P4 reflection

The open curiosity over global climate change has become one of the main incentives to start my graduation thesis in Urban Metabolism studio. It is more and more widely acknowledged that global climate change is really threatening the dignity of life of all the species on the earth. Extreme weathers and negative changes in natural characteristics have been observed in many areas of the world. For instance, with 26% of its land lying below the sea level, the Netherlands is under a great pressure of the rising sea level and the change of precipitation pattern. The chief culprit is the greenhouse gas emissions which relates to the use of fossil fuel energy without restraint, calling for an urgent transition from traditional energy system towards a more sustainable one.

With an essential concept of sustainable development, Urban Metabolism aims at researching and developing more innovation and efficient ways of resource management. In terms of energy, it is interpreted into three main topics: (1) renewable energy production; (2) reduce energy demand; (3) create a close loop of energy cycle. My interest towards sustainable energy topic arose after Q3-Studio, when I for the first time tried to decentralize the existing energy network of AMA by promoting neighborhood on-site renewable energy production. Therefore, in my graduation thesis, I would like to continue the research of regional sustainable energy landscape in Urban Metabolism studio, choosing the MRDH region as project site.

With the largest European port and the majority of Dutch greenhouse sector residing within its borders, the MRDH region is the most energy intensive area of the Netherlands. However, only 2.7% of the total energy consumption came from renewable sources in 2016. Although it seems quite clear that the MRDH region needs sustainable energy solution, still, it's not only a matter of investment or construction. There are some obstacles and back forces against the transition. In order to define what the back forces are and structure the whole research process, I developed a 7-stage methodology derived from the 4-step methodology published by Lucienne T. M. Blessing and Amaresh Chakrabarti and the 5-step approach by Stremke:

1. Defining the existing back force
2. Analyzing the current condition
3. Illustrating future scenarios
4. Creating a catalog of general solutions
5. Developing regional energy visions
6. Identifying key spatial interventions
7. Reflecting upon the process

The first step was to define what the possible back force are and whether it can be decreased or eliminated through urban planning and design. Only the problem that is related to space

can become the topic of my research. After going through many news and literatures, I found out a practical gap between governmental aspiration on renewable energy generation and local aspiration on landscape quality, which will slow the installation of renewable energy facilities. Therefore, I came up with my research question 'How to integrate spatial quality in the energy landscape which facilitates sustainable energy transition of the Metropolitan Area Rotterdam-The Hague (MRDH) through spatial planning and design?'

After defining the main research question, it comes to the second step: analyzing the current condition. This step provides me with the basic understandings of the MRDH region in terms of renewable energy potential, landscape typology and landscape quality. The data of renewable energy potential is collected from online open sources and demonstrated in mappings, while 3D models and sections are made to analyze landscape typologies in order to draw the spatial fitness maps of renewable energy technologies. The most difficult part is the analysis force landscape quality. Economic quality and ecological quality have objective measurement and can be mapped based on online data sources. However, the aesthetic quality is rather subjective and might differ from person to person. It's almost impossible to quantify and assess the aesthetic quality of landscape. I tried to overcome this problem with the generalization of aesthetic quality criteria. After literature review, I decided to choose a method called 'Visualand Framework' by Tveit, which summarizes 8 criteria to define aesthetic quality. Although it can't cover every aspect, it provides with basic standards on 'what does a good view look like'.

The third step is illustrating future scenarios. Since sustainable energy can't be detached from landscape, it's necessary to predict the future urban landscape of the MRDH region. Data collection for this part is the most difficult one in the whole graduation period, because there's no specific or clear vision on future landscape, and many policies haven't been translated into spatial consequences yet. I reviewed the official web site of South Holland and tried to combine its ecological policies, new housing and business projects, densification areas and recreational sites to develop a comprehensive urban landscape for 2030. The limitation is that the vision I developed is not fixed, so there might be other possibilities or it might change during the development of the region.

Based on the future landscape scenarios, a catalog of general solutions can be developed. The region is divided into 5 different realms. And for each realm, renewable energy technologies are integrated in a form that not only fits the landscape typology but also preserves or improve landscape quality. For example, natural preservation areas should be strictly protected and no construction activity is allowed there, while in recreational areas land art generators are installed to produce energy as well as provide visual beauty. However, although the design proposals in the catalog are supposed to reveal landscape quality, still it's impossible to meet everyone's satisfaction. In order to make the research more reliable, there needs to be an interactive feedback and review session. Ideally, by showing the before and after comparisons to local inhabitants, it can provide a stronger reason why the decision maker should follow the plan or if there needs to be any other change.

Together with the catalog of spatial solutions, regional energy visions are also developed to calculate whether the planning proposal can make the MRDH region energy neutral. The conclusion is that energy generated from wind and solar sources can meet the electricity demand in 2050 and the two sources should be the alternative for each other in case there's no wind or solar. With good geothermal and residual heat potential, the district heating demand can also be fully satisfied. And the overflow heat can be transported to surrounding areas. Only biomass energy capacity is far less than the regional demand which should rely on biomass import, or the gap can be filled with electricity. For example, electric cars and buses will be more widely used in the future.

The last step of design is to identify key spatial interventions. Two key sites will be chosen to have detailed spatial design and test whether the design proposal is coherent with regional vision. The first key site is located in Delft South. I chose this area because it composes with different urban landscape typologies: densification area, business transformation area, natural preservation, railway, highway and peak landscape, which makes it an ideal place to test sustainable energy solutions and draw synergy in between. The problem or the limitation I'm facing is that the existing buildings and environment might change a lot in the future, but if I design a completely new project, it will lose its unique spatial identity. So, what I did is just based on current situation and provide different solutions on sustainable energy, trying to make other elements simpler and more general.

The societal relevance of this theses is revealed at three different scales: neighborhood, regional and European scale. The largest relevance relies on the regional one. The design of sustainable energy landscape will not only generate local on-site energy to make this region more energy independent, but also preserve or improve landscape quality to contribute to creating a more livable MRDH.

In neighborhood scale, one of the main characteristics of sustainable energy landscape is decentralization (on-site production). Energy from renewable sources can be generated on top of your house roof, in the neighborhood playground, and also in parks and other public spaces. It is much closer to our daily life and needs to be integrated into local landscapes which are perceived and sensed by people every day. The high visibility of these installations might cause conflicts with the existing landscape quality and therefore require cautious spatial planning (Boer, 2018). What's more, because of the decentralized system, it's more possible to achieve energy justice. Vulnerable groups who don't have enough or fair access to the energy market can produce energy on their own.

In the larger European or even worldwide scale, the societal relevance is mainly related to generalizing the results of the research. In my research project, the generalization will be possible because I summarized urban landscape typology and developed a general catalog of sustainable energy solutions. The design proposal tested in the MRDH region can be easily duplicated in any other area of the world as long as it demonstrates similar landscape characteristics. If the spatial conditions are very different from the MRDH region, the methodology I used in this project can still be applied. It provides a relatively comprehensive

way of integrating landscape quality into the design of sustainable energy landscape.

For the ethical issues, the biggest dilemma is how to balance sustainable energy production and landscape quality. While aesthetic quality can be preserved or added based on the Visualand Framework criteria, economic quality and ecological quality might need to be sacrificed to some extent because sustainable energy generation occupies land space. Then it becomes an ethical problem since different stakeholders stand in different positions. For instance, pasture owners might be against to the installation of wind turbines on their farmland when they are worried about the negative effects on livestock. What's more, since it's a long-term spatial intervention, which area should be the priority is still a problem. In my opinion, vulnerable groups which have trouble accessing energy market need to be taken into special consideration because it's an important part of social justice.

To summarize, I review my research project as a comprehensive solution on sustainable energy landscape design, filling the gap between the governmental aspiration of sustainable energy production and local aspiration of a better living environment.