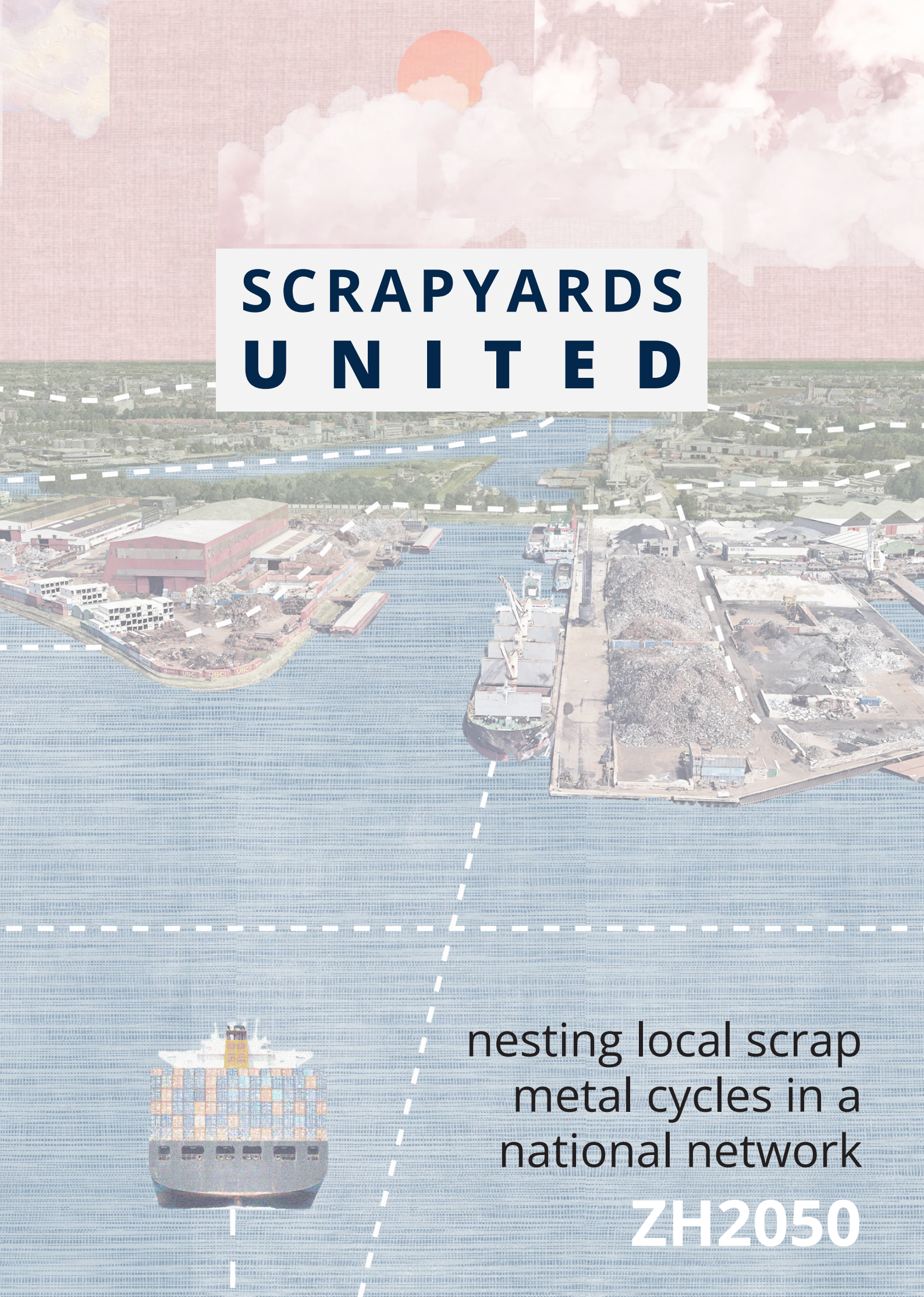
SCRAPYARDS UNITED



nesting local scrap metal cycles in a national network

ZH2050

TU Delft Department of Architectural Engineering +Technology
BK Bouwkunde

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Abstract

Steel is a widely used and very circular material, it can be recycled endlessly but that consumes a lot of energy, therefore, it is one of the most polluting industries in the world. Only 2% of this pollution is caused by production, the other 98% is caused by transportation during the production and recycling process. Half of the pollution caused by transport is by export en import of scrap metal from and to the port of Rotterdam to Asian and African countries, this also creates geo-dependency on non-EU countries for essential materials. We will use research through design approach, quantitative (LISA data and Openstreetmap data) and qualitative methods such as research on the steel cycle, scrapyard activities, stakeholders, and social and spatial environment. The main objective is to reduce the logistic effort by closing loops more locally by creating a network of bigger and smaller hubs and reinstalling makers- and manufacturing industries around the hubs in a symbiotic relationship. Hereby we aim to move metal recycling higher up in the R-ladder of circularity. Different socio-spatial, techno-economic and governmental strategies should make scrapyards more attractive and interesting locations and intertwine them more into the urban tissue. Herefore, they should attract makers- and manufacturing industries around the scrapyards to form a symbiosis in the use of metal and scrap metal. Simultaneously, this increases dutch manufacturing and increases the local economy and decreasing geo-dependency. The end of the report provides a set of strategies that can be applied to scrapyards throughout the country to improve the locations and the network between them. This project can form a precedent, both for other bigger industrial or port cities in Europe, as well as for different material flows.

Preface

A world without metal, can you imagine? In a world without metal there would be highrise buildings, no Erasmus bridge and no Euromast, there would be no cars, trains, boats or planes, there would be no machines, no devices, no computers or phones, there would be nearly 50 million people out of jobs[1] and there probably would not even be a European Union[2]. On the other hand, in a world without iron, there would be 7% less CO2 pollution (Pooler, 2019), there would be less smog, there would be no guns, no bombs, there would be no 'Tata Steel steel dust clean team[3] and no man unworthy iron ore mines. So how to combine the best of both worlds, how to keep using and producing this indispensable, versatile and strong material while diminishing its polluting effect and dealing with the depleting natural stock is one of the biggest challenges we are facing in the world of 'iron'.

In this booklet, the untold world of steel will be explored, analysed and revised with a set of proposed strategies and case studies. Its goal is a national strategy that aims at making the steel material flow more circular, while making it an attractive process for **investors, neighbours** and **governing authorities.**

1 Globally 6 million people work in the steel industry, 2 million directly work in the mill, 49.3 million people are indirectly linked to the industry (World Steel Association, 2021).

2 In 1952 the European Coal and Steel Community (ECSC) was established by the Netherlands, Belgium, Luxembourg, France, West Germany and Italy. The governing role of the ECSC was more or less taken over by the European Economic Community (EEC) in 1958. In its turn, the European Union ensued from this. (Koops, 2018)

3 Tata steel has its own cleaning team that cleans cars, windows and window frames in Ijmuiden and Wijk aan Zee from steel particles that descend around the factory. (NOS, 2018).

Chapter 1:

Uniting the Scrapyards

Scrapyards are dirty places where our old products go and it always smells of socks. You could even go as far as saying they are landscapes of waste.

But this does not have to be true. In this project, we make a strategy that not only re-unites the scrapyards into a well-oiled machine, but also re-unites people and their products.

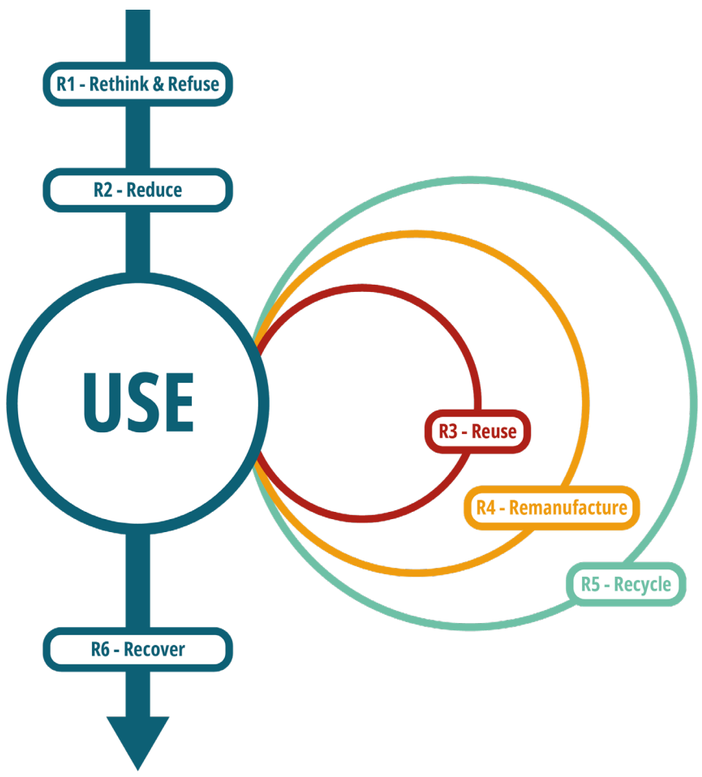
The first thing that should be clear is that in the world of waste, it is all about circularity. When a material or product is circular, this simply means that it can be reused, repaired, recycled or in any other way be turned from waste into product. If we look at the Netherlands, we do not need to look far to see that this is already happening a lot. Second hand clothing is sold online, bikes are brought to a repair shop so they can be used again and even cars are stripped for parts that still work.

This project focuses on how to make steel more circular, starting out by analysing the scrapyards.

THE R-LADDER

The first thing that should be clarified when talking about circularity is the R-ladder, a set of strategies that are aimed at reducing the use of new resources. There are multiple variations on the R-ladder, in this report, the R-ladder created by 'Rijksdienst voor Ondernemend Nederland' or 'Netherlands Enterprise Agency' is used (RVO, 2022), see image below.

The higher up in the R-ladder, the higher the level of circularity is. Moreover, steps that are higher up the R-ladder usually require less energy and effort than those lower down the ladder. To put it simply: reusing a material is simply cheaper and less complicated than sending it to a facility where it can be recycled.



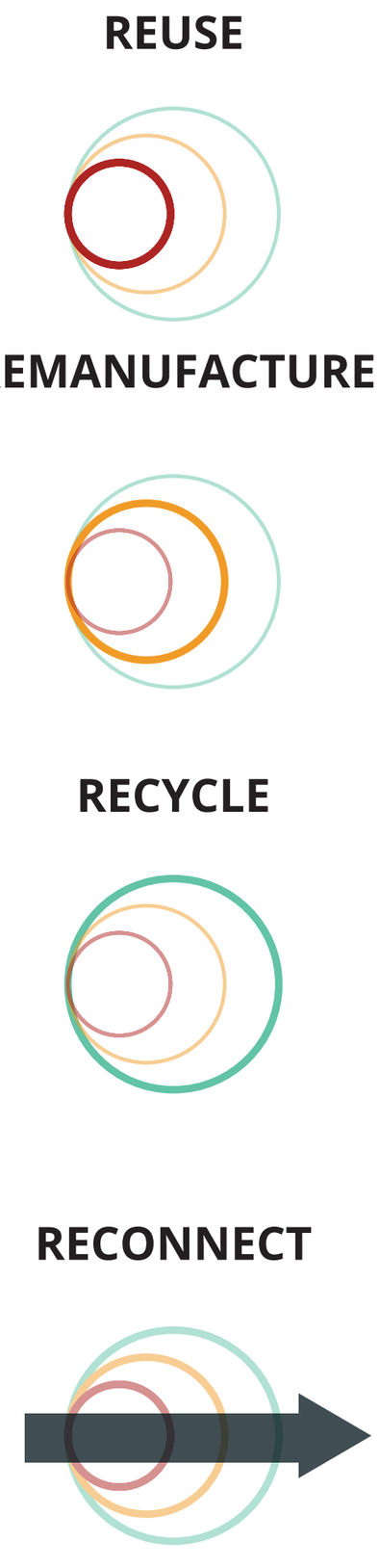
4R STRATEGIES

In order to make scrapyards more circular, 3 of these R-ladder strategies are most relevant: R3 - Reusing, R4 - Remanufacturing and R5 - Recycling. These are the main activities that currently happen on most scrapyards and waste facilities. However, we introduce a 4th strategy: Reconnect.

Reconnecting happens on 2 distincts facets of the process: the social and the technical one.

In the technical approach, it is important not only to make sure that the facilities can Reuse, Remanufacture and Recycle, but also that they are connected with each other. This helps in making the different R's accessible. For example: if a scrapyard is too small to repair bicycles, it can send them to a nearby facility that can do it, making sure that the circle is kept small.

From a social point of view, it is important that the scrapyards are accessible to the companies and the people around it. By turning them into lively places, scrapyards can be places where it is not only useful, but also fun to go.

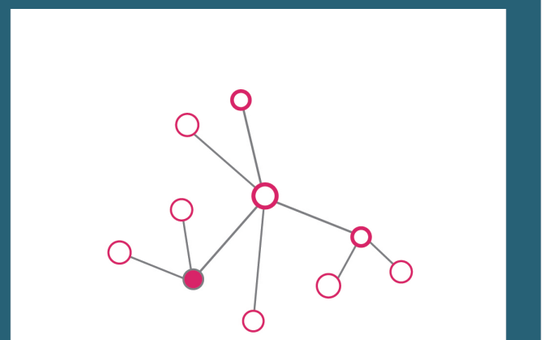


UNITING THE SCRAPYARDS

In order to connect the scrapyards properly, they need to form a strong network, so that they can benefit from each other's qualities. A clever hierarchy of types of existing scrapyards has to be connected to the hierarchy of the R's. This means connecting R3 to smaller scapyards, R4 to the bigger ones, and R5 to a single central location. Going up in this hierarchy, the scale of the scrapyards, the type of scrap, and the processing posibilities grow. This way we can connect the Dutch scrapyards in **SCRAPYARDS UNITED: ZH2050**

SPATIAL

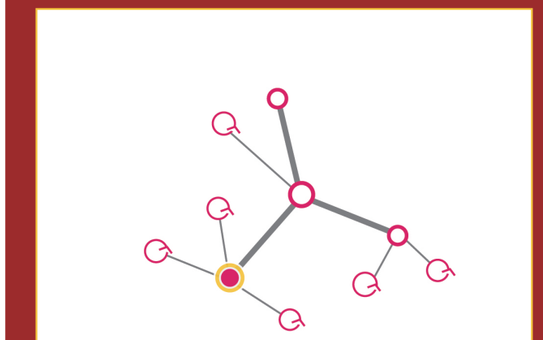
1. Identify Existing Scrapyards



Scrapyards of different scales are spread all over the country. They are linked with dense connections but in a non-hiearchy system which might leads to extra logistic pollution.

MATERIAL

2. Build Local Flow



Include small-scale existing repair shops, initiatives to build the local cycles and change people`s mindsets. Bigger plants start to build the remanufacturing facilities and connections with local repair shops.

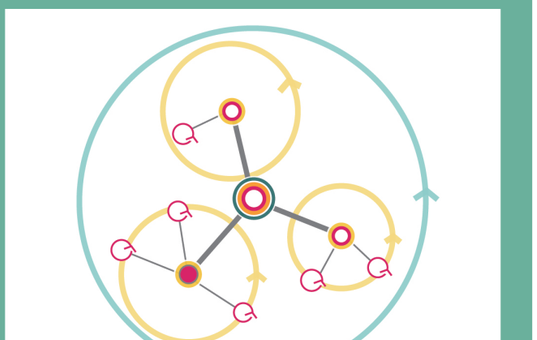
SOCIETAL

3. Use Local Context

Identify the promixity of scrapyards and collaborate with spatial captials like institutions, stakeholders and makers industry so to make use of the strength and have better synergy with places nearby.

SCRAPYARDS UNITED

4. Cultivate Multi-scale Cycle Network



Strengthen the networks connecting different scales and functions of the scrapyards. Complete the network cycle in multi-scale with R-Ladder. SCRAPYARDS UNITED have positive impacts to the whole society in a circular system.

+ R-Ladder

+ Urban elements Catalog

RESEARCH QUESTIONS

To approach the research leading up to the creation of the strategies to allow the vision to become reality, a research question supported with subquestions is used. The main question being answered in this report is:

HOW CAN A STRENGTHENED NATIONAL NETWORK OF LOCAL SCRAP METAL COLLECTION AND MANUFACTURING CONTRIBUTE TO THE TRANSITION INTO A CIRCULAR STEEL CYCLE?

What are the current process and processing locations of metal production and recycling of metal scrap?

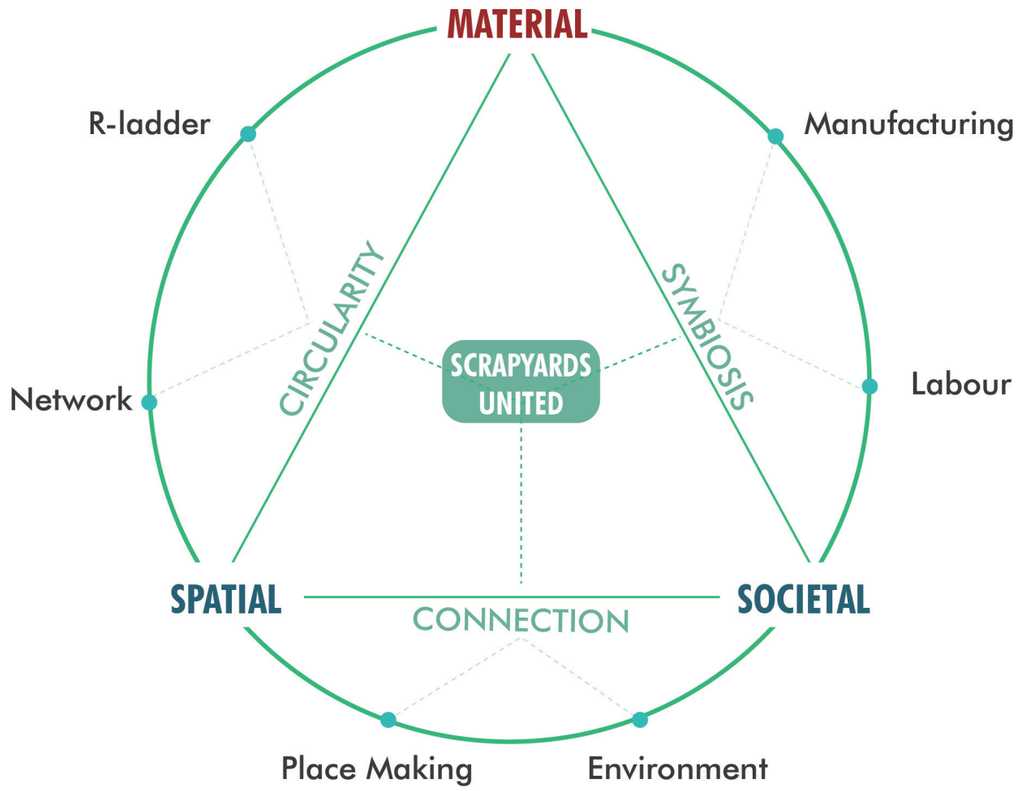
How can a network be formed between metal scrapyards of different scales and specialisations to create an optimal circular flow of scrap metal in the Netherlands?

What spatial and governmental strategies can be applied to create a symbiosis between scrapyards and metal manufacturing industries?

What spatial and governmental strategies can be applied to metal scrapyards to intertwine them with the urban tissue?

CONCEPTUAL FRAMEWORK

Next to the more practical research questions a conceptual framework is made to guide the project to multiple themes and concepts to reach the goal. Central in the conceptual framework stands 'SCRAPYARDS UNITED', placed inside a triangle formed by the three main concepts of the project: Material, Spatial, Societal. These three main concepts are then connected by some linking themes: Symbiosis (between scrap and society) Connection (between society and the scrapyards) and Circularity (between scrapyards and scrap). More concrete tools to support these linking themes are Manufacturing and Labour to create Symbiosis, Placemaking and Environment to create Connection, and Network and R-ladder to create Circularity.



METHODOLOGY

The goal of the project is to make the metal industry more circular by focussing on the processing and locational cycle of metal scrap. The project is approach by research through design “an approach to conducting scholarly research that employs the methods, practices, and processes of design practice with the intention of generating new knowledge” according to (Zimmerman & Forlizzi, 2014). Next that, the outcome of the research through design process is used to formulate a vision and strategies to find a solution to the statet goal. The data is collected through SDS and Capita Selecta lecture series provided by the TU Delft, scientific papers and other readings, site analyses, and Geographic Information System (GIS) analyses. The data is than processed and interconnected by assessment and evaluation to draw yet undiscovered conclusions.

The report started with Chapter 1: Uniting the Scrapyards by giving a brief and general introduction of our vision to make clear what the report is leading up to. It then continues in Chapter 2: The Untold Truth of Steel where a general introduction about steel is given to then explain the process to make steel and finish by opening up about how steel travels the whole world in its making process and the pollution it is creating. In Chapter 3: Scrap in an ideal situation we start by stating our goals and link them to the Sustainable Development Goals (SDG’s), after that the vision is explained through a series of diagrams, to then be projected onto a vision map. Next, the strategies related to the R-ladder are shown together with systemic section to then create a catalog of used spatial elements. In Chapter 4: Mapping the scrap, a series of analyses maps is shown to set out the current situation and distribution of scrapyards in the Netherlands. In Chapter 5: Strategic Field Experiments,six case study scrapyards are analysed and the R-ladder strategies of chapter 3 are implemented in these case studies to come up with a fitting set of strategies per case. The chapter finishes with a more extensive design for the sixth case study; the main hub in Rotterdam. Lastly, Chapter 6: To conclude... concludes the report by concluding the strategies and answering the research questions. Finally, the relevance, ethical implications, further research options, and research biases are in this project.

Chapter 2:

The Untold Truth of Steel

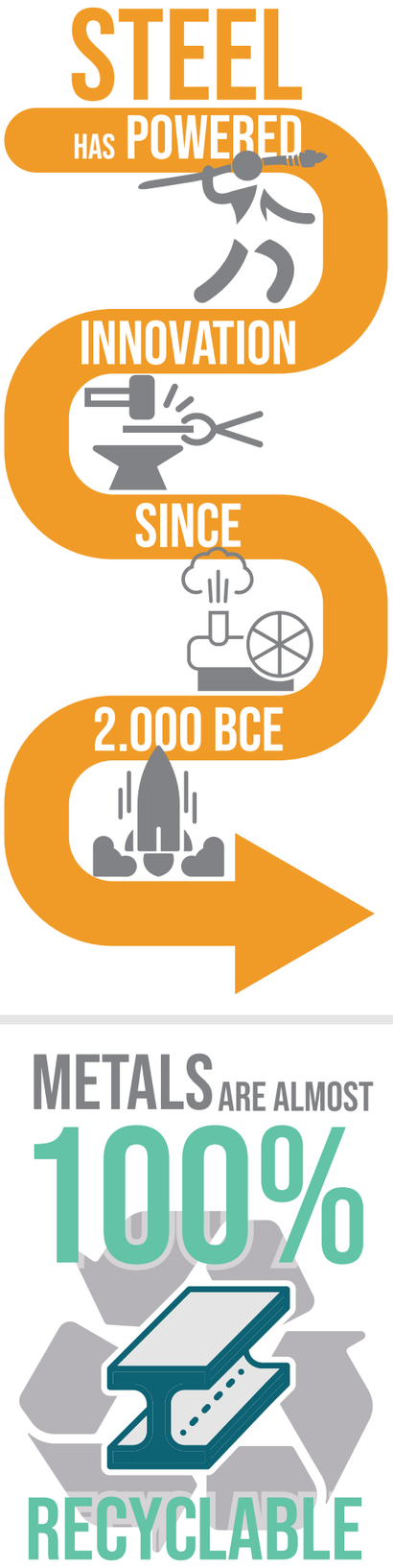
We see it everywhere nowadays: “we make maximal use of recycled and renewable materials” and this is no different for metal. This all sounds very promising. However, this recycling process is by far not as good, sustainable and clean as they make it seem.

Let’s find the Untold Truth of Steel

INTRODUCTION

It could be said that steel is a world-changing material having a huge positive and negative influence on people and the planet. This has been the case for many centuries, iron has changed our world three times in history already and now we are on the verge of a fourth time. The first big change happened in prehistoric times when the invention of the cheap and mass production material iron replaced the much scarcer bronze which created a huge power shift and disruption of a fairly united Europe. The second time was in 1709 when British entrepreneur Abraham Darby used a blast furnace to melt iron and made it possible to cast it, this was the birth of cast iron. Cast iron made mass production of iron products possible and meant the start of the industrial revolution from which we know and still see the effects. It allowed Great Britain also to become one of the largest empires in the world initiating globalisation. The invention of Bessemer-steel in the UK in 1856 meant the third big change. This type of iron was much more flexible, stronger and cheaper than cast iron and made huge changes in infrastructure, construction, utensils and society as a whole. The effects of this technology are still visible in our world today. (Kuijpers, 2020)

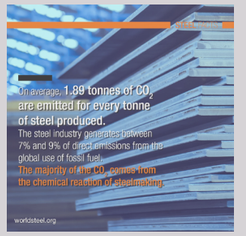
We are now on the verge of the fourth big change in the metal industry. Metal is endlessly recyclable and it happens a lot already. However, the recycling process costs a lot of energy which is produced by coal and creates huge amounts of CO2 emissions. Next to that, scrap metal travels half the world to be recycled which is also not sustainable. If we can keep recycling metal more local and use new clean technologies to do so, we can step into the fourth generation of steel; the generation of Green Metal.

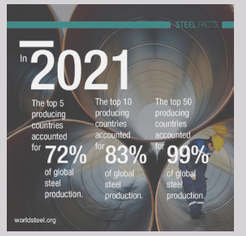


WHAT IS STEEL?

Metal can be divided into two main categories, ferrous metals and non-ferrous metals. In a technical sense, ferrous metals contain the element iron and non-ferrous metals do not. Steel is iron with a very small amount (1,5% or less) of carbon (WorldSteel Association, 2022). All types of iron and steel are considered ferrous metals, all other types of metal are non-ferrous. The vast majority of metals are ferrous metals, mainly steel. Steel is the most widely used metal in various applications, while most other metals are mainly used for more specific purposes. Some metals are very scarce, however, iron is also getting more scarce as we are using a lot for a long time already. This also means that the price of non-ferrous metals is much higher than ferrous metals, although this price is rising as well. When thrown away they often end up on the same scrap heap, creating problems in sorting and recycling. Splitting ferrous metals from non-ferrous metals is quite easy because of the magnetic property of ferrous metals, but sorting different ferrous metals between themselves is much harder and often has to be done manually, the same goes for splitting non-ferrous metals between themselves. While for the highest possible recycling rates metals should be as sorted as possible. (QuestTech, 2018) and (WorldSteel Association, 2022)

STEEL FACTS





retrieved from: WorldSteel Association (2022)

Applications of Steel

Steel is an essential and widely used material, it is hard to imagine a world without any steel. The vast amount of steel in all kinds of sectors has a big variety of applications. To give an idea of the steel we use see figure 1: in 2019 the worldwide steel consumption was 1,768 megatonnes of steel, and in 2020 in the Netherlands 4,3 million tonnes yearly which equals around 235 truckloads of steel every day according to the WorldSteel Association (2022). They calculated that we use 227 kg of steel per capita per year worldwide and in the Netherlands 252 kg. They also estimate an increase in steel use of about 20% until 2050 to meet the needs of the growing population. About half of the steel is used in the building and infrastructure sector and metal products. Mechanical equipment and the automotive industry are the other main users of steel according to the WorldSteel Association (2022). However, because of different service lives, the amount of scrap produced by these sectors is not equally divided. Longer service life generally means less created scrap. The production process of steel is highly polluting, according to the WorldSteel Association (2022) steel is accountable for 7% to 9% of all CO2 emissions created by fossil fuels. However, simultaneously steel is indispensable in the energy transition and the Paris Agreement. “Almost every greenhouse gas mitigation technology relies on steel, including the generation of thermal and renewable energy, electrification, mass transport and the hydrogen economy. Without steel, the Paris Agreement target will not be met.” (World Steel Association, 2021)

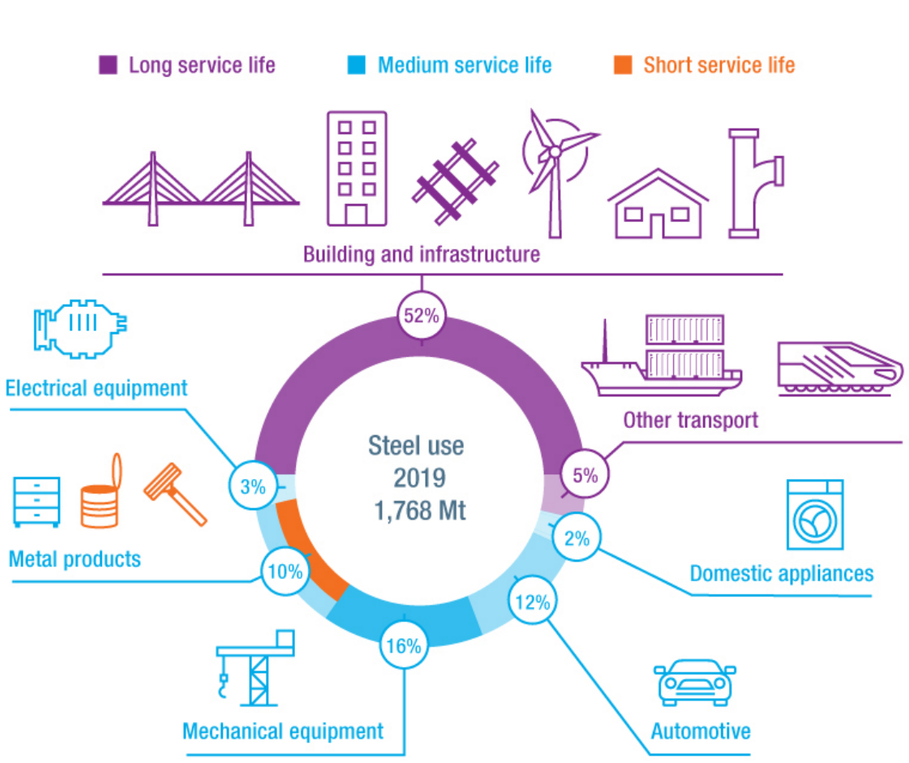
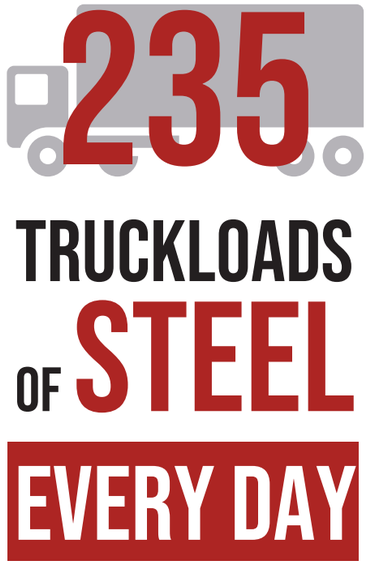


Figure 1: Worldwide steel consumption (WorldSteel Association, 2022)



WHY ROTTERDAM

Rotterdam is a **big consumer** of steel because of the large amount of construction steel in its highrise buildings and its big population consuming metal. Next to that, the port is a large consumer, having multiple steel maritime facilities like **ship- and container repair** and offshore facilities like wind parks that are managed from the port.

TO CONCLUDE

Steel is a crucial material for all kinds of industries and applications and the use of steel is predicted to grow even more in the coming decades to provide for the needs of the fast growing population. Steel is at the same time very polluting but also indispensable in the way to achieving the targets of the Paris agreement

Recycling of Steel

Metal is a very recyclable material, theoretically, 100% of all metal can be recycled. The recycling process can be divided into three main steps, collection, preprocessing (separation and sorting), and final processing (recycling and refining) (UNEP & Reuter, 2015). The recycling rate is the product of each step in the process, so it is important to reach high efficiencies in every step of the process.

COLLECTION

The first step of the collection is done in two ways, firstly by consumers and secondly by formal take-back systems according to (UNEP & Reuter, 2015). The first is the hardest since it is necessary to convince consumers to bring their waste material to the right place and not just throw it into the general waste. This can be done by buying steel and offering more money for high value and more sorted metals or charging people for throwing away unsorted waste. The second one is easier to control, a good example is a new regulation for deposits on tin cans by the end of 2022, helping the collection and sorting process a lot (Ministerie van Infrastructuur en Waterstaat, 2021). Also, bigger waste is generally already thrown away at the right place because it is too big for general waste collection.

PREPROCESSING
(SEPARATION AND SORTING)

The second step is preprocessing. To be able to recycle metal it has to be 'pure'. This means it can not be mixed with other metals and it can not be contaminated with other materials or treatments like paint and coatings. To be able to do high-value recycling, metal should be disassembled, separated, sorted and cleaned and often shredded to make transport and recycling easier. These steps often happen in different locations by different companies, which also means logistic efforts between every step.

Figure 2: Magnetic sorting drum (Steinertglobal, n.d.)

Figure 3: Manual metal sorting (Minter, 2011)

Figure 4: Laser-based metal sorting technology (Cronimet Ferroleg, 2021)

Sorting metals is a very precise and time-consuming process, there are 60 sorts of metals from which only 18 have a recycling rate of over 50% (UNEP & Reuter, 2015). Steel sorting is an easier, quicker and automated process that is possible because of its ferrous property as shown in figure 2. There are a lot of different types of steel existing, but most of them can be combined in the steel recycling process and therefore do not always have to be separated from each other. The difficulty in the steel preprocessing phase is the cleaning, steel is prone to corrosion and is therefore often treated with for example paint. This paint has to be removed before it can be recycled properly which can be difficult and adds an extra step in the recycling process. Sorting of non-ferrous metals is much more difficult and time-consuming because it usually has to be done manually as shown in figure 3. However, a lot of research is done into new technologies to make the sorting process of non-ferrous metals automated as well, see figure 4.

Steel makes for 94% of all the used metals annually according to Bhutada (2021). This is mainly attributable to the magnetic quality of steel which makes the sorting process much easier. According to the UNEP & Reuter (2015) steel is already recycled for around 90%, with highly varying recovery rates per sector, figure 5. However, they warn that it should be taken into account that using mass-based recycling rates does not address the problem of not recycling critical metals. However, this should not be neglected because of the huge difference in mass compared to bulk metals like steel, aluminium and copper. This mainly causes problems for the depletion of these critical materials, for climate impact the recycling of bulk metals, steel, in particular, is much more crucial.

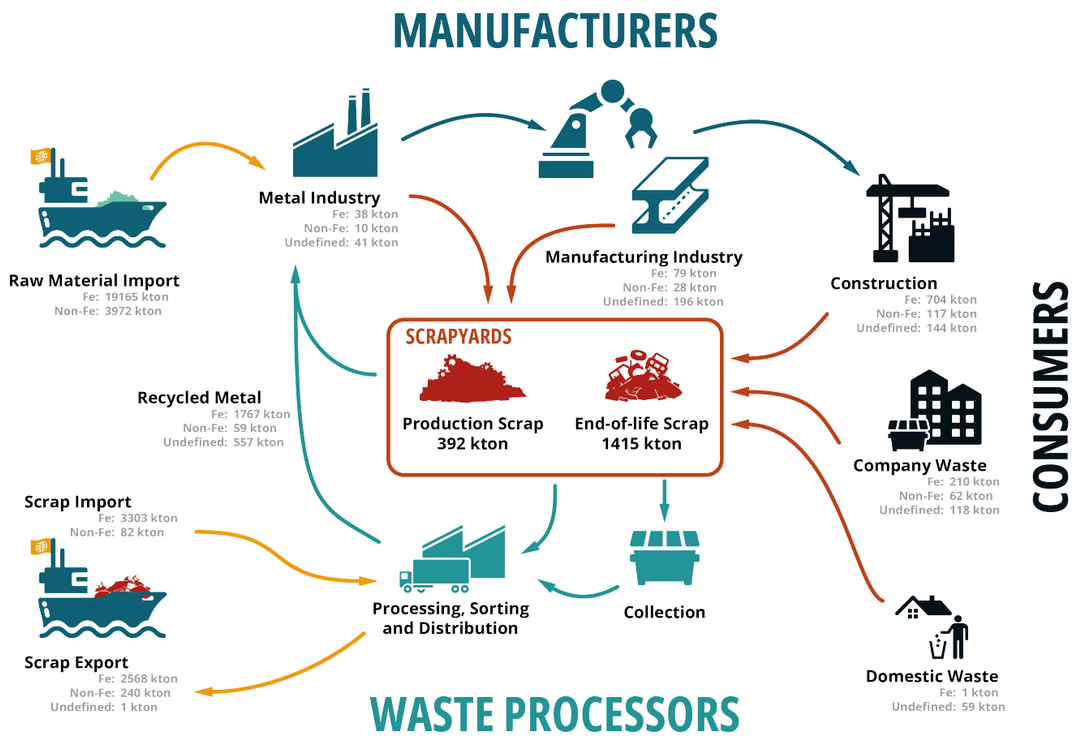


Figure 5: Scrap produce per sector

FINAL PROCESSING
(RECYCLING AND REFINING)

The third step is final processing (recycling and refining). As said before, theoretically it is possible to reach a 100% recycling rate when it is rightly presorted. Recycling metal is important for critical metals because of the depletion of the materials and for bulk materials, mainly steel, it is important because of the polluting effects. In the Netherlands, there are already some recycling facilities for different types of metal, but not for steel; the most polluting one.

To understand the advantages of recycling compared to producing steel out of raw material we need to understand both processes. The production of steel from raw material is done by a method using first a Blast Furnace (BF) and then a Basic Oxygen Furnace (BOF), The recycling from scrap steel into new steel is done by an Electric Arc Furnace (EAF). The explanation of both processes is retrieved from ArcelorMittal (n.d.).

For steel making process from raw material, the iron has to be subtracted from the iron ore, this process requires the iron ore itself, limestone and coal. The iron ore and limestone are processed in a sinter plant where they are combined at high temperatures to be processed into so-called sinters that can be used in a BF. The coal has to be pre-processed to cokes, a very pure form of coal, in a cokes oven that also requires very high temperatures. The next step is to extract the actual iron from the sinters, this happens in a BF that is heated by the cokes to around 1.650 needing around 13,5 MJ of energy per tonne of steel in the process (Martelaro, 2016). In this process, the carbon is removed from the iron ore with CO2 as a byproduct, next to the CO2 that is produced by burning the cokes for heating the BF. The liquid iron is then cast into the BOF, where the steel is formed at around 1.600 using around 11 MJ of energy per tonne of steel in the process (Martelaro, 2016). The outcome product is liquid steel that is cast as semi-finished products which can be further processed into the actual product(parts), mostly in a different factory. Doing the further processing in the same location is more efficient because the steel does not have to be melted again, but this is a much more specialised industry and is thus often distributed to other factories.

The steelmaking or recycling process from scrap steel is much easier, however, only after the steel sorting and cleaning process. Especially the cleaning of steel is, as already mentioned, a time consuming and expensive process, but crucial for high-value recycling. Recycling scrap into new steel can be done with 100% scrap, so no added material is needed. Another advantage is that the furnaces that are used for this process can be powered by electricity instead of fossil fuels. The scrap is melted in an EAF to be heated to approximately 1.800 using only around 2,25 MJ of energy. This means that this is a much more sustainable option than the previous, especially if the needed electricity is produced green. An EAF is more than ten times as efficient as the BOF steelmaking method. On top of that, the electricity used in the EAF can be produced green without CO2 pollution, the BF can only be powered by coal and the BOF by either coal or gas, creating a lot of CO2 pollution: 1,89 kg per kg of steel produced (WorldSteel Association, 2022).

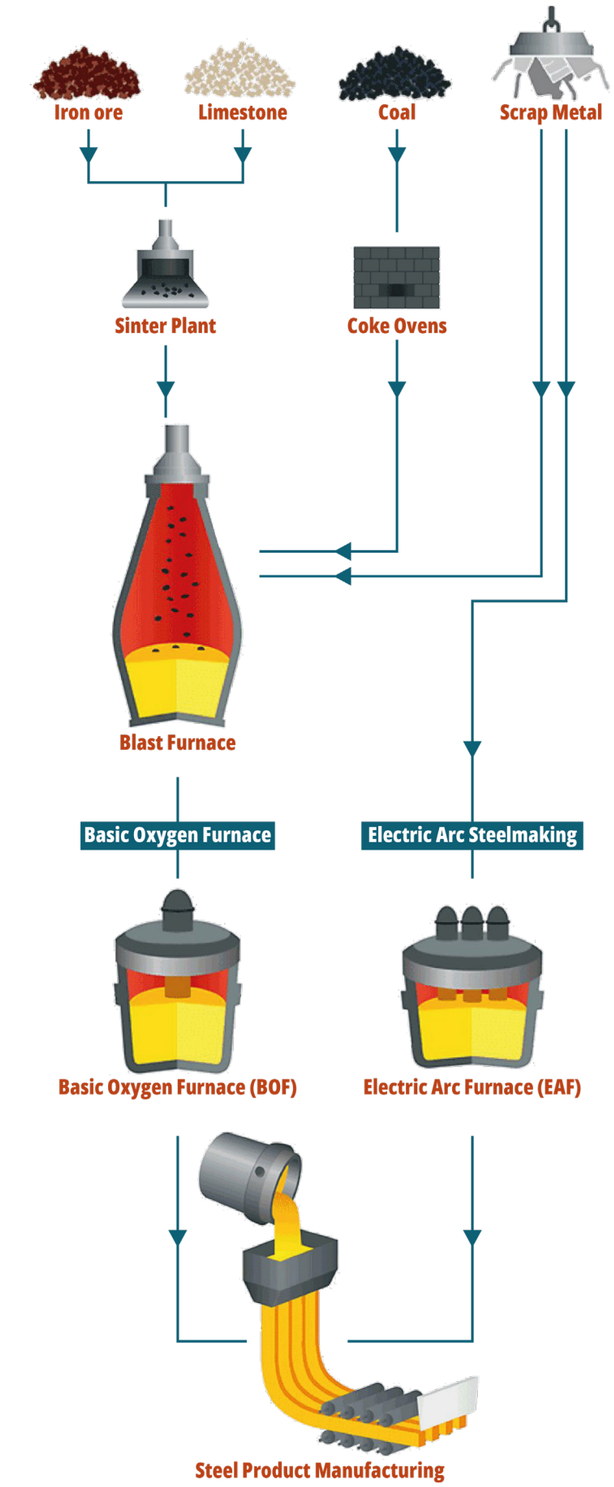
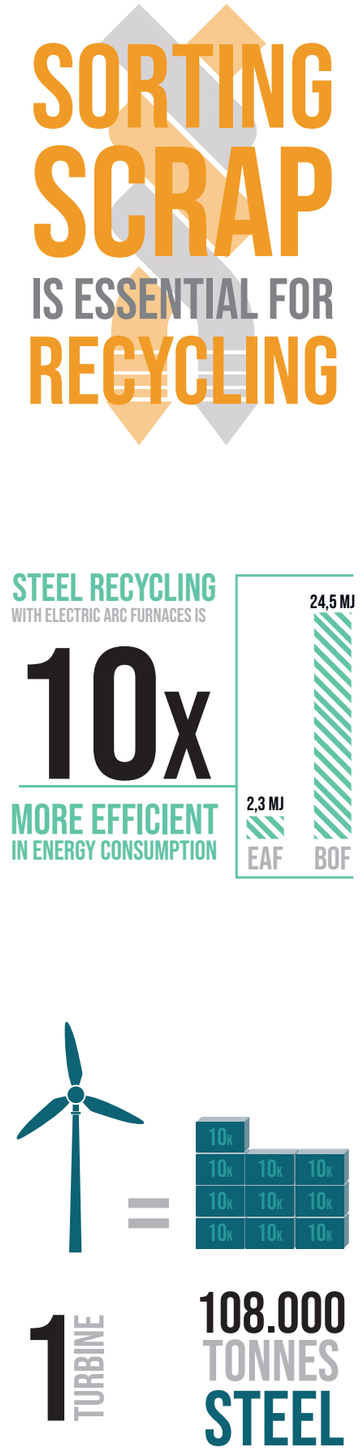


Figure 6: Steelmaking diagram (Nieto, 2019)

An EAF uses on average around 425 kWh per tonne of steel produced, newer ones can be even more efficient (Logar & ŠKrjanc, 2021). To produce this energy in a green sustainable way, the best source is wind energy on the North Sea. A 10 MW turbine (one of the bigger ones currently, however, there are already turbines being developed of around 15 MW) on the North Sea produces around 46.000.000 kWh per year (Rijksoverheid, n.d.). This means that with the energy of one of these turbines, 108.000 tonnes of steel can be produced yearly.

According to ESTEP AISBL (2019) the current production by EAF accounts for 28% of the total steel production and reaches 46% in Europe. The production by EAFs is expected to exceed 45% worldwide starting from 2030 when the market-driven steel production will become more technology and climate-driven. Local and global climate goals and regulations will push this transition forward. Mombelli et al. (2020), state that the currently available scrap might not be sufficient to reach these higher levels of steel production from scrap. They write that to reach these goals the scrap collection and recovery should be higher and can be done by improved sorting and recycling methods and the introduction of cleaner iron sources to power the EAFs.



WHY ROTTERDAM

Rotterdam already has small scrap collection **facilities** and big **hubs** inside the port. These big hubs also account for the preprocessing phase by sorting, cleaning and shredding the scrap metal. The final processing step of recycling is not yet present in the Netherlands, but the port is the **perfect location to create such a recycling facility** because of its heavy industrial character. Next to that, it could contribute to the manufacturing and recycling of **maritime industries** and the offshore wind turbine industries. Also, there is already a lot of specialised (industrial) **labour** and **innovation** in proximity.

TO CONCLUDE

The first challenge in the circularity of steel is to move higher up the R-ladder and do more reuse and repair locally. In the collection process, more incentives and encouragement for consumers to separate their waste and bring it to the right waste collection, and more formal take-back systems for different types of scrap can help. In the preprocessing phase, better sorting of critical metals by manual labour or by new innovative automated technologies and better sorting and cleaning of ferrous bulk metals can improve the situation. The steelmaking process by Electric Arc Furnace is preferred above the Basic Oxygen Furnace, as this process is in itself more circular and efficient and the needed energy can be produced green.

Material Flow

As stated before: “we make maximal use of recycled and renewable materials” and metal is no exception. We already saw that there are quite some obstructions in the recycling process in terms of material, energy and pollution. Additionally, there are more difficulties in the material flow and the processing locations. To find these out, we follow the route that metal and scrap metal travel during their life.

RAW MATERIAL IMPORT

There is a lot of logistic effort involved in the metal making and recycling process, starting from the raw materials that are needed, through the locations of metal production, the location of the consumers to the collection and place of recycling to then start all over again. First, let us have a look at some numbers.

The Netherlands imports around 30 Mt of iron ore from which around 65% is throughput to Germany, and 8 Mt is processed in the Netherlands (all by Tata Steel) see figure 7. Tata Steel is the only steel-producing factory in the Netherlands and produces 6,1 million tonnes of steel, all by BOF production method (WorldSteel Association, 2022). There are however some other factories that make steel products out of crude steel. The import and export of finished steel products are around the same and the Dutch consumption of steel products is 4,3 million tonnes. The Netherlands produces around 2,6 million tonnes of ferrous scrap (Amsterdam Economic Board, 2019). The 3,6 million tonnes of scrap that is imported is imported as throughput from Germany and Belgium to be shipped to recycling plants outside of Europe.

Tata Steel IJmuiden, which uses the BOF method to produce steel, needs the input of iron ore, coal, limestone and scrap steel from which only the scrap steel is coming from the Netherlands itself. The other materials are not available in the Netherlands so we are depending on other countries. Tata Steel gets their limestone from quarries in Belgium by train according to Jansen (2016), a fairly reliable country that is also very close and thus does not require long travel distances. For iron ore and coal, however, we are dependent on other countries, outside of Europe. The coal Tata Steel uses is coming from India and has the same big travel distance (Tata Steel Europe, n.d.). 75% of all the iron ore that is mined comes from only these seven countries (LePan, 2020). Another issue is that we are simply running out of high-quality iron ore, low-quality iron ore is still usable but requires more energy to process and turn into steel. For other, critical metals this matter is even more pressing, some metals are really running out, making recycling them essential. The travel distances between raw material producers and Tata Steel are huge, creating huge amounts of emissions.

Tata Steel produces only crude steel which needs further processing into final products, which happens partly in the Netherlands, but a lot is also imported. This is because most steel factories are highly specialised and produce only specific products. Specific products are produced here and are exported, and other specific products are produced elsewhere and imported. However, the amount of industry that is located in the Netherlands is relatively low, about 12% of the GDP, while the European average is around 20%.

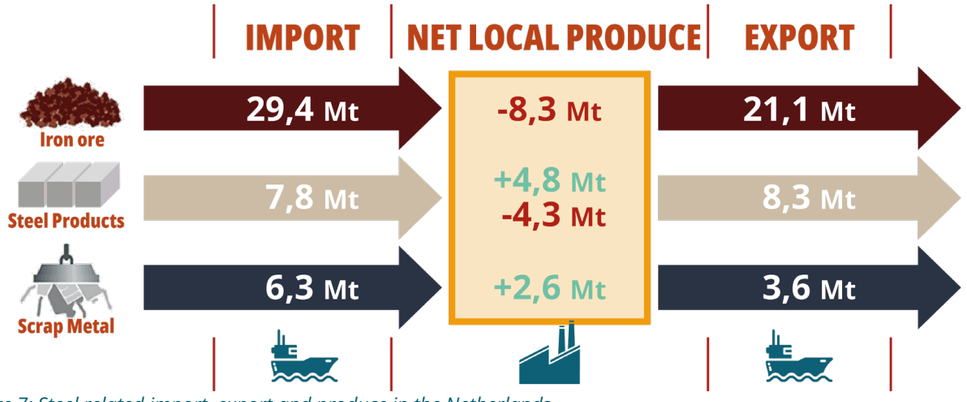


Figure 7: Steel related import, export and produce in the Netherlands

SCRAP EXPORT

When metal products come to the end of their life they are, as explained in the previous chapter, collected, sorted and recycled. The collection happens in local scrapyards and is then sorted and shredded to make it ready for recycling. This recycling, however, is not happening in the Netherlands. In the last decades, a lot of dutch melting plants went bankrupt (Wester, 2020). There are still some non-ferrous or very specialised ferrous metal recycling plants existing, but they only process very small amounts of high value and highly sorted metal. The biggest bulk of scrap, mostly steel, is exported to non-European countries to be recycled there (Stooker, 2021).

Turkey is by far the biggest scrap metal importer, importing more than 30% of the world’s scrap steel according to Stooker (2021). She writes our scrap export even goes for 80% to Turkey. From the economic point of view, this makes a lot of sense as well, Wester (2020) writes that Turkey offers around twice as much for scrap (20-25 cents/kg) as local buyers offer (8/15 cents/kg). Transport costs also do not weigh up to this big price difference; inland trucks cost often cost around €30-€40 per tonne while the price for a shipment to Shanghai costs around €20-€30 per tonne according to Wester (2020). He writes that if dutch metal traders are trading with European countries, it is often with the Czech Republic, Poland or Italy. A truck drive there costs around €1.250-€2.000/container, while shipping a container to China only costs around €850/container. Although trucks are almost 15 times as polluting as ships, the travelled distance to Turkey is around 25 times further than from Rotterdam to Groningen. Besides, to get the scrap metal on a ship from Rotterdam to Turkey, the truck drive Rotterdam-Groningen is still necessary. Next to that, some scrap collection locations can also be reached by train or barge and these modes of transport are much more efficient and clean than trucks. Another reason to export especially these unsorted bulk metals is that the sorting often has to be done manually and labour costs are much cheaper in Turkey and the energy prices are much lower according to Stooker (2021).

> “Netherlands world champion recycling? In fact, we are exporting our climate- and waste problem.

ENVIRONMENTAL IMPACT

The environmental impact of steel production is huge, as already stated, 7% to 9% of all pollution created by fossil fuels is coming from the steel industry. The Netherlands has one big steel-producing factory, Tata Steel, which is the biggest CO2 polluter in the Netherlands (Smit, 2021). However, next to the pollution during the production process, there are also a lot of emissions produced by the huge travel distances. For the creation of steel, iron ore, coal, and limestone are needed that can all not be mined here in the Netherlands and have to come from all over the world. At the end of the life of steel products, they are collected and shipped to Turkey and sometimes the recycled product is even shipped back again according to Stooker (2021). This creates a lot of unnecessary logistic efforts and thus a lot of unnecessary pollution. This pollution can be reduced by reducing the creation of scrap by moving higher up the r-ladder. Also, recycling steel in

the Netherlands by the Electric Arc Furnace method contributes to reducing emissions massively. The production process itself is much more efficient and clean, there is no need to export scrap, and the production of steel out of raw materials is decreased and with that their transport.

Right now, we are basically exporting our climate- and waste problem (Wester, 2020). Although it is currently economically attractive to export our scrap to Turkey, there is increasing pressure to reduce shipping distances. Not only will this reduce the emissions from shipping, but it will also be economically more attractive in the long run. Moreover, recycling within the European Union is, according to Wester (2020), about 3 times less polluting than for example India, due to the strict environmental norms the European Union upholds. Additionally in the European Green Deal, there are mentions of general waste and thus also scrap export bans.

European Green Deal

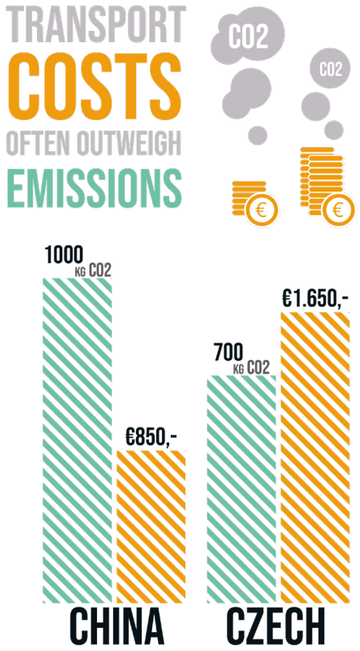
"A sustainable product policy also has the potential to reduce waste significantly."

"Where waste cannot be avoided, its economic value must be recovered and its impact on the environment and on climate change avoided or minimised ... EU companies should benefit from a robust and integrated single market for secondary raw materials and by-products"

Proposals:

- "mandatory recycled content"
- "EU model for separate waste collection"
- "rules on waste shipments and illegal exports"

retrieved from: (European Commision, 2019)



WHY ROTTERDAM

Rotterdam has some main collection hubs scrap steel in the port, now to be exported to Turkey. The Netherlands has a high quality and high-density logistic network of water, railway and road, especially to the port. Additionally, the port of Rotterdam is the biggest in Europe and has a central location in the country in North-Western Europe already being a gateway to Belgian and German industrial locations. Making the steel cycle more national will reduce the number of jobs in logistics to other countries, however, it will add new jobs in the collection, sorting and recycling industry.

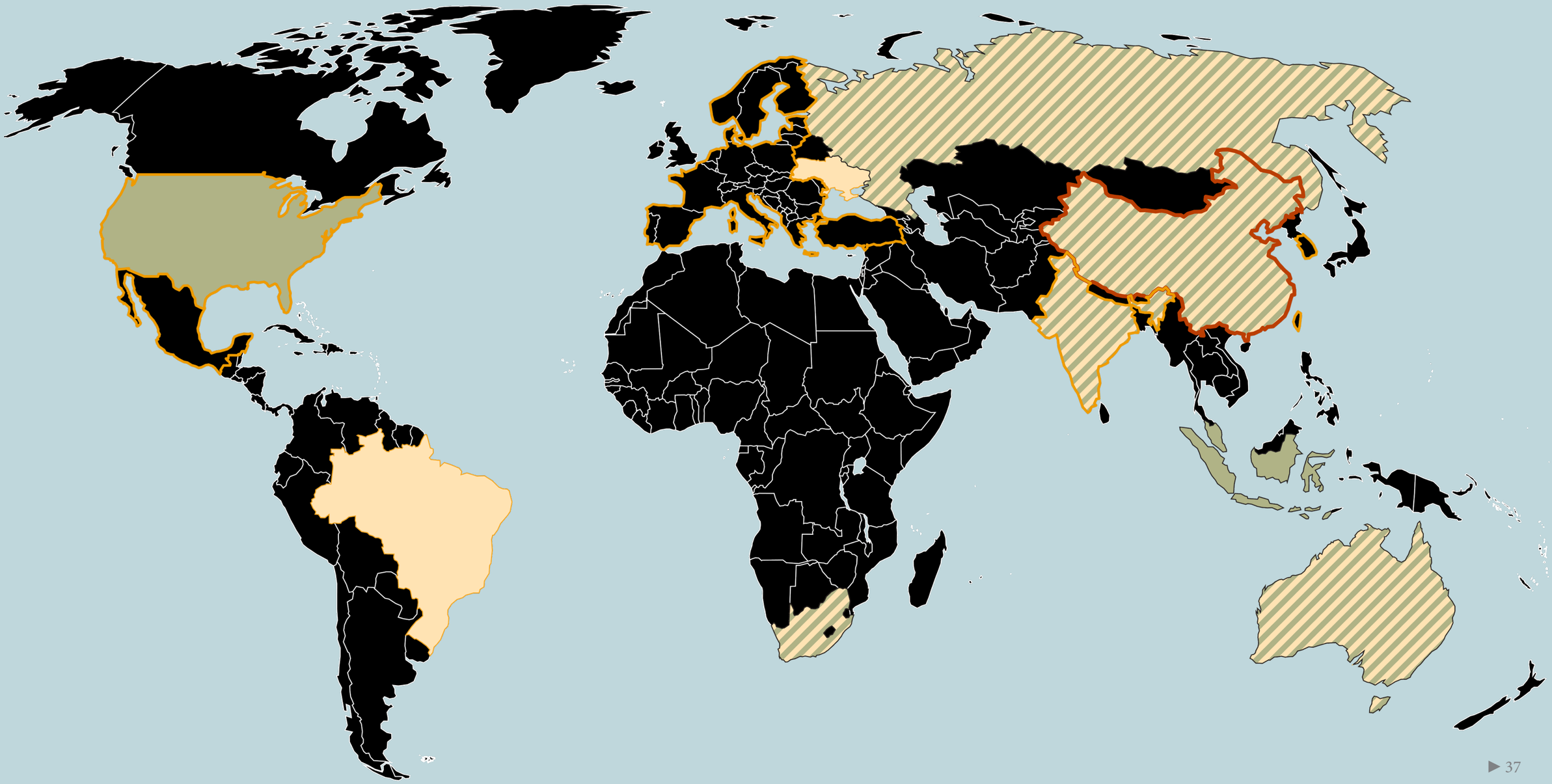
TO CONCLUDE

Luckily there are some shifts and solutions to solve this polluting steel problem. There is an upcoming idea that the polluter has to pay, if in the coming years this becomes a broadly supported idea and a basis for new regulations this might mean that the polluting long-distance shipments of waste will become more expensive and recycling locally will also become economically more attractive. If this is extended, even more, it might even mean that the pollution that is caused by the recycling of our steel will be charged back to us, and not the country that is doing the recycling. Next to that, one of the bigger scrap metal importers, China, put restrictions on waste imports (Teurlings, 2019). Additionally in the European Green Deal, there are mentions of general waste and thus also scrap export bans.

analyzing steel Geo-dependency

The Netherlands depends on less- or even unstable countries making the supply less reliable, while steel is already shown to be very essential. This geo-dependency has become very clear in the past months with the war in Ukraine, with Russia and Ukraine being two of the seven biggest iron ore producers.

Coal Producers Iron Ore Producers Scrap Importers Limestone Producer



Chapter 3:

Scrap in an Ideal Situation

After forming our research question and setting our goals, we envision an ideal zero-scrap world. However, it's very unrealistic for the time being. In this chapter we will take references from SDGs, and we will revise our goals through them. Then we will present the nested loop system, which will set the basis for our project. The vision map will visualize our strategy

UTOPIAN SCRAP

In an ideal situation, there is no metal scrap at all. All products and structures stay up-to-date, have great durability and require no maintenance. But it is no secret that this will not become reality soon. Realistically speaking, we need a highly resilient system that deals with metal in all phases of the R-ladder (RVO, 2022).

In this system, all scrapyards require a makeover, changing them from waste collection, sorting and processing hubs, into places of local reusing (R3), remanufacturing (R4) and recycling (R5). Additionally, it is important that the scrapyards are well-connected to one another, forming a network that is flexible and resilient.

Apart from the impact these new places have on the material facet, they can have great beneficial impacts on the social, economical and even political facet as well. By connecting the new scrapyards to the cities and villages, they can become places where neighbours come together to sell and buy second hand products, local manufacturing centres where start-ups can sprout and grow, and where local companies can cluster and organise themselves to ease communications with the governing authorities.

Our Goals

0 **Put the metal cycle higher up on the R-ladder**

1 **Decreasing the logistic effort made in the circular metal cycle**

2 **Introduce repair and remanufacture on a local scale**

- Change mindset
- Create a symbiosis between scrapyards and manufacturing industries
- Intertwine scrapyards more in urban tissue and make them more
- Intertwine scrapyards more in urban tissue and make them more attractive

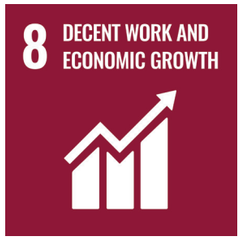
3 **Improving the recycling process by the use of hydrogen**

4 **Reduce geo-dependency of metal on non-EU countries**

working towards a SUSTAINABLE FUTURE

Meanwhile, it is important to understand how these interventions can contribute to reaching the Sustainable Development Goals (United Nations, 2015) set by the United Nations in 2015. These 17 thematic goals form a "blueprint to achieve a better and more sustainable future for all" (United Nations, 2017)

SUSTAINABLE DEVELOPMENT GOALS



PROMOTE SUSTAINED, INCLUSIVE AND SUSTAINABLE ECONOMIC GROWTH, FULL AND PRODUCTIVE EMPLOYMENT AND DECENT WORK FOR ALL

HOW WE ACHIEVE IT:

By proividing more low-cost workplaces in industrial clusters, start-ups and scale-ups can more easily establish and grow while staying connected to innovation and industries.

BUILD RESILIENT INFRASTRUCTURE, PROMOTE INCLUSIVE AND SUSTAINABLE INDUSTRIALIZATION AND FOSTER INNOVATION

HOW WE ACHIEVE IT:

By creating strong industrial and innovation clusters around metal waste collection and processing points, circular manufacturing will be encouraged.

MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

HOW WE ACHIEVE IT:

The new reuse and remanufacture hubs are aimed at making inclusive places where citizens can get to know the ins and outs of the manufacturing industry first hand.

ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS

HOW WE ACHIEVE IT:

By making new places close to residential areas where products can be reused, repaired or remanufactured, their lifetime can be increased. It also helps to create consumption awareness.

OVERVIEW OF SPECIFIC TARGETS

8. DECENT WORK AND ECONOMIC GROWTH

8.2: Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors.

8.3: Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services.

9. INDUSTRY, INNOVATION AND INFRASTRUCTURE

9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.

11. SUSTAINABLE CITIES AND COMMUNITIES

11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

11.a: Support positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning

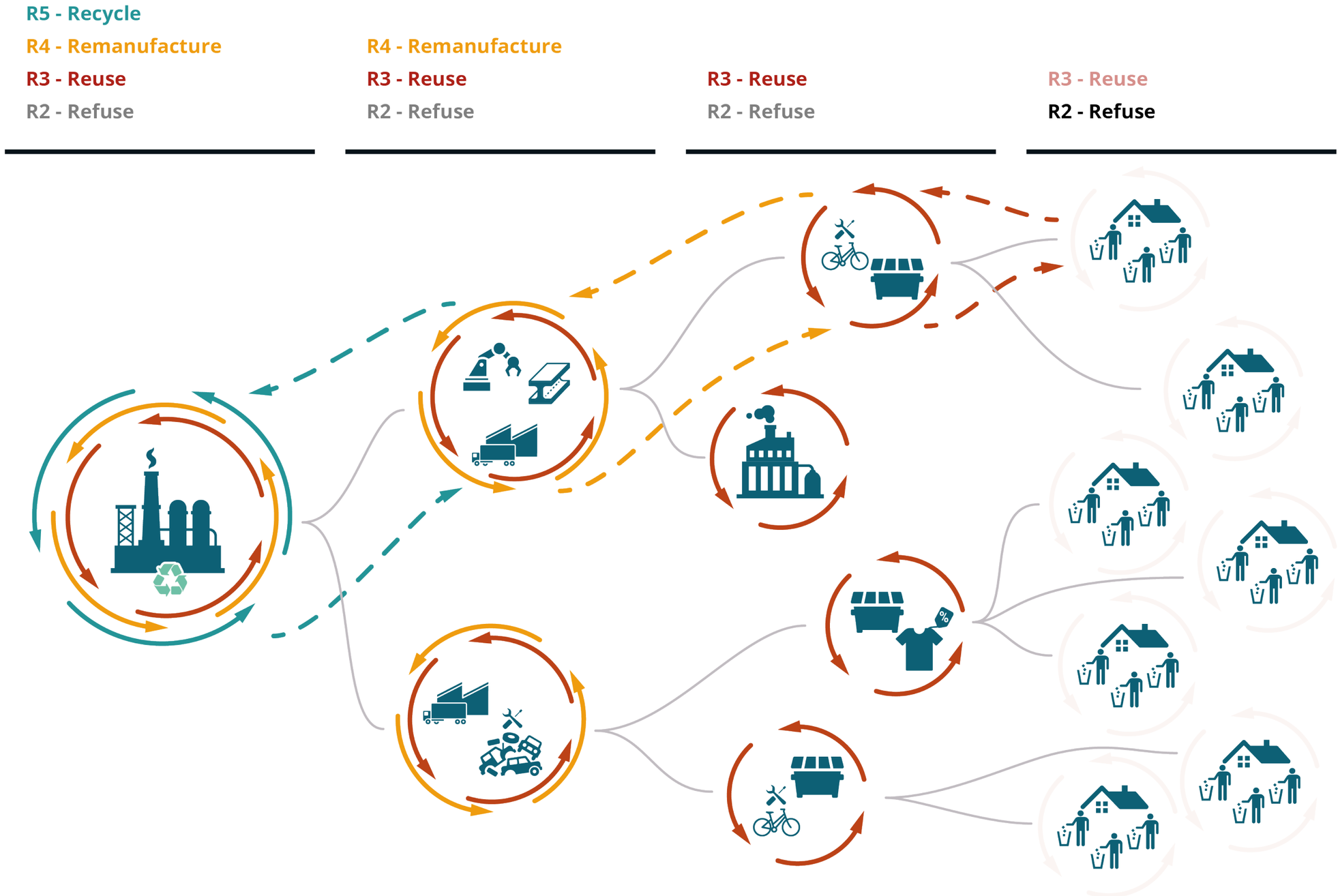
12. RESPONSIBLE CONSUMPTION AND PRODUCTION

12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.

12.5: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

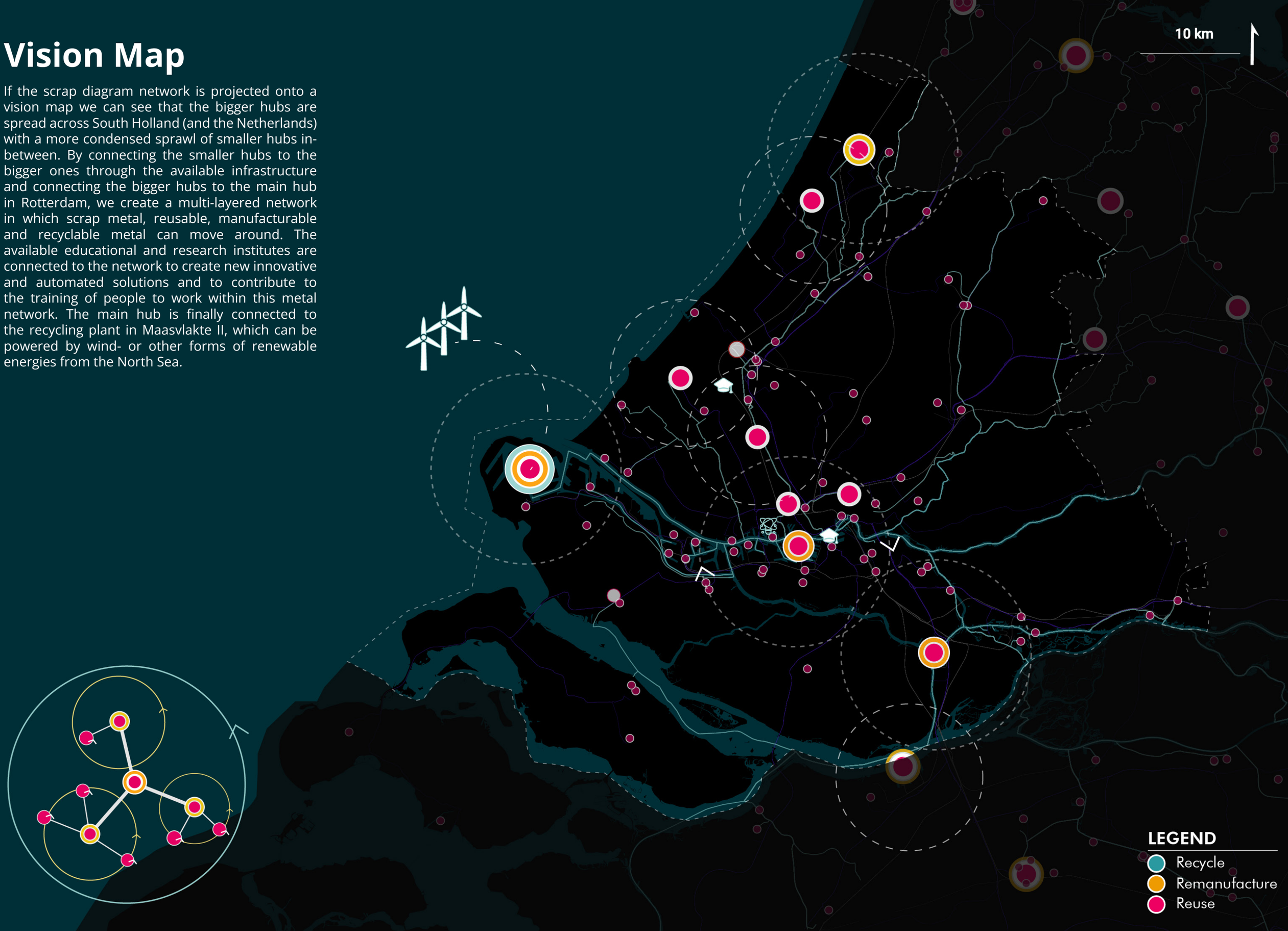
Nested Loops

Our proposal is to create a dynamic nested loop system for metal scrap using R-Ladder to define each step. The first step is residential sorting wastes and change people`s mindsets. The next step is repair and reuse in local shops. For the items cannot be repaired and reused they end up in the next level where they will be remanufactured and processed. The last step in the R-Ladder is the main hub where metals will end up to recycled. This is not one-way process, but a circular one.



Vision Map

If the scrap diagram network is projected onto a vision map we can see that the bigger hubs are spread across South Holland (and the Netherlands) with a more condensed sprawl of smaller hubs in-between. By connecting the smaller hubs to the bigger ones through the available infrastructure and connecting the bigger hubs to the main hub in Rotterdam, we create a multi-layered network in which scrap metal, reusable, manufacturable and recyclable metal can move around. The available educational and research institutes are connected to the network to create new innovative and automated solutions and to contribute to the training of people to work within this metal network. The main hub is finally connected to the recycling plant in Maasvlakte II, which can be powered by wind- or other forms of renewable energies from the North Sea.



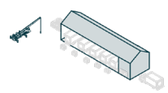
Reuse

Every day we throw away things that can be reused because they are old or just need a small fix. Most of the time we do not have the tools or the space to repair them or a physical place to sell or exchange them in public space. And, added to the high cost of labour in countries like the Netherlands, fixing things can be more expensive than buying new ones.

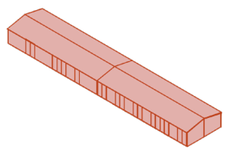
In order to inspire change in these consumers' behaviour and encourage people to reuse and repair locally we propose to integrate a - Fix it yourself facility – and re-use shops to repair, resell and reuse locally connecting the local scrap dump to the urban tissue.

This strategy is the smallest loop possible in the R-ladder of circularity presented in chapter 1 and prevents small scale and domestic waste from becoming disused. The aim is to also connect this small hub with the community and present small scrapyards and local dumps as part of the city's growth.

URBAN ELEMENTS

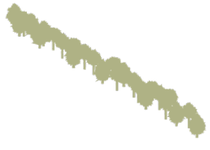


THE LOCAL DUMP



FIX IT YOURSELF CENTER

RE-USE SHOPS



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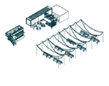
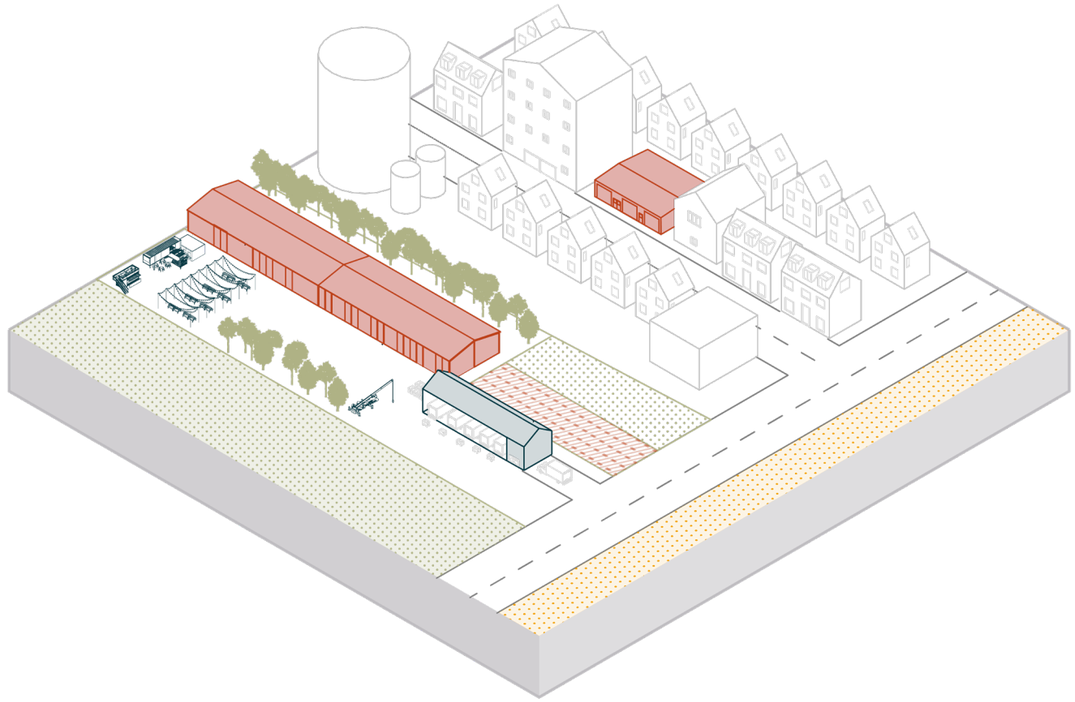
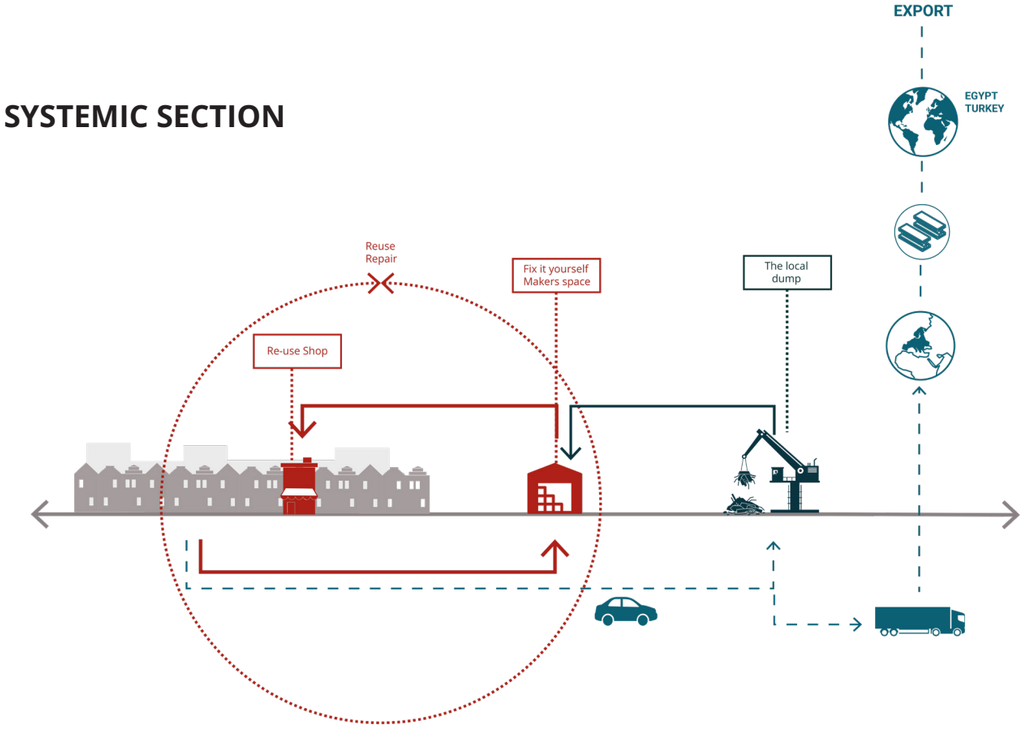


THE LOCAL DUMP

AXONOMETRIC



SYSTEMIC SECTION



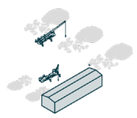
Remanufacture

By identifying (specialised)manufacturing hubs throughout the country, we can promote the sorting of scrap metal there. Additionally, it can incentivise a local specialised manufacturing industry that can reuse parts to repair and remanufacture locally.

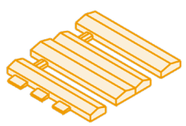
The proximity to innovation and educational hubs promotes new technologies regarding waste processing, as well as the establishment of a makers industries that can benefit from the materials collected and disassembled.

The industrial area is usually fragmented and disconnected from the urban fabric by network infrastructure (highways, railways and waterways). It can be integrated by adding functions related to the specific activity benefiting the local community, creating jobs and providing relevant civil services.

URBAN ELEMENTS

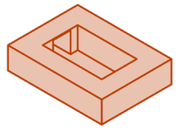


SPECIALISED DUMP



MAKERS HERITAGE HUB

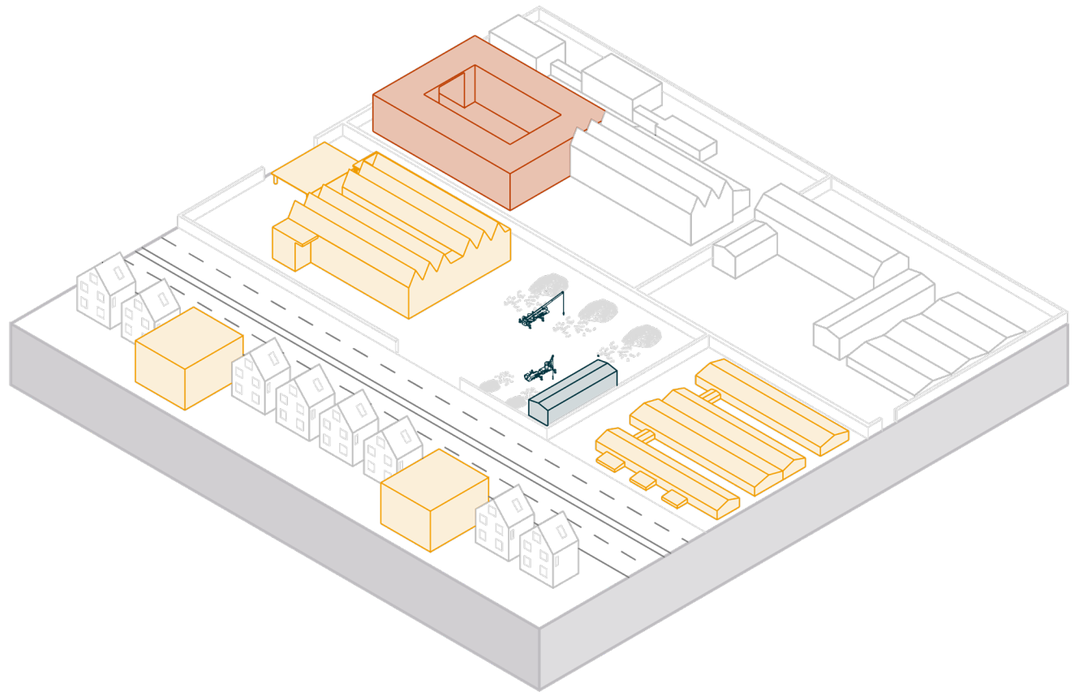
SPECIALISED MANUFACTURING



INNOVATION HUB

SPECIALISED SHOPS

AXONOMETRIC



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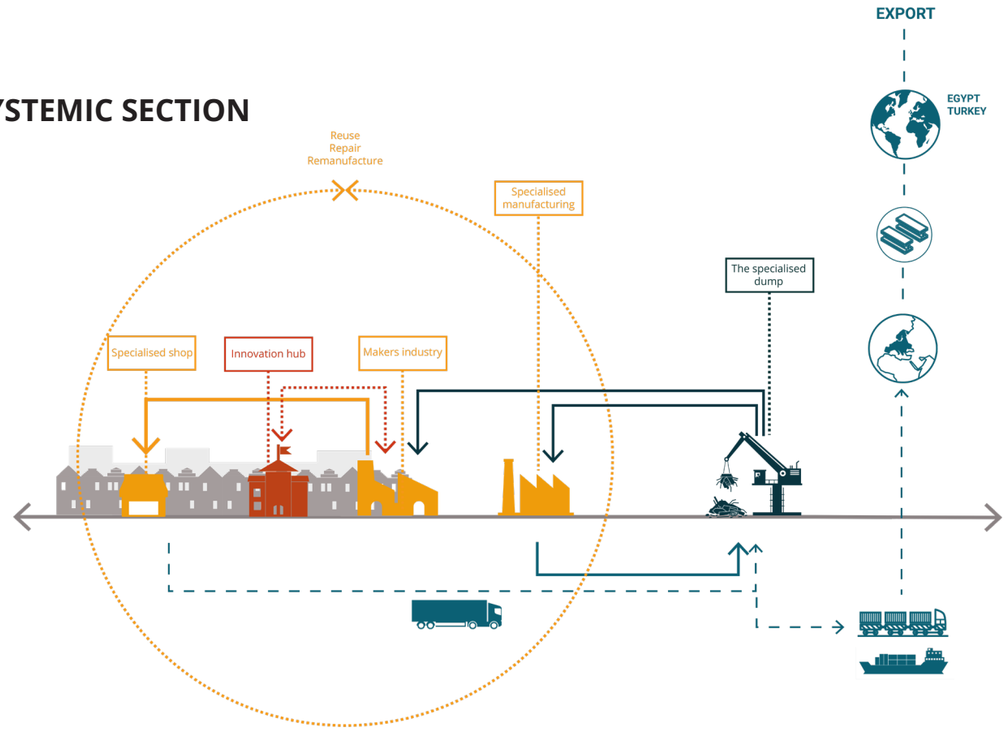


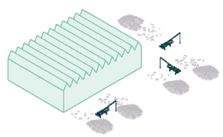
Recycle

This strategy is the biggest and most intensive loop in the system, so when scrap is not reusable or when it is not possible to remanufacture locally, it is transported to the recycling hub where it is processed and returned into the cycle.

The new material can be used locally by both big scale and highly specialised industries such as wind turbine manufacturing, ship building, as well as other, small manufacturing industries.

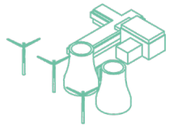
A highly connected water and railway network is required to maintain the material flow with the lowest emissions possible. Furthermore, the process is sustainable by the use of renewable energies resources like the North Sea wind turbines and solar energy and green hydrogen with low environmental impact.

URBAN ELEMENTS

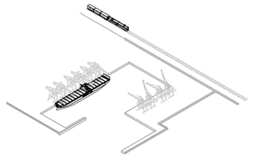


BIG SCALE DUMP

HIGHLY SPECIALISED MANUFACTURING

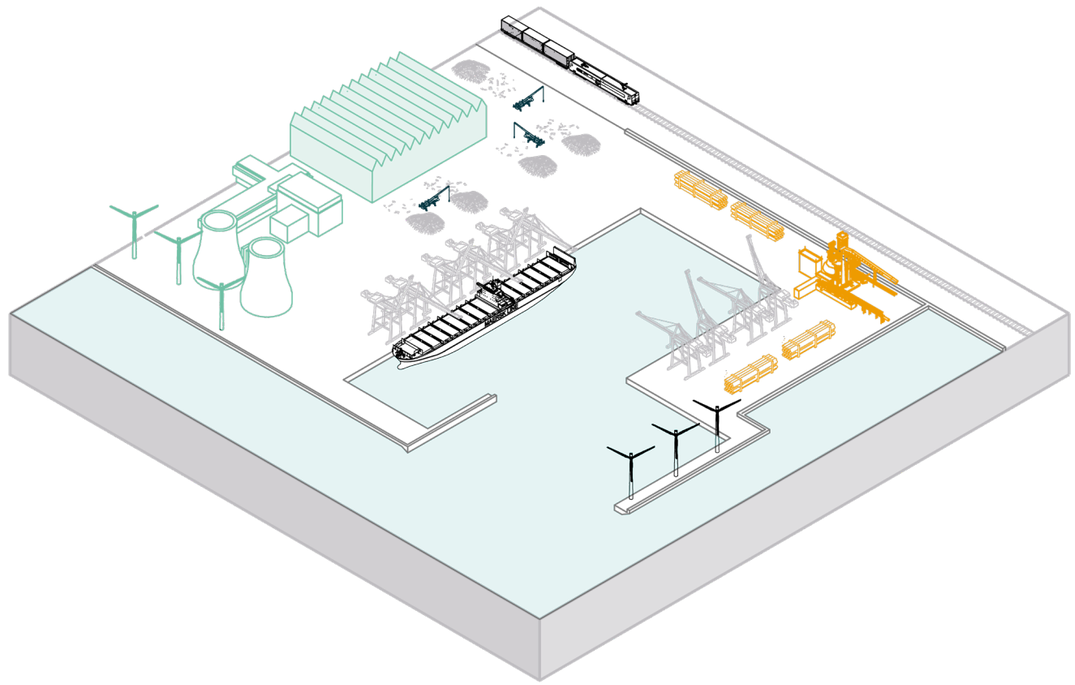


SUSTAINABLE ENERGY HUB



NETWORK AND CONNECTIVITY

AXONOMETRIC



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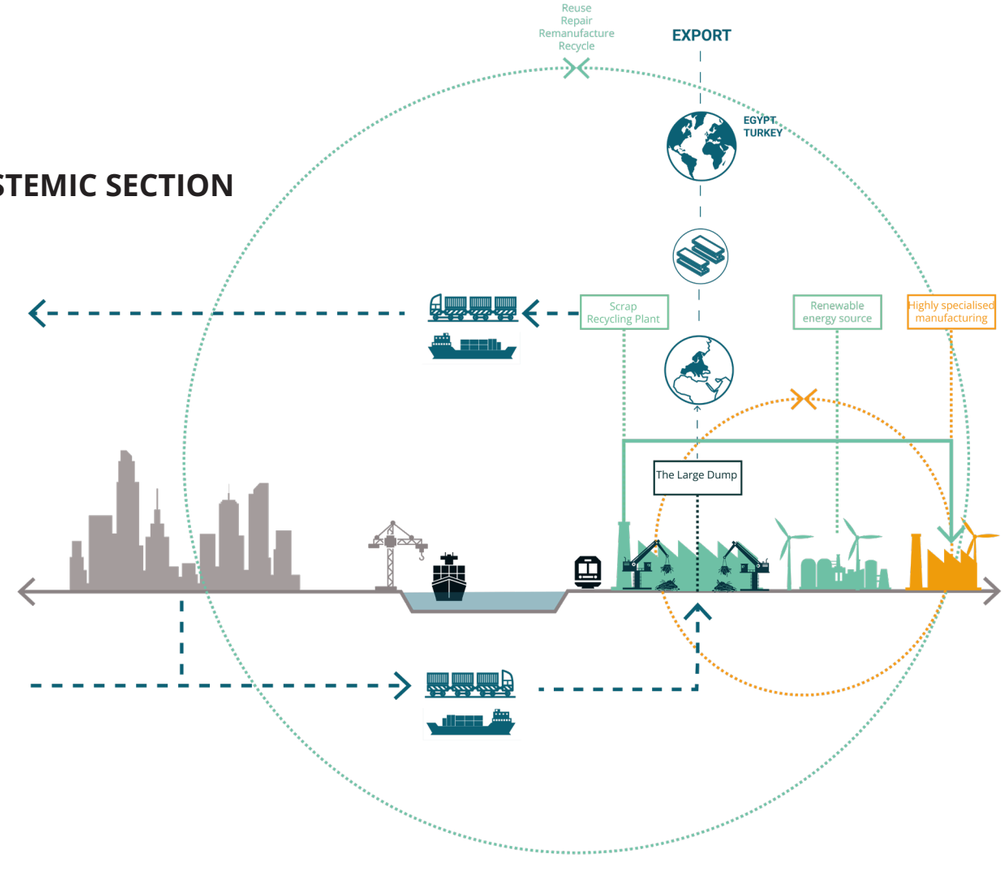


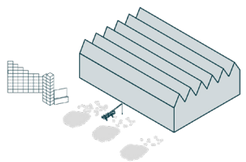
Reconnect

This strategy is not aimed at shaping the types of activities in the scrapyards, but at creating a strong network of waste facilities that can support each other and form a resilient system. This reconnection is essentially embracing the other 3 strategies, in understanding that they are at their strongest when they can complement each other.

From a technical point of view, this means that facilities should be able to use the re-using, remanufacturing or recycling capabilities of other nearby facilities to ensure the cycle is kept as small as possible. This can be done by utilising the existing strengths that each facility has, like access to a water- or rail network, innovation hub nearby or advanced sorting equipment.

But there is also a socio-cultural perspective, where the ‘reconnecting’ refers to creating a strong cultural bond between the people and companies and their local scrapyard.

URBAN ELEMENTS

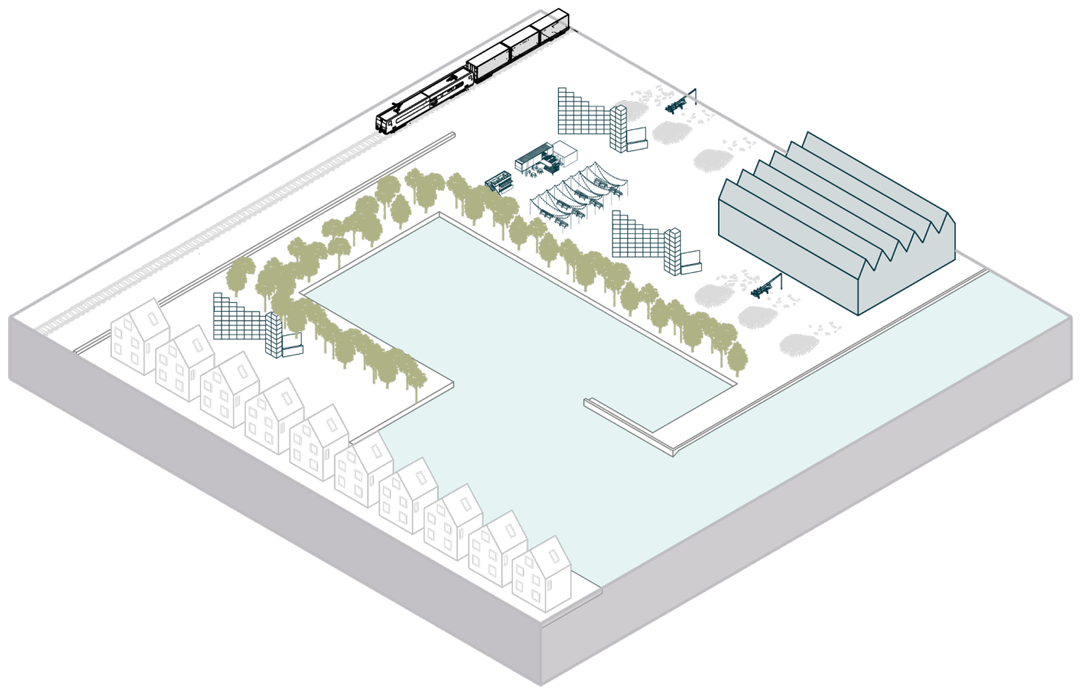


THE FUN DUMP

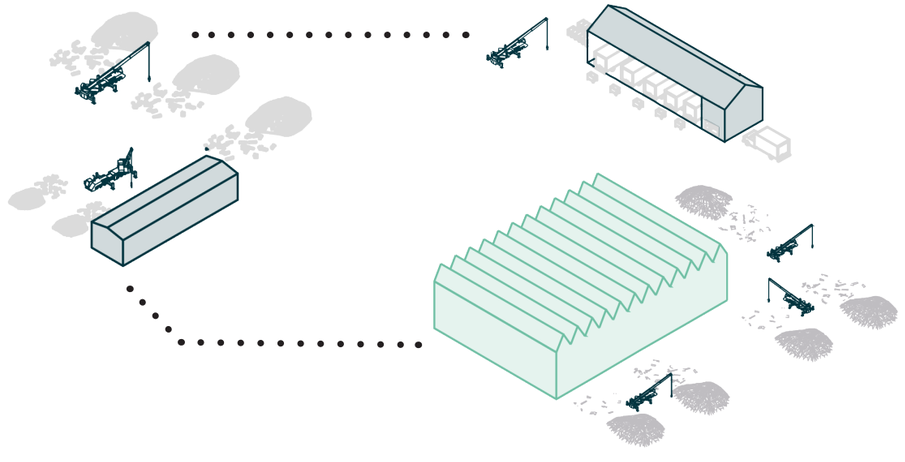
GREEN CORRIDOR

SCRAP GARDEN

AXONOMETRIC



SYSTEM DIAGRAM



Catalog of Urban Elements

SCRAPYARD TYPE

MAKERS INDUSTRY

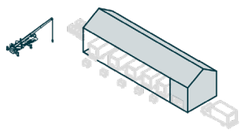
MANUFACTURING INDUSTRY

ENVIRONMENTAL/ ENERGY TRANSITION

PLACEMAKING/ SOCIAL TRANSITION

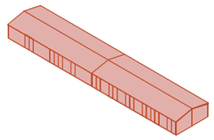
REUSE

THE LOCAL DUMP



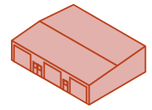
Usually a disaggregated element from the urban tissue, consist in a series of containers of different types of waste for sorting domesting garbagge of all kinds accesible by car.

FIX IT YOURSELF CENTER



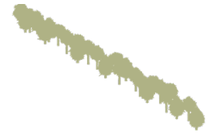
Warehouse or flexible structure in proximity with the local dump that can support different programs. This facility provides public services by offering space sand tools to work and repair things. Also suitable to rent workspace for makers.

RE-USE SHOPS



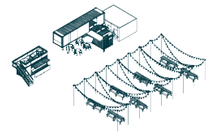
Shops integrated in the urbanity that can provide space to sell and buy secondhand products. Open for public to function like a flea market or a garage sale.

GREEN BUFFER



Green buffer introduced on farm land surrounding the urban area to connect the market and warehouse emerging hub with the community and the urban tissue in expansion.

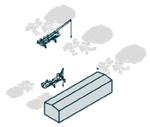
SCRAP GARDEN



Placemaking intervention, introducing food trucks and containers restaurant and cultural activities to activate and attract people to use this spaces close to the scrapyard and promote a change of behaviour and the image of waste scapes.

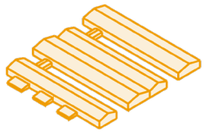
REMANUFACTURE

THE SPECIALISED DUMP



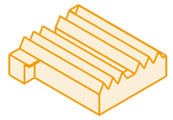
Scrapyard specialised in one activity (automobile industry, containers etc). Usually covers a large surface and facilitates meticulous sorting equipment.

MAKERS HERITAGE HUB



Warehouse or existing industrial heritage structure in proximity with the specialised dump that can work as space for makers cooperatring with the nearby educational and innovations hubs.

SPECIALISED MANUFACTURING

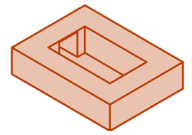


Manufacturing industry that can reuse and recycle parts of the material sorted in the specialised dump, making the production more sustainable and circular.

SPECIALISED SHOPS

Retail and shops open to the local community that can benefit from the production and services of the specialised hub. For example, a facility to wash your car, buy supplies, etc.

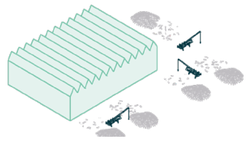
INNOVATION HUB



Innovation and educational centers close by that can provide innovative solutions for scrap metal processing and production in the specialised hub.

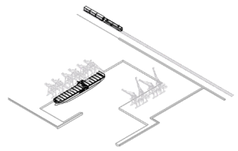
RECYCLE

LARGE DUMP



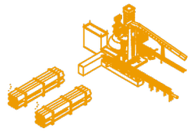
Big scale scrapyard that containts all the material that could not be reused or remanufactured. This place has the potential to become a recycling plant to fully close the cycle of scrap metal.

NETWORK AND CONNECTIVITY



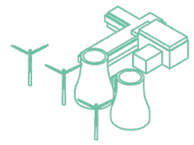
High presence of multiple types of infrastructre like train, barge or highways. These contribute to the logistic connection with other scrapyards.

HIGHLY SPECIALISED MANUFACTURING



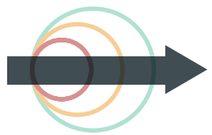
Manufacturing industry that produces highly specialised metal products such as wind turbines. These can benefit from the proximity to the recycling plant for the supply of processable metals.

SUSTAINABLE ENERGY HUB

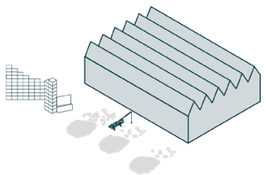


Clusters of facilities that provide sustainable energy sources for the recycling process like green hydrogen, solar panels and wind turbines.

RECONNECT

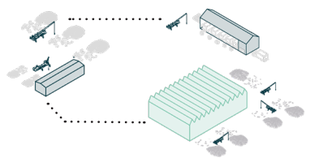


THE FUN DUMP



Medium scale scrap yards that house public functions like events. These can be open to various cultural activities and help forge a connection with the community.

SCRAPYARD INTERWIRED



The network of scrapyards united aims to connect them all, from the local dump to the big scale recycling plant. The water network, railway and highways create a regional and national network that can expand.

GREEN CORRIDOR

Green belt that connects the scrapyards with the makers districts, residential neighbourhoods and urban centers.

POP-UP ACTIVITIES

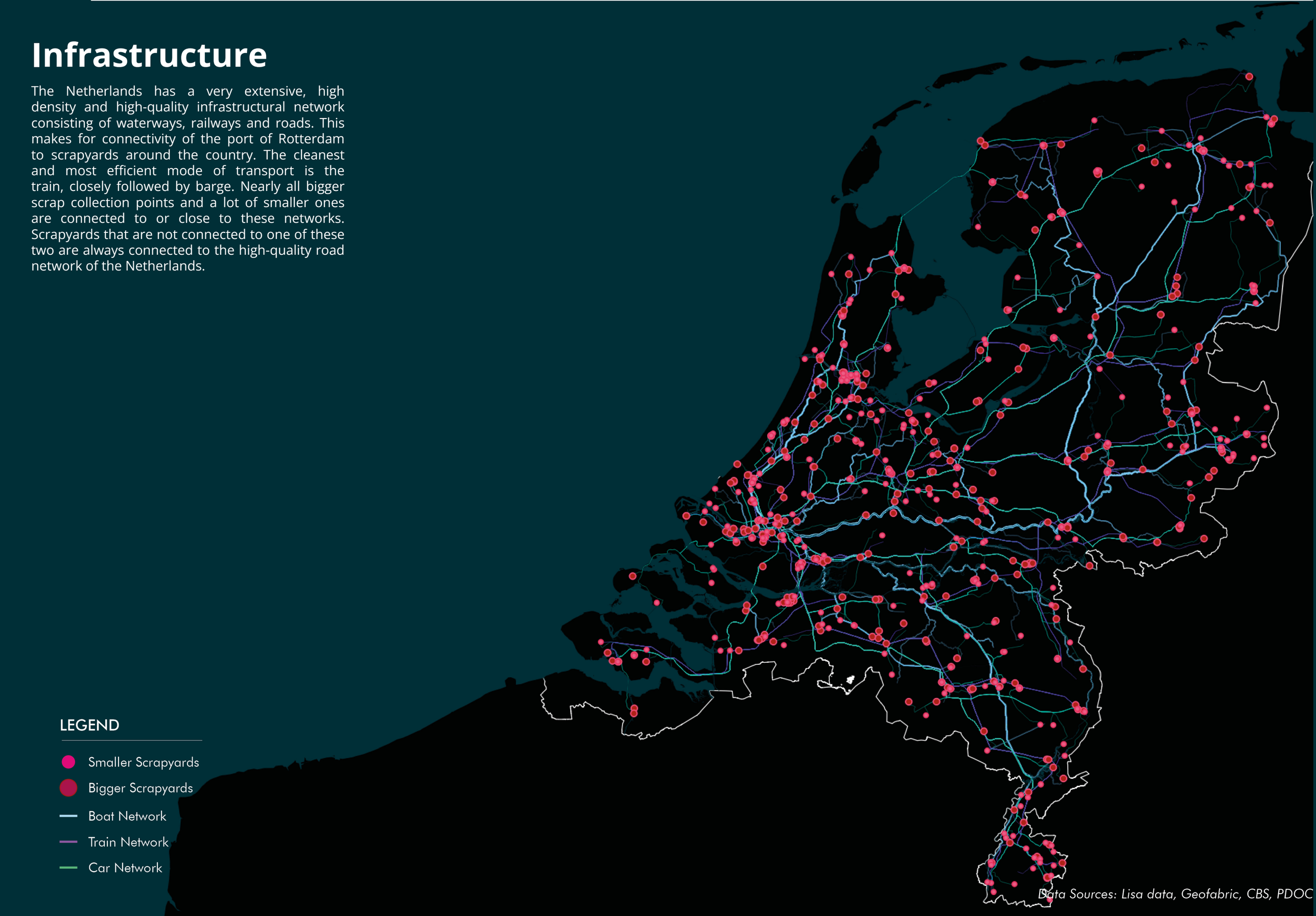
Pop-up cultural and leisure hub with art interventions, foodtrucks made out of containers, bier garden etc. These contribute to the cultural reconnection.

Chapter 4:
Mapping the Scrap

Before jumping into specific cases, a good understanding of the current national situation is required. In this chapter, the current waste system of the Netherlands is analysed using maps.

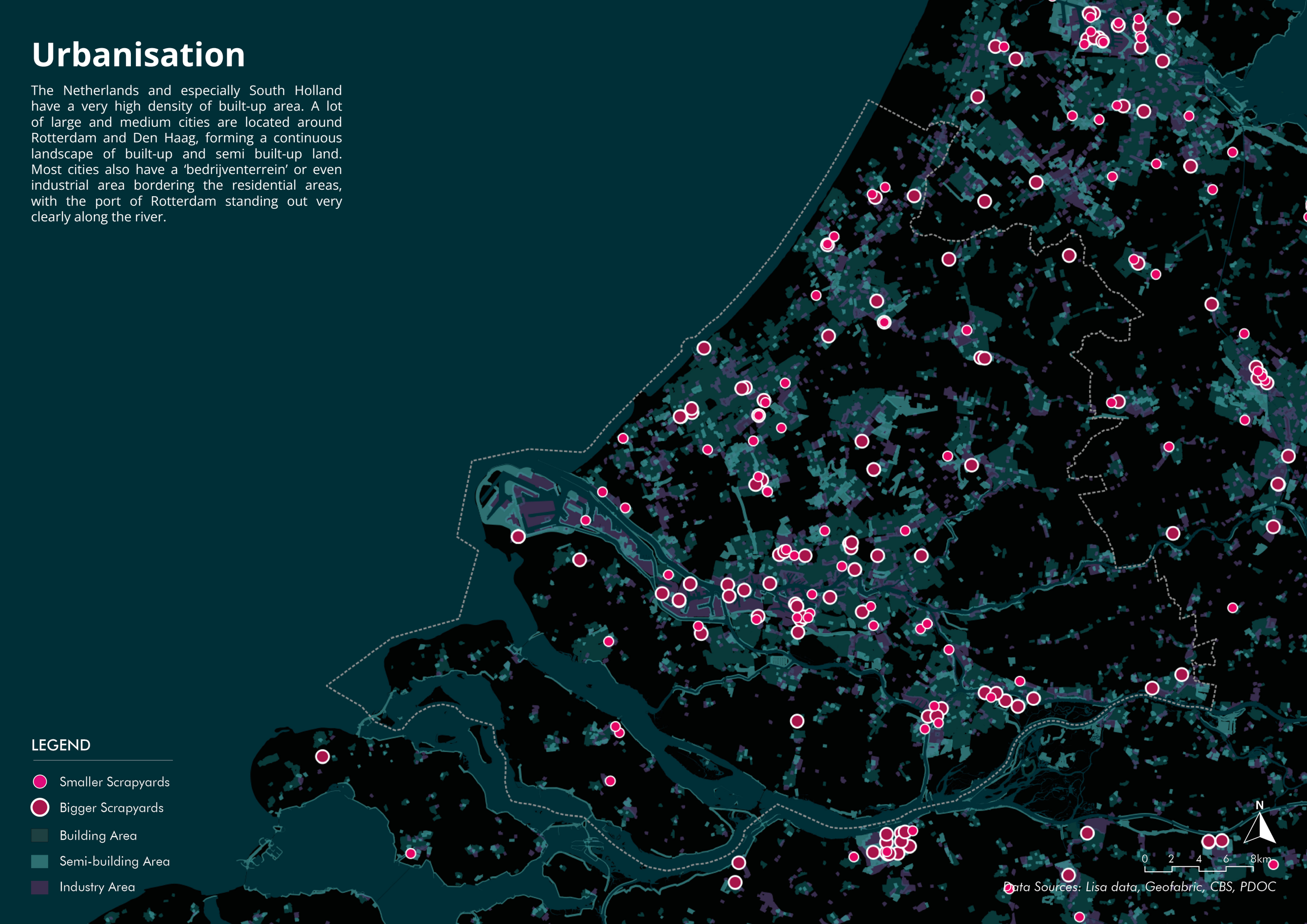
Infrastructure

The Netherlands has a very extensive, high density and high-quality infrastructural network consisting of waterways, railways and roads. This makes for connectivity of the port of Rotterdam to scrapyards around the country. The cleanest and most efficient mode of transport is the train, closely followed by barge. Nearly all bigger scrap collection points and a lot of smaller ones are connected to or close to these networks. Scrapyards that are not connected to one of these two are always connected to the high-quality road network of the Netherlands.



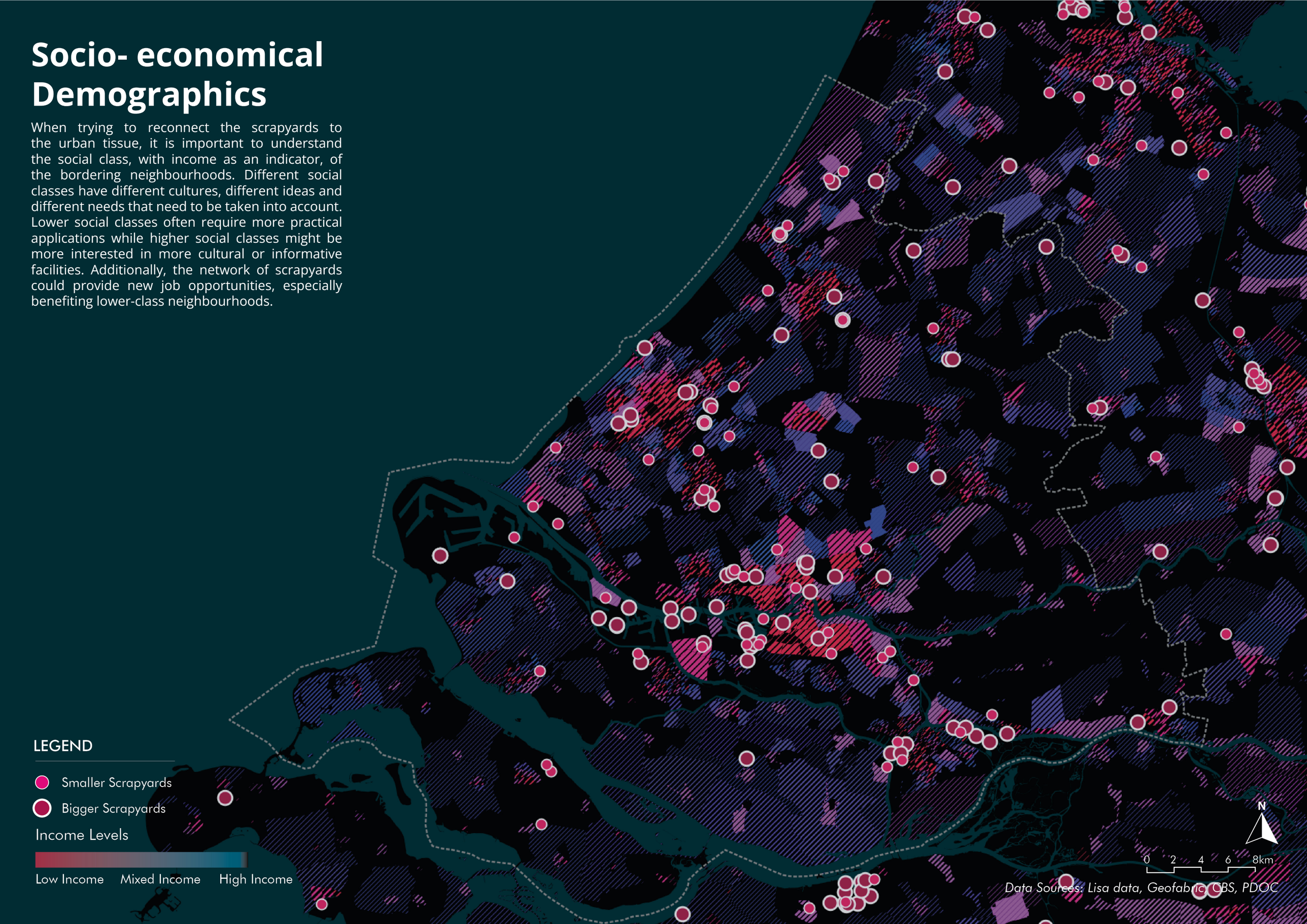
Urbanisation

The Netherlands and especially South Holland have a very high density of built-up area. A lot of large and medium cities are located around Rotterdam and Den Haag, forming a continuous landscape of built-up and semi built-up land. Most cities also have a ‘bedrijventerrein’ or even industrial area bordering the residential areas, with the port of Rotterdam standing out very clearly along the river.



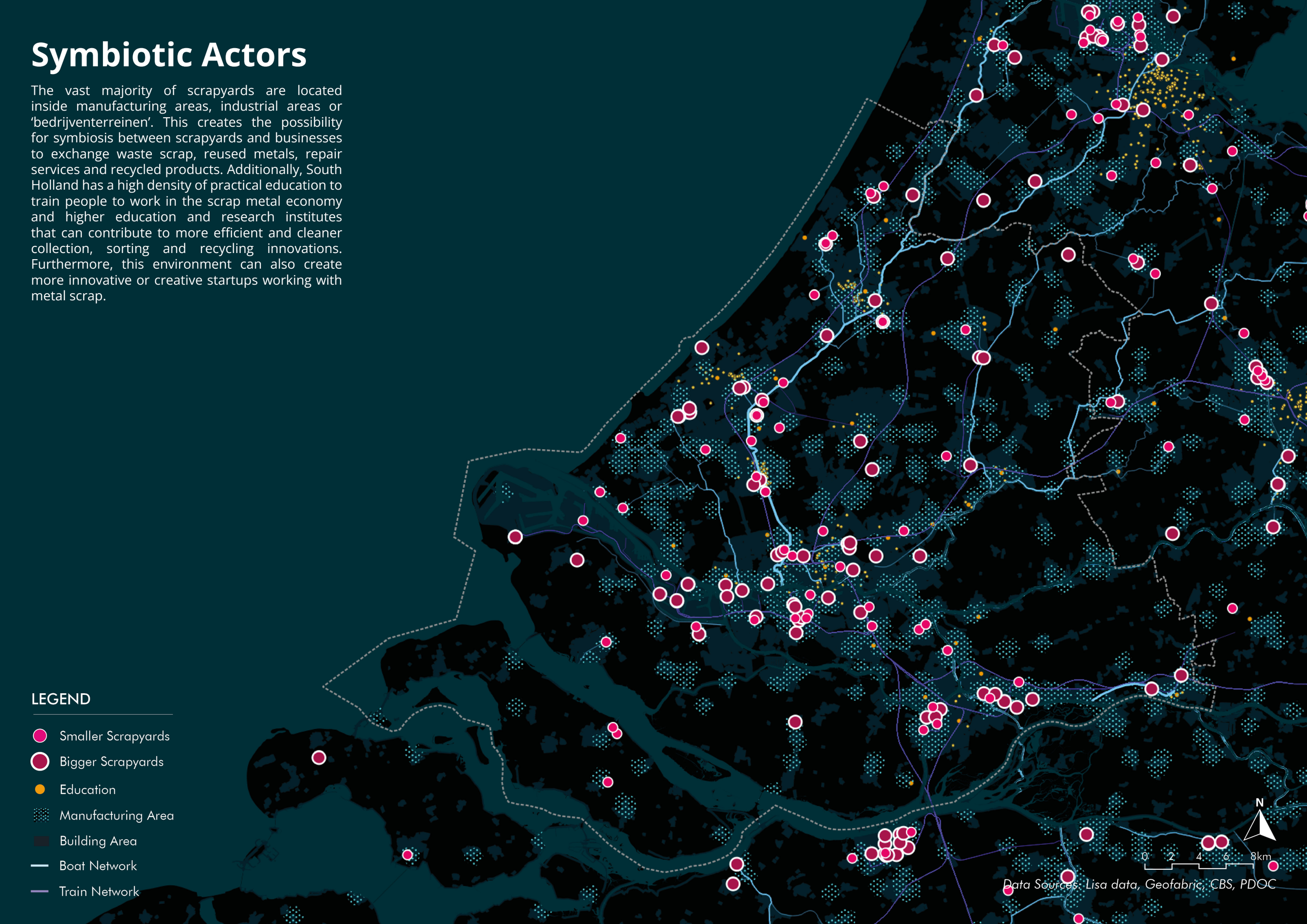
Socio- economical Demographics

When trying to reconnect the scrapyards to the urban tissue, it is important to understand the social class, with income as an indicator, of the bordering neighbourhoods. Different social classes have different cultures, different ideas and different needs that need to be taken into account. Lower social classes often require more practical applications while higher social classes might be more interested in more cultural or informative facilities. Additionally, the network of scrapyards could provide new job opportunities, especially benefiting lower-class neighbourhoods.



Symbiotic Actors

The vast majority of scrapyards are located inside manufacturing areas, industrial areas or ‘bedrijventerreinen’. This creates the possibility for symbiosis between scrapyards and businesses to exchange waste scrap, reused metals, repair services and recycled products. Additionally, South Holland has a high density of practical education to train people to work in the scrap metal economy and higher education and research institutes that can contribute to more efficient and cleaner collection, sorting and recycling innovations. Furthermore, this environment can also create more innovative or creative startups working with metal scrap.



Chapter 5:

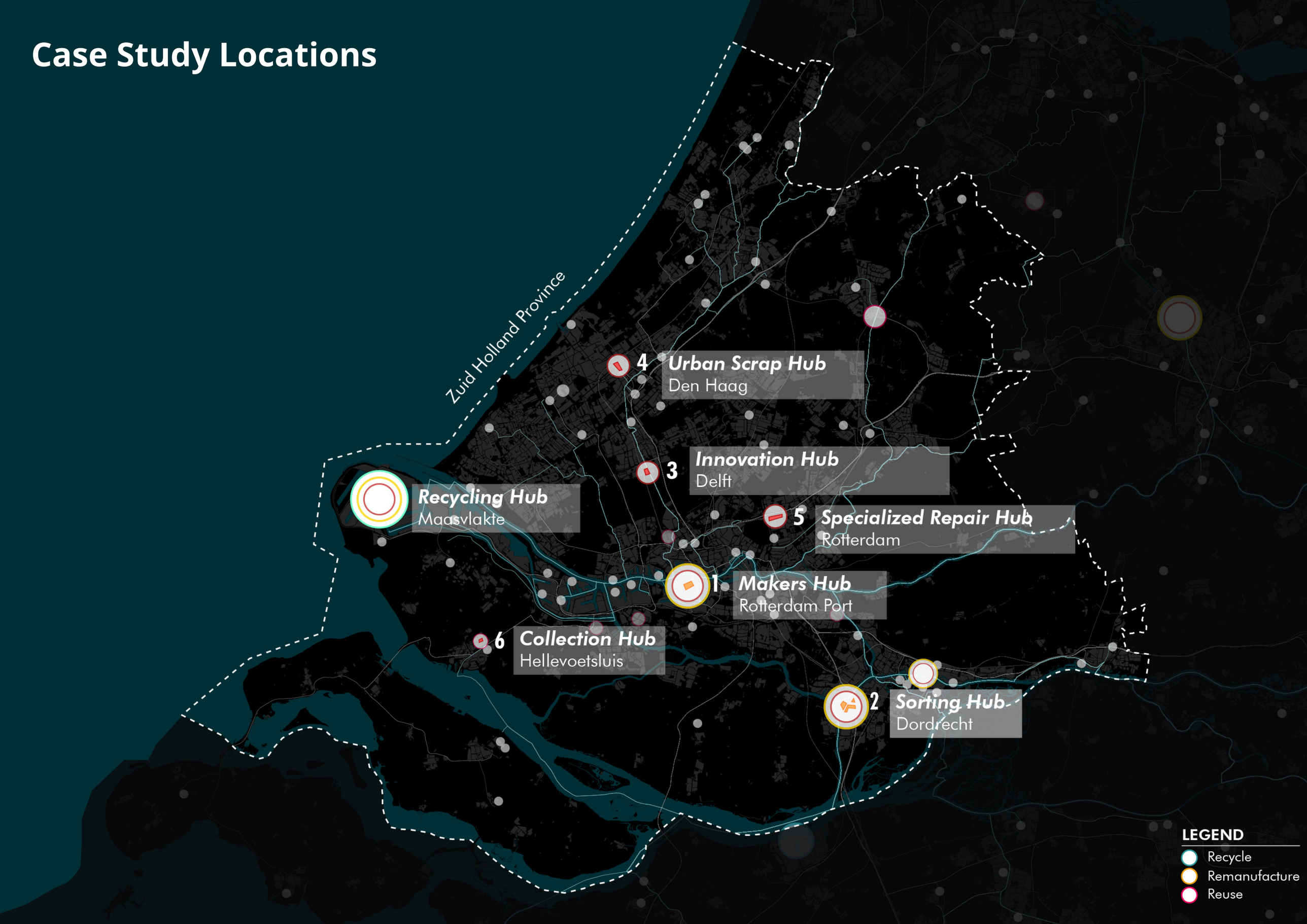
Strategic Field Experiments

In this chapter, 6 cases will be analysed and designed according to the new strategies. The sites are all located in Zuid-Holland, but are carefully selected to form a representative set.

The largest one, located at Waalhaven, Rotterdam is designed in more detail since it covers most of the strategies.

All cases are concluded with an collage to create an impression of the designs.

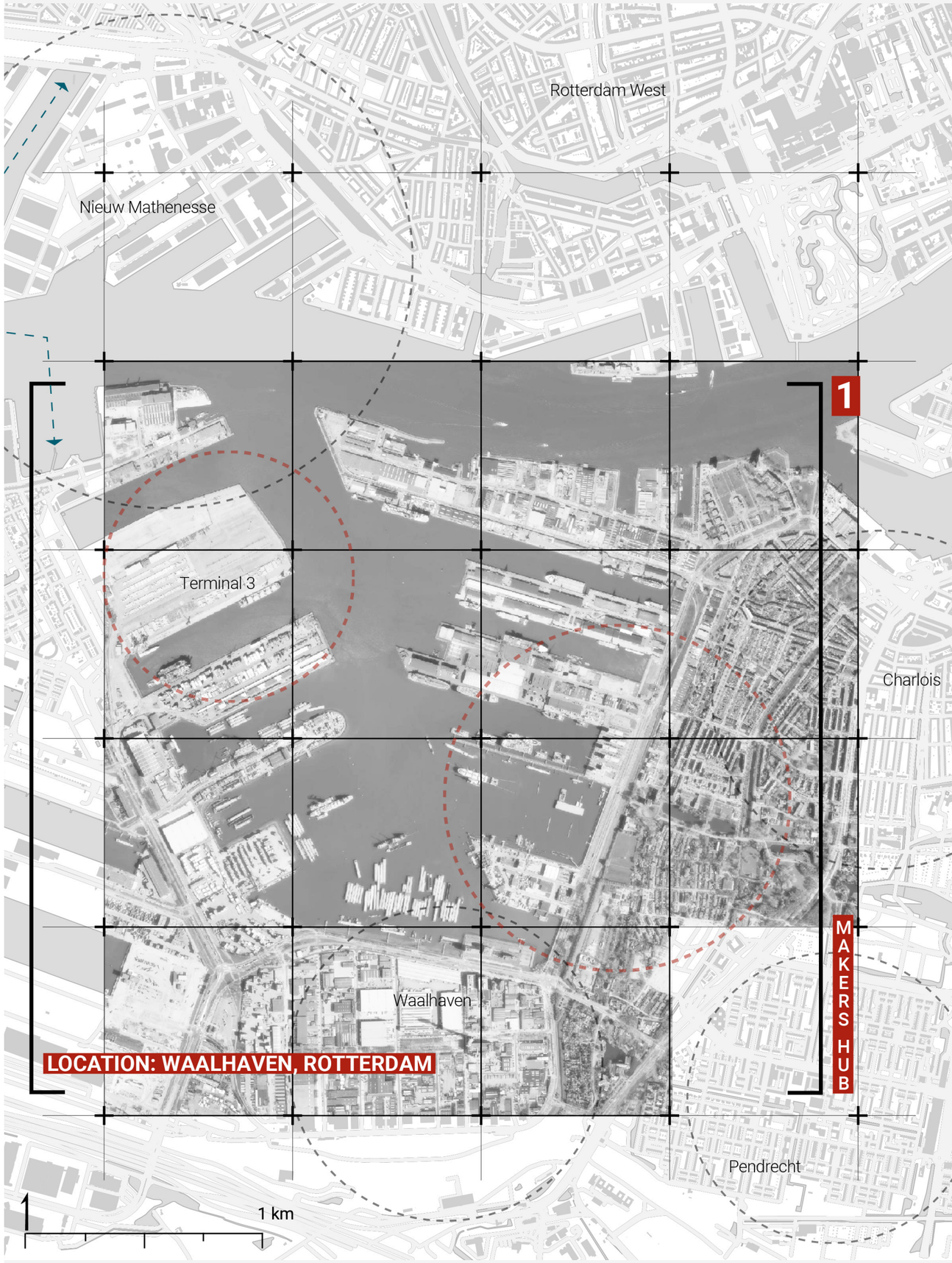
Case Study Locations



Makers Hub

ROTTERDAM

The Waalhaven in Rotterdam is an industrial inner-city location fairly close to the centre of Rotterdam. This is an interesting location because it is located in the port of Rotterdam and therefore it is envisioned to be the centre of the national network. There is not yet a scrapyard present, however, there are a lot of steel-related industries in the area and innovative makers industries in the MH4 on the opposite side of the river, making this location suitable for the introduction of a new scrapyard.

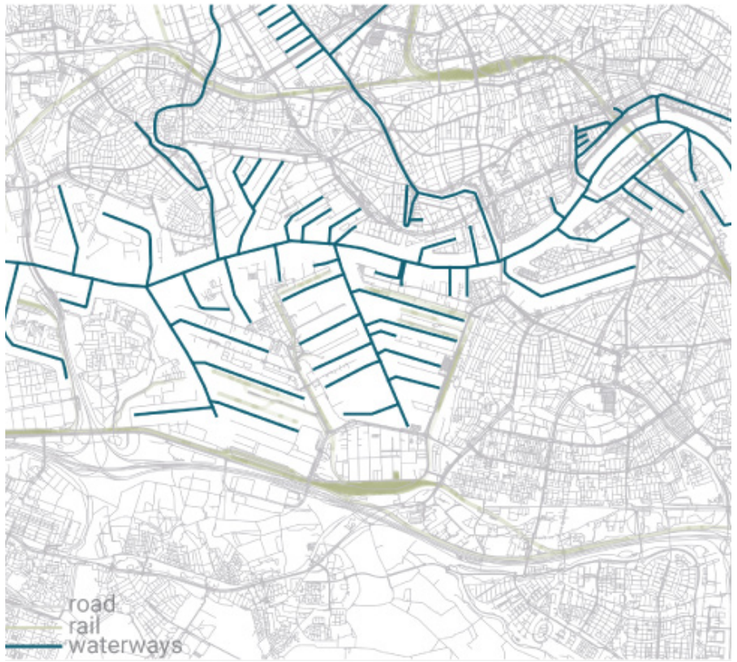


BLUE & GREEN STRUCTURES

This location is inside the city of Rotterdam, meaning the green that is in proximity are urban parks and at the south of the industrial area, a railway and highway separate the industrial area from farmlands. In the area itself, there is hardly any green at all, which can be a point of improvement for this area.

INFRASTRUCTURE

The location is highly connected to the water because of its harbour location, all the water edges are docks so inland ships, as well as deep-sea ships, can dock everywhere in this location. Consequently, the water creates a connection to the east and north to other waterside scrapyards in the Netherlands but also in Germany and Belgium and on the west side to heavier port industries like on the Maasvlakte and to international waters.



ZONING

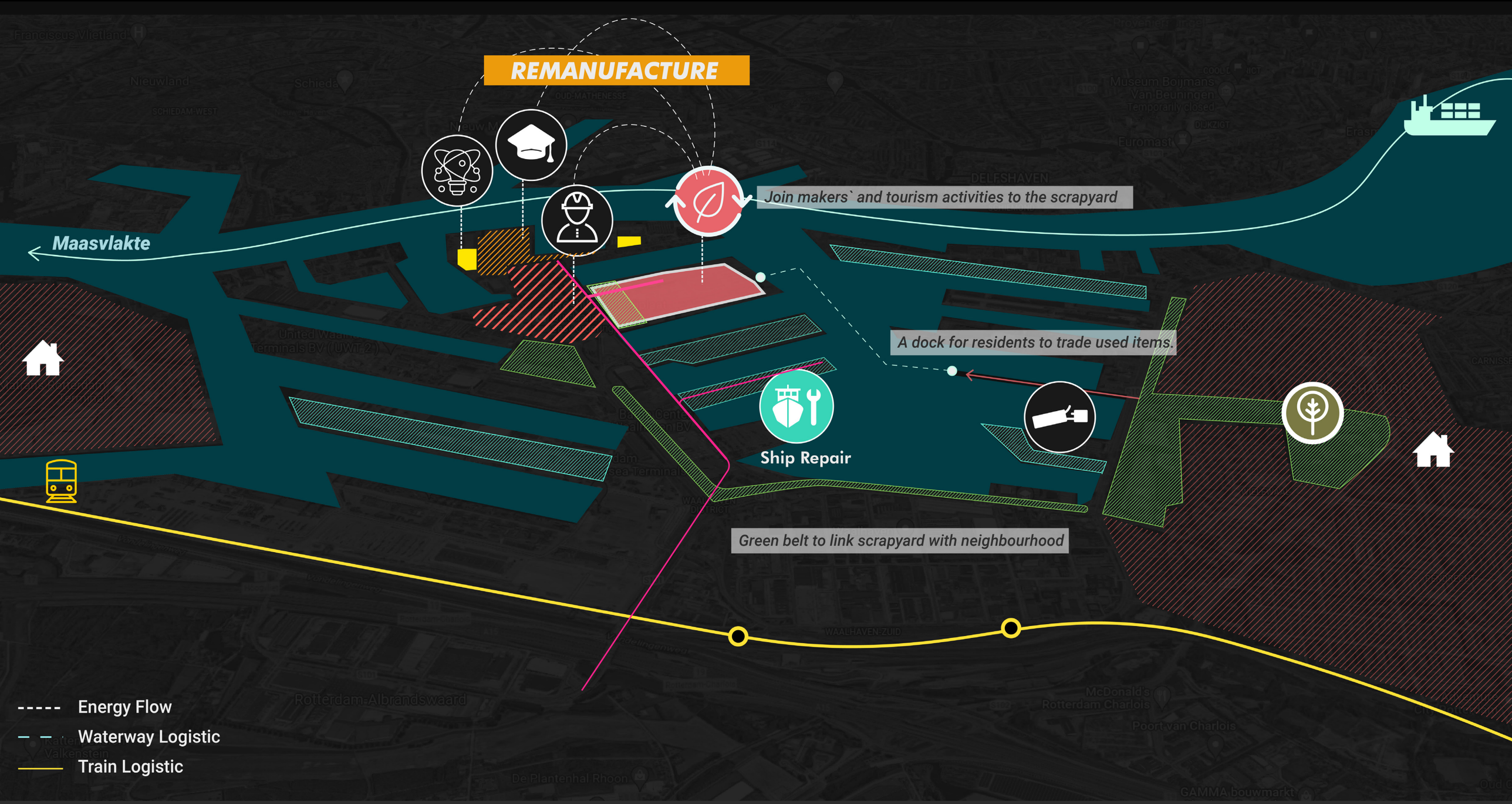
The area is part of the port of Rotterdam which is located as a strip along the meandering Nieuwe Maas. Around the industries, the city of Rotterdam is located, mostly on the east, which is slowly pushing the port away towards the sea on the west. The large number of (steel-related) industries in this area provide this area with the potential to become a large metal and scrap metal hub in the network.

URBAN DENSITY

The city, industrial and agricultural areas are easily distinguishable by looking at the urban densities. The city is located to the north-east having very high density, the port to the west, has a relatively low density, and the low-density farmland with occasional higher density towns.

Makers Hub Waalhaven

Scrapyard help build the port into a mixed city port area that combines living, working, manufacturing and learning, and profiles itself as a testing ground for the innovative manufacturing industry. It brings together large-scale industry, small-scale makers initiatives and educational institutions in the same ecosystem, working on innovations for the port and the city.



DETAILED DESIGN

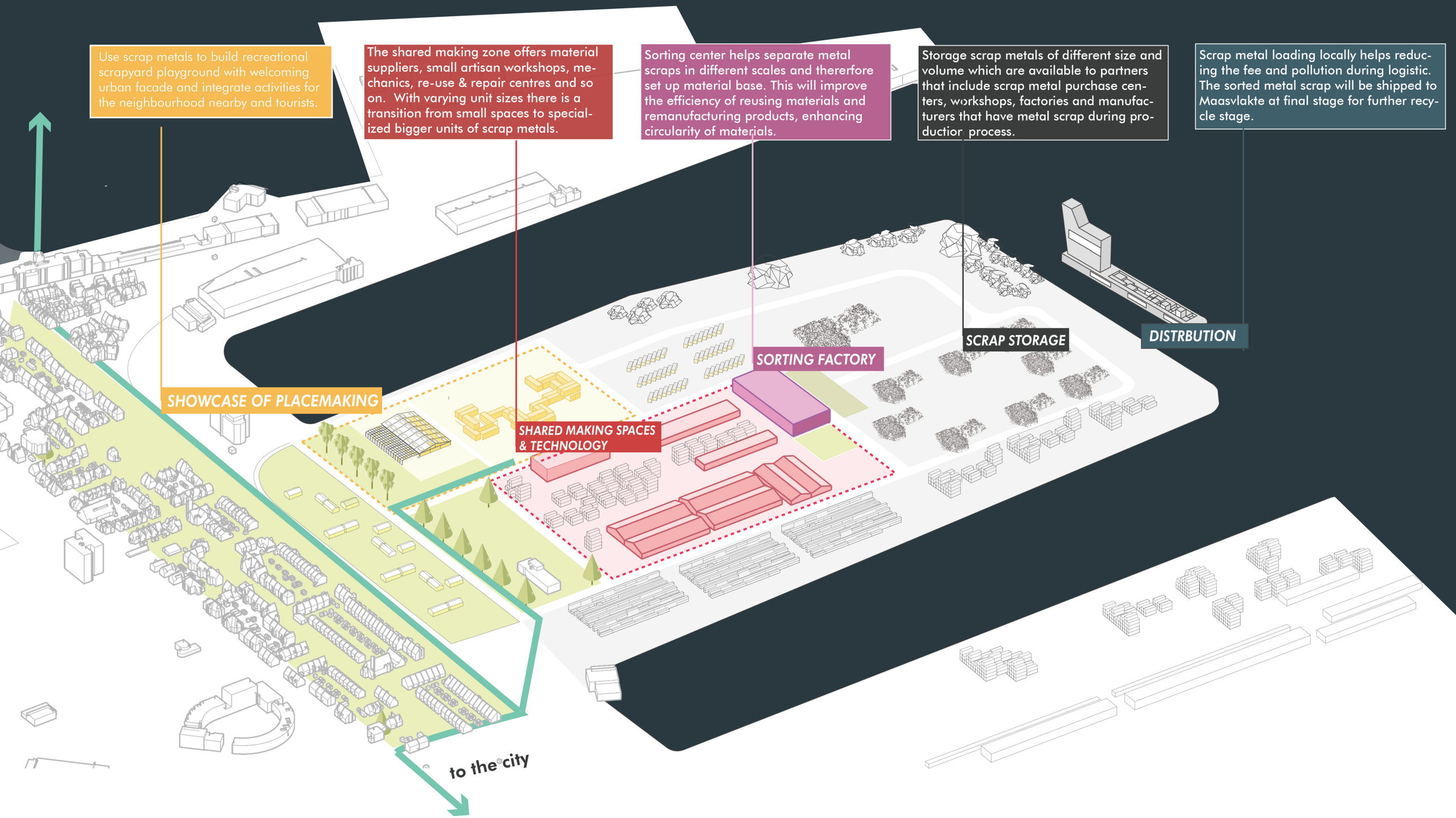
Use scrap metals to build recreational scrapyard playground with welcoming urban facade and integrate activities for the neighbourhood nearby and tourists.

The shared making zone offers material suppliers, small artisan workshops, mechanics, re-use & repair centres and so on. With varying unit sizes there is a transition from small spaces to specialized bigger units of scrap metals.

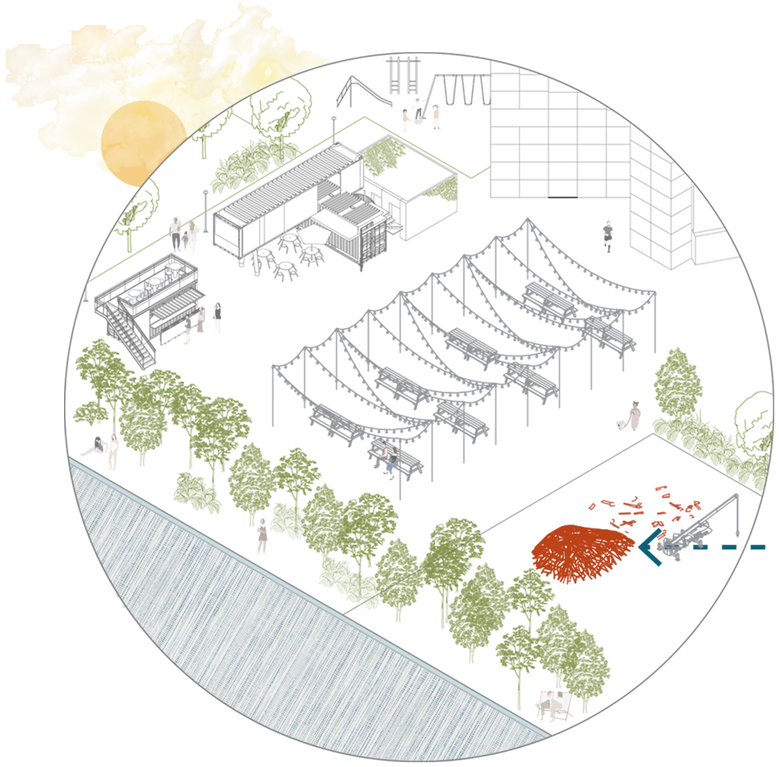
Sorting center helps separate metal scraps in different scales and thererfore set up material base. This will improve the efficiency of reusing materials and remanufacturing products, enhancing circularity of materials.

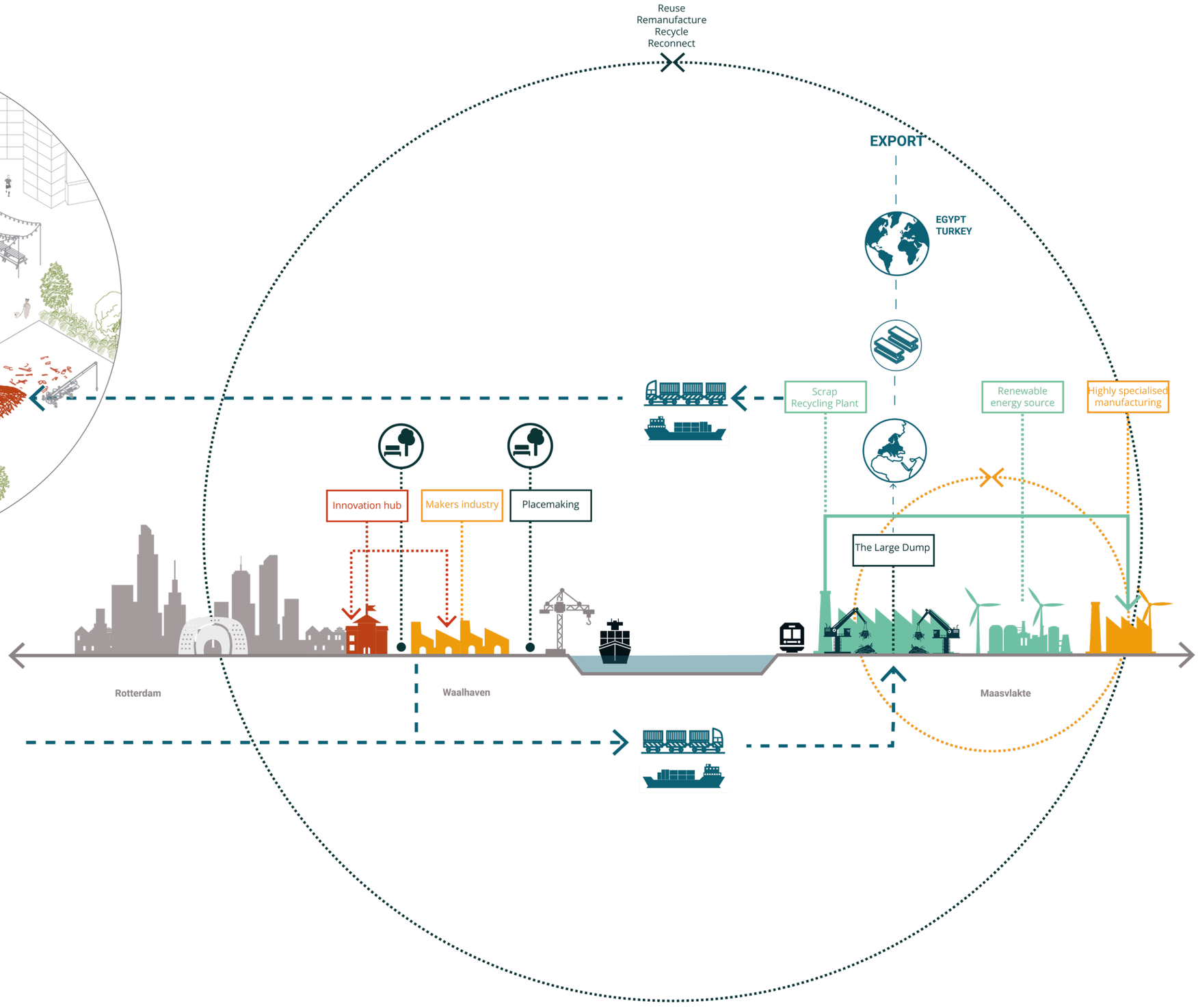
Storage scrap metals of different size and volume which are available to partners that include scrap metal purchase centers, workshops, factories and manufacturers that have metal scrap during production process.

Scrap metal loading locally helps reducing the fee and pollution during logistic. The sorted metal scrap will be shipped to Maasvlakte at final stage for further recycle stage.



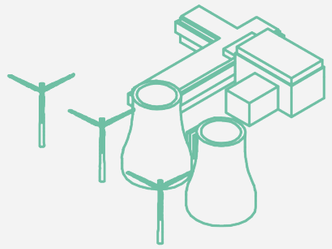
SYSTEMIC SECTION





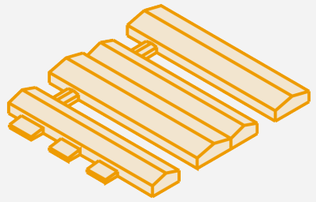
APPLIED STRATEGIES

SUSTAINABLE ENERGY HUB



Clusters of facilities that provide sustainable energy sources for the recycling process like green hydrogen, solar panels and wind turbines.

MAKERS HERITAGE HUB

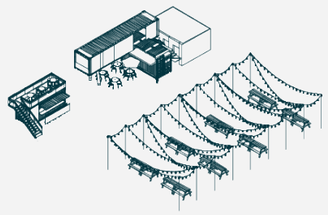


Warehouse or existing industrial heritage structure in proximity with the specialised dump that can work as space for makers cooperatring with the nearby educational and innovations hubs.

THE GREEN CORRIDOR

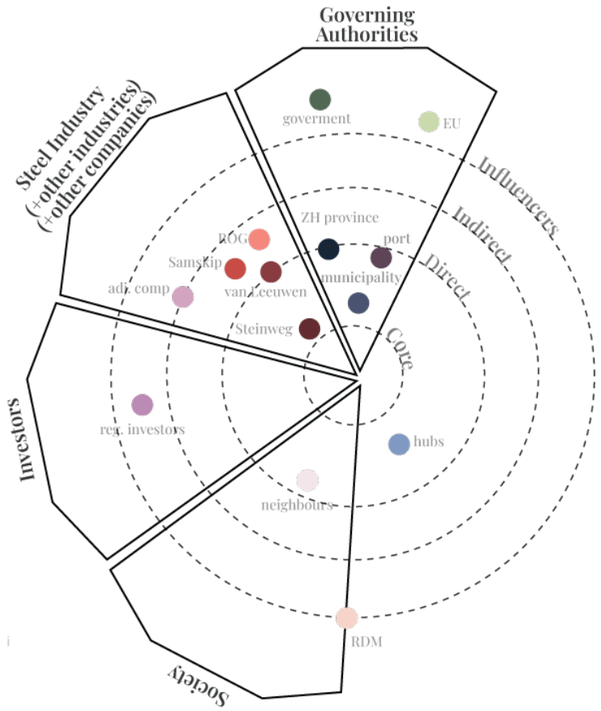
Green belt that connects the scrapyards with the makers districts, residential neighbourhoods and urban centers.

SCRAP GARDEN



Placemaking intervention, introducing food trucks and containers restaurant and cultural activities to activate and attract people to use this spaces close to the scrapyard and promote a change of behaviour and the image of waste scapes.

STAKEHOLDER ANALYSIS



Stakeholders for Waalhaven

Local
- C.Steinweg Handelsveem B.V
- Van Leeuwen Metaal Recycling
- Samskip
- ROG Shiprepair BV
- Neighbouring + adjoining companies
- RDM
- Neighbours (e.g Heijplaat, Pernis)

Regional
- Rotterdam Municipality
- ZH province
- Port of Rotterdam
- All proposed hubs
- Possible new investors

National
- Goverment

European/Global
- European Union

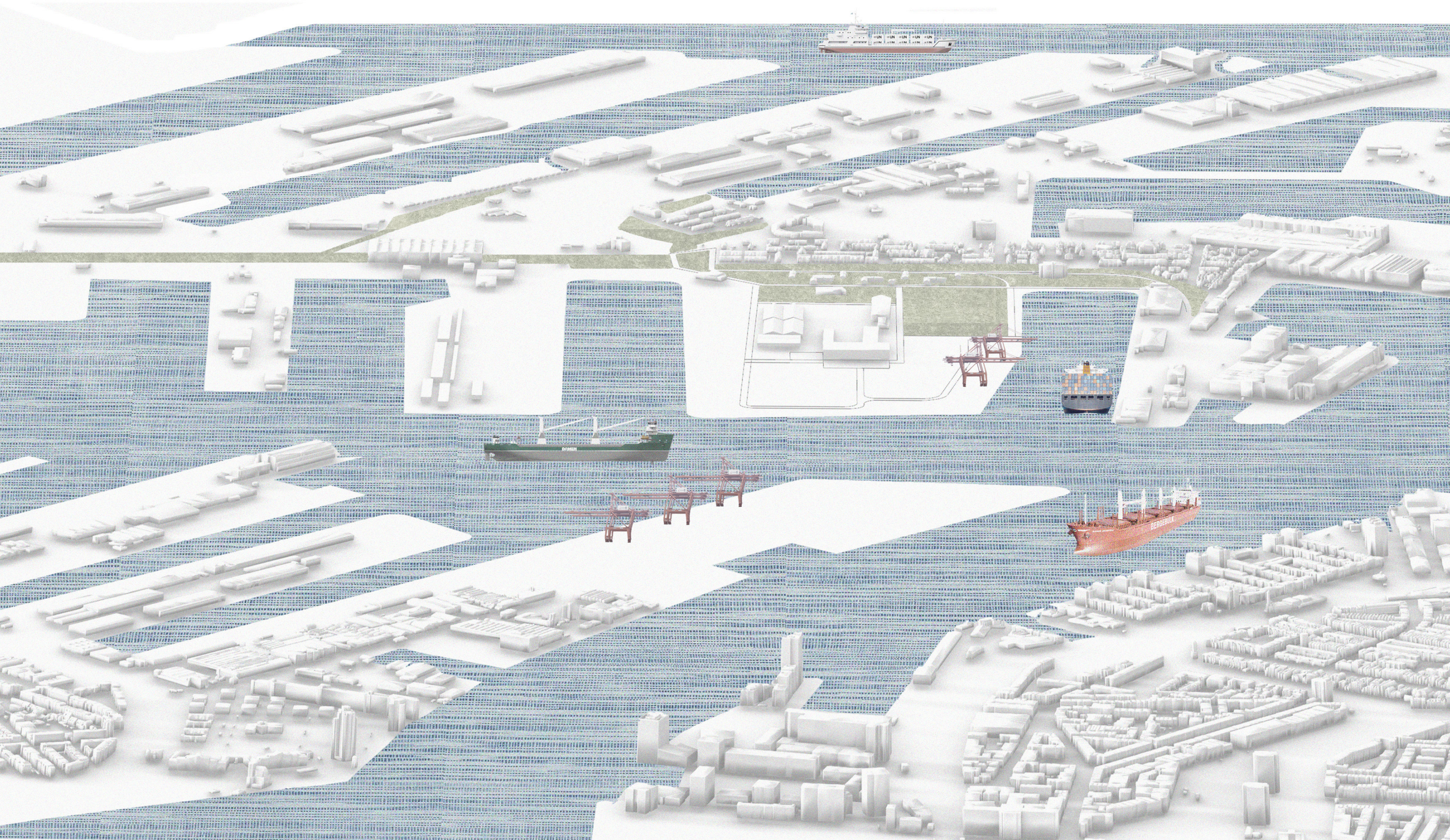
In the diagram above, the stakeholders that operate in the surrounding area and other factors that would have an impact on future propositions are listed. The stakeholders are being placed in the diagram, by taking into consideration two factors, the overall theme-category, and their engagement-impact.

On the local scale, there is a multitude of steel-related businesses, of which the biggest ones are listed and mapped in this diagram. Among these businesses, there is a metal recycling business, a ship repair company and two large industrial logistic companies. Additionally, the RDM Campus is a collective multifunctional education and innovation location within the harbour. That can contribute to training (new) workers and to new innovation in the (scrap) metal industry. Neighbouring inhabitants should also be heard and be taken into account in the development of the area.

On the regional scale, the municipality of Rotterdam and the province of South Holland are the governing authorities, together with the Port of Rotterdam. That can guide the development of this area. Possible new investors should be attracted and convinced of the quality of this project, also on an economic level. Additionally, all scrapyards that are connected to this network will rely on this central location.

On the national scale, the national government has a stake in this location especially because it is the centre of the network. Next to this, the port of Rotterdam has a big direct and indirect contribution to the employment and economy of the whole country.

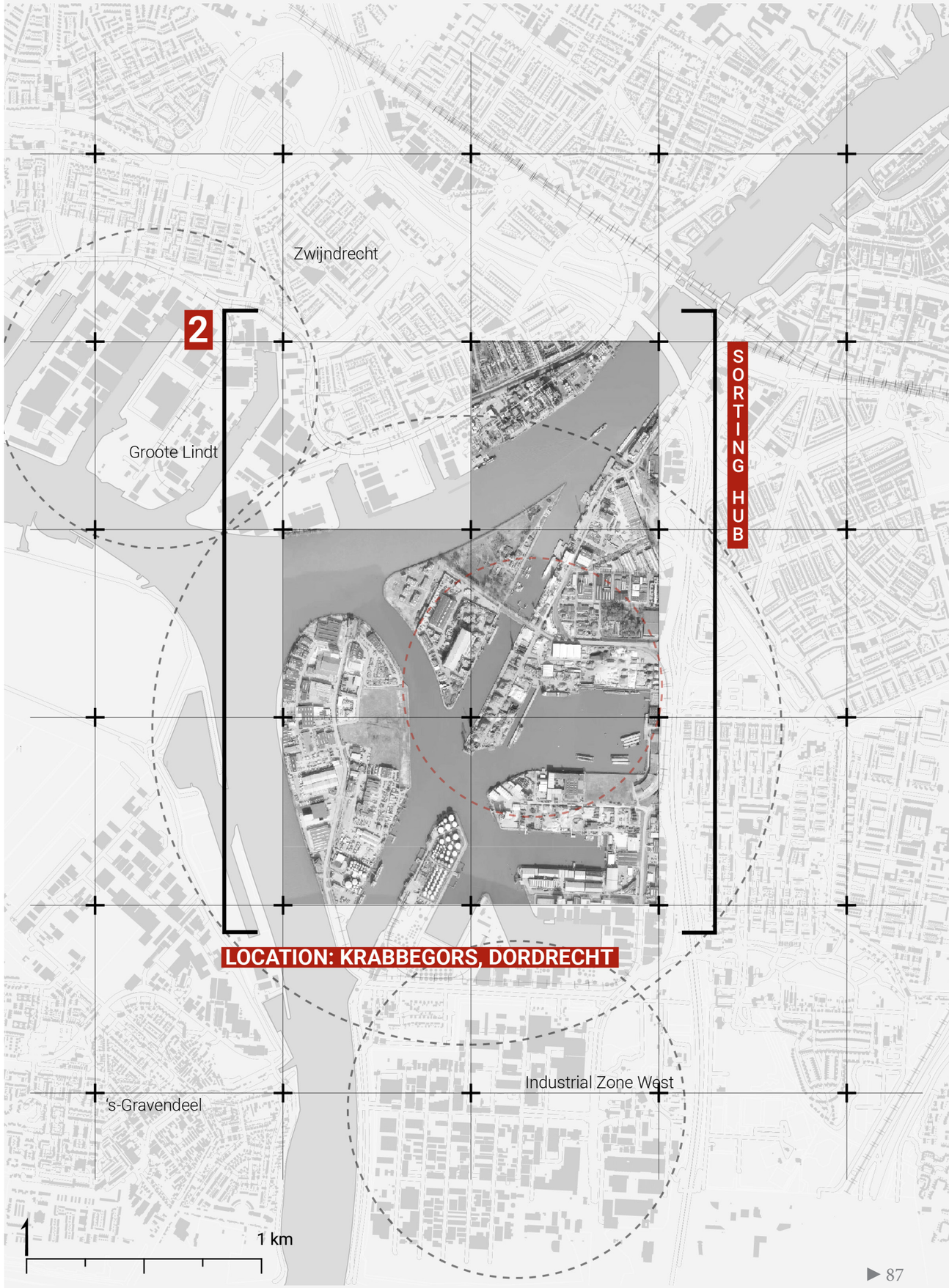
On the European scale, Germany and Belgium are stakeholders in this location because the port functions as the throughput harbour for product import and scrap export. Additionally, the port is the biggest in Europe and therefore a major trading hub, also in metal and has therefore a big influence on the European market, but also on, for example, European sustainability goals.


DOMEIN
BERGENHUS

Sorting Hub

DORDRECHT

Krabbegors is a triangle-shaped peninsula in the Oude Maas where Jansen Recycling Group BV is located. The location was chosen mainly for the large-scale existing recycling centre, and for its strategic position. The proximity to the water, the direct connection to the Port of Rotterdam, and the steel- and scrap-related industries nearby, like Oryx Stainless Holding BV and Koninklijke Van der Wees Groep BV are also important, as all these factors create a dynamic place, where the synergy between industries and companies can flourish.



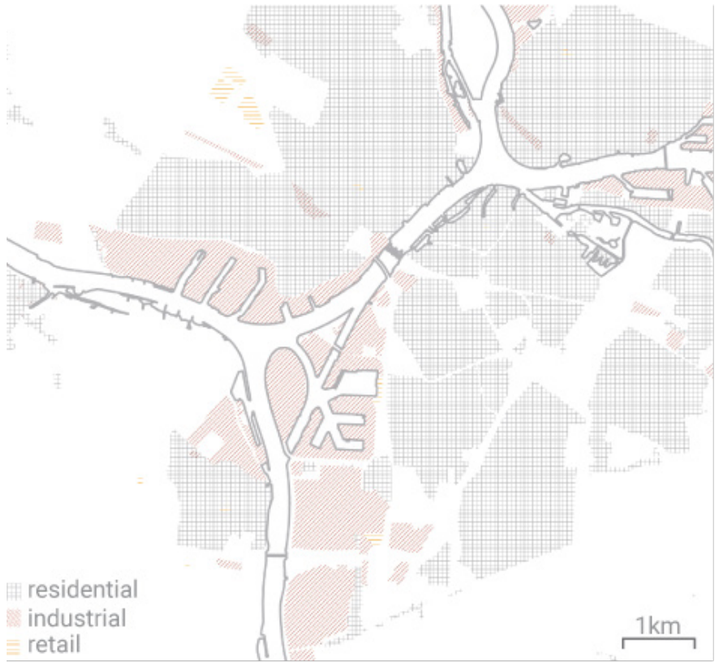
BLUE & GREEN STRUCTURES

The site is not adjacent to arable land, therefore the risk of contamination is lowered.

The green area on the northeastern side of Krabbegors, is fenced and owned by a government facility. The green that can be found around the side is only green urban parks, the map also indicates a clearly defined border between the build-up area and the agricultural land.

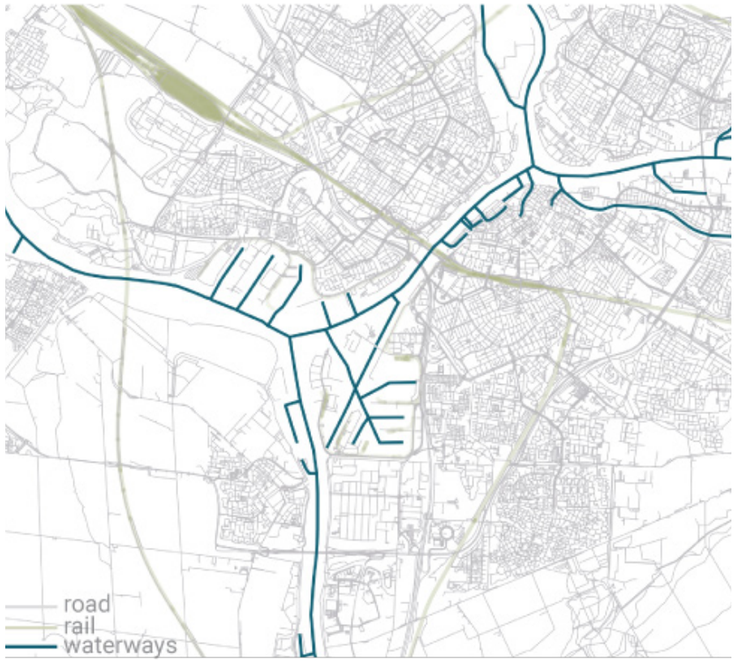
ZONING

The land uses in the surrounding area are quite monofunctional. In the Krabbegors area, which is in direct contact with the water, industrial functions are placed, creating a 'belt' of the industrial waterfront, extremely convenient for establishing a sorting hub, which requires good connectivity to the other hubs in the region.



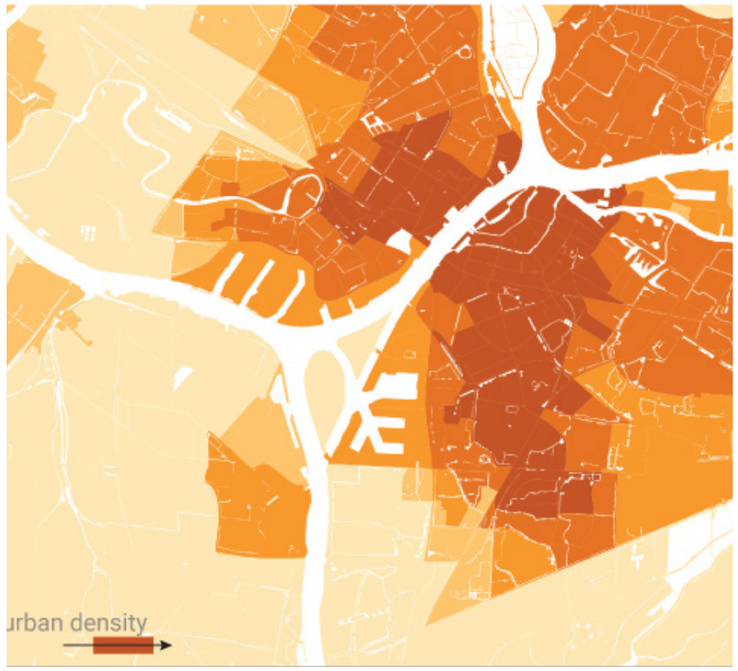
INFRASTRUCTURE

The connection to the water is one of the strongest elements in this case, as it enables materials and scrap metal to travel in a more sustainable way than trucks. It makes for a quick and sustainable connection to the port of Rotterdam in the north and the port of Antwerp in the south. With a small addition, Jansen Recycling Center can also be connected with the rail network, giving more potential to the place.



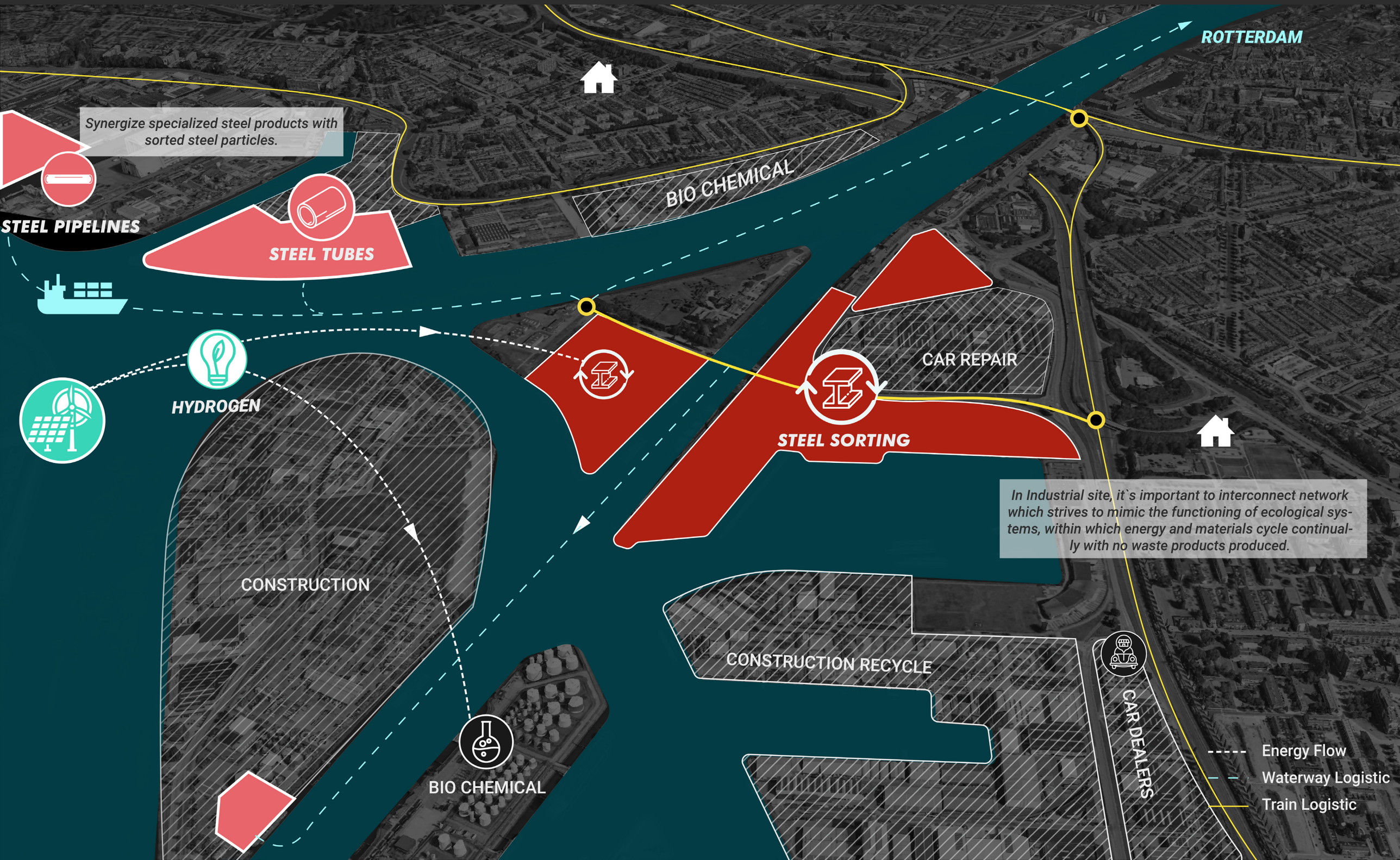
URBAN DENSITY

When referring to urban density, we map the total number of addresses per km2, we can clearly see how the city centre has a high-density fading throughout the outskirts into the farmland, with Krabbegors being in the same ring as the outskirts.



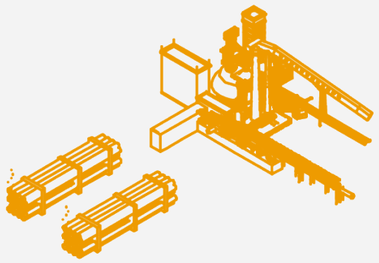
Sorting Hub Dordrecht

In Industrial site, it`s important to interconnect network which strives to mimic the functioning of ecological systems, within which energy and materials cycle continually with no waste products produced.



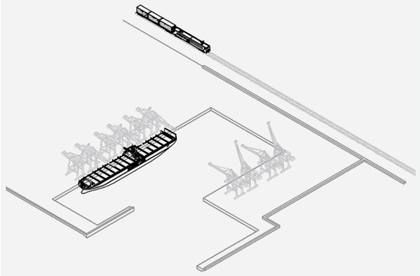
APPLIED STRATEGIES

HIGHLY SPECIALISED MANUFACTURING



Manufacturing industry that produces highly specialised metal products such as wind turbines. These can benefit from the proximity to the recycling plant for the supply of processable metals.

NETWORK AND CONNECTIVITY

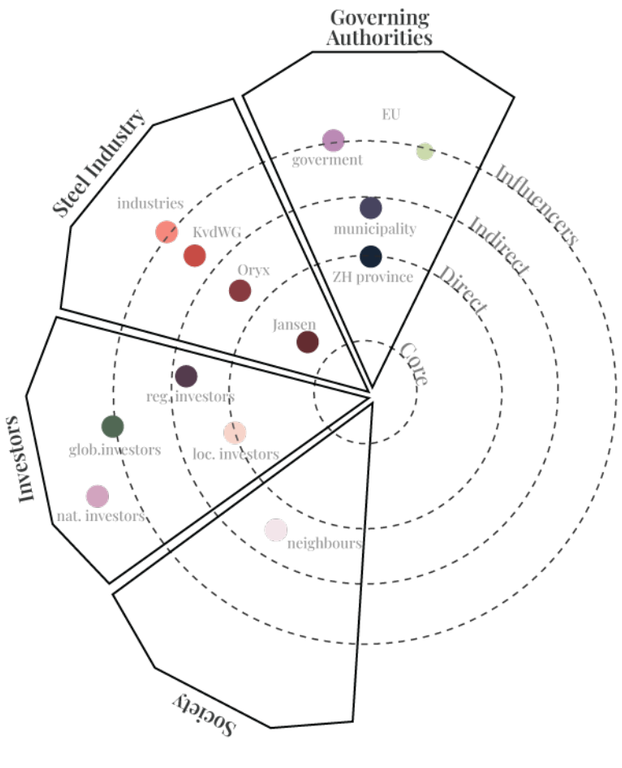


High presence of multiple types of infrastructre like train, barge or highways. These contribute to the logistic connection with other scrapyards.

THE GREEN CORRIDOR

Green belt that connects the scrapyards with the makers districts, residential neighbourhoods and urban centers.

STAKEHOLDER ANALYSIS



Stakeholders for Dordrecht

Local
- Jansen Recycling Group B.V
- Oryx Stainless Holding B.V
- Koninklijke Van der Wees Groep B.V
- Neighbouring industries
- Investors
- Neighbours

Regional
- Dodrecht Municipality
- ZH province
- Possible new investors

National
- Goverment
- Possible new investors

European/Global
- European Union
- Possible new investors

In the diagram above, the stakeholders that operate in the surrounding area and other factors that would have an impact on future propositions are listed. The stakeholders are being placed in the diagram, by taking into consideration two factors, the overall theme-category, and their engagement-impact.

On the local scale, there are two metal-scrap companies, a company that specializes in logistics (also offshore) and other nearby industries and companies that would be affected and can add to a symbiosis between each other. Also, the neighbouring communities should be informed, however in this case they would not really have a lot to do with the development in this location.

On the regional scale, we are addressing governing authorities, such as the municipality, the South Holland province and potential investors. Additionally, since this is a big and central hub, other scrapyards have a connection to this location.

On the national scale, we have the government and investors operating outside the province and influencing this location by general policies for scrapyards.

Last but not least, we wonder about the impact of the EU on this case and the geo-dependency on foreign companies, industries, and investors.

Specifically for Dodrecht, neighbouring communities would play a crucial role in all decisions, as their proximity to the area would strengthen their relationship with the new proposed activities and foster new career opportunities.

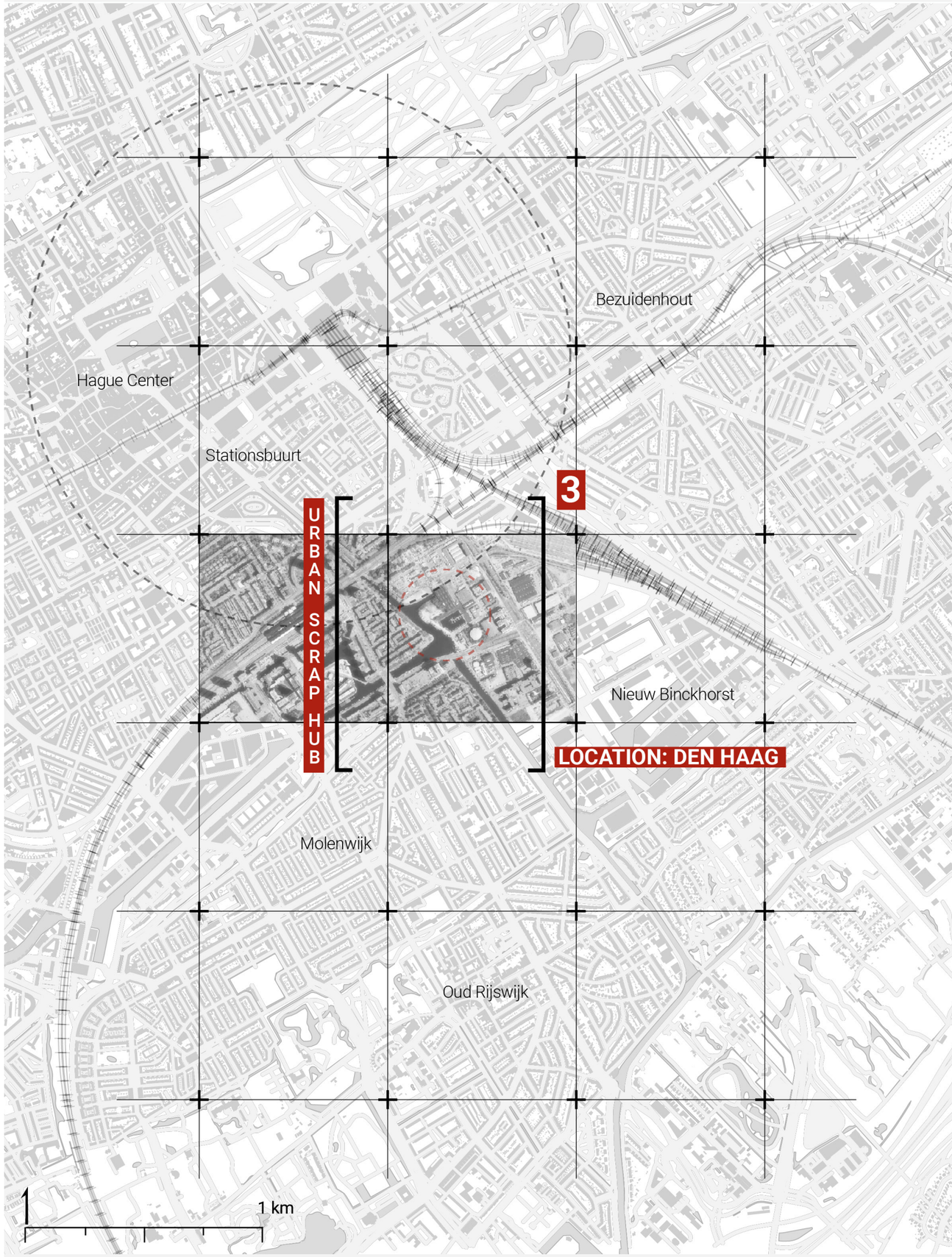
Dordrecht as a sorting hub can also be influenced by EU regulations, however, the municipality and province can have a quite interesting role. Scrap-metal related industries have also a great impact and engagement.


DAMEN
UBC
UBC
UBC
UN
UN
UN
UN
UN
UN

Urban Scrap Hub

DEN HAAG

The case study is located in the south of Den Haag with great proximity to the city centre. On the site, there are three companies dealing with waste and recyclable products. Specifically, NV HMS is responsible for the collection of private and household waste, AVR specializes in processing different types of residual waste and actively participates in metal and minerals recycling efforts. Additionally, Renewi offers solutions for collecting and processing waste. The proximity of the aforementioned companies offers a great possibility, by using the precedent and their expertise in maximizing the recycling and remanufacturing processes in the steel industry.

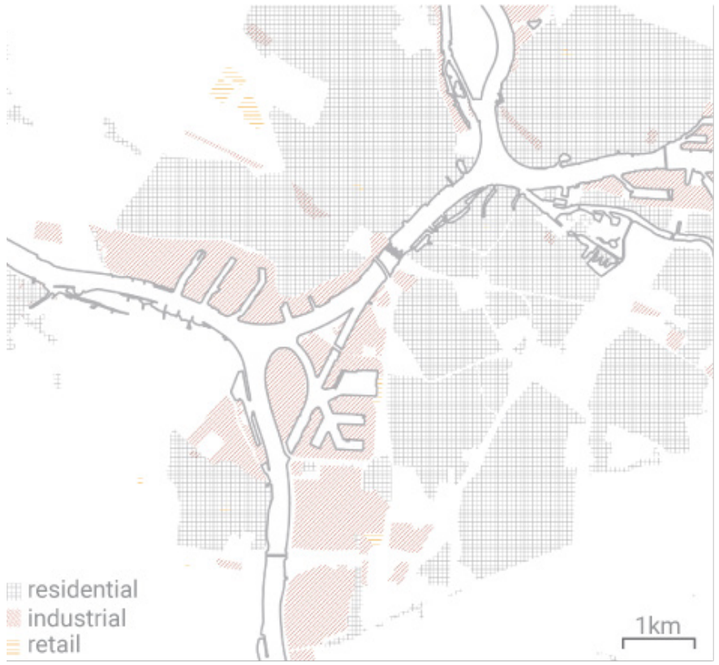


BLUE & GREEN STRUCTURES

The presence of green areas is limited, they can be found mostly as urban green parks. The absence of arable land is due to the urbanized environment of the city. Water elements are mostly dikes and canals. An interesting element of our site, is the 'Poolsterhaven', offering storage space for pleasure boats. The overall site can be identified as a high potential area for transformation. For these purposes, the water element would have a crucial role.

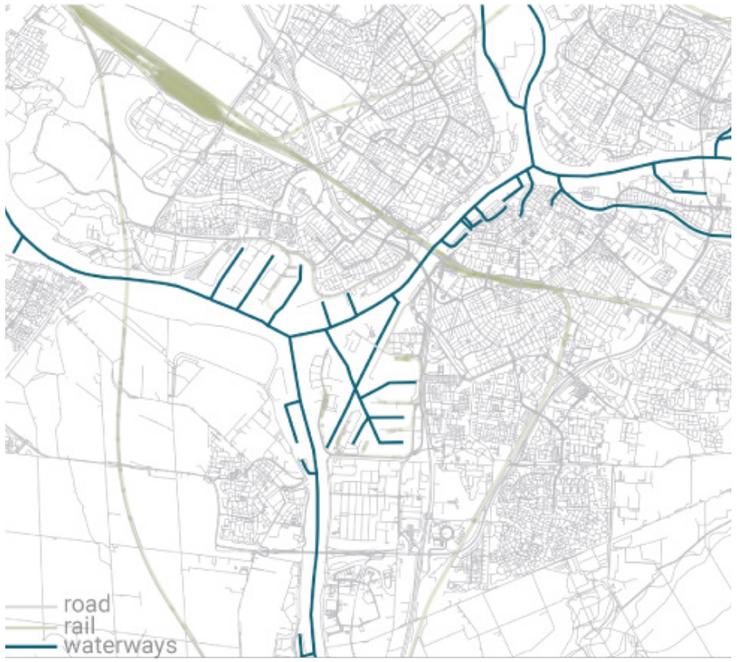
ZONING

The land uses in the area are quite mixed, with a strong presence of residential areas. On the other side of the other side of the water, there are housing units, overlooking the waste-related activities.



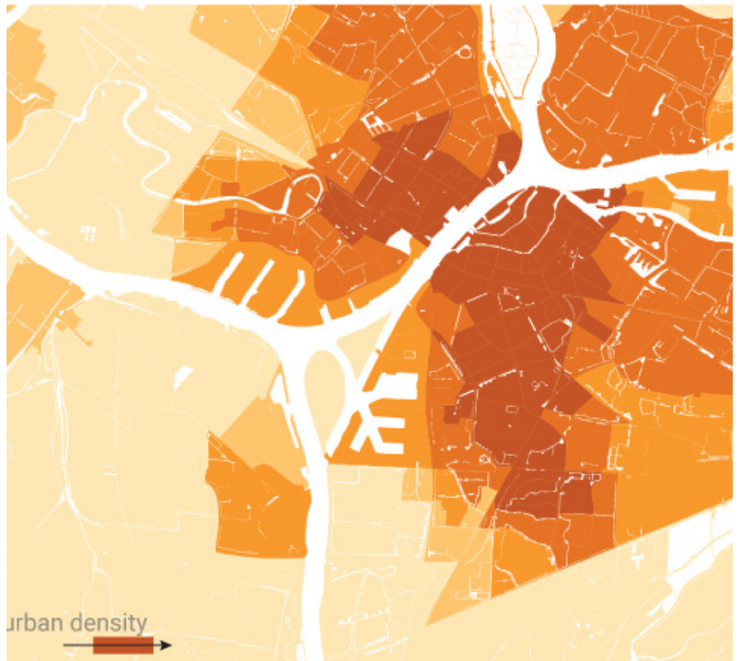
INFRASTRUCTURE

The connection to infrastructural networks is a strong element. It is accessible by road and water. The location is close to the train station Den Haag HS. Furthermore, the location has facilities to easily load and unload ships. There is also a strong connection to the waterway that leads to Rotterdam.



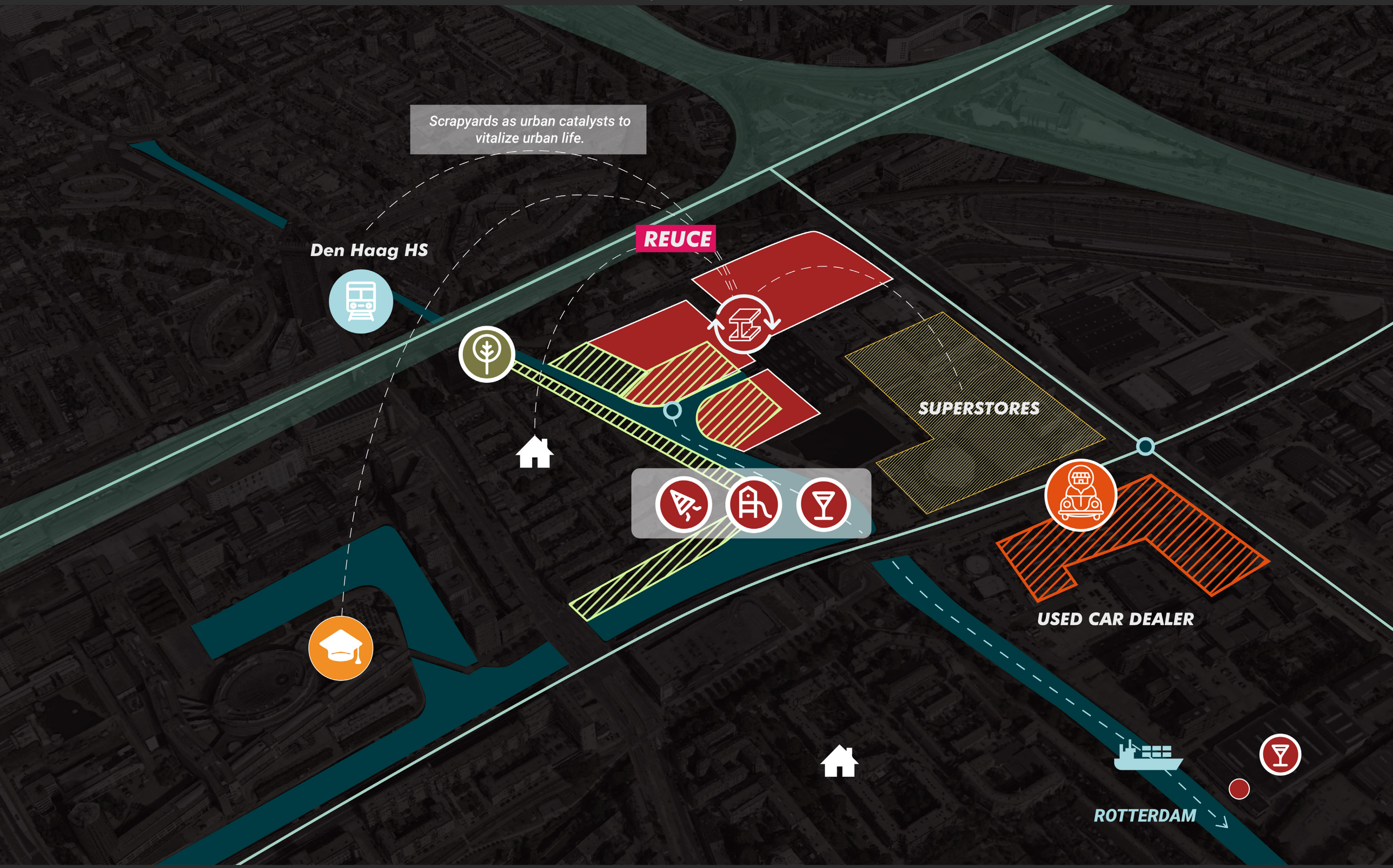
URBAN DENSITY

It comes as no surprise that the area is highly densified, as it lies in the centre of the Den Haag. The density lowers to the northeast reaching the edges of Den Haag.



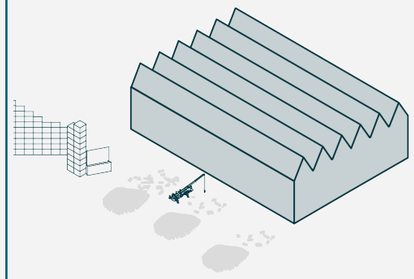
Urban Scrap Hub Den Haag

Scrapyards located in urban areas can be used as catalysts to vitalize urban life. The one in Den Haag is already a good case with turning scrapyard into a laser game ground. The waterfront is covered with the green as a good environment for local placemaking.



APPLIED STRATEGIES

THE FUN DUMP

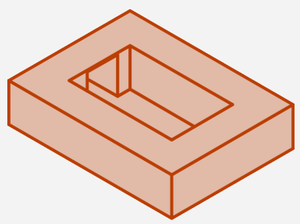


Medium scale scrap yards that house public functions like events. These can be open to various cultural activities and help forge a connection with the community.

POP-UP ACTIVITIES

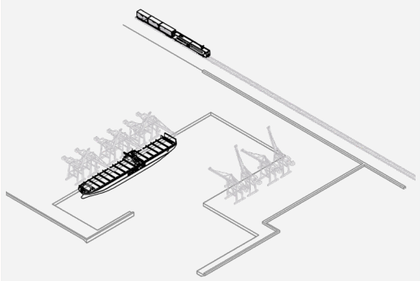
Pop-up cultural and leisure hub with art interventions, foodtrucks made out of containers, bier garden etc. These contribute to the cultural reconnection.

INNOVATION HUB



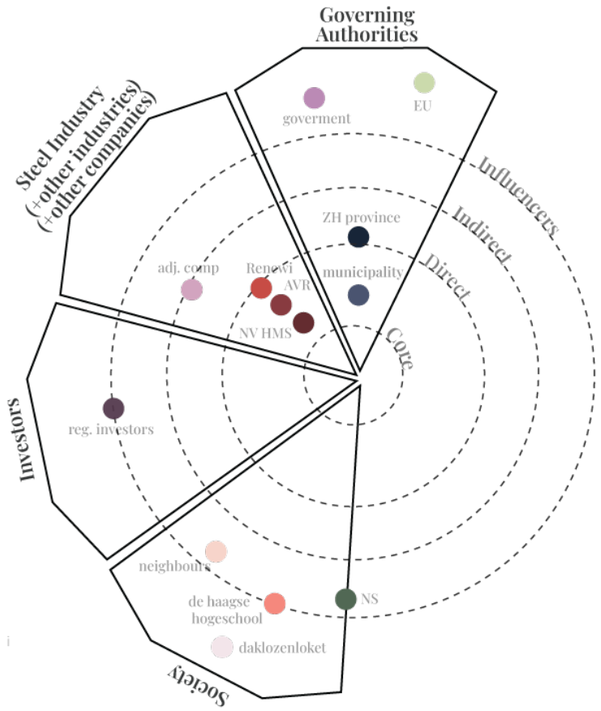
Innovation and educational centers close by that can provide innovative solutions for scrap metal processing and production in the specialised hub.

NETWORK AND CONNECTIVITY



High presence of multiple types of infrastructre like train, barge or highways. These contribute to the logistic connection with other scrapyards.

STAKEHOLDER ANALYSIS



Stakeholders for Den Haag

Local
- Haagse Milieu Services (NV HMS)
- Afvalverwerking AVR
- Renewi Overheidsdiensten Bv
- De Haagse Hogeschool
- Neighbouring + adjoining companies
- Neighbours
- Daklozenloket

Regional
- Den Haag Municipality
- ZH province
- Possible new investors

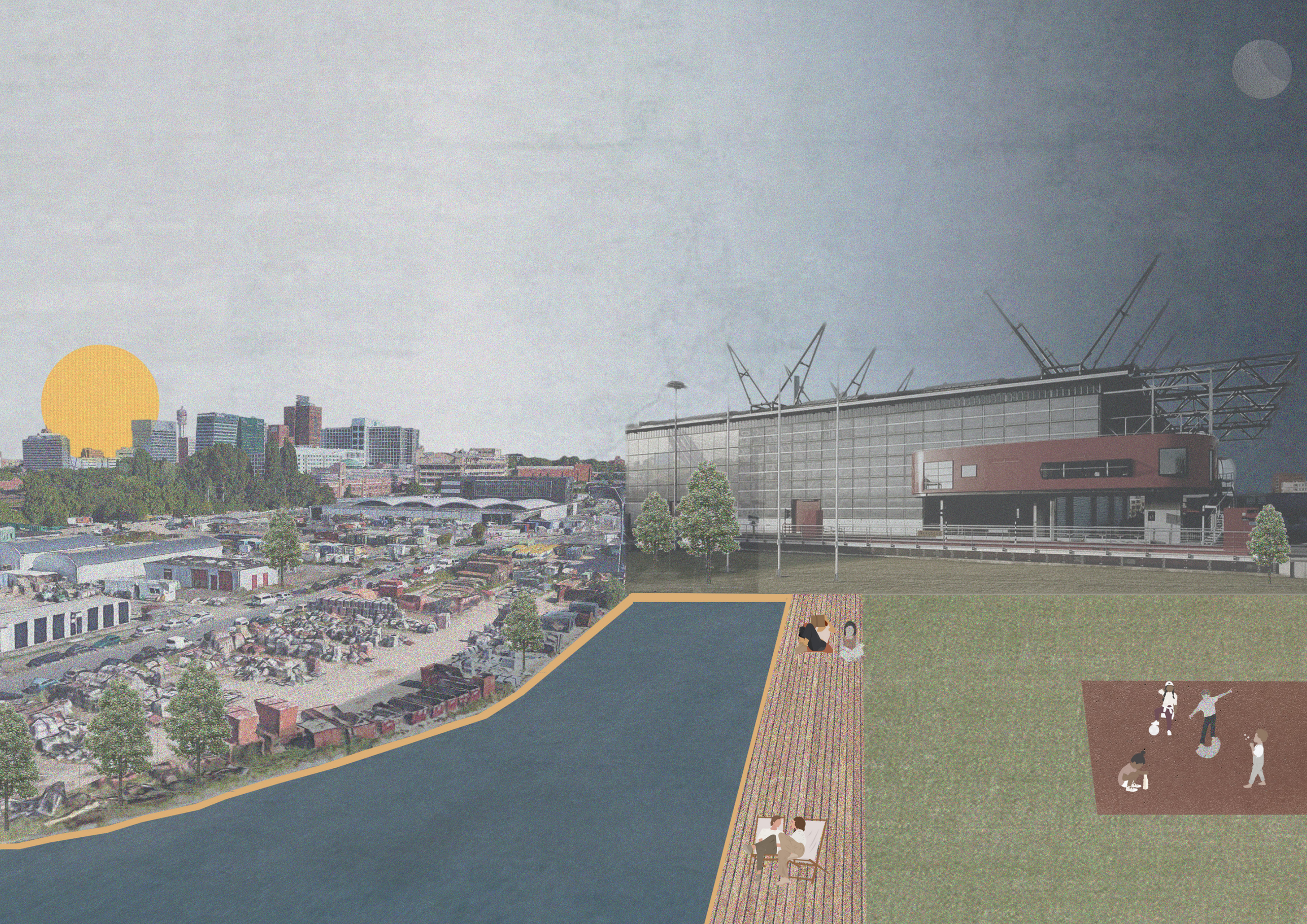
National
- Goverment
- NS trains

European/Global
- European Union

In the diagram above, the stakeholders that operate in the surrounding area and other factors that would have an impact on future propositions are listed. The stakeholders are being placed in the diagram, by taking into consideration two factors, the overall theme-category, and their engagement-impact.

On the local scale, as the area has great potential of undergoing transformation, stakeholders play a crucial role in the decision making. The three acting waste companies have a great impact. Also, nearby is located the Den Haagse Hogeschool which can have an influence on the process and benefit.

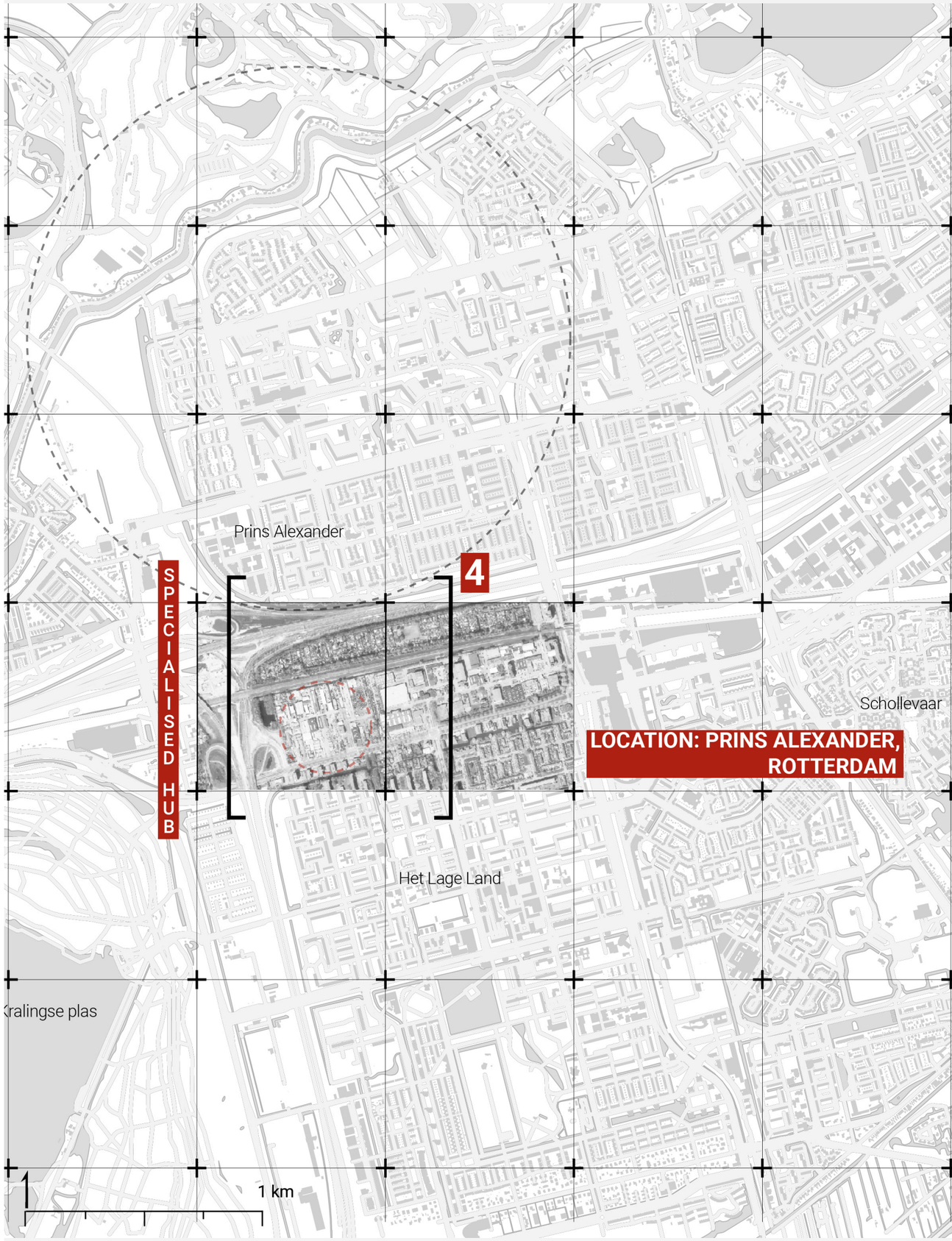
On the regional scale, the steel industry is not directly linked to the site, but byproducts that end up there have high value for our project. The governing authorities that have the utmost impact are the municipality and the Zuid Holland province. Concerning society, neighbours can influence the future plan. Last, close to the site, there is the 'Daklozenloket', the central coordination centre offering help to homeless people. This facility, under the right context and timing, could foster opportunities for the local community.



Specialised Hub

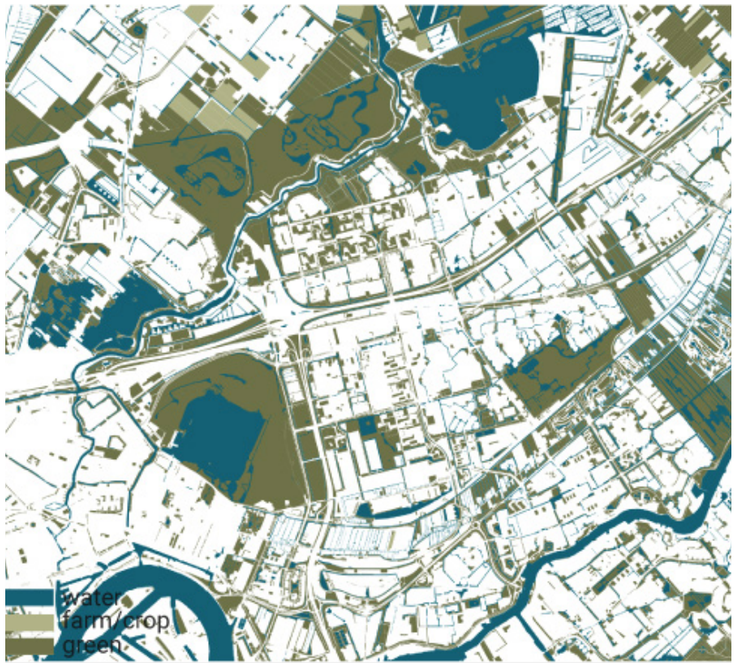
ROTTERDAM

This area is specialised only in car repair and car scrap collection and sorting. There are multiple smaller and bigger car repair and collection businesses among which multiple so-called car graveyards. The specialisation of only one product makes this area interesting to analyse, the conclusions can apply to other specialised scrap locations.



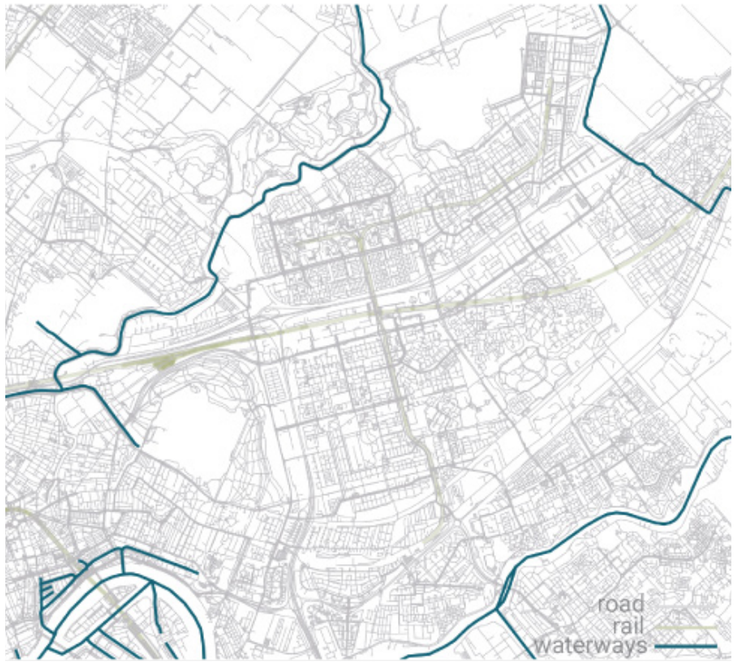
BLUE & GREEN STRUCTURES

The location is located in the middle of the build-up area, reducing pollution risks in nature reserves. There is a small strip of green adjacent in the north with allotment gardens, split from the scrap location by a railway.



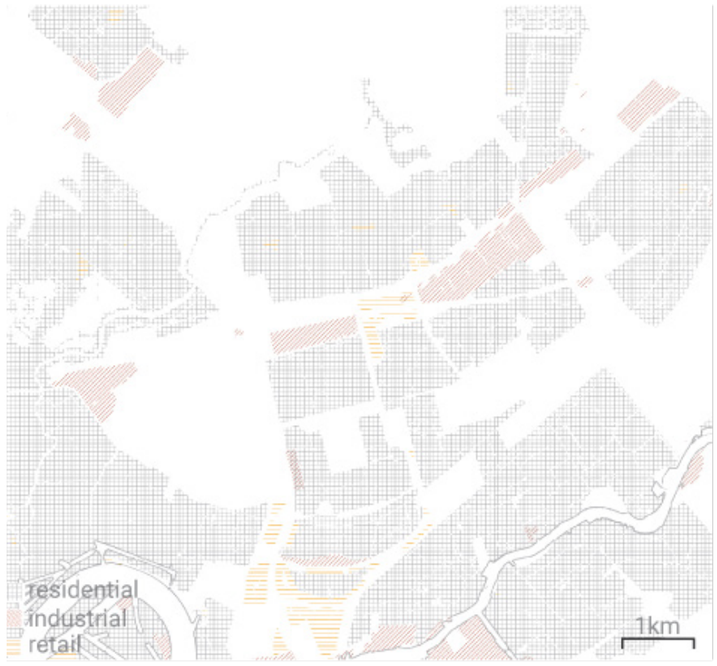
INFRASTRUCTURE

This location does not have a connection to a waterway, however, it does have a connection to the highway making it very accessible. A railway is passing right alongside this location, however, there is no actual connection to it, which might be a future addition to make more sustainable transportation to other hubs possible.



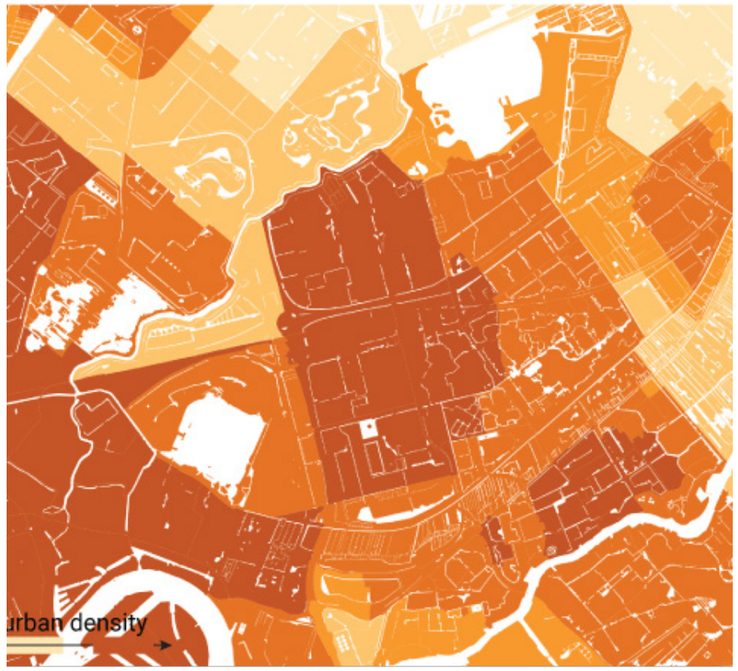
ZONING

The area is located in a strip of an industrial area or 'bedrijventerrein' and a retail area spread along the railway and the highway. It is an island in the urban fabric bordered by the highway on the north and a regional road on the south. On the north and the south of this strip, there is a residential area. Because there are already some repair shops in the area, people from the neighbourhood might already have a connection to it when they need their car to be fixed.



URBAN DENSITY

The area is a high urban density location itself surrounded by equally dense areas. Only to the north and east the density slowly decreases reaching the edge of the city of Rotterdam.

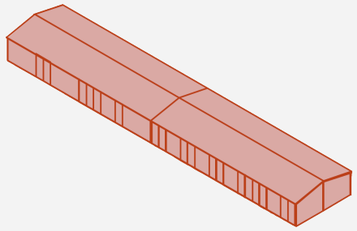


Specialised Repair Hub Rotterdam

The Specialized Hub focuses on processing one type of metal scrap. Almost all the parts of a car or any other auto can be recovered, with a recycling rate greater than 90% for a typical vehicle. This case proposed a car dismantler, separating cars into different parts which can be repaired or remanufactured later again. Second car dealers are located near supershops, offering a complete automobile chain.

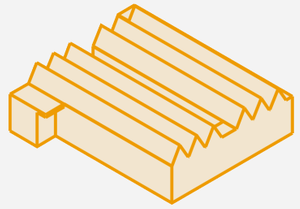
APPLIED STRATEGIES

FIX IT YOURSELF CENTER



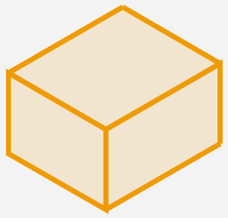
Warehouse or flexible structure in proximity with the local dump that can support different programs. This facility provides public services by offering space sand tools to work and repair things. Also suitable to rent workspace for makers.

SPECIALISED MANUFACTURING



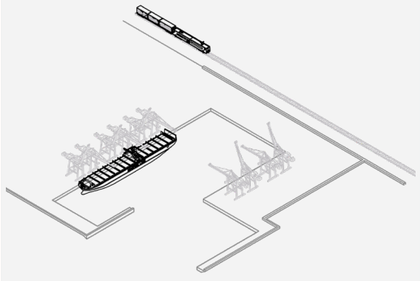
Manufacturing industry that can reuse and recycle parts of the material sorted in the specialised dump, making the production more sustainable and circular.

SPECIALISED SHOPS



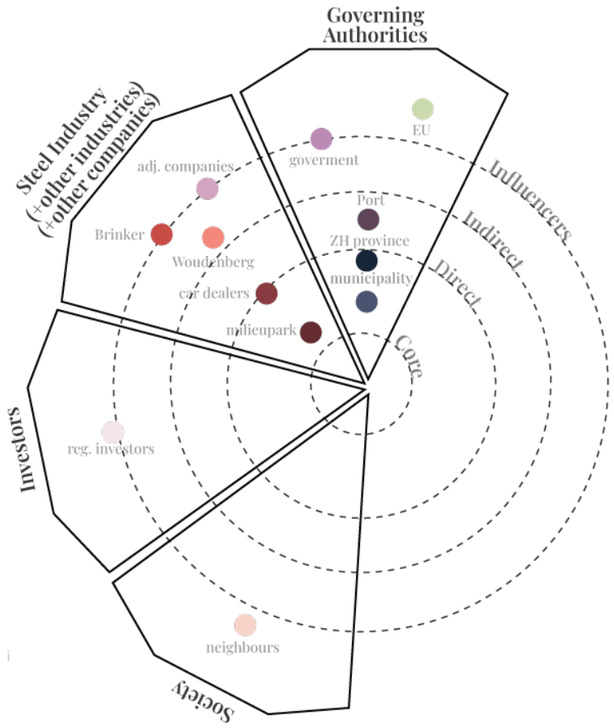
Retail and shops open to the local community that can benefit from the production and services of the specialised hub. For example, a facility to wash your car, buy supplies, etc.

NETWORK AND CONNECTIVITY



High presence of multiple types of infrastructre like train, barge or highways. These contribute to the logistic connection with other scrapyards.

STAKEHOLDER ANALYSIS



Stakeholders for Pr. Alexander

Local
- Milieupark Prins Alexander
- Car Dealers
- Brinker BV Straal/Coatingbedrijf
- H. Woudenberg Transport
- Neighbouring + adjoining companies
- Neighbours

Regional
- Rotterdam Municipality
- ZH province
- Port of Rotterdam
- Possible new investors

National
- Goverment

European/Global
- European Union

In the diagram above, the stakeholders that operate in the surrounding area and other factors that would have an impact on future propositions are listed. The stakeholders are being placed in the diagram, by taking into consideration two factors, the overall theme-category, and their engagement-impact.

On the local scale, as said there is a multitude of car-related businesses, from repair shops, second-hand car dealers and disassembly and sorting locations. The biggest ones are listed in the diagram but there are many more small ones listed as ‘Car dealers’ in general. Other than that there are the neighbours, that make use of the offered car-related services of this area.

On the regional scale, the municipality of Rotterdam, the province of South Holland and the port of Rotterdam are stakeholders in this area. They should be willing to make regulations helping the development of the area and should therefore be attracted to the proposals that are done later on.

On the national scale, the national government can apply pressure or trigger innovation through regulations, they also have the power to give subsidies to initiatives that support the strategy.

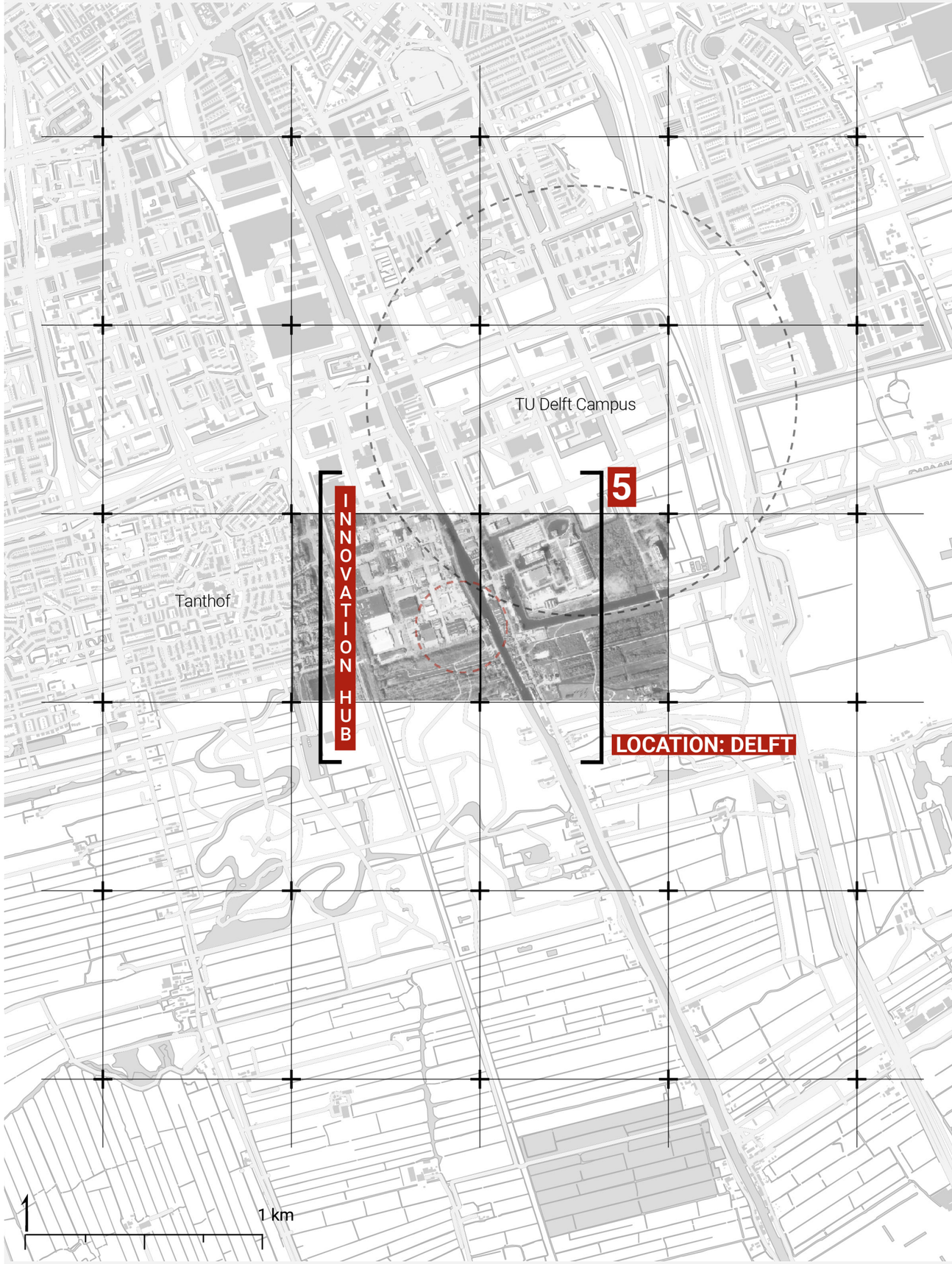
On the European scale, the European Union has the power to influence this kind of location because the car industry is a huge industry with huge economic, social and environmental impact.

Case V

Innovation Hub

DELFT

The residential waste collection and sorting centre located south of Delft in the Schieweg neighbourhood is owned by Avalex Delft. This is an interesting location because of the large amount of technical education and research and innovation centres nearby. Additionally, it has a strategic location at the waterfront with a loading dock. Next to that, it is located in a 'bedrijventerrein' providing possibilities for symbiosis between scrapyard and manufacturers.



BLUE & GREEN STRUCTURES

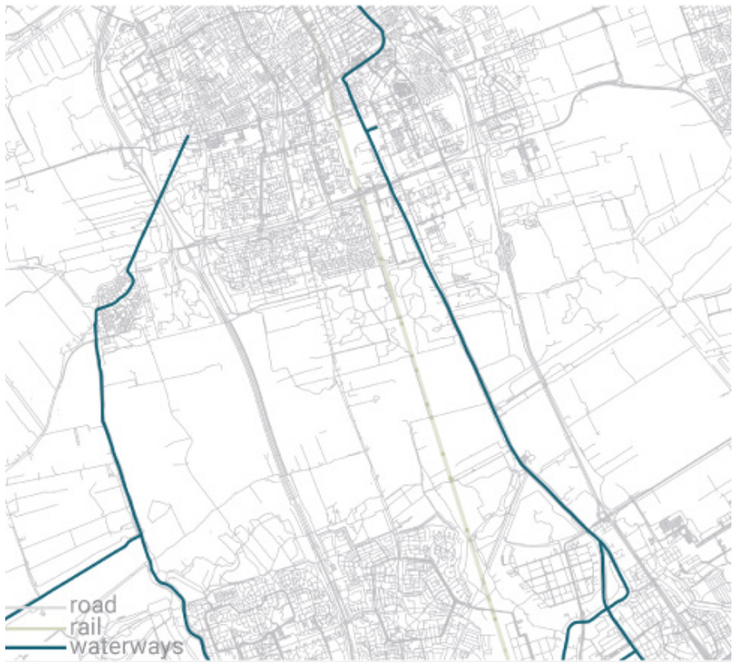
The location is on the edge of the build-up area, with on the other side a man-made forest meant for timber extraction, which is also used as a recreational area with walking and cycling paths.

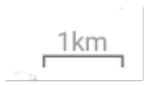
ZONING

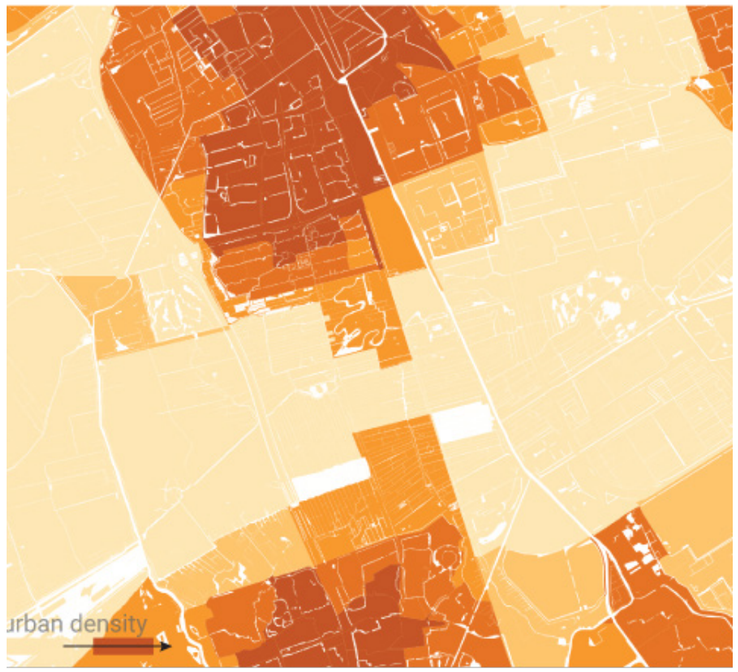
The scrapyard is located at the edge of an industrial area or ‘bedrijventerrein’. This area is shaped like an island in the urban tissue surrounded by a residential area on three sides and by green land on the fourth side. The presence of other manufacturing businesses creates possibilities for symbiosis and exchange of scrap and metal products.

INFRASTRUCTURE

The connection to the water is a strong asset of this location. The waterway de Delftse Schie, having a direct connection to the port of Rotterdam. The railway is also very close offering another logistic option next to the water connection if necessary.





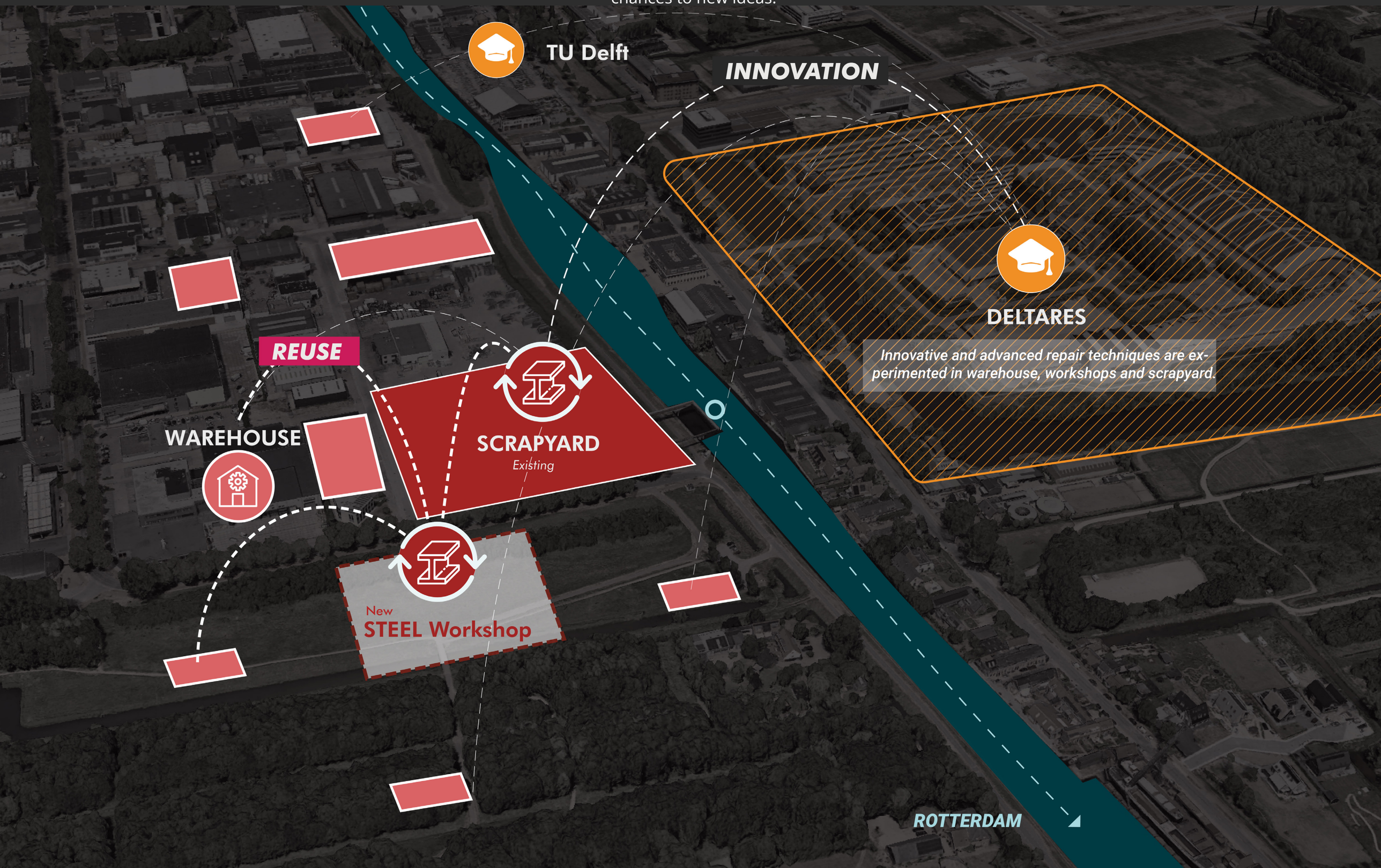


URBAN DENSITY

The urban density around the delft location is high on the north and west side, towards the city centre and low on the south and east side, towards the green area.

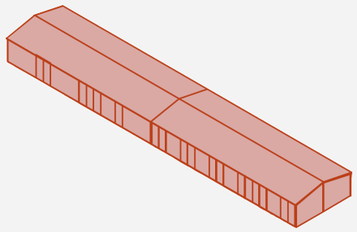
Innovation Hub Delft

The Innovation Hub focus on developing innovative sorting and recycling techniques in collaboration with existing labs, offices or campuses. Scrapyards and workshops nearby serves as experiment fields for students, remove barriers and offer low cost chances to new ideas.



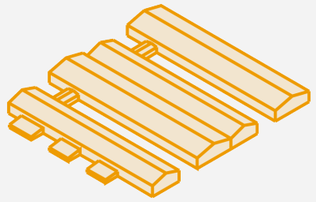
APPLIED STRATEGIES

FIX IT YOURSELF CENTER



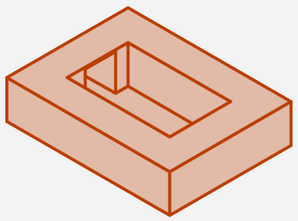
Warehouse or flexible structure in proximity with the local dump that can support different programs. This facility provides public services by offering space sand tools to work and repair things. Also suitable to rent workspace for makers.

MAKERS HERITAGE HUB



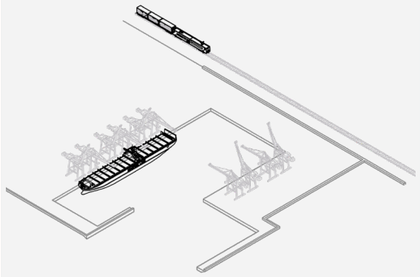
Warehouse or existing industrial heritage structure in proximity with the specialised dump that can work as space for makers cooperatring with the nearby educational and innovations hubs.

INNOVATION HUB



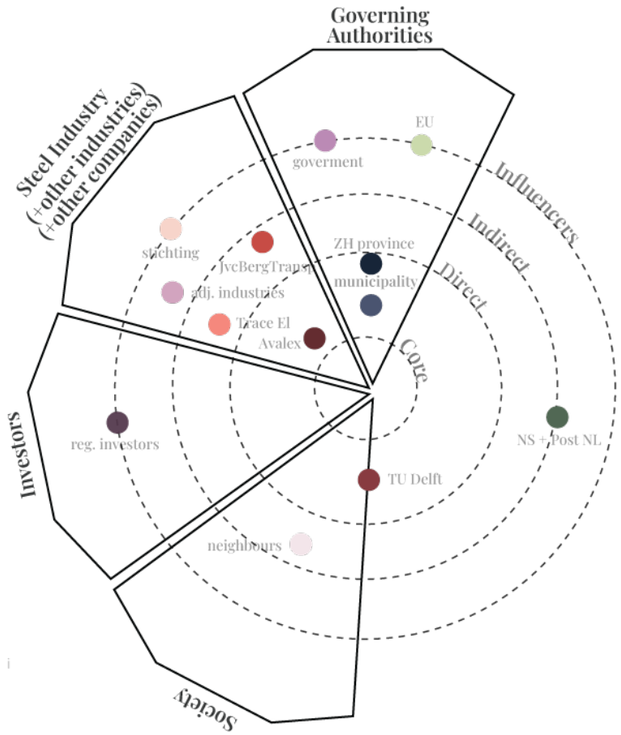
Innovation and educational centers close by that can provide innovative solutions for scrap metal processing and production in the specialised hub.

NETWORK AND CONNECTIVITY



High presence of multiple types of infrastructre like train, barge or highways. These contribute to the logistic connection with other scrapyards.

STAKEHOLDER ANALYSIS



Stakeholders for Delft

Local
- Avalex Delft
- TU Delft
- Jan van den Berg Transport
- Trace Elemental Instruments
- Neighbouring + adjoining industries
- Stichting Kringloopbedrijf
- Neighbours

Regional
- Delft Municipality
- ZH province
- Possible new investors

National
- Goverment
- NS trains + Post NL

European/Global
- European Union

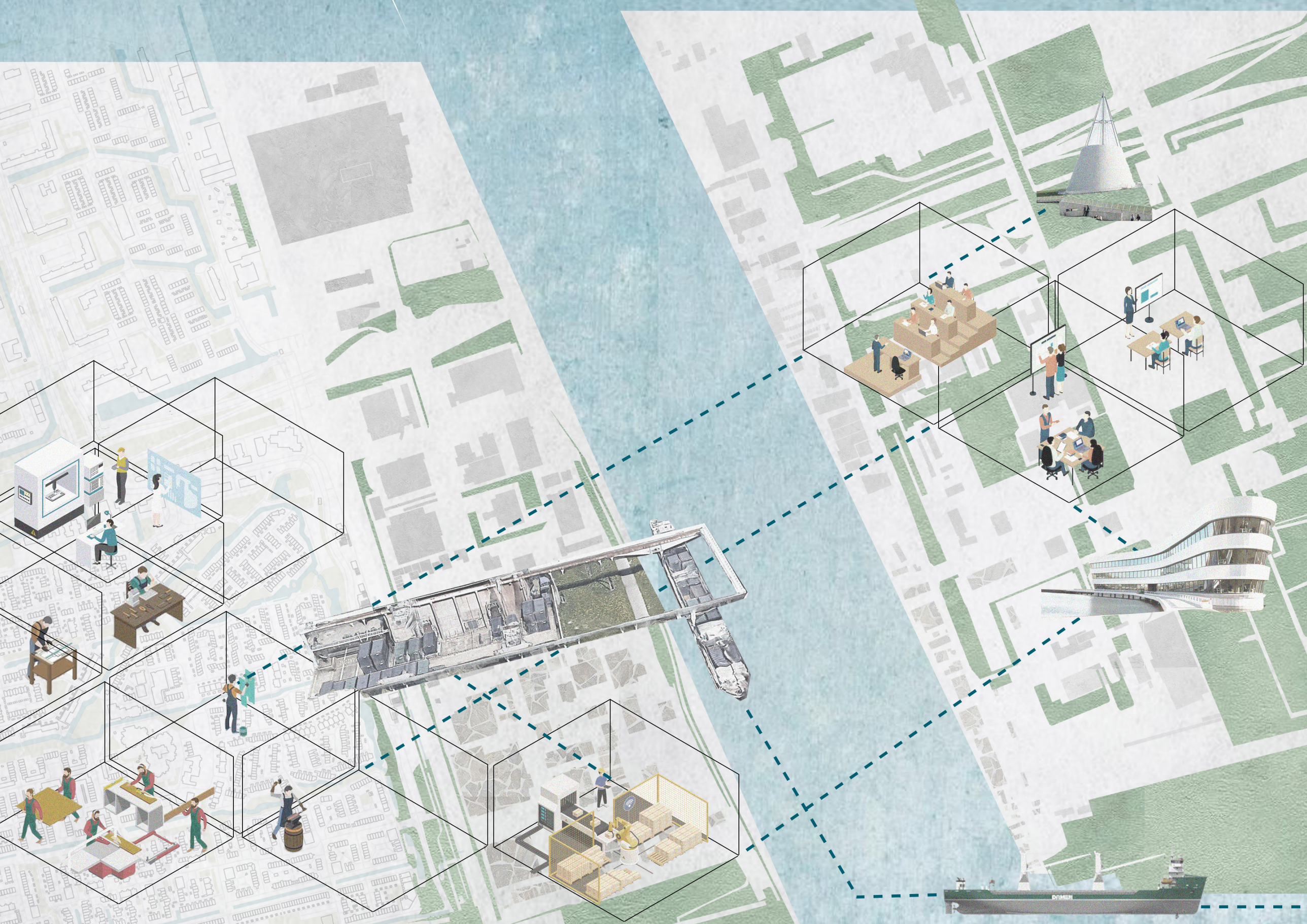
In the diagram above, the stakeholders that operate in the surrounding area and other factors that would have an impact on future propositions are listed. The stakeholders are being placed in the diagram, by taking into consideration two factors, the overall theme-category, and their engagement-impact.

On the local scale, there is Avalex Delft, the scrapyard itself and a transport company. Next to that are neighbouring industries that can create a symbiosis with the scrapyard, and there is a thrift shop: Kringloop Delft, that can work together with the scrapyard in reusing and repairing still usable items.

On the regional scale, the municipality of Delft and the province of South Holland should be inspired and attracted to the strategy and can have an influence by making regulations. Investors should also be attracted to invest in the development of this area to join in the overall strategy.

On the national scale, the national government can apply pressure or incentives to the location to transform it for the strategy. Additionally, bigger transport companies like NS and PostNL can play a part in this location to connect it to other scrapyards and the port of Rotterdam.

The TU Delft is not placed in the stakeholder diagram because they do not have a direct influence on the scrapyard. However, they can have a big secondary influence by doing (student) research projects about scrap sorting, processing or use. Additionally, the proximity of this technological education and innovation institution might provide graduates that want to start an innovative startup around the scrap cycle, which can contribute to the development of this scrapyard into a scrap innovation location.



Collection Hub

HELLEVOETSLUIS

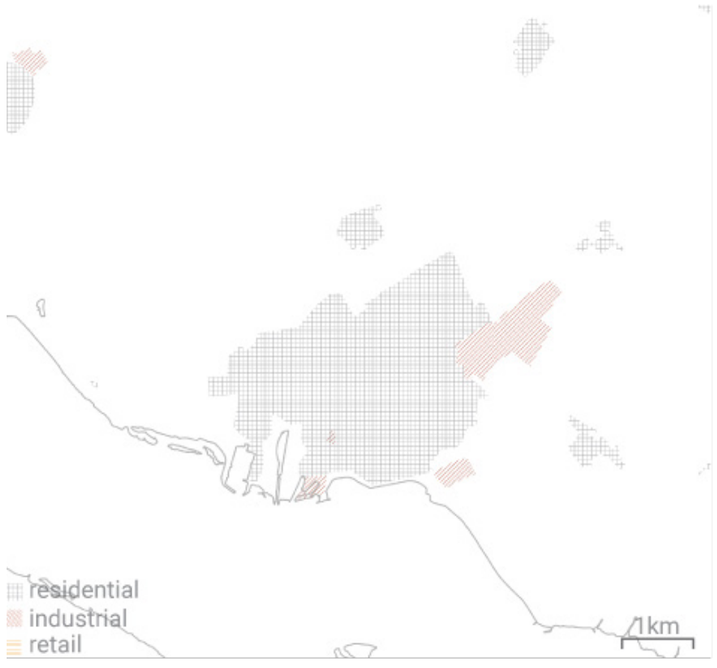
Hellevoetsluis is a town in the southwest of the Zuid-Holland province. On the outskirts of the town, a residential waste collection and sorting centre is located in proximity to the local cemetery. The case was chosen as an example of a small-scale, local waste collection location, that has great potential to enhance re-using and repairing objects. The territory around it is very interesting, mostly covered by green fields. The road network passing in front of the site, attracted a small linear urban expansion, mostly housing.

BLUE & GREEN STRUCTURES

The town is surrounded by green fields and arable land. The south part of the town is in direct contact with the waterfront, hosting smaller-scale maritime activities.

ZONING

Land uses are quite monofunctional in the way they have been allocated with segregated residential and industrial activities, which are positioned in the northeastern part.

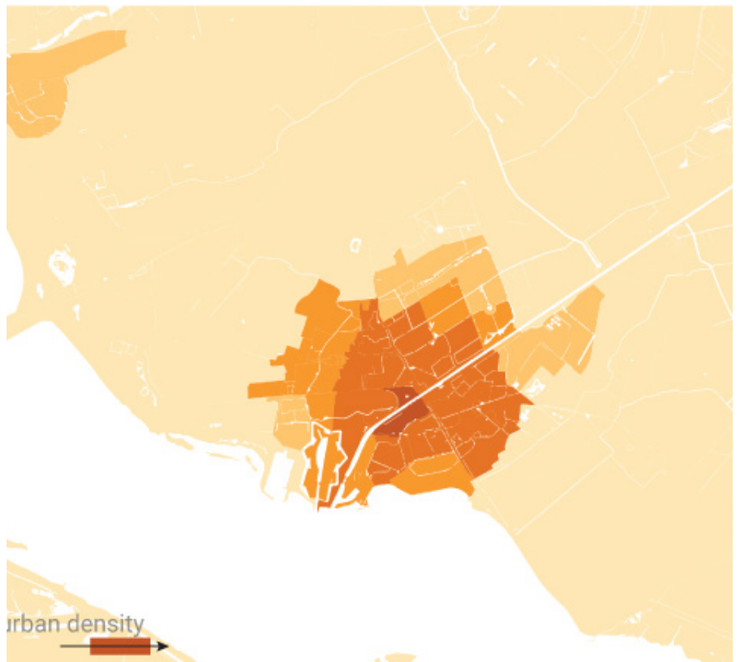


INFRASTRUCTURE

The town is only accessible by road and water, however, the scrapyard itself does not have a direct water connection and the railway network does not reach it. Specifically for the site, it is accessible by road, and upon arrival, trucks have designated zones for (un)loading. The facility is kept to its bare minimum, having containers and equipment for (un)loading and sorting.

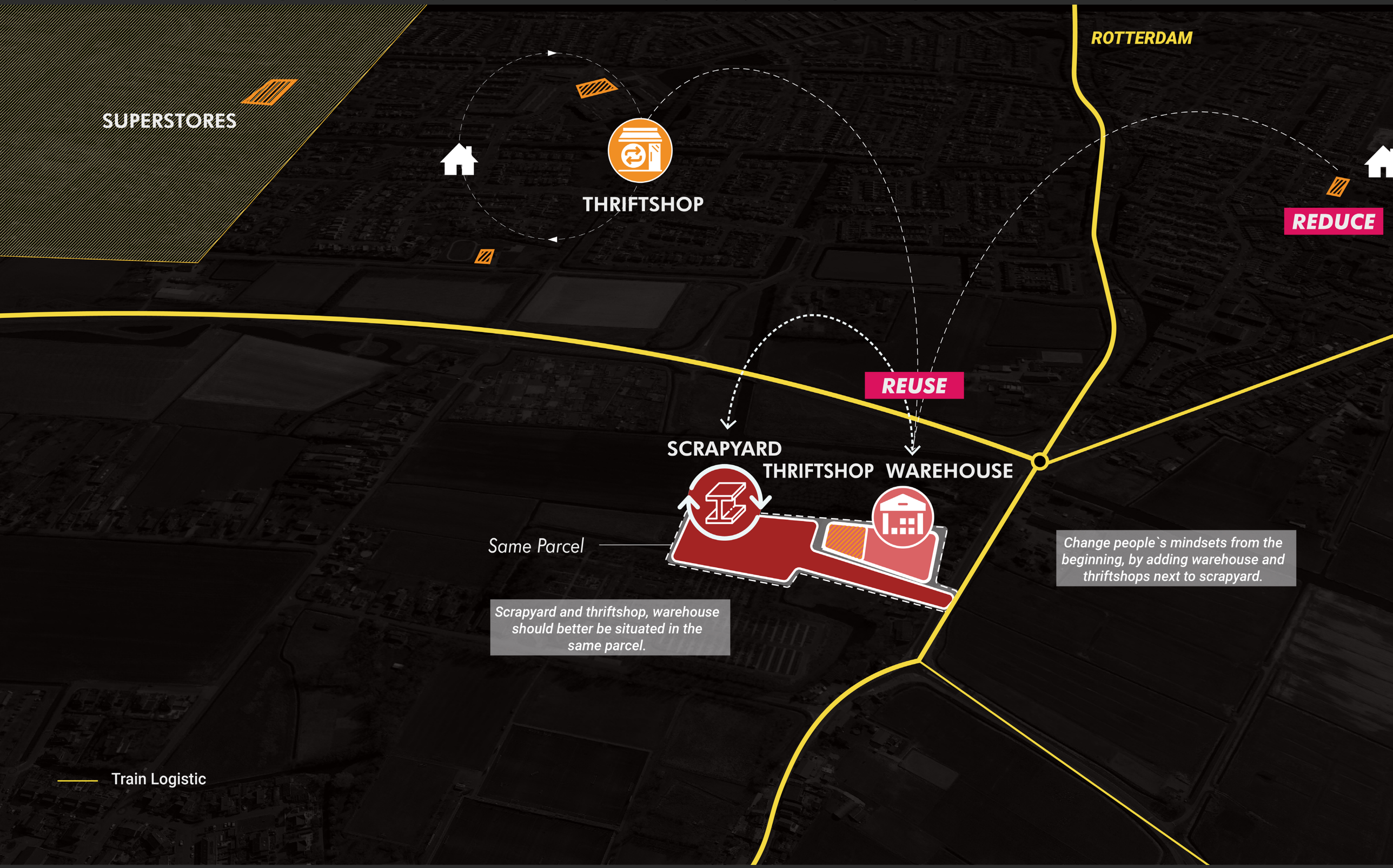
URBAN DENSITY

When referring to urban density, we map the total number of addresses per km2, categorised by buurt. The urban density coincides with an almost radial pattern, with higher concentration along the canal.



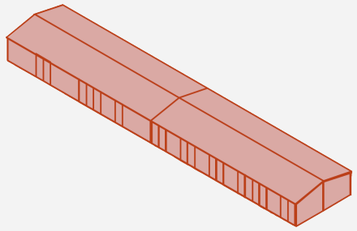
Collection Hub Hellevoetsluis

The small-scale collection hubs are aimed to change people's mindsets from the very beginning of sorting domestic scrap metals. Thrift shops and warehouses are suggested to locate beside the scrapyard, so people can think twice before throwing things away. This also helps build a sense of community with people repairing, collecting, or even artisan out of scraps.



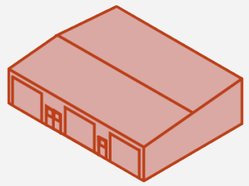
APPLIED STRATEGIES

FIX IT YOURSELF CENTER



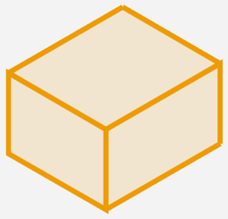
Warehouse or flexible structure in proximity with the local dump that can support different programs. This facility provides public services by offering space sand tools to work and repair things. Also suitable to rent workspace for makers.

RE-USE SHOPS



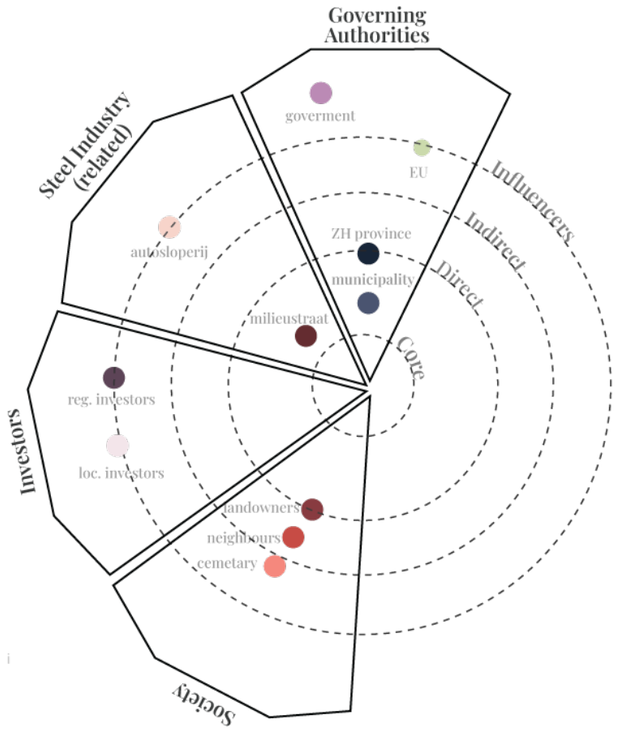
Shops integrated in the urbanity that can provide space to sell and buy secondhand products. Open for public to function like a flea market or a garage sale.

SPECIALISED SHOPS



Retail and shops open to the local community that can benefit from the production and services of the specialised hub. For example, a facility to wash your car, buy supplies, etc.

STAKEHOLDER ANALYSIS



Stakeholders for Hellevoetsluis

Local
- Milieustraat Hellevoetsluis
- Adjoining landowners
- Neighbours
- Cemetary
- Autosloperij Molshoek V.O.F.
- Investors

Regional
- Hellevoetsluis Municipality
- ZH province
- Possible new investors

National
- Goverment

European/Global
- European Union

In the diagram above, the stakeholders that operate in the surrounding area and other factors that would have an impact on future propositions are listed. The stakeholders are being placed in the diagram, by taking into consideration two factors, the overall theme-category, and their engagement-impact.

Stakeholders analysis for this case is quite interesting, as the scale of the city and the functions of the waste centre differ from the other cases.

On the local scale, the societal aspect is quite important. In particular, neighbours are a strong element as their proximity to the site can influence decision-making. Nearby landowners should also be on board with future plans, as a possible expansion of the site might affect their activities and trigger their reluctance. All planned future activities should bear in mind the proximity to the cemetery, by respecting its presence in the area.

Investors do not have a strong presence, perhaps if any they would act as influencers. This means, that indirectly they can foster an environment that boosts a more effective sorting and reusing of materials that can also benefit their businesses.

The steel industry factor here is not directly linked to the site. However, in the town, there is a car junkyard, where they take cars apart and ship the materials elsewhere. That business can influence the overall effort of recycling and reusing materials with initiatives.

On the Regional scale, concerning the governing authorities, the municipality has the greatest impact in fostering a community-driven environment for sorting waste and recycling. Zuid Holland province has direct involvement in overlooking the activities happening and perhaps gives incentives to other towns/cities in the region to follow the Hellevoetsluis example.

On the national and European scale, there will not be much influence of any stakeholders because of the small scale of this location. The only influence would be from the national government as they might influence the strategy as a whole.

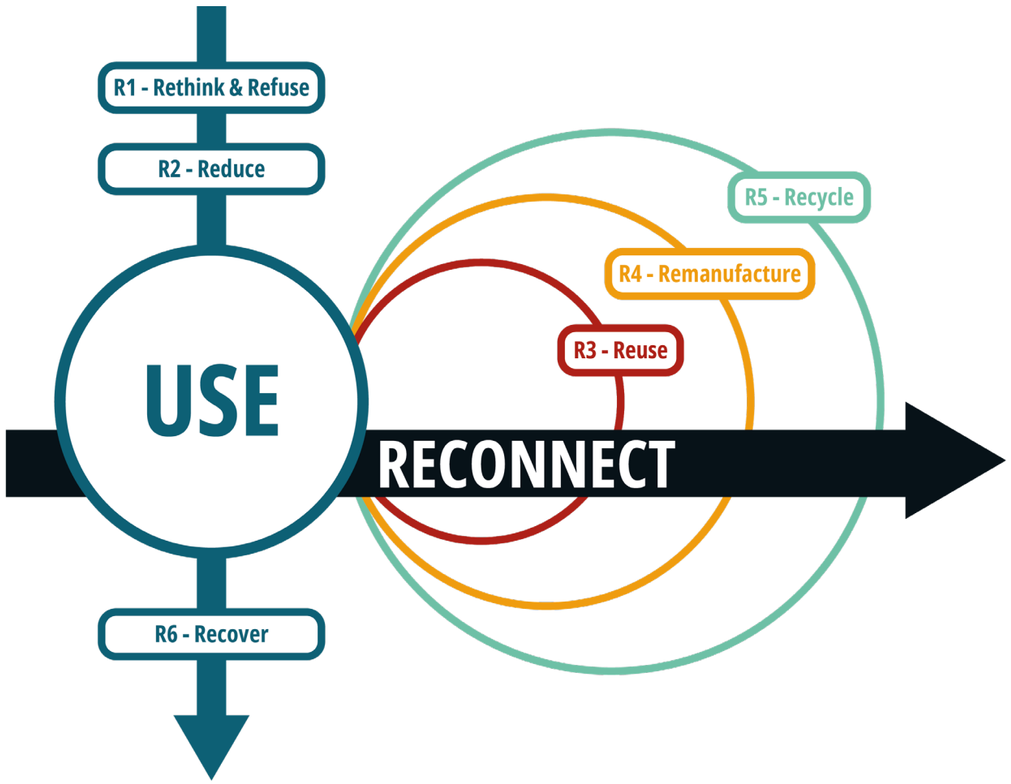
Chapter 6:

To Conclude...

Conclusion

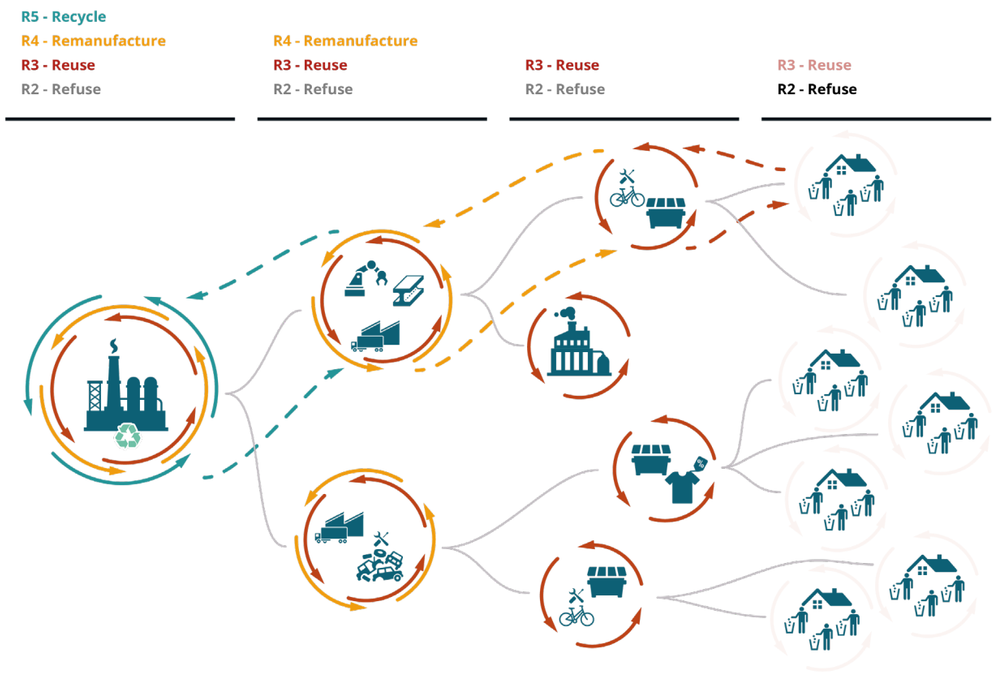
“The first thing that should be clear is that in the world of waste, it is all about circularity.” (Chapter 1). When aiming to make a material more sustainable, making it circular is your best option. The R-ladder as shown below is often used as a main tool in the circularity process, as it was used as a basis for this project as well.

The paradigm of waste scapes is a very urgent one. Waste scapes are very present in our cities, and we, therefore, need to deal with them. The current tendency is to try to get rid of them, however, they also serve a purpose and therefore they should be accepted. To make them accepted by the population, they need to be more open and integrated into the urban tissue. The multiscalar is crucial in this, the project as a whole addresses multiple scales that are reflected in the four strategies as well.

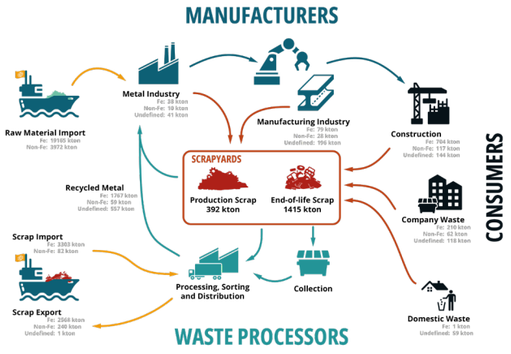


How can a strengthened national network of local scrap metal collection and manufacturing contribute to the transition into a circular steel flow?

We propose a strategy in which metal scrap is kept more local, and is R3 - Reused or R4 - Remanufactured locally, and only moving to the R5 - Recycling facility when R3 and R4 are not possible anymore as shown in image x (scrp diagram). Additionally, we propose an R5 - recycling facility in the Port of Rotterdam, where steel can be recycled locally and in a green sustainable manner. Next to the R-ladder strategies, we propose a fourth R-strategy, namely Reconnect. To be able to create this R3, R4, and R5 strategy we need to create a connection between the scrapyards in the Netherlands and define their function within the system. Additionally, to be able to Reuse and Remanufacture more locally, we need involved stakeholders, consisting of governments, the steel industry and also society as a whole to participate. Therefore we propose to transform scrapyards into more attractive places, not only for collection and sorting but also to introduce other activities.

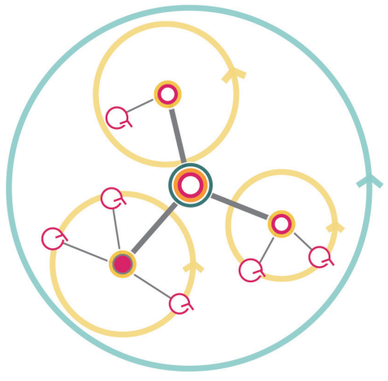


What are the current process and processing locations of metal production and recycling of metal scrap?



Metal is in itself already a very circular material, however, it is highly polluting despite its circular nature. The circularity of steel is now one of the lowest steps on the R-ladder; R5 - Recycling, moving it further up in the R-ladder, to R4 - Remanufacturing and R3 - Reusing already makes the steel cycle more efficient and thus more sustainable. Additionally, the pollution is not only created in the production and recycling itself, but also in the transportation between the different steps in the process. The Netherlands gets raw material for steel production from all over the world, and after its life, metal is exported to Turkey as scrap, where it is recycled in highly polluting factories.

How can a network be formed between metal scrapyards of different scales and specialisations to create an optimal circular flow of scrap metal in the Netherlands?



To create an optimal circular flow of scrap metal, the currently strong infrastructural network plays a crucial role. The network in itself is already strong enough to support this cooperation between scrapyards. The hierarchy of functions and size in existing scrapyards can be linked to the hierarchy of the R-ladder strategies. Scrap from the smallest hubs should first be exchanged with the nearest bigger hubs and then the bigger hubs can exchange among each other or with the biggest hub in Rotterdam. Next, to scrap, this exchange can also include services provided in specific scrapyards. In this way, the (scrap)metal cycle is as efficient and local as possible, this is visualised in image.

What spatial and governmental strategies can be applied to create a symbiosis between scrapyards and metal manufacturing industries?

The importance of symbiosis between scrapyards and local makers- and manufacturing industries, is reflected in the need to have steel climbing up the R-ladder to R3 and R4 and to do that locally. There should be governmental incentives to make it interesting for manufacturers to work with scrap, instead of using new metal. This could include taxing waste, subsidising initiatives, and changing specific site regulations. Spatially, big warehouses or scrap exchange markets where makers and scrapyards can come together to exchange can link them locally. Additionally, connections with educational and research institutions regularly could foster an environment for new initiatives, cooperation and innovation. In bigger or specialised scrap collection locations cooperation between specific manufacturing, and industry could increase the chances for circular material use.

What spatial and governmental strategies can be applied to metal scrapyards to intertwine them with the urban tissue?

As mentioned, scrapyards are regularly perceived as wastescapes, breaking up, or being isolated within the urban tissue. To make the strategy work, the connection between inhabitants, businesses and scrapyards is crucial as they are creating and dumping the scrap. Scrapyards have to be accepted by society, it is, therefore, important to make them more accessible, functional and interesting. In the strategies, a catalogue of urban elements is supposed to be able to be applied to all scrapyards in the Netherlands. These include more functional services to ‘fix’ or exchange your waste. Additionally, recreational or educational activities can be added to attract people to and in the scrapyards. Lastly, placemaking can add to the accessibility of the scrapyards and make them visually more attractive.

RELEVANCE

The project was created based on the existing conditions in the province of Zuid Holland, however, the results and design methods can be reapplied. The synergy between port and city and the steel industry, moving towards a circular approach can be implemented in many different contexts. Although the vision is made on a provincial scale, the overall strategy has a more general approach, making it adaptable as stakeholders, policies and phasing can be quite different in parts of the world.

The project carried out created a strategy, however, further research should be made to bring awareness and set a strong framework for others to refer to.

Our team was comprised of university students coming from diverse study backgrounds, therefore lacking expertise in steel manufacturing and policymaking and was carried out within a time span of nine weeks. Due to the fact that it was based on theoretical knowledge, a more detailed and scientific evaluation could facilitate the transition and the implementation.

ETHICAL ISSUES

The Scrapyards United system is faced with geo-dependency ethical issues on a worldwide scale. In the long term, the system will also be a precedent for other worldwide cases. Making steel more circular and boosting local manufacturers, will partially cut down world trade and reduce the import of raw materials and scrap recycling elsewhere. The current global material flow is that resources come from the “periphery” of poor and underdeveloped states to wealthy ones, enriching the latter in the sacrifice of the former. What we envision here, is a circular economy by eliminating the resource exploiting world trade and the exporting of waste and polluting activities to other countries. On the other hand, reducing the import of raw materials and the export of scrap can also have a more negative influence on the counties that are involved now. Most of the counties are developing countries so cutting them off from the material flow, will also mean cutting in their work and income. This is an ethical issue in which it is very hard to decide which is the better way.

Another ethical issue is the danger of gentrification in our project. By opening up scrapyards and wastescapes more, and trying to mix functions, the danger exists that other functions, especially housing, are valued higher in inner-city locations. Additionally, they might cause some nuisance to residents, resulting in more strict regulations and making it hard to remain in these high-density locations. Therefore, we should either make the scrapyards more valuable to match the value of the other functions or be strict in regulations for these scrapyards and wastescapes to empower them to remain their importance and position in the urban fabric.

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Chapter 7:
Appendix

REFLECTION THOMAS BOLLEN

To begin with, I think we have worked very well together as a group. I felt like the cooperation went very seamlessly and with only some minor hiccups regarding the content and the technical aspects, we got along on a personal level very well. This made it easy for me to trust my peers more and helped me to be more open to the suggestions the team made during discussions. It also helped a lot to get us through stressful times around the deadlines.

Generally, I think our personalities fit together very well. The fact that we did something not related to this project in the first part of the project and often had lunch together also helped to forge a personal bond. And this was reflected in the discussions we were having. Although some of us were more talkative than others, I felt like we all made substantial contributions to it and we all were at liberty to speak our minds.

Now I know how a personal bond helps me to better understand my teammates, I know for future projects that it would help to get to know my teammates better on a personal level as well.

All in all, I'm happy with the project we produced. I think that, especially in the general conceptual strategies and the exploration of our possibilities in the beginning, we have been very critical. Not only on ourselves, but also on the teachers and the papers we read. I believe this helped us a lot to align our minds and focus on making the initial SCRP strategy, which I think is a very feasible approach. It was easy for me to support our visions as they were not too bombastic in their interventions, but still made a big impact.

However, I do think that we could have been more critical of ourselves when doing the case studies and their respective designs. Whereas the entire project, we have been looking out for every effect our project could have and how it would incite stakeholders to get on board, I feel like we have made too many assumptions in the case studies. And I think this could have been better if we would limit the amount of cases and look at them more critically.

Finally, I really enjoyed working on making our project visually and narratively appealing for readers and listeners (during presentations). I think I have found a strong point of myself in this and I would like to improve myself on this facet in future projects.

REFLECTION JOOST VAN DRIESUM

To start, I want to state that I enjoyed working in this group. We got along very well personally, contributing to the group's atmosphere. We had regular instances where we talked about non-project related stuff. This made the work more fun and had a good contribution to the teamwork and our ability to overcome problems. Although we were pretty much on the same line throughout the project, there (of course) were some moments of discussion and disagreement. However, we always managed to get over them without any big arguments because of the nice atmosphere. I believe that being critical and having discussions are important to lift a project to a higher level, as long as you do not get stuck. The nice atmosphere also created a 'free' environment where everyone could speak up (at least I felt so). Also, we had each other's backs in more difficult or stressful moments. Although I always felt that a nice group would help, I am now very sure it does. I have worked with groups before where this was not the case, and it makes a huge difference. Not only in how I enjoy the work, but also in the quality of the work.

In the end, I am very happy with the end product of this quarter. Especially with the concepts and the vision. Although it took some time, effort, and struggle to start the project, mainly because we lacked previous knowledge about circular maritime manufacturing. However, after a lot of preliminary research, we were able to come up with a good, strong, and renewing concept. We took our time in the first phase of creating a vision, mainly because we were very critical about all the input, from ourselves but also from tutors and information we found. This made the vision and concepts in my opinion very strong.

However, unfortunately, this long but good first part was a little bit at the expense of the second part; the strategy. We could have been a bit more extensive here, but we struggled with making the step from the conceptual vision to the practical strategies. Next to that, the 'extra' time we took for the vision could not be used for the strategies anymore. In some extra weeks, I think we could have lifted the strategies to the same level as the vision. However, looking at the result, I am still proud of what we reached considering the time we had, and put into it.

During this project, I found out that I am good at organising a project in my head and keeping the whole structure in mind. Therefore, I think I had a good overview of what we were doing, and I was able to push the project back on track when we were straying from 'our path'. Next to that, I found out that being critical of my work but also the work of my group (or other input) is one of my qualities. However, there were a few instances I realised that I must be careful not to be too critical of others' work. I already tried to do that, but I think there is still a lot to learn in this and I will definitely take that with me for future projects.

REFLECTION MADELEINE FAGALDE

In the current stage of the Anthropocene, we face the major challenge of having to revert the impact of human activities in the environment to secure the life of the future generations in this planet. As human nature has always imposed: we are going behind and we have no time. Therefore, as planners and designers we need not only to propose a transition in spatial terms, but also lead a social transition by shaping and envisioning a near future and a fast change in the mindset of people.

The concept of circularity and circular economy explored in this quarter is precisely related to this, the aim of an immediate repair in the insert – extract relation in between people and with the environment. We gained knowledge shaping our understanding in the way materials flow, the impact of globalisation and interdependency between countries and urban areas. But we must understand that the current linear system only works because of the lifestyle we have and is more questionable than ever after living a worldwide pandemic and seeing how climate change is affecting the planet.

The multiple scales of circularity really interest me because after having a top-down approach towards urbanism I have come to realise that bottom-up strategies are not only necessary, but they are essential to make our proposals work since they allow us to reach people directly and in a short term.

As a group we decided to dive into a very specific subject: the flows of scrap metal, where it comes from, where it goes and how can we apply the R-Ladder of circularity to propose bottom-up strategies (reuse and remanufacture) combined with a top-down ones (recycle and reconnect).

The lecture of Rodrigo Cardoso on the potentiality of integration in polycentric urban regions showed us the big scale of circularity, the benefits of the nested nature of human settlements and the importance of their interaction that we applied in our nested system of "United Scrapyards" (Cardoso, 2022). Furthermore, our design process was really shaped by the limitations of space in a local scale and by the integration between the city and this industrial islands. As Karrel Van den Berghe explained during this lecture on Circular Ports, one of the biggest challenges is the scarcity of land and must shorten transportations distances to think in having the lowest environmental impact possible making this articulation and integration in the urban a must (Van den Berghe, 2022).

In this process, we faced the complexity of taking the interest of stakeholders and the environmental aspects of this very pollutant industry. We were challenged by our lack of technical expertise in the world of steel and scrap metal and managed to channel our disagreements and different approaches to a clear narrative which I am very thankful for.

In conclusion, one of the most important things I learned during this quarter is that to achieve the goal of shifting to a sustainable and circular world, we, as planners, must go from applying regional or global strategies to also apply simultaneous local ones, working together with different stakeholder and disciplines as the only way to make this work is to change people's behaviour locally first and for that we need to face the challenges together.

References:

SDS and capita selecta lectures: Polycentric urban regions and the process of metropolisation by Rodrigo Cardoso. https://brightspace.tudelft.nl/d2l/le/content/398764/viewContent/2609085/View

SDS and capita selecta lectures: Circular Ports by Karrel Van den Berghe. https://brightspace.tudelft.nl/d2l/le/content/398764/viewContent/2598773/View

REFLECTION AGAPI KAPERONI

Coming from architecture studies, I started this course having no prior experience in such projects. Throughout the course, we were introduced to new concepts, tools, and an approach that was both interesting and challenging for me. The combination, or should I say the cooperation, with the Methodology course, provide us with an insightful way of constructing our way of thinking and the project. Having to design smaller scales in the past, it was really difficult for me to balance, how to be general and abstract but at the same time spatial. Specifically, the feedback that we were regularly having, "you need to think spatially", still troubles me, but gave me an axis to work on for the remaining of my studies.

Cooperation within the team was comfortable, but not always easy. Working in such a big group, was also very new to me. The bigger throwback of working in big teams is that it required long conversations, for all members to agree and be on board. And here lies one of the most important takeaways for this aspect. Now I can finally understand how challenging and time-consuming is, to have all stakeholders on board on a project. Even if sometimes, these long conversations were leading to nothing concrete and often looked like we were not actively participating in the course, they taught me to listen to others, respect their opinion and work along thin lines to come to a consensus. This experience I think will be of utmost importance for our future years in the urban design process.

The dynamics inside the team and the pace of work were often changing, but everyone was always eager to help and support each other. One major issue, that I would like to point out, although I understand that it is logical, is that a lot of materials, sources, and data, that we needed to complete and deepen into the project, were in Dutch. That meant that we had to rely on some members of the team, proving however that in such projects, being part of a team is helpful and completely needed.

The peer evaluation after mid-term proved to be very helpful, as it pointed out some aspects of my personality that also reflected on my input to the team. For the remaining of the quarter, I did my best to improve myself and I took into great consideration my teammates comments.

Overall, the quarter structure and the team-working environment, were a great opportunity for me to gain knowledge in developing a strong strategy for regional planning, involving material flows, stakeholder engagement, and social justice. The whole experience felt like a real participatory design, which unfortunately is not present in my country and completely eye-opening for me.

REFLECTION YUQIAN SU

The rise of metropolisation and capitalism has created a host of social problems. Urban designers in our century are confronted with unprecedented climate change, social inequality, epidemics and uncontrolled consumption of resources. But at the same time, we have reached unprecedented heights in technology and ambition. Under such circumstances, regional design, as a call for the circular development of post-World War II, comes into being. Regional design is both material and social, not only guidelines on space, but also spatial expressions of politics, economy, society, and ecology. As regional planners, we explore solutions to complex problems in the built environment.

The Scrapyards United is a unique regional subject with which we try to build a spatial narrative of the dynamic South Holland maritime region. (Helmut, 2022) Started with spotting the unnecessary material loop and isolated wasted spaces, the system is then brought with iterations of research/analysis, design and reflection. As we exploratively research layer by layer, we continuously integrate and break down the territory with hierarchies of the system, networks of the material flow, context of the surroundings and introducing collaborative actors, timespan and policies. We realized that regional design is such a massive agenda that the only way to face uncertainties and ignorance is to have determined vision and keep questioning ourselves until we find solid reasoning grounds. Uncertainties can bring possibilities with adaptive framework instead of a fixed plan which also need smart analysis and decision making,

The humane care and addressing social agenda triggered my great interest. By involving stakeholders and care for social groups, we come up with symbiotic systems including scrapyards from the most subtle to the most centralized ones. It really showed how much difference design can make, even the starting point is steel, which seems to be far away from our daily life.

Different from my previous education on urban planning, this quarter combine design and systemic research in various scales with different time span. ‘Design’ in a regional scale and finding support for that would seem paradoxical in my previous experience. But in the end, we even developed designs with ripple effect in eliminating global geo-dependency that has been thought to be far beyond my reach. This can only happen with methods of regional planning, as Remin Rooji introduced in his lecture which helped us to handle these problems both quantitatively and qualitatively.

Working collaboratively with people from different social backgrounds, ways of thinking and perspectives of views in a group of 5 is very difficult at the beginning, especially for me as my previous education was so different. But with almost every workday`s formal and informal group chat, we learnt through the process and from each other how to compromise and negotiate based on good identification of spatial capital. Also, with help of the tutors pointing out our overlooked focal points, we move slowly but steadily. I learnt to communicate more and express my feelings with their company which means a lot.

Reference

Rooij,R. (2022) Methods of regional planning and design. [SDS and Capita Selecta lectures] retrieved from https://brightspace.tudelft.nl/d2l/le/content/398764/viewContent/2609086/View

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CALCULATIONS (1)

Logistic efforts and pollution calculations

6,1 Mt of steel produced in the Netherlands yearly (WorldSteel Association, 2022)

Needed raw material:

	BF and BOF for one tonne of steel	Raw material needed to produce 6,1 Mt of steel	Containers (TEU, max. 26 tonnes) needed
Iron ore	1370 kg	8,35 Mt	321.150
Coal	780 kg	4,75 Mt	182.690
Limeston e	270 kg	1,65 Mt	63.460

(WorldSteel Association, 2022), (Mombelli et al., 2020)

	Travelled distance to Rotterdam (km)	CO_2 emissions per container (kg)	Containers	Total yearly CO_2 pollution (Mt)
Brasil	9760 km	760 kg	321.150	247 Mt
India	12060 km	770 kg	182.690	141 Mt
Limestone	300 km	45 kg	63.460	3 Mt
Total				391 Mt

(Port of Rotterdam Authority, n.d.)

Scrap steel export: 6,3 Mt yearly (WorldSteel Association, 2021)

	Travelled distance to Turkey (km)	CO_2 emissions per container (kg)	Containers	Total yearly CO_2 pollution (Mt)
Turkey	6080 km	700 Mt	242.310	170 Mt

(Port of Rotterdam Authority, n.d.)

Total import raw materials + export scrap = 391 Mt + 170 Mt = **561 Mt**

CALCULATIONS (2)

Steel use calculation:

Netherlands steel use: 4.300.000 tonnes

Truckload: 50 tonnes of steel

$\frac{4.3.000.000}{50}/365 \; = \; 235 \; truck \; loads$

Wind turbine calculation

10 mW turbine on sea produces 46.000.000 kWh/year (Rijksoverheid, n.d.)
The Netherlands exports 6,3 million tonnes of scrap yearly (World Steel Association, 2021)
An EAF uses 425 kWh/tonne of steel on average (Logar & ŠKrjanc, 2021)
(This is data of current possibilities, future technologies might improve the efficiency of these technologies and increase their production power.)

$1 \; turbine: \; \frac{46*10^6 \; kWh/year}{425 \; kWh/tonne} \; = \; 108.000 \; tonne \; steel \; per \; year$

Maasvlakte windturbines calculations

10 mW turbine on sea produces 46.000.000 kWh/year (Rijksoverheid, n.d.)
The Netherlands exports 6,3 million tonnes of scrap yearly (World Steel Association, 2021)
An EAF uses 425 kWh/tonne of steel on average (Logar & ŠKrjanc, 2021)
(This is data of current possibilities, future technologies might improve the efficiency of these technologies and increase their production power.)

6.300.000 tonnes scrap/year * 425 kWh/tonne = 2.677,5*10^6 kWh/year
46.000.000 kWh/year/turbine = 46,00*10^6 kWh/year

$\frac{2.677,5*10^6 \; kWh/year}{46*10^6 \; kWh/year/turbine} \; = \; 58 \; turbines$