regeneration of industrial / mining lands to a higher ecological value (e.g. forests or natural habitats) could generate “credits” that can be traded to develop near-urban lands. This is relevant e.g. in China, where construction lands are being curtailed buy the “Red Lines” policy, but similar applications are possible in any situation where spatial planning requires the dedication of certain percentages of lands with high ecological function / value. Moreover, land reserves retained on former mining lands could be used for creating offset / compensation areas, that can be marketed to other investments with high environmental</td>
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impacts with the objective of restoring them to higher levels of environmental quality and ecological value and thus offsetting adverse impacts created by these investments.

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<tr>
<th>Business parks, manufacturing, waste management:</th>
<th>These are economic opportunities focused on repurposed lands directly; they are sensitive to location, infrastructure, energy supply, connectivity and proximity of settlements. They also require lands that are geotechnically stable and have shallow gradients.</th>
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<tr>
<td>Agriculture, forestry:</td>
<td>These are economic activities that are often the default post-mining land use, especially in areas with open pit mining and large areas covered by mine waste (e.g. overburden). They are sensitive to soil quality, climate (temperature and precipitation) and the presence of contaminants (e.g. acid mine drainage, heavy metals, saline wasters / soils). They also require a favorable morphology and hydrographic situation.</td>
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<td>Tourism:</td>
<td>Some mining areas have converted large land parcels into recreational areas, ranging from lakes and forests to theme parks and race tracks. Low intensity tourism can often be combined with ecological restoration, agriculture and forestry. The economic returns are highly sensitive to location and connectivity of the former mine lands. Tourism development could be an important revenue stream for the area but besides the land repurposing, requires marketing investments.</td>
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<td>Chemical Stabilization:</td>
<td>This is both a precondition and purpose of environmental regeneration. One objective is to prevent emissions of pollutants from the former mine site. These can range from windblown dust containing heavy metals of salts, to sulfur dioxide and smoke from coal seam combustion, to acid rock drainage and saline waters impacting ground and surface water. A second objective is to remediate the site to a condition where either natural attenuation or re-cultivation can take place, and a new ecological equilibrium is reached. During the phase out, this activity enables the retention of mining jobs towards reclamation and can contribute significantly in the transition to a low carbon economy.</td>
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<td>Natural habitats:</td>
<td>Here is a variety of potential advantages in establishing natural habitats on former mine sites; they can be used as recreational areas if near human settlements; can fulfill important ecological functions, e.g. as bird resting / nesting areas; be clustered or integrated into larger protected areas; or used as offsets for projects affecting natural habitats elsewhere. The latter use is related to the land swapping described further above and can be an important economic incentive.</td>
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<tr>
<td>Carbon forests:</td>
<td>These are a variation of forestry, where the key purpose is not timber production, but to create carbon sinks. This may be the option of choice where mine lands are of abundant size and where the creation of carbon sinks is economically incentivized.</td>
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<tr>
<td>Coal reduction:</td>
<td>This is probably the most direct contribution of land repurposing. Generating value (energy, economic, ecological, recreational) on former mine lands incentivizes and facilitates coal reduction. While it is an intrinsic element and result of mine closure it’s impact may vary – from very little decrease during coal consolidation to varying amounts of reduction until – hypothetically - complete shutdown at complete transition.</td>
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<tr>
<td>CBM management:</td>
<td>Coal Bed Emissions (CBM) demonstrably continue post closure (citation?) and may have climate impacts which can significantly offset the emissions avoided through mine closure. While, after closure, the coal stays in the ground, methane can be quite mobile and may leak from closed mines for decades. Coal transition thus needs to take CBM management into account as one of the key technical challenges of sustainable mine closure.</td>
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<tr>
<td>RE development – PV and HPS:</td>
<td>The cessation of mining activities often creates large parcels of land available for redevelopment on former mine lands. Specially if the land is of low productivity for agriculture or forestry, if soil conditions or chemical pollution restrict its use, energy production with PV may be the optimum use. Some basic requirements are defined by climatic factors (solar intensity), basic ground stability (no large / differential settlements or subsidence), absence of excessive dust generation (would impact efficiency of PV) and water availability (for cleaning). Hydro Pump Storage (HPS) can be established with the use of residual mine pits. These HPS can be combined with floating PV and produce additional value of the repurposed residual pits.</td>
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<tr>
<td>Research and development:</td>
<td>There are few examples of well managed mine closure on a</td>
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larger regional scale. Research on post mining land use would help to develop reliable
baseline and context analyses, to systematically capture and analyze favorable and
unfavorable factors, and to comprehensively utilize available information on mining lands
for optimized repurposing and post-mining land use planning.

| **Regional spatial master planning:** This is an overarching topic that supports developing
strategic recommendations for repurposing lands and assets in current / former mining
areas. Key purposes are to (i) systematically capture land properties, e.g. risks, use
restrictions, liabilities, but also favorable conditions for a variety of use scenarios; (ii)
support organizing mining operations towards maximizing productive land use after
closure and repurposing of mining lands (“mining for closure”); (iii) optimize post mining
land use in terms of economic value generation and environmental and social
sustainability. |  |  |

3. These principles are not only applicable to Western Macedonia. The constitute an important
collection of thoughts and principles for planners and policy makers for any mine closure and transition
project globally. They also highlight the linkages between land reclamation and repurposing and
subsequent economic activities, such as the renewable energy hub concept, jobs generation, or the
creating of “added spatial value” e.g. in form of natural parks and recreational features. It should be noted
that remediation and repurposing activities can be of significant scale, and that a percentage of the original
mining jobs could be retained during the reclamation phase of the mined lands; building on and in parallel
to such transition phase jobs, retraining programs towards the requirements of a new low carbon economy
can be initiated.
SECTION 2.1 A SPECIAL SPATIAL PLAN FOR THE REGION LAND CLASSIFICATION METHODOLOGY (LRM)

4. This section will explain the land repurposing methodology (LRM) developed under this Technical Advisory (TA) work, the type of data and information the LRM will generate, and what purpose and value they have for subsequent planning and decision-making. This section will also clarify the differences between LRM and other spatial planning tools.

What is the LRM?

5. The Land Repurposing Methodology (LRM) represents an objective procedure for the determination of post mining land use with a high spatial resolution and a high degree of reproducibility. Currently the LRM is based on five themes with respective parameter groups: morphology, hydrography, geotechnical risks, socio-economic factors and land value (both positive as added value and negative as remediation cost); further parameters, e.g. permitting requirements or restrictions can be added as required by the various stakeholders. The LRM is not a standalone instrument but needs interfaces and integration with other planning frameworks and tools. LRM provides basic facts and data needed for decision making around repurposing planning. The methodology informs on which types of post-mining use make sense to plan for on a given parcel of land but does not prescribe a specific investment scenario; this would be a level more granular, e.g. in the realm of an SSP – special spatial plan.

6. Other planning instruments connected to the LRM can be preexisting, hierarchically higher level, covering wider geographic scopes (e.g. regional spatial plans, national energy strategies, special spatial plans); or they can be parallel, on the same level and laterally connected (e.g. economic development plans of adjacent municipalities).

Description of the Land Repurposing Methodology (LRM)

7. The objective of land repurposing is to think and plan beyond achieving environmentally stable landscapes and complying with environmental permits, but to develop former mining lands towards conditions that allows a wide scope of diverse land uses. Of course, the environmental quality of repurposed lands should be maximized, and remediation and reclamation should start preferably already while mining operations are still ongoing (“mining for closure”). Repurposing should be economically efficient and technically effective, delivering fit-for-purpose lands for a variety of utilization options. In cases of abrupt mine abandonment such repurposing activities should be considered in the context of initiating low carbon economic development and should be included in the overall master plan design. The process should be transparent and result in the generation of net value when all factors - redevelopment potential, socio-economic, environmental / ecological quality, and climate effects - are accounted for. Repurposing requires an optimized assessment and planning process that has the following elements and steps:

1. **Stocktaking and site inventory**, including landforms and topography, operational records, geotechnical and hydrographic monitoring data, geochemical data on soils and waters;
2. **Clarification of the legal, regulatory and permitting situation**, dialogue with stakeholders (including operator and regulator) on potential future use of post-mining lands and assets as well as the requirements for ES assessments, plans and permits;
3. Development of supplemental **site investigation and monitoring** programs;
4. Establishment and application of a **land classification methodology**; categorization of discrete land parcels regarding their post mining utilization potential;

5. Use of the outcomes for **formulation of repurposing strategies and as contributions for other spatial planning instruments**, e.g. special spatial plans for post-mining lands and their functionally linked surroundings.

**Stocktaking and Site Inventory**

8. This step relates to the collection of a range of baseline information, and is a precondition for developing the subsequent steps. The methodology closely follows established practice, e.g. from the production of environmental and social impact assessments and covers a range of bio-physical and socio-economic conditions; these are supplemented by specific information on existing infrastructure and installations, as well as an analysis of identifiable risks and liabilities of the investigation area. The investigation area should be scoped to include both the lands to be repurposed, and the functionally connected, adjacent areas. This undertaking is being and will be discussed with PPC operational and environmental units for their mining lands in the Western Macedonian Lignite Basin.

**Clarification of Permitting Situation**

9. It will be of key importance for the number, scope and diversity of repurposing options to understand the legal and regulatory constraints governing land use, e.g. existing zoning plans, spatial plans, environmental permits, or protected areas and other land use restrictions. A key question relates to the requirements for a mine closure plan and related ES assessments for the (partial) closure of mining operations. The World Bank team is currently working on a thorough review of legislation relating to environmental assessments and permitting, spatial planning and alternative land use scenarios for the PPC mining lands. In Greece, legislative barriers have been identified that require time consuming permitting procedures for new developments on reclaimed lands. It is important to recognize that legislative reforms may be required and combined with the drafting of a “Special Spatial Plan” (explained further below) are preconditions to enable classifying land parcels with specific typologies for uses as organized receptors for low-carbon economic development, under a simplified permitting regime.

10. Some of the challenges identified relate to: (i) the currently valid mining status of the PPC’s area, which extends over the next 90-100 years, which would necessitate a change of spatial designation; (ii) new forest areas on the area of the lignite mines would already fall under the jurisdiction / protection of forestry regulations.

11. However, there are also opportunities: (i) the Environmental Assessments Approvals (EAA) Decision for PPC’s current operations is due for renewal in November 2021. This offer the opportunity to combine re-drafting and renewal of the EAA with the approval of the SEIA for a Special Spatial Plan; (ii) PPC is already gathering on projects on their post-mining lands that are either in the permitting process or in the design project, for future implementation; (iii) if some parts of the PPC lands could be dedicated as “Organized Receptors – Business Parks” under Greek spatial planning / environmental regulations, this would allow a significant reduction of the mandatory requirements for environmental permitting of projects and activities, within these Organized Receptors; (iv) as on mined lands archaeological investigations and excavations will already have been carried out, there should not be a requirement for another opinion from the Archaeological Authorities; (v) for re-forested areas not officially classified as forest areas under the Forest Cadaster, the requirement for an opinion of the Forestry Authority should be waived.

Annex xxx contains a detailed analysis of the permitting situation around post-mining lands in Western
Macedonia.

**Site Investigation and Monitoring Programs**

12. Generally, there will be a requirement for additional and supplemental data to underpin land characterization and classification for spatial planning purposes. Related activities could include:

- Design of instrumentation and monitoring programs for geotechnical investigations, ground stability assessment and chemical assessment of soils, water and groundwater
- Implementation of geotechnical site investigations and monitoring of ground settlements
- Implementation of site investigations, sampling and testing for detecting and assessing chemical contaminations from legacy pollution
- Mapping areas with different degrees of geotechnical and/or geochemical constraints
- Definition of post-repurposing monitoring requirements (e.g. long-term settlements, slope stability, groundwater and water quality)

13. It is considered important, for due diligence, that the appropriate amount of site-specific data and a baseline report is established. Since the former mined lands are considered either brownfields or reclaimed brownfields, geotechnical stability analyses, due diligence and environmental assessments will be prerrequired for any future development.

**Land Classification Methodology**

14. This approach has been developed and tested in the Western Macedonian Lignite basin on lands currently under ownership and management by PPC and utilized under various stages of the lignite mining cycle (resettlement/clearance of structures, removal of overburden, extraction of lignite, deposition of overburden to internal and external dumps, reclamation and remediation of dumps and residual pits).

15. From extensive site visits and stocktaking, interviews with various functions in mine management and operation, and drawing from international experience and practice, five criteria were defined to characterize mining lands’ repurposing potential: (i) location and socio-geographical situation; (ii) environmental risks/liabilities; (iii) geotechnical stability; (iv) topography and hydrography and (v) development potential and financial risks.

16. These criteria were then combined with broad scenarios for post-mining repurposing: (i) energy production and storage (see e.g. draft strategy paper for an Alternative Energy Hub at Kozani) / industrial production / waste processing; (ii) agricultural/horticultural/forestry; (iii) recreational/tourism; and (iv) office/research/technology parks. The table below lists and describes in detail the evaluation criteria to screen and classify locations regarding their repurposing potential for different types of post-mining use.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Criteria</th>
<th>Favorable for…</th>
<th>Unfavorable for…</th>
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<tbody>
<tr>
<td>Location</td>
<td></td>
<td>Any industrial process depending on delivery and shipping of goods or materials by road, water and energy; producing significant amounts of solid and liquid waste.</td>
<td>Recreational areas, research parks and other non-industrial uses may be negatively impacted by proximity to infrastructure.</td>
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<tr>
<td></td>
<td>Distance to infrastructure and utilities</td>
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<td></td>
<td>Distance to human</td>
<td>Recreational, business</td>
<td>Industrial activities creating noise,</td>
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<tr>
<td><strong>Development opportunities</strong></td>
<td><strong>Settlements</strong></td>
<td><strong>Research facilities would profit from closeness.</strong></td>
<td><strong>Emissions, odors and other risks / impacts should be isolated from settlements.</strong></td>
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<tr>
<td><strong>Geotechnical stability</strong></td>
<td><strong>Expected residual ground settlement</strong></td>
<td>Almost irrelevant for agriculture and forests, recreation and tourism.</td>
<td>Can be extremely important for large scale structures with high loads and low tolerances esp. for differential settlement.</td>
</tr>
<tr>
<td><strong>Slope stability – seismic risks</strong></td>
<td>Potential risk for any utilization scenario.</td>
<td>Can be actively hazardous for community health and safety, and infrastructure near the slopes of OD. Relevant for almost any use scenario; seismic risks need to be factored into stability assessments.</td>
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<tr>
<td><strong>Impact of groundwater rebound</strong></td>
<td>Almost irrelevant for agriculture and forests, recreation and tourism; can have positive biodiversity impacts due to creation of lakes, ponds and wetlands with high ecological value.</td>
<td>Can be very relevant and have negative impacts for large scale structures with high loads and low tolerances esp. for differential settlement. Potential agricultural / recreational issues due to water percolating through fly ash layers with elevated heavy metals in OD.</td>
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<tr>
<th><strong>Topography and hydrography</strong></th>
<th><strong>Surface gradient and relief</strong></th>
<th>Placement of PV on berms on high, stable slopes, if exposure appropriate; forests and natural reserves on slopes for stability, biodiversity, timber production or as carbon sink.</th>
<th>Any development requiring large, level space and stable ground; this will include almost any built structures.</th>
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<tbody>
<tr>
<td><strong>Surface drainage</strong></td>
<td>Poor drainage and resulting standing water can be irrelevant, even and advantage for recreational use or biodiversity enhancement</td>
<td>All other uses require well drained surfaces, and tolerate neither stagnant water, nor erosion due to high flow velocities.</td>
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<tr>
<td><strong>Hydrological risks – extreme precipitation events and flooding</strong></td>
<td>Limited tolerance for forestry, recreational use or biodiversity enhancement</td>
<td>Very limited or no tolerance for all other uses. Floods are particularly hazardous where they may interact with poorly consolidated dumps, which have high erosion potential.</td>
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<tr>
<th><strong>Environmental risks</strong></th>
<th><strong>Presence of soil / GW contaminations or hazardous materials; acidic soils</strong></th>
<th>Likely of low relevance for all industrial uses</th>
<th>Highly relevant and significant risk for agriculture; moderate risk / deterrent for recreational / touristic uses.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current / manifest environmental impacts of ongoing Lignite production</strong> (dust, noise, vibrations, traffic, odors, pollutants)</td>
<td>Limited relevance for industrial activities (which themselves may create noise, emissions, odors etc.), and for forestry. Moderate to significant relevance for agriculture activities – dust could e.g. create negative impacts.</td>
<td>High relevance / potential negative impacts for recreation and tourism, as well as “white collar” type activities such as R&amp;D or office parks.</td>
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<tr>
<td><strong>Proximity to operating TPPs, including post-repurposing, lignite bunkers, fly ash stockpiles</strong></td>
<td>Irrelevant for all uses except industrial processing of fly-ash.</td>
<td>When processing fly-ash into secondary products (e.g. concrete) need to ascertain acceptable levels of potential contaminants, especially heavy metals.</td>
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| **Table xxx**: Evacuation criteria for post mining lands; developed during missions from 02/2019 to 10/2019 for PPC mining | | | |
lands at Kozani Lignite Basin, Western Macedonia, Greece.

17. The following broad post-mining repurposing scenarios were defined: (1) **renewable energy production**; (2) **industrial production / waste processing / workshops, services and storage**; (3) **agriculture / horticulture / forestry**; (4) **recreation / tourism**; and (5) **office / research / technology parks**.

18. These scenarios define the land repurposing categories for a given post-mining area. A land category basically means that for a defined area, an optimized utilization scenario has been proposed based on various potential combinations of the criteria described in the table above: bio-physical and chemical characteristics; liabilities and constraints imposed naturally or due to the mining history; the geographic situation with respect to existing infrastructure, settlements and economic clusters; and the potential added value development options and the opportunity cost of sub-optimal development. The methodology takes cost sensitivity into account, striving to avoid e.g. costly remediation or upgrading measures for a particular purpose, if other areas are equally or better suitable and require lower investments to be fit for purpose.

19. The following figures explain how various combinations of land properties and characteristics were analyzed and matched with optimized utilization scenarios, that minimize the exposure to risks and liabilities and maximize the potential added value of redevelopment. Here are four utilization scenarios, graphically depicting the five underlying criteria:

![Diagram](image)

*Figure xxx*: Graphic characterization of four exemplary land repurposing scenarios, based on five defining criteria. These “radar charts” allow a quick assessment, categorization and testing of lands’ suitability for a specific envisaged utilization.

20. The LRM is linked to Global Mine Closure Standards, which contain broad principles and
expected to be less prescriptive on specific mine reclamation parameters; from these principles the LRM would inform upon how different categories of land are to be reclaimed – at a specific mine site. This will introduce a dynamism to Mine Closure allowing to optimize closure planning and implementation according to local conditions and potential future uses, while ensuring compliance with international best practice. The optimization of land uses will eventually optimize the needed funds for reclamation and repurposing of the former mine lands. This type of optimization is considered of paramount economic importance as well, e.g. in order to avoid excessive spending in areas that could be repurposed in a more cost-efficient manner for a better suited use.

21. To support efficient and optimized land classification of former mining lands (or other industrial brownfields) a user-friendly, cloud-based GIS application has been prepared under this technical advisory work, which incorporates all above steps, and can be accessed by various stakeholders. This software follows the previously presented methodological approach via a simple mathematical algorithm which processes user-input indices and produces a map visualizing recommended optimized land uses (seem example of map in Figure XXX and details regarding this GIS application in Annex xxx-1).

![Figure XXX: Software output of a land classification test exercise using the developed GIS cloud-based application. The land has been subdivided in different elements, and for each element an automatic land use has been assigned based on the classification outcome. This figure is only for illustration purposes of the final output of the software and should not be treated as actual land proposed typologies.](image-url)
22. Typical data that would be required for the successful operation of the GIS based application (named “LURA” – Land Use Repurposing Application) are: (i) up-to-date electronic topographic maps of 1:5,000 scale or larger; (ii) maps of same scale, depicting surface topography during past mining operations in 2 to 5 year intervals (if available); (iii) geological maps in same scale, with several representative cross sections in different directions and comments from PPC down to which geological layer / material excavation reached. This information would be supplementing the topographic maps of past mining stages; (iv) hydrogeological data and information; priority would be current groundwater elevation as well as during past mining stages. Ideally the original groundwater table before mining started would be available, as well as the future projection of the ground water table after all closure activities are completed, groundwater pumping has stopped and a full groundwater rebound achieved; (v) environmental data of the two areas which should include test results for key pollutants in a map or in specific coordinates; key parameters would be: Soil -> pH; organic content; sulfur; As, Cd, Cr, Cu, Ni, Pb, Zn; aliphatic, aromatic, polycyclic hydrocarbons. Groundwater -> same parameters, plus: dissolved oxygen, total oxygen demand (TOD), total organic content (TOC), hardness, conductivity, nitrate, ammonium. All parameters as available; (vi) provision of placement methodology by zone, e.g. using large placement equipment with conveyor belts as opposed to dump tracks; (vii) provision of specific deposition zones segregated by type of material (e.g. clayey marl, sandy marl, rock overburden, fly ash) and deposition location would be very beneficial.

**Formulation of repurposing strategies and as contributions for other spatial planning instruments**

23. The outcomes of the sequence of (i) stocktaking and site inventory; (ii) clarification of permitting situation; (iii) developing site programs for investigations and monitoring; (iv) establishing and applying a land classification methodology, can be used for the formulation of a repurposing development strategy and as basis and inputs for other spatial planning instruments. This step follows general spatial planning methodologies and would entail the following elements:

*Match the land properties (as expressed in the identified land categories) with potential land utilization options*

24. The basis of this planning element is the land use zoning map produced under the land categorization activity. The output of the land categorization exercise will be a land utilization zoning map, which delineates areas classified according to their optimized types of utilization (See figure xxx, depicting land utilization scenarios from mining to repurposing). This allows a first, approximative assignment of spatial elements and dedicated zones that incorporates both the constraints imposed, and opportunities presented by the physical and chemical characteristics of former mining lands.

25. The process of Land Repurposing Planning (LRP) for the PPC mining lands will need to closely align, interact, and integrate with spatial planning processes for a wider scope than the mining lands. This technical advisory (TA) work is recommending aligning the LRP with a Special Spatial Plan (SSP) that would cover the entirety of the current “coal region” in Western Macedonia, i.e. the current mining lands, the adjacent lands, infrastructure, settlements and communities, and major population centers and economic clusters, such as Kozani and Ptolemeida.

26. In the following explanations, LRP refers to the analytical and planning process around mine lands repurposing, which is governed by the methodology developed under this TA, while SP (spatial planning) refers to the wider planning horizon governed by prevailing Greek regulations and approved methodologies.
Figure xxx.2: Current (2018) situation at the central mining area of the Kozani Lignite Basin, consisting of Mavropigi, Kardia and the South Field Mines.

The yellow shades indicate external overburden deposits, the orange shade internal overburden deposits, and the brown shade active mining faces.

Figure xxx.3: Planned final land forms and land use after mine closure according to the environmental permits for the past decades and the next 10 years of operations.

The lands will be mostly returned to forests (green shading), agricultural lands (yellow) and residual lakes (blue).

Figure xxx.3: Vision for potential land use after implementation of repurposing planning approach (n.b.: this is only a mock-up map and not intended as actual guidance).

There still will be abundant forests, natural habitats and agricultural lands (index 1), but significant areas will also be dedicated to alternative energy production (3), business parks (4) industry (5), pumped storage reservoir volume (6) and repurposed TPPs, possibly with attached R&D installations (7).
ESIA to guide land repurposing planning and allow pre-licensing of utilization typologies

27. One key component in the LRP process is the production of an (strategic) environmental and social impact assessment (ESIA). This would be scoped to include the entire SSP area, i.e. former mining lands as well as adjacent areas that could be affected by the spatial planning initiative. This is also an issue that may require additional attention to the drafting of an SSP. It may be necessary for a combined SSP drafting from PPC for its lands and the Region for the neighboring lands.

28. The geographic and temporal scope should also include any areas that could be affected by adverse impacts, e.g. river basins or air-sheds. Within this ESIA-scope, various land types, landscapes, natural features, valued environmental components, built assets and existing adverse impacts would be inventoried and assessed, additional impacts and effects of the proposed changes in land use investigated. The environmental and social constraints and boundaries established by the ESIA would guide spatial planning, especially the definition of land use zones and the allowable activities within these.

29. This would be a key advantage for the further SP process and the eventual development of the lands, as the approval of the ESIA would establish a permitting basis for specific activities within defined zones, that would greatly simplify and streamline the permitting process for individual projects.

Link the spatial organization within repurposed lands with external spatial elements

30. The key spatial elements to be considered for linking the surrounding (external) lands to the former mine lands are the following: (i) infrastructure and transport (roads, railways, canals, transmission lines, pipelines, conveyor belts); (ii) agricultural areas; (iii) natural habitats and forests; (iv) industrial and commercial zones, business parks; and (v) generally equivalent land use patterns.

31. The overall objectives of this element would be to (i) keep or increase connections between internal and external transport and linear infrastructure elements; (ii) optimize transport and linear infrastructure corridor alignments using the mining lands made available; (iii) create continuity between equivalent internal and external land use types and scale up the size of plots / parcels (especially important for agricultural lands, forests and natural habitats); (v) restore the natural hydrographic networks and drainage patterns, as far as possible; (v) link planned commercial or industrial development to the proximity of existing zones or to important infrastructure features (e.g. highway interchanges, railway corridors, energy grid).

Mainstream Environmental and Social Sustainability criteria into SP process

32. This would entail locating e.g. high impact utilization types (waste processing / disposal, waste water treatment, industry, energy production) in zones that are removed from sensitive receptors such as human settlements, natural habitats, water courses, aquifers. It also could mean the provision of space for sustainable environmental management practices, e.g. engineered wetlands for water treatment, or retention areas for floods. An important sustainability element would also be the dedication of significant areas for renewable energy production and storage (e.g. photovoltaic plant, pumped storage plants, hydrogen production) or carbon capture (e.g. carbon forests).

Retain a spatial reserve for flexible future use

33. Related to above item is the concept of retaining a land reserve of undetermined, flexible use. This could become highly beneficial as offset or compensation areas for development projects in the region (e.g. to offset the loss of forest, natural habitat or wetland by an investment project by upgrading the post mining lands to a higher ecological value then the baseline). Given the size of some post mining lands there could be significant potential for this type of land use.
Present successive drafts of LRP to all involved stakeholders

34. Continuous stakeholder engagement (SE) is a crucial element of the spatial planning process and an important determining factor in the quality and sustainability of the final product. Consultations should specifically target the linkage with spatial planning processes and existing plans for the external lands, both on regional and local levels. SE should solicit input and ideas from a wide range of stakeholders, including e.g. business associations, farmers’ unions, environmental organizations, trade unions, producers and distributors of energy and water, etc. Guiding questions for SE in the context of spatial planning could relate to making land available for specific development concepts, for optimizing transmission / utility lines, making mine installations and infrastructure available for subsequent uses, creating space for projects of public interest, and securing broad consent for the general spatial organization of the lands.

Finalize and implement the LRP

35. The finalized SSP represents a spatial organization of lands that should allow the rapid development and implementation of utilization scenarios that are compatible with the SSP’s designated zones and categories. Ideally, in order to function as an enabling vehicle to crowd in economic activity and development, the SSP needs to be legally underpinned, including general land use and environmental permitting for specific zones, based on a general ESIA for the SP (see separate item above). For example, a warehouse operator who wants to develop a parcel of land in a zone dedicated for light industry / commercial use, should be able to use a streamlined licensing process to obtain construction and operation permits. The compatibility with the developer’s plans would have been pre-established, e.g. by a list of allowable project typologies for a specific SP zone defined in / based on the ESIA. Hence there should be no need for another detailed environmental assessment, but rather a standardized environmental management plan that shows compliance with regulations on e.g. noise and gaseous emissions, stormwater management, sewage and canalization, workplace health and safety, fire and electrical safety, etc.

36. This may be a workable way to significantly reduce the time required for EIA processes and permits, providing important incentives to future developers while respecting and complying with all environmental regulatory requirements. The ex-ante production of environmental assessments (SEIA and EIA) that are based on an anticipation of typology of land use scenarios, which would be derived from the SSP, may require legislative amendments. Under current legislation, regardless if a typology has been set for land use and a SEIA or even a EIA has been produced, any new development still has to produce its own, investment-specific ESIA. This is considered a significant barrier for future economic land development of the area.

37. The finalized LRP should be incorporated into regional or community level economic initiatives, marketing strategies, outreach campaigns to investors etc. There is also an important interface with the Alternative Energy Hub Strategy which is also developed under the World Bank’s TA activity.
38. In the context of the project "A Just Transition for All: Preparing for a managed transition of coal-dependent regions in Western Macedonia, Greece (P169761)" it is presumed that an integrated spatial planning effort should be undertaken for setting a detailed proposal for the new “spatial destination” and land uses in the area of the PPC’s coal-fired units and lignite mines in Western Macedonia. For that purpose this report looks into the national legislation on spatial planning, its planning tools and relevant procedures, existing and proposed regional plans for Western Macedonia as well as the legislation on the assessment of the effects of certain plans and programs on the environment and the latter's relationship and interconnections to the obligations deriving from the legislation on environmental assessment of projects.

39. For the new land use planning in the areas of the coal mines and lignite-fired units to be decommissioned, a Special Spatial Plan (SSP) should be prepared pursuant to article 8 of law 4447/2016. The SSP is a powerful and versatile planning tool suitable for the repurposing of the PPC’s land and the new land use planning in the area. This plan would set a detailed proposal for the new “spatial destination” and land uses in the area.

40. During the preparation of the SSP, and prior to its enactment, its Strategic Environmental Assessment (SEA) must be prepared. Pursuant to the law, the preparation of a SSP will start with an initiative of the Ministry of the Environment and Energy or the Municipality or the Region or the competent body for the implementation of the relevant plan, project or work.

41. The procedures, contents, technical specifications etc. for the preparation of the study of a SSP are being set in the law: The SSP is enacted via a presidential decree. The SSP must conform to Special and Regional Spatial Frameworks.

42. Accordingly, the proposed new regional plan for Western Macedonia gives some strategic directions and suggestions for the transition to a post-lignite era and the future use of depleted lignite mines in the region. The transition of the regional economy to the post-lignite era must occur smoothly, having as its basic desideratum the continuation of the region’s role as an energy center by shaping the spatial, financial, institutional etc. requirements for the development of the renewable energy sources, including not only their operation but the construction of their parts as well. An integrated plan should be prepared by the central and regional government for the transition and development in the post-lignite era, as well as a strategic plan for the restoration and reuse of the depleted lignite mines.

43. As regards the relationship of the assessment of the environmental impact of the SSP with the assessment of the environmental impact of individual projects, it is stressed that the preparation of the SEA of a SSP does not substitute for the obligation of environmental licensing for all projects to be constructed in the area covered by the SSP, that is the preparation of an Environmental Impact Assessment (EIA), opining by various civil services, public consultation and issuance of an Environmental Approval of each project.

44. This obligation derives directly from the EU legislation. Pursuant to article 11 of the Dir. 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programs on the environment "Relationship with other Community legislation. 1. An environmental assessment carried out under this Directive shall be without prejudice to any requirements under Directive 85/337/EEC and to any other Community law requirements." Consequently, getting around this obligation would result to a violation of EU law. The par. 3 of art. 10 of the joint ministerial
decision incorporating the Directive in the national legislation embodies a similar provision.

45. Nevertheless, the procedure of environmental licensing of individual projects could be made easier by the fact that the opining services would have gained sufficient knowledge of the natural environment of the area through the thinking out of their opinions in the context of the preparation and approval of the SEA of the SSP, which precedes the stage of environmental approval of individual projects.

46. In the case of a business park, industrial area etc. (organized "receptors" of manufacturing and business activities / planned areas) for which an environmental approval has been given, some of the opinions of the public services required in the context of environmental approval of individual projects, can be omitted. On the one hand it depends on the nature of a specific project, on the other hand it has to do with sectors which should have been environmentally approved as part of the procedure of the environmental approval of the business park / industrial area itself e.g. the issuance of a permit for the industrial area's sewage disposal etc.

47. In this context, the provisions of the article 54 of the law 3982/2011 could prove useful. As provided by the law, for projects of certain business categories, which are allowed to be installed in business parks of industrial use, such as energy and thermal production from renewable energy sources and natural gas, co-production of electricity and heat, research centers and laboratories, agricultural and stock-raising business etc. services in charge do not have to opine as part of the procedure of environmental licensing. The scope of these provisions could probably be widened by including additional categories of activities which could be of interest for the envisaged development model in the area.

**Potential barriers linked to the existing legislative framework**

48. Regarding the preparation of an SSP, potential barriers could derive from, at least, the following causes:

1. Delays during the public procedure for the assignment of the study contract due to possible objections and litigation.
2. Delays due to shortages of competent personnel for the supervision and the approval of the study of the SSP and its SEA.
3. Bureaucratic procedures in various sectors and stages which can be complex and slow.
4. Delay during the legal editing of the draft presidential decree by the Council of State.1
5. Regarding the environmental approval of the individual projects, potential barriers could derive from, at least, the above-mentioned causes nos. 1, 2 and 3.

49. Attention should be paid on the, still valid, mining status as well as the new forest maps of the PPC’s area. Both issues could hinder the procedure of land-use planning in the area. The preparation of the SEA of a SSP does not substitute for the obligation of environmental licensing for all projects to be constructed in the area covered by the SSP, that is the preparation of Environmental Impact Assessment (EIA), opining by various civil services, public consultation and issuance of an Environmental Approval of each project.

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1The Supreme Administrative Court.
Recommendations

50. A proposal for the establishment of business parks with specific land uses for economic development in the area should take precedence, as a major component of the new land use planning in the area, and with the purpose of speeding-up the procedures of environmental licensing of the projects contained therein. Such precedence does not preclude the construction of major individual projects outside the business parks.

1. The procedures of the preparation and approval of (i) the SEA of the SSP and (ii) the EIAs of the individual projects could be sped up by legislating the abbreviation of the periods of time needed for the competent authorities to opine and for the public consultation procedures, and the reduction of the number of the competent services. Furthermore, if for a specific land use included in the SSP, opine has been provided for unchangeable conditions (such as archeological sites, forests etc), it could be omitted for the future specific EIA of a new project which applies to the proposed land use.

2. The scope of the provisions of the article 54 of the law 3982/2011 could be widened by including additional categories of activities which are of interest for the envisaged development model in the area.

3. Similarly, the abbreviation of the period of 12 months for the enactment of the SSPs must be legislated.

4. The abbreviation of the time for the preparation of the studies needed in the context of the preparation of the SSP (SSP, SEA, geological study, study for the delineation of the streams) must, as well, be legislated.

5. The periods of time needed for the preparation of EIAs and the issuance of Environmental Approvals of individual projects must also be abbreviated.

6. The period of 6 months into which the Central Council of Urban Planning Affairs and Objections must complete its reasoning (par. 5 of art. 8 of law 4447/2016) should be abbreviated.

7. All competent authorities (opining, checking, approving the SSP and the EIAs of individual projects etc.) must be well-staffed and organized.

8. The potential should be explored to streamline the content of the EIAs of individual projects in relation to the content of the SEA.

51. The Figure below summarizes and visualizes how a streamlined approach to permitting could be practically achieved: obtaining higher level, generic permits for larger area and a specified range of uses would establish pre-clearance for certain aspects of ES assessment and management, which would not need to be repeated at lower / more specific permitting levels. For instance, PPC’s land assets could be covered by an SEA, which would define the permissible land use, delineated into zones with defined typologies of utilization (e.g. RE/PV, forests, biomass production, commercial, business, research, industry); such a “defined zone” would be covered by an ESIA, which would be the basis for a permit for this zone, for specified types of use, and covering e.g. all aspects connected to land and natural resources in this zone; finally, a specific investment on a single plot within this zone would only require a simplified ESIA or an ESMP, which would be a basis for an operational permit.

52. This model has been successfully applied in the “Chemiepark Bitterfeld” in Saxonia-Anhalt, where a large area of former industrial brownfield was remediated, designated as future industrial area for a range of chemical industries, for which a blanket permit was issues by the environmental authorities. Individual investors seeking to establish an operation within the “chemical park” were benefitting from
a simplified and accelerated permitting process.

53. The success of the Chemiepark is based on a combination of strategic planning and financing instruments; its favorable location in terms of infrastructure, labor availability, academic and research institutions; and an innovative, client-oriented management approach. When the current business model was established in the early 1990’s as succession to a variety of legal forms ranging from the late 19th century through WW1, WW2 and the GDR (German Democratic Republic) period, the Federal Republic of Germany (“Bund”) guaranteed a waiver of the new owner’s responsibilities for legacy pollution and environmental liabilities. Considerable public funds were invested in site cleanup; however, cleanup costs were controlled and minimized through smart spatial planning and remediation sequencing, allowing to market remediated land parcels and start reaping economic returns, while completing remediation activities in other areas. The waiver for environmental liabilities associated with the location is seen as one of the key incentives for the Chemiepark’s success as a business location.

54. In addition, park management provides a range of incentivizing customer services: joint waste management services, on-site effluent treatment, circular materials use, and – importantly - assistance which environmental permitting, both for the establishment of the businesses as well as for ongoing compliance. For the latter purpose, Chemiepark management employs a range of environmental and chemical engineers and technicians who execute the day to day monitoring, reporting and interaction with the environmental authorities.

55. Figure xxx below illustrates how a designation as an “organized receptor” under Greek legislation, the definition of specific types land use, activities and industries for a defined zone, and the provision of joint permitting and compliance services could be organized for the selected parcels on the PPC lands.

The detailed, full report on the legal analysis around spatial planning and permitting can be found in Annex xxx.2, the full report on environmental permitting in Annex xxx.3.
SECTION 2.2 REGIONAL STRATEGY REPURPOSING

56. This section offers thoughts on how to use the LRM in a broader regional planning context. Key questions relate to (i) the main uses/applications of the LRM; (ii) how LRM’s use be optimized in Western Macedonia; and (iii) how the processes around linking LRM with regional planning could be managed, e.g. by a specially created legal entity.

57. **Main uses / applications of LRM:**

- It can provide technical baseline information for e.g. environmental permitting; conversely, it can (after modifications) contain constraints and requirements from the regulators / permitting authorities;
- contribute to spatial planning instruments or zoning plans adjacent to the mining lands or covering the mining lands partly or fully;
- be an important tool for stakeholder information, planning discussions, decision support in an ongoing multi-stakeholder dialogue.
- act as information repository including morphological, topographical and geographical land characteristics, risks and constraints, opportunities and land value instituting a prerequisite due diligence of the lands.
- be an important tool for land valuation, estimation of added value through various development scenarios, estimation of required remediation costs for selected repurposing scenarios.

58. **How could LRM’s use be optimized in Western Macedonia?**

- One key advantage of the system is that it can be co-operated by several parties, and their access rights and input areas can be clearly defined.
- As this would mean co-ownership of the information stored in the LRM, its objectivity and validity would be less likely be questioned or disputed by the involved stakeholders. Hence the LRM would constitute an important collaborative platform, on which to build further planning and decision-making processes.
- The LRM’s operation could be subdivided into thematic areas; e.g. PPC could supply / input / maintain all data related to morphological and geotechnical data; municipalities and regional development initiatives (e.g. ANKO) could supply socio-economic data, including data on potential added land value;
- Possibly, additional layers could be added, e.g. permitting requirements or constraints, which MoEE could “own” and operate.
- Special consultants could work on remediation cost scenarios or legal constraints.
- This division of labor would enable all parties to contribute what they consider their area of expertise and feel a measure of control over, and confidence in the information stored in the system. This could be a key enabling factor to establish and maintain a functioning collaborative structure around lands repurposing.
- In addition, the LRM will inform on specific application of Global Coal Mine Closure Standards. Global Standards tend to be less prescriptive on specific mine reclamation parameters and rather rely more on meeting the spirit of the intended future land-use determined using the LRM. On a case-by-case basis, the Closure Standards would contain broad principles to apply the LRM, and from that the LRM would inform upon how different classifications of land are to be reclaimed – at that specific mine site. An adjacent mine might have a different set of environmental remediation actions – depending on the application of the LRM there.
59. **There could be a key role for a “special purpose vehicle” (SPV) in WM:** An SPV could be an entity created with participation of all key players around a large transition project including closure, remediation, repurposing and economic regeneration. In the case of Western Macedonia, PPC could be a major shareholder of the SPV, as well as the regional Government, affected municipalities and others. An advisory or steering committee could include additional stakeholders from the NGO/CSO scope, academia, specialized agencies and EU / international organizations. The SPV could be given a variety of potential mandates, which are listed as a menu of options below:

1. to assume ownership / control of (post) mining lands;
2. act as receptor and manager of financial means (subsidies, public funds, investments) for remediation and repurposing;
3. act as turnkey contract manager for the required civil works;
4. be a key driver of land marketing and redevelopment;
5. assume a key role in obtaining environmental and other required permits for the repurposed lands;
6. provide educational and training incentives in innovative technologies and job profiles, e.g. in land remediation and repurposing; renewable energy installation, operation and maintenance; environmental / geotechnical services; or innovative agricultural approaches (e.g. biofuel production, carbon forests); for this purpose, the SPV could develop dedicated trainee / apprenticeship programs (see LMBV case example below).

60. The SPV could also have an important role as a “moderator” of discussions around implementation of SSP and the LRM, curate information, manage a continuous stakeholder dialogue, review information stored in LRM database and request updates as needed, and present / utilize / promote LRM in key meetings and decision-making processes.

61. Two examples are presented to illustrate the potential roles and impacts of SPVs in mine closure and remediation, land repurposing and recycling into productive economic use: (1) Chemiepark Bitterfeld, Saxonia Anhalt, Germany; and (2) LMBV (Lausitz Mitteldeutsche Braunkohleverwaltung), Brandenburg / Saxonia / Saxonia Anhalt and Thuringia, Germany. Both developed out of the context of derelict, low productivity, economically unviable industries of the former GDR being closed, the lands remediated and repurposed, a range of new, often innovative economic uses identified, and enabling conditions created for investments and economic development.

**Case Study: Chemiepark, Bitterfeld in Saxonia-Anhalt**

In Bitterfeld, Saxonia-Anhalt, a large area of former industrial brownfield was remediated using public funds, and then designated as a future industrial area for a range of chemical industries. Considerable public funds were invested in site cleanup; however, cleanup costs were controlled and minimized through smart spatial planning and remediation sequencing, allowing to market remediated land parcels and start reaping economic returns, while completing remediation activities in other areas. A blanket permit for the reuse of the area as industrial park was issued by the environmental authorities. Individual investors seeking to establish an operation within the “chemical park” were benefitting from a simplified and accelerated permitting process. An essential barrier removed was a waiver for the new owner’s on legacy pollution and environmental liabilities.
The Success of the Chemiepark rests on the following factors:

1. The waiver for the legacy of environmental liabilities associated with the location as key incentive;
2. Strategic planning and financing instruments;
3. Favorable location in terms of infrastructure, labor availability, academic and research institutions;
4. Innovative, client-oriented management approach with full time staff providing a range of logistical and organizational services to clients, such as a joint waste water treatment plant, supply with utilities as well as steam, nitrogen, oxygen and other basic chemical agents;
5. Joint waste management services, on-site effluent treatment, circular materials use, and – importantly - assistance with environmental permitting, both for the establishment of the businesses as well as for ongoing compliance (a range of environmental and chemical engineers and technicians who execute the day to day monitoring, reporting and interaction with the environmental authorities).

The Chemiepark example illustrates the rebound of investments and job-creation that is enabled by well planned land remediation and repurposing and the provision of both physical and legal space and enabling conditions for investors.

Case Study: LMBV

For over 25 years LMBV, on behalf of the German federal government and its states, has restored and reclaimed decommissioned lignite mining facilities left behind by former East Germany in the Lusatian and Central German mining regions. These activities have created environmentally and geotechnically safe landscapes that offer new perspectives as they offer new uses.

Over the past one hundred years, the regions and landscapes of Central Germany and Lusatia have been primarily characterized by lignite mining and lignite refining. These formerly structurally and
economically weak regions experienced an economic boom until the collapse of the socialist industrial model after the reunification of GDR and German Federal Republic. In 1990 the remediation of former mining areas commenced, initially led by the “Treuhand” (Treuhandanstalt of the German Government: the agency responsible for privatizing former East German assets).

LMBV (Lausitzer und Mitteldeutsche Bergbau-Verwaltungsgesellschaft mbH), was founded on 9 August 1994 by the. LMBV was assigned responsibility for phasing out and restructuring lignite mining regions in the regions of Central Germany and Lusatia. LMBV is wholly owned by the Federal Republic of Germany, represented by the German Federal Ministry of Finance. Activities of LMBV initially included management and coordination of lignite mining being terminated in Lusatia and Central Germany. LMBV prepared operational plans for decommissioning and oriented mining operations being wrapped up toward overall remediation of the mining districts. The last production facilities ceased operation in late 1999. Since this date, LMBV has concentrated activities on remediation of former lignite mining areas: i.e. in conversion of these regions to new and productive future use. These activities at the same time satisfy prerequisites for comprehensive restructuring and environmental / geotechnical remediation of these regions. LMBV plays a major role in implementing this transformation. LMBV has been assigned the following responsibilities:

1. Conversion of former lignite mining areas to new and constructive future use;
2. Execution of remediation work as project executor legally responsible under German mining law, to include planning, solicitation of tenders, award of contracts, supervision, and official turnover/acceptance of completed remediation work – with the final objective of ending responsibility as German National Mining Authority;
3. Safekeeping of decommissioned deep mines for potassium, spar, and ore;
4. Repurposing, marketing and re-utilization of former mining areas for future uses, with the objective of re-integration into natural and economic cycles, and to foster job creation;
5. Planning and execution of measures to eliminate dangers of present and future rise in groundwater level in former mining areas
6. Project execution in behalf of German states for new and productive land use

The two figures below illustrate the trends in budget and labor development of LMBV since the early 1990s:

Figure xxx: Funding allocated for mine closure, remediation and land repurposing of LMBV assets from 1990 to 2018 (source: https://www.lmbv.de/index.php/Daten_Fakten.html). The figure emphasizes the importance of public funding, which secured a continuity of works over a significant time frame.
Case Study: LMBV – Lausitz-Mitteldeutsche Bergbauverwaltung (Lausitz Middle-German Mines Management Corporation), Brandenburg, Saxonia-Anhalt, Saxonia and Thuringia in the former GDR

Figure xxx: Trends in employment of LMBV from 1995 to 2018
(source: https://www.lmbv.de/index.php/Daten_Fakten.html)

The figures tell an interesting story for the Western Macedonia Context: in 1994 LMBV absorbed practically all staff from the former lignite mine operators. With mining operations closing, mainly in the first half of the 1990’s, many jobs are lost. However, with funding made available for extensive remediation and repurposing works the losses are less than would have been predicted under a compliance-driven closure model. Looking at the period from 2000-2018 a stabilization at admittedly low numbers, and even slight job growth takes place. The growth during the late 2010’s is likely attributable to the land repurposing, marketing, and management business line replacing the former closure / remediation orientation, and generating long-term jobs resulting from the economic incentivization LMBV contributed to in the former mining area.

Two facts are noteworthy: There is continued hiring of trainees by LMBV, indicating that their workforce is not on a continued shrinkage path, but rejuvenated and kept dynamic by new hires. Second, a significant part of LMBV’s layoffs was absorbed by outsourcing staff to external employers, thus preserving their jobs, while they no longer appear on LMBV’s books. Many of these outsourced jobs went to firms and contractors specialized in services connected to remediation and repurposing, such as geotechnical / environmental planning and services; civil contracting and geotechnical stabilization works; property management; afforestation and forest management, and others.

Figure xxx below presents, in a schematic way, how an SPV could function in a similar way in terms of labor development in the Western Macedonian Lignite Basin.
It is important to note that the numbers are indicative only and not based on detailed analytics or predictions. The main objective is to illustrate the connection between diligent, long-term mine closure planning and labor development. A special purpose vehicle could – similar to the LMBV model – in a primary post-operational phase be a primary absorber and retainer of at least part of the lost jobs in mining operations. In subsequent phases the SPV could, through its mandate and activities, support a productive spatial reorganization, help to create an enabling legal and permitting situation, and thus contribute to an enabling environment for economic growth and job creation.
ANNEX 1: DESCRIPTION OF GIS APP FOR LAND REPURPOSING PLANNING

Basic functionalities:

- The software will use an open source third-party map service such as Open Street Map, Bing maps or similar as a geolocation tool. Drawings or similar AutoCAD files could be inserted but they will need to be converted to an image file first.
- The user will be able to select an area on the online map for classification purposes. The selected area could be any type of polygon line.
- The selected area will be subdivided into an orthogonal grid. The grid dimensions will be selected by the user. It could range from tens of kilometers to as small as 100 X 100m. Smaller grid size can be selected.
- Each rectangular area of the grid will be able to be zoomed in or zoomed out and any grid cell could be selected regardless of the size. The interactive maps and could be selected to be rated based on 5 distinct criteria.
- The user will be able to select the area to rate either by clicking on the corresponding map grid rectangle (called “pixel” onwards) or by clicking the “next” button once they are done evaluating an area and want to proceed to the next one. The user can retain the rating values from a previous pixel to the next one, or copy values from one pixel to another which does not need to be a neighboring one.
- When selecting a “pixel” a menu of five different themes will appear next or under the image. The user will be able to select a theme to continue rating or “drive” up and down the menu to select other themes.
- When a theme is selected then a new menu will appear that will present the different criteria to be rated. For example, when the theme “LOCATION” is selected then a submenu will appear with the “DISTANCE TO INFRASTRUCTURE” and “DISTANCE TO HUMAN SETTLEMENTS” sub-options. When the user selects any of the two predefined, a new form will appear in which the actual rating will take place.
- For each criterion, predefined descriptions will appear together with information pertaining to the criteria in an explanatory way. The user will select the clearly defined criterion and a score will automatically be assigned. For example, in the “DISTANCE TO HUMAN SETTLEMENTS”, five options will be available to the user to select from.
- For “GEOTECHNICAL STABILITY” and other more complicated themes, a dual rating process will be available, one simplified rating, which the score will be assigned based on simplified geotechnical assumptions, or one more detailed rating where additional subcriteria will be presented to the screen and will cover different geotechnical conditions with different ratings. The user will be able to select the description most suitable to the issue. The numerical rating of each criteria will be stored to a database for internal calculations.
- As soon as a rating has been completed for a “pixel” then this “pixel” will be assigned with a color which will be based on the proposed optimum repurposing option. Also, when selected, a radar chart will be generated and displayed which will present the actual rating output of the different criteria.
- The combined rating for the color scheme as well as the description of the color and the description of possible future use of the “pixel” will be calculated internally based on the different ratings and a weighted average or closest value to a mean average” This algorithm is under preparation and will be finalized very soon.
- The rating can be completed for an area without selecting and rating all the pixels. These pixels will remain without a color overlay specification.
• An overlay of colored “pixels” will be shown on top of the online map for the outlined area and each color will represent a favorable land use. A legend of each color and land use will be shown under or the side of the map. Additional color schemes could be used to depict areas that can have more than one optimal use. The color scheme could be additional distinct colors or a blend of colors from the primary land uses.

• An output of coordinates, total areas for specific land uses and detailed score descriptions can be easily exported to an excel or csv file. Such a file can in turn be easily imported and processed in other GIS tools such as ArcView; this would facilitate sharing between various users / parties.

• The map will be convertible / printable in pdf format or exportable in an image file format.

• The application administrator will be able to set up numerous user accounts with access to rating functionality or result outputs.

• Different user roles will be available for different level of access such as administrator, rater and viewer, viewer of results.

• Users will be able to create Project records for the various evaluation areas

• All information will be kept in a database for future reevaluation or rating and a rating history will be kept and could be available to evaluate the development of an area and the differentiation of rating.

• Application will be in English language

1st Level of Additional Functionalities:

• Administrative functionality to review and edit predefined values and texts for Themes and Criteria. i.e. the application administrator will be able to modify the descriptions of themes and criteria as well as the rating algorithm, e.g. allowing to assign different weighting factors to scores.

• Administrative functionality to modify the actual score values for each criterion or the partial factors for the detailed rating (no additional programming will be required)

• Multi-language support for Descriptions and Captions. Two languages will be available (English and Greek), and additional languages could be implemented if the one to one translation of descriptions or captions are provided.

• Rating “projects” will be stored under a Project and User context. This means that more than one evaluation can be performed and stored for a project area if required. For example, rating could be performed from the owner and the regulator under different user name, maps can be viewed for all raters. Furthermore, an option will be available that could average the ratings from different users in order to produce a final “averaged” rating for an area or for specific selected grids.

2nd Level of Additional Functionalities:

• In an already defined grid an area could be further selected and subdivided into finer grid for further rating

• If an area has been already rated and then subdivided, the new smaller pixels will retain the initial rating and the rating can be edited. For example, only some themes or some sub criteria edited and not the total rating.

• Calculated areas per land use will be presented together with percentiles of the selected parch of land

• Areas which have been differently rated by different users, will be shown on the map and combined radar graphs with marks and lines per user.
Technical Specifications

The software will be a web-based application with a database backend for storage. In terms of technologies, the following will be used:

- Python with Flask web framework
- MySql Database Backend
- Linux or Windows Server(s) for Web application and Database
- NGINX or IIS Web server depending on the deployment server(s) commissioned
- The software application will not require any other third-party components that might require additional licensing.

Quick start application manual:

Type the following address in your browser https://wb.geosysta.com/ and then enter your username (e-mail) and password

![Login page](image)

The user is prompted to the Project page where the user can select an existing project or create a new one from the top left corner “Start new project”.

![Project page](image)

When the user selects “+start new project” the following page is displayed. In this page need to type the new “Project Name” and either insert coordinates in WGS system or select from the world map your location. Use your mouse roller to zoom in.
Then the user needs to select the area want to rate with your mouse. Start forming a polygon for the area the user wants to rate by clicking your left mouse button. As the user clicks his left mouse button the polygon is created and at the same time you see the already selected area and the coordinates of its point.
on the right side of your screen. When selected area is finished press submit in the bottom of the page. Or the user can cancel your selection and start over.

As soon as you select submit you are sent to another page where the user can define the cell size and create your rating grid. A default value of 0.5x0.5km is shown. When you enter your preference of cell size press “Finalize” in the bottom of the map.
As soon as you finalize your selected area and grid and you press the “finalize” button, you are prompted to a new page where the user can start rating. If it is a new project you must press the “+Start new rating” in the upper left corner of your browser as seen in the next capture.

A new page is open and to start rating you need to add a comment to identify your rating as can be seen in the next figure. It could be your name, it could be a numerical value for rating, anything. After you enter for example “First rating” and you press submit, you are taken in the rating file page.

If you have more rating files, completed or partly completed the user can see them in this page. The user can also generate a report of previous ratings by pressing the “Show” in the right side of the screen. To start rating on your new project or to continue rating a previous project just press the file name in the left.
You are now in the actual rating page. To start rating just press on a grid cell and start rating.

As soon as you press on a cell grid with your mouse pointer the following screen is shown in which the different score categories are included. In the screen before you start rating the user can see the number and the area of the grid that you are rating and it is also depicted with highlighted outline in the map. The user can zoom in or out in the map to get more details. In this “map” area a different map could have been uploaded, for example a topographic map.
Bellow the general information of the area which are the cell number, the area and its coordinates, the user can select with a “tick” if the need to use “Advance Criteria for Rating”, or the cell is considered “unusable”. If none of the two are checked the user can continue rating using the regular “simplified” criteria. The user can either enter a rating value “by heart” in the left side or you press on the blue text and the rating information appears so the user can select, as can be seen in the next figure.

The user can just press the rating number with your mouse under the appropriate criteria and the value is included. If you need to adjust the numerical value the user can do it either by clicking and inserting from the keyboard or use the up and down arrows. For example, you may consider that a score between 2 and 3 is need. You press the 2 and then adjusted to 2.5 which consider a rating in between.
You continue rating your cell until you complete the assigned values and you press save in the bottom of the screen. As soon as you save your results you see the rating on the pentagram, also you see the average score for the different criteria in the left bottom of your screen and the assigned typology on the cell. You then press “OK” on the bottom of the screen and the user can continue rating a different cell.
By default, the application takes you to the next numerical cell, but the user can omit and go to a different cell. If you consider that all or most of the ratings for the next cell are identical the user can just press the “copy scores from other segments” and then a drop-down menu appear so the user can enter the cell number from which you wish to copy the rating. Then the user can either accept the rating as complete or adjust only some values and press save on the bottom of the screen to complete your rating.

During your rating you may wish to upload a file, or a photograph or a report in a cell which has been used in your rating decision. For example, a borehole report, an environmental report, photograph or any other file including additional information. This file is stored for that cell only and can be reviewed in a latter stage, or can be seen by other Raters which are rating the same project.
As soon as you complete rating your selected area you see the colored typology map in the screen and the pentagram for the cell selected. The user can review any cell and modify the rating to new values.

As soon as you are done the user can press on the top left of your screen the “Show Overall Report”. This is the final outcome of your rating. In this page you see the map with the different assigned typologies.

Under the map you see the project information which is the total selected for rating area, the number of segments and the segment dimensions.

Then you see the different typologies, the number of cells with the same typology assigned and the percent of the total area that this typology covers.

Finally, the user can export this project to a short one-page report by pressing the “Create PDF Report” in the upper right corner of your screen.

After you completed your rating and reporting the user can go and edit your rating or create a new rating project in the same or different area of the world.
<table>
<thead>
<tr>
<th>Utilization</th>
<th>Total Segments</th>
<th>Total Area Size</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest, natural habitats</td>
<td>0</td>
<td>0.00 km²</td>
<td>0.00</td>
</tr>
<tr>
<td>Agriculture</td>
<td>293</td>
<td>18.99 km²</td>
<td>47.56</td>
</tr>
<tr>
<td>Industry, energy production</td>
<td>130</td>
<td>8.43 km²</td>
<td>21.10</td>
</tr>
<tr>
<td>Business, recreation, tourism</td>
<td>39</td>
<td>2.53 km²</td>
<td>6.33</td>
</tr>
<tr>
<td>Possible Water Body</td>
<td>114</td>
<td>7.39 km²</td>
<td>18.51</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>576</strong></td>
<td><strong>37.34 km²</strong></td>
<td><strong>93.50</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unusable Category</th>
<th>Total Segments</th>
<th>Total Area Size</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archaeological interest areas</td>
<td>43</td>
<td>2.79 km²</td>
<td>6.98</td>
</tr>
<tr>
<td>Forest authority areas</td>
<td>6</td>
<td>0.39 km²</td>
<td>0.97</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>49</strong></td>
<td><strong>3.18 km²</strong></td>
<td><strong>7.95</strong></td>
</tr>
</tbody>
</table>
**Administration privileges:**

The advance users have also access to “Administration” where they can modify most of the input for the system.

When you click “Administration” in the upper right part of your screen, next to your user name you are prompted to the following menu:

From the drop-down menu the user can select the item they want to modify. Selecting the first “Themes and Criteria” you are prompted in the page where all the discretions for themes and criteria are fully editable such as “Location”, “Geotechnical Stability” etc.
By clicking the left mouse button on the blue criteria description, you are prompted in the edit page for that criterion.

In this page the user can edit the description text and even format the text. In the bottom of the page you see also a menu for when you have “Advance Criteria” such as for slope stability, the user can edit them also.

Selecting from the “Administration” drop-down menu the “Score Categories” you are promoted to the page shown in the next figure. The user can edit or modify the “Category” discription by clicking the mouse left button on top of the blue colored text, or the user can change the displayed color of the “category”.

The user can also edit the Unusable Categories and change color. The software allows the creation of
more than one unusable categories since the may not be known beforehand. A different or the same color can be assigned for different “Unusable Categories” that will be displayed in the main map. The main categories can not be increased or decreased because they are directly linked to the rating capability of the application.

When the “Score Guide” is selected from the drop-down menu from the “Administration” function, the rating criteria description can be edited or modified. For example, the user can press the “Edit” button in the right of the screen and change the >2.500m to a different value, for example 5,000m.

When the “Utilization Scores” is selected from the drop-down menu from the “Administration” function, you are prompted to the criteria weighted values per typology which are fully editable.
When the “Users” is selected from the drop-down menu from the “Administration” function, you are prompted to the registered users in the application.

The user can edit each user by clicking on the edit in the right side of the screen, and then the following page is displayed.
The user can edit name, email, password and also the user authorization as “Administrator”, “Rater” or “Viewer”. The user can have full access with the Administrator selection, or just a simple viewer of the map and final rating.

The user also can modify his password when selecting the “preference” from the drop-down menu when clicking in his user name or to log out. Additionally, the date format can be changed per user.