Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Tim Van Oorspronk
Student number	5734665

Studio		
Name / Theme	Transitional Territories Studio	
Main mentor	Nikos Katsikis	Urban Design
Second mentor	Alexander Wandl	Environmental Technology and Design
Argumentation of choice of the studio	In our pursuit of clean energy, the need for domestic lithium landscapes that facilitates mining, processing, battery-production and recycling activities is growing rapidly which is forcing a massive transition in Europe's territorial landscapes. Addressing this challenge fits well within the TT Studio, which also investigates the transitions of territorial landscapes and allows to first build an broad understanding of the problem field and identify the societal, environmental, geopolitical and economic conditions that force the transformation of the territory in order to propose a new territorial order.	

Graduation project	
Title of the graduation project	Mobilizing lithium landscapes: a spatial strategy that guides an evolving lithium economy in Portugal's Norte region.
Goal	
Location:	Norte subdivision region of Portugal
The posed problem,	With the phase out of fossil fuels and our pursuit of clean energy raises the demand for critical raw materials. Notably, the demand for lithium, a silver-white to grey metal with a high energy density that is a vital component in the production of electric vehicles (EVs) and battery storage technologies, is poised for exponential growth (IEA, 2021). Mobilizing the required landscapes to set up a domestic lithium supply chain (including the mine sites where lithium is extracted out of hard rock, the refinery plants sites for the conversion of the raw ore into battery grade

	ore, the battery production plant sites and recycling plant sites for the recovery of lithium as secondary source), is accompanied by a massive spatial issue, but essential to support the shift to clean energy technologies and reduce Europe's dependency on this highly dominated market. The appropriating of Europe's lithium reserves has particularly potentials for Portugal, since Portugal is having Europe's largest lithium reserves. However, the process of mobilizing lithium mines in Portugal's Norte region encounters resistance. This resistance stems from insufficient citizen participation in centrally-led decision-making processes and concerns among local communities about potential negative externalities on the local society, environment, and economic activities generated by the mine operations. The current mobilization process lacks a comprehensive understanding of the spatial and metabolic impact of the lithium landscapes to ensure just long-term development. Research aim and expected outcome: This thesis aims to develop a spatial strategy that guides the mobilization of lithium landscapes in Portugal's Norte region. This strategy should not only address the challenges of the extractive phase but also envision a post-extractive state to ensure just long-term development of the evolving lithium economy in the region, while considering the local socio-environmental vulnerabilities and the broader economic impact.
research questions and	The main research question derived from the problem statement: - How to design a spatial strategy that guides the transformation of Portugal's Norte region through an evolving lithium economy from an extractive mode to an recycle post-extractive mode, while considering the socio-environmental and economic vulnerabilities? Analytical sub-research questions: A. What are the spatial implication of mobilizing the lithium landscapes including their spatial interventions generated by the required support and transportation systems? A.1. What are the spatial implications of lithium extraction? A.2. What are the spatial implications of lithium refinery? A.3. What are the spatial implications of lithium-battery production? A.4. What are the spatial implications of lithium recycling?

	A.5. Which new lithium distribution patterns emerge and what are the generated spatial implications to support these distribution patterns? B. What is the *economic* impact of mobilizing the lithium supply chain on the Norte regio's economy? C. What is the *environmental* impact of mobilizing the lithium supply chain in the Norte region? D. What is the *social* impact of mobilizing the lithium supply chain in the Norte region? …and how to incorporate these insight to ensure a more just outcome for human and non-human? E. What are the potential domestic mining, refining, battery-production and recycling capacities in the Norte region? E.1. What are the lithium extraction quantities / volumes? E.2. What are the lithium processing quantities / volumes? E.3. What are the lithium-battery production volumes? E.4. What are the lithium recycling quantities / volumes? F. When are the projective lithium landscapes and (planned) support systems in operation? Projective sub-research questions: A. How to plan strategically spatial interventions that support the development and operation of the lithium extractive mode while anticipating on an evolving recycle post-mining mode? B. Where to locate strategically the nodes of the new lithium landscapes? (meso scale) C. How can the spatial implications generated by the mobilization of the lithium landscapes themselves and their support and transportation systems land in the place-specific context of Portugal's Norte region? (meso- scale and micro scale)
design assignment in which these result.	The design assignment is to ground the lithium landscapes of the lithium supply chain and their generated spatial interventions (which includes their required support and transportation systems to support the operation and distribution of each landscape) in Portugal's Norte region, while considering the socio-environmental and economic vulnerabilities. To mobilize these landscapes, the design assignment concerns three scales of design.

1. The meso scale, which refers in the context of this project to the scale of the emerging lithium corridor in Portugal's Norte region. At this scale, are the capacities per lithium landscape qualified, is the operationalization between the landscapes aligned and is the location of each lithium landscape and the infrastructural network that support the distribution of lithium and waste streams between the landscapes and exportation nodes, in both the extractive mode as the recycle-post-mining mode, proposed.

2. The meso- scale (meso minus scale), which refers in the context of the project to the scale of the lithium landscapes itself and its generated support and transportation systems. At this scale, the composition of the landscape itself and their support and transportation systems is proposed and evaluated.

3. The micro scale, refers in the context of the project to the scale which will evaluate on how the proposed spatial intervention interact with their adjacent surrounded elements (the actual conditions of life in place). This scale will zoom in on the transitions zones and relationships between the proposed interventions and the pre-existing elements on the scale of human level.

Process

Method description

A. Literature review

I use literature review as a method to gather the knowledge that help me to build the theoretical and conceptual framework and to identify the social and environmental conflicts that mine landscapes force to anticipate on and minimize these vulnerabilities.

B. Industrial ecology analysis / metabolic analysis

I use this method to identify the spatial and metabolic footprint of the mine, processing plant, battery-production plant and recycle plant. This helps to identify their associated required support and transportation system that support their operation and distribution and to get an overview of the input and outputs each site. The main metabolic subject of investigation are water, energy, waste and exports. Additional I use this method the metabolism of the current local activities which are mainly agriculture forms. By overlaying the metabolic ecology of the mine and current landscape I could were possible anticipate on potential conflicts.

C. Online desk research

I use this method to gather information out of company reports, industry and markets reports, case reference project, to qualify the lithium raw ore potentials out of the deposits, the processing, battery-production and recycle capacities and plan the alignment of the operationalization of the lithium landscapes and their required supported systems.

D. Spatial planning / adaptive planning and design

I use this method to plan in an efficient and flexible manner the minimize the impact of the proposed spatial interventions. This methods include planning for phases, identify the (spatial) needs for each phase and overlap these needs and try to reuse interventions in multiple phases.

E. Suitability analysis

This method involves the systemic evaluation of various factors and criteria to identify and propose suitable and strategic locations for lithium processing, battery-production and recycling sites in Portugal's Norte region. Criteria for evaluation are: proximity to mine sites, proximity to the market, access to transportation networks (roads, railroads, ports and pipelines), availability of energy (green energy), environmental regulations, access to labor, availability of water, safety for people and nature (noise levels, land use, air and water quality).

F. Research by design exploration

I use this method to project spatial interventions and evaluate the impact of each intervention on micro (local) scale.

Limitations:

This thesis is based on the idea that Europe is committed to electrification and battery storage as key technologies of the clean energy transition to combat climate change. The demand for lithium (landscapes) is highly dependent on the deployment of certain types of clean energy technologies. Ultimately, policymakers will determine whether lithium remains an essential factor in the clean energy transition. Additionally, the demand of lithium is depending on the product design industry. Alternative battery designs could reduce or eliminate the appropriation of lithium.

Literature and general practical references

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Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

The relation between this graduation project and the studio is that both investigates the transitions of territorial (often non-urban operational) landscapes, in my case the transition to extractive landscapes. The studio – which is an critical thinking studio – allows to first build an broad understanding of the problem field and identify which societal, environmental, geopolitical and economic conditions transform the territory. In that sense the methodology of the thesis and the studio approach overlap, both start with building a broad understanding of the problem field and positioning yourself in this framework. Secondly, investigate and analyze the different subject and their relations in play and lastly propose an new order by speculating on possible forms. The project fits within the track Urbanism and the broader master program because there is a clear role for urbanist to shape the spatial challenge that is accompanied by this the transition to domestic lithium landscapes that facilitates mining, processing, battery-production and recycling activities.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

Scientific / Professional relevance:
In our pursuit of clean energy, we not only face a massive challenge in the quest for clean energy, but also a huge spatial issue that is associated with this. Not merely the deployment of clean energy technologies require space, but also the extraction of natural resources for the production of clean energy technologies involves a massive spatial dimension. The latter is a spatial issue that, with the rising demand for domestic critical raw material supplies in Europe, raises many questions. Where can we mobilize these mining landscapes? Are we able to adopt and get used to these landscapes? How will the European's daily life be affected by these extractive practices? I believe it is the task of our profession to contribute to provide a better

understanding of the spatial impact (and the spillover effects of that) through the scales of implementing such transitions, which in this case is the need for domestic critical materials capacities in Europe to support the clean energy transition.
The project hopes to provide a possible strategy that helps envision how these landscapes could mobilize while considering the context-specific socio-environmental and economic vulnerabilities in Europe, by using the case of Portugal's Norte region. This case study can be used to inspire the mobilization of more lithium landscapes in the hinterlands of Europe. However, for each individual project, the context-specific conditions should be considered and serve as the basis on which spatial interventions can be proposed.

Apart from the contribution in the field of spatial planning, this thesis tries to provide scope that advance a more sustainable just way to appropriate lithium in Europe's hinterlands. This scope could contribute to the broader understanding and discourse of just resource management and circular economy principles.

Societal relevance:
It is clear that the availability and access of critical raw materials such as lithium have a huge impact on the functioning of the world we live in. It strongly affects the success of a decarbonizing energy system and is thus an important factor in combating climate change. Secondly, it affects the availability and development of all the battery-containing products humanity uses on a daily basis.
However, implementing mines raises resistance and has limited public acceptance, especially on a local scale. This is understandable because the implementation of mining involves large-scale land use change. It is therefore relevant to further investigate how the implementation of mines can coexist with society and ecology in a just manner.