TU Delft

Urbanism

FANTASTIC PLASTIC

transitioning towards an inclusive and circular plastics economy

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Fantastic Plastic:
transitioning towards an inclusive and circular plastics economy

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and circular plastics economy

Executive Summary

Context

Plastic is a durable and versatile material that underpins our global economy. However the increasing leakage to the environment and greenhouse gas emissions is concerning. To address it, this report provides a comprehensive plan to integrate the network and push forward this change using data, technology and spatial planning for the province of Zuid-Holland.

Vision

Our ambition is that by 2050, the way we use plastics within the province of Zuid-Holland has changed drastically.

The plastics industry, which is primarily linear at the moment, will shift to a circular model. The province will no longer rely on the import of non-renewable resources as raw materials for this industry, or rely on the export of excess plastic waste as an end of pipe solution - to plastic waste issues. Consumption has been limited to a minimum through socioeconomically fair and viable alternatives. End-of-pipe solutions shift to recycling and, perhaps, composting - diminishing the environmental impacts and closing the loop of the plastic cycle.

In thirty years, the circular model will entail fair and viable solutions throughout the plastic lifecycle.

Process

The strategy is that the plastics cycle runs sharing the values of cooperation, responsibility and spatial justice in every stage of the material loop. To realise this future, we propose the spatial intervention seen in the Fantastic Plastic hubs, parks and port. They are like catalysers of the first examples for the goals below can thrive:

People actively engage in the plastics cycle

Space and resources are used in fair, inclusive and efficient ways

All plastics in Zuid-Holland are produced and processed locally

Plastic use is reduced to a minimum and the plastic that is still used is recycled or fully compostable

Recycling is the norm for end-life plastics

Pilot Projects

Fantastic Plastic Hub | Centre

The hub centre is a place in the city center, right outside your doorstep. It is a place where start-ups are located and where you as a citizen can engage in the plastic cycle through workshops, classes and other activities.

Fantastic Plastic Hub | Industrial

The hub industry is similar to the hub centre, but the activities and the desired location are different. It is located on the edge of the city where the old car focused infrastructure is transformed into attractive public space. In the hub, people can engage in the plastic cycle and it is a place for start-ups and innovation with bigger scale processes.

Fantastic Plastic Park

At the Park, all different kinds of activity take place, namely, the distribution of goods, the researching of technologies, the recycling of plastic packages but also living and relaxation. The Fantastic Plastic Park is a place where spatial quality and new functionalities mix with the peri-urban areas.

Fantastic Plastic Port

At the port you can have a swim at the Fantastic Plastic harbour beach, have a walk at the park, get a tour at one of the many chemical recycling or biomass plants. The port is a place for innovation, experimentation, production and relaxation.

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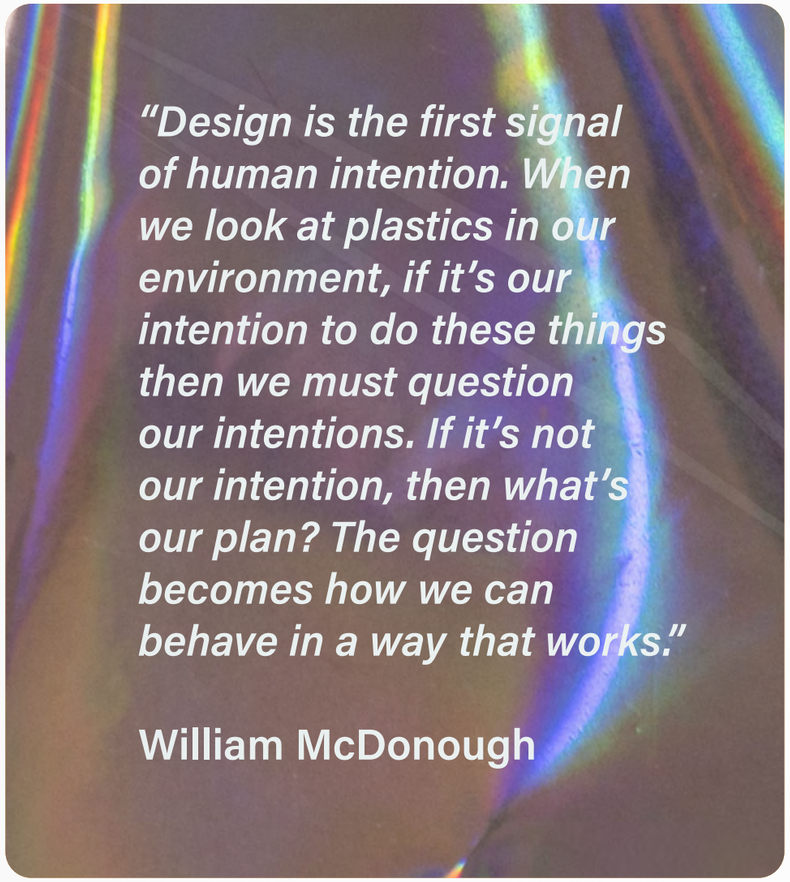
Abstract



In thirty years plastic will not have disappeared from our life. However, the way we use and see plastics will change. The current plastic chain is highly damaging to the environment and needs to transition into a more sustainable and circular model. Therefore, the following research question was raised: How can regional planning and design stimulate circularity throughout the plastic network in Zuid-Holland? Fantastic Plastic is a project that articulates a framework for this sustainable future with plastics. We relied on an integrated framework that combines spatial interventions with circularity and the plastic network. The current situation is analysed through the framework and future systems are prosed. In addition, this report identified four different spatial interventions that are crucial for making the plastic chain circulair, namely: The HUB centre, the HUB industry, the Park and the Port. These spatial interventions coexist and work together to form an integrated approach. These interventions can accelerate the transition towards a sustainable future so as that in 2050 plastic is transformed into Fantastic Plastic.

Keywords: plastic network, circularity, spatial intervention, responsibility, cooperation

1

Introduction
more than an ordinary material

Plastics as a sector

The plastic sector is an important sector for the Dutch economy, namely it is the biggest producer and exporter of plastic in Europe (Stijnen, 2020). Twice as much plastic is produced than what is used in the Netherlands. Specifically the province of Zuid-Holland is of big importance, namely there are approximately 337 companies and 5900 people who are working in the chemical sector in the region (LISA data, 2018). The port of Rotterdam especially plays a big role in the production, consumption and logistics of plastics.

To get a better understanding of the role of the harbour in the plastic cycle, first a general knowledge needs to be established about how plastic is produced. The main raw material used for the production of plastic is petroleum (Plastic Europe, 2021), which is imported from different countries like Russia, Iran, etc. The oil is brought to the harbour with containerships and then unloaded at the oil refineries in the harbor. There the raw oil is heated to be able to separate the different kinds of oil, for example kerosene, naphtha, etc. The naphtha is the oil that is used for the production of plastic, because it consists of different monomers which can be interlinked to form a polymer. These multiple polymers together then form a liquid plastic. The liquid that is produced then is cooled and shred into plastic kernels. The kernels are melted to make plastic packages or other plastic objects (Plastic Europe, 2021).

There are alternatives for oilbased plastics, namely biobased plastics or bioplastics. Biobased plastics are plastic that are made out of natural raw material, such as corn, potatos or sludge. There are different types of bioplastics, namely: biodegradable and compostable. All plastics are in principle degradable, even plastics that are made from oil will in time degrade into microplastic, however the material will never return to nature (Cho, 2017). In contrast to plastics, biodegradable plastics are able to break down underwater and can be composed by microorganisms within a time span of multiple months, thereby 'returning to nature.' Compostable plastics are plastics that can be degraded at a composting plant, where at the right temperature (65 degrees) the microorganisms are able to break down the plastic (Plastic Soup Foundation, 2021).

At the port of Rotterdam are multiple oil refineries and plastic factories, recently more companies are focussing on the environment which sometimes leads to greenwashing but there are also some companies that are working on the sustainability of plastic. Because of this combination of companies the Port is extremely crucial to make the plastic chain circular and thereby transforming plastic into Fantastic Plastic.

Why is it relevant?

The Earth is currently coping with global warming as a result of the strong influence of human behaviour. The influence of humanity on the planet was increasing exponentially since the first industrial revolution to the point that in 1950 we can begin to affirm that only the human influence can explain the rise in the global temperature (WUR, 2020). The cause of this problem is the rising amount of CO2 that is released during the combustion of fossil fuels. One of the products that is made from fossil fuels and is produced in large quantities is plastic. Since 1950, 8,3 billion tons of plastic have been produced worldwide (Borghardt, 2019). Not only the production and transportation but also the spillage in the environment is extremely damaging. For the Netherlands, although the Dutch government recently enforced new laws that ban a certain type of disposable plastics and free plastic bags in the supermarkets (NOS nieuws, 2020) this is not enough to turn the tide, a change in the plastic chain is needed.

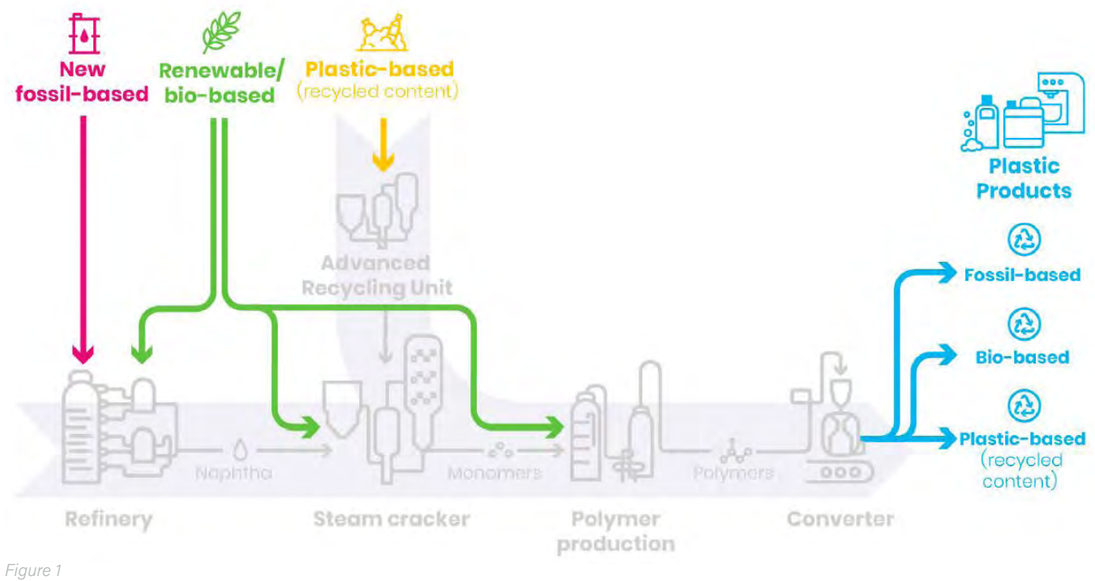
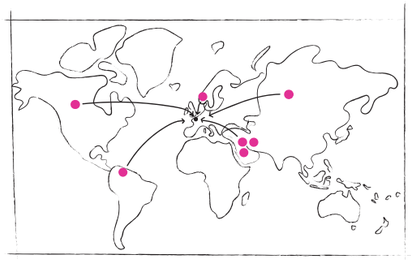
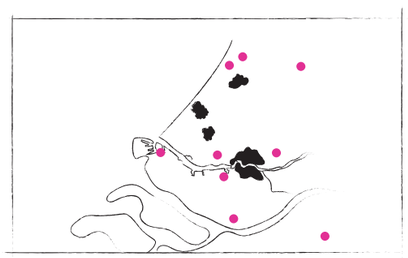
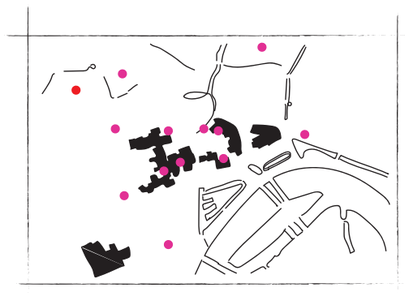


Figure 1
How plastic is made

Source: DSGC Publication 'Transition Time! – A Circular Economy for Plastics'

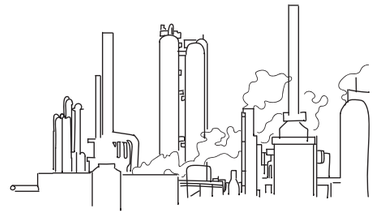






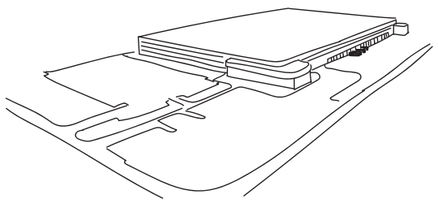
Pomping of oil
The oil that is used in plastic is extraxed in countries like Saudi Arabia and Canada and then imported to the Netherlands.

Oil Refinery
The oil is then braught to oil refineries who breaks down the oil into different kind of oils.

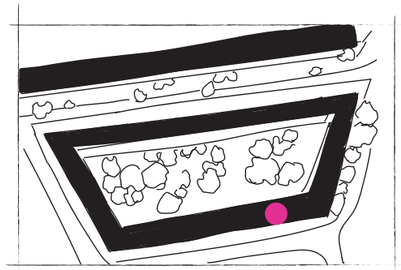


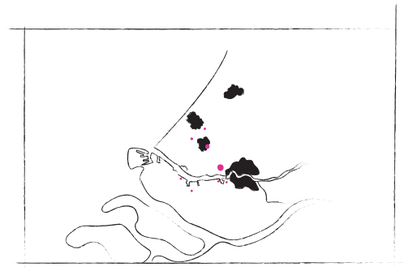
Plastic Factory
The oil made into grains and these grains are being melted into plastic packages

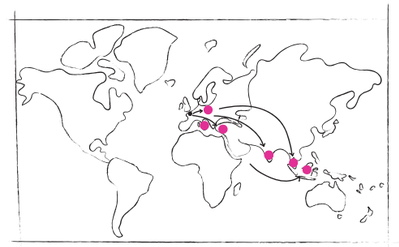
Distribution Center
The plastic packages are brought to distribution centers.



Supermarkets
The packeges then up in your local supermarket.



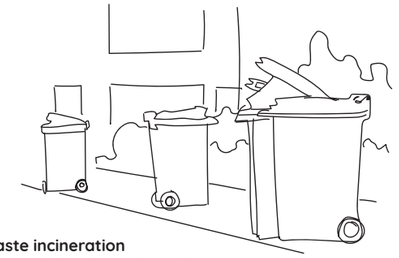




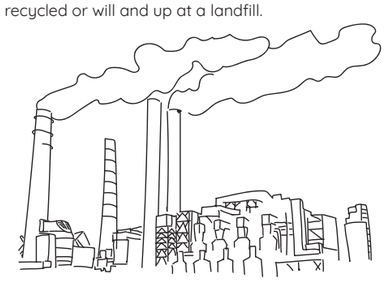
DIfferent stages of plastics and its location

Home
You buy the product and then throw the plastic away.

Waste
The waste will be collected by the municipallity.



Waste incineration
A part of the plastic then will go to a waste incinerator, will be recycled or will and up at a landfill.



Waste exportation
One-third of the waste that is produced in The Netherlands goes to other countries.

The current plastic problem

An ubiquitous problem

From the moment plastic was discovered in 1907 the amount of plastic that is produced has grown exponentially, from worldwide 2.00 million tons in 1950 to 381.00 million tons in 2015 (Geyer, 2017). Plastic is permanently intertwined with our daily lifestyle. However as explained before, plastic is made from a non-renewable resource, namely oil which is imported from various countries with sometimes questionable human rights values, for example Russia, Saudi Arabia, Iran and China. Moreover, 90% of the plastic and in the Netherlands 0,42 kilogram per person per day ends up as waste (Global change data lab, 2010). One third of the waste, 361 thousand tons a year, are exported to other countries like Germany, Indonesia and Turkey (Geurtsen, 2017). The majority of the plastic that stays in the Netherlands is then being burned to 'recover the energy' and only 9% of the plastic is recycled (Parker, 2020).

All this plastic is currently causing two main types of problems, namely environmental and social problems. The production, transportation and wasting of plastic cause long lasting water, soil and air pollution. Which have a negative effect on both human and natural life. Especially the plastic waste that comes into the ocean is very problematic, the plastics that flow from the rivers to the specific ocean accumulate and form plastic islands. Sea animals get entangled or eat this plastic and are injured or die (Center for biological diversity, 2020). Humans too in their daily lives ingest microplastic, because it is in our water and food (The washington post, 2019). There is however some difficulty to determine the long term effect of these microplastic on human health, because there is at this moment not enough scientific research to support this statement. The world health organization did publish a report in 2019 stating that the current amount of microplastics in our drinking water are not harmful to human health at current levels (Stevens, 2020). Moreover, traditional plastics are depleting finite resources and emit carbon dioxide due to the large traveling distances for resources and waste.

Next to the environmental problem with plastic there is also the social problem. People are extremely dependent on plastic, plastic is everywhere. Still most people will not know what happens with the plastic they have used and throw away. People are distant from the processes related to plastic and therefore many people have little concern what its effects are. The effect is that people act irresponsible and litter more.

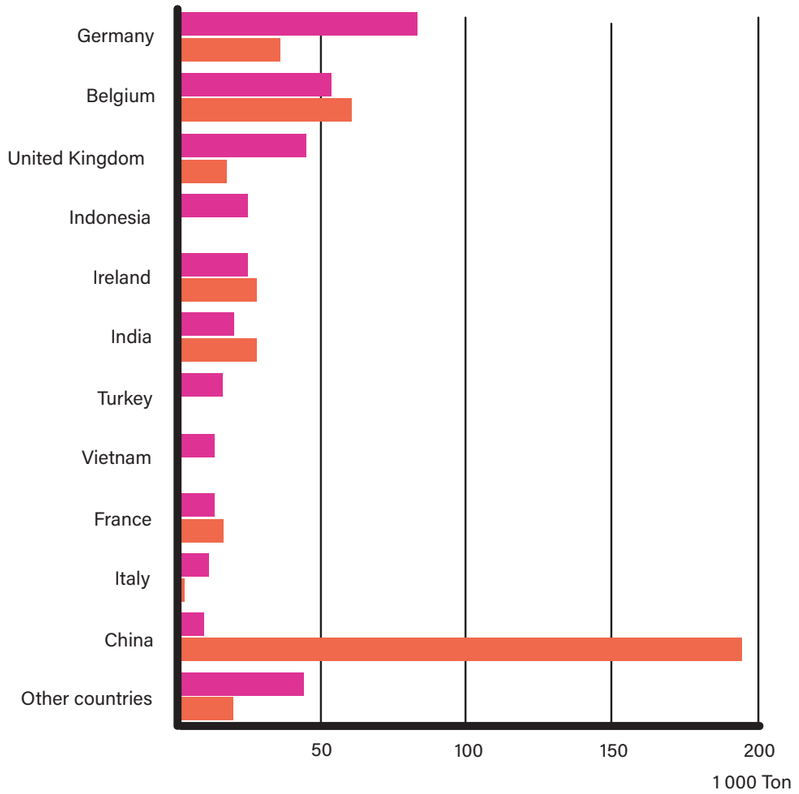


Figure 2

Recycable plastic export destination

Source: CBS (2019)

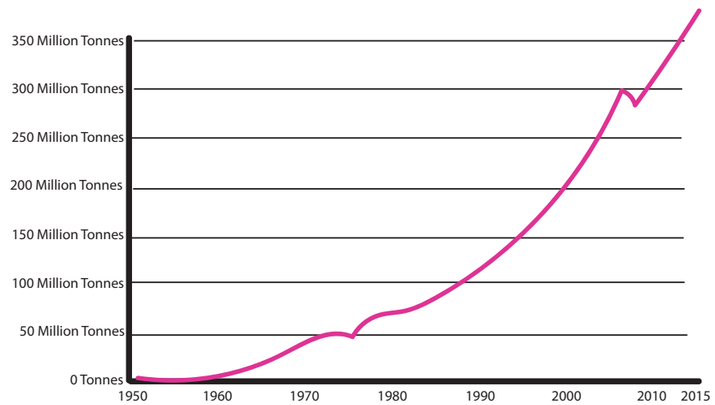


Figure 3

Global plastic production between 1950 to 2015

Source: Greyer et all. (2017)

Problem statement

As the current traditional plastic production is unsustainable, a more sustainable and recognised alternative would be to switch from oil based to biobased plastics. However, In the province of Zuid-Holland, spatial competitiveness might be one of the biggest issues for the transition towards a circular way of life. In recent times, the population growth within the province has been higher than the national average. The population has now reached 3,7 million (Staat van Zuid Holland, 2018). This growth has also been visible in a spatial sense: the percentage of urban area within the province has gone up from 20,4% in 1996 to 23,4% in 2015 (CBS, 2019). Nevertheless, agricultural land remains the biggest contributor to the use of land, as almost half of the land area is agrarian (CBS Statline, 2018).

The first step towards a circular chemical sector – with a particular focus on the plastics industry – would be to transition to the use of new raw materials: currently, the common use of non-renewable fossil fuels for the production of plastics makes the sector unsustainable per definition. A solution would be to switch to the use of biomass to produce bioplastics. As an example, wood chips can be used: bioplastics can be created with sugars that are extracted from these chips (Cordis, 2018). However, if the province of Zuid-Holland were to transition to the use of biomass for the production of plastics, it would have severe consequences on the aforementioned spatial competitiveness.

An investigation of material flows within the province has shown that within one year, over 45 thousand tons of biomass had been used to produce 3,6 thousand tons of bioplastics. In that year, only about 1% of produced plastics were made out of biomass (van Exter et al, 2018). If we were to extrapolate the amount of biomass needed if the complete production came from biomass - using the current yield (conversion rate from biomass to bioplastics) - over 4,61 Mtonnes of biomass would be needed yearly. The yield of biomass per hectare varies per tree type, but a general estimation is that 20 tonnes of biomass in the form of dry wood chips can be harvested each year (Boosten et al, 2016). This would then essentially mean that over 67% of the land area of the province of Zuid-Holland would have to be used for the production of bioplastics, just to fill the plastics needs of the own province. This calculation shows that within the transition to a circular plastics industry, a simple shift of raw materials can not be the only solution. Other developments need to take place within the different stages of the plastic cycle, ranging from harvest and production to consumption and recycling.

Problem statement

"Simply switching to biobased materials for the production of bioplastics is not spatially feasible for the province of Zuid-Holland. Therefore, transitioning to a circular model will require an integral approach between all stages of production and consumption."

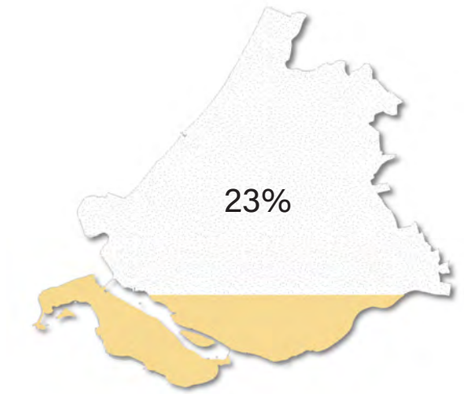


Figure 4
Percentage of urbanized land

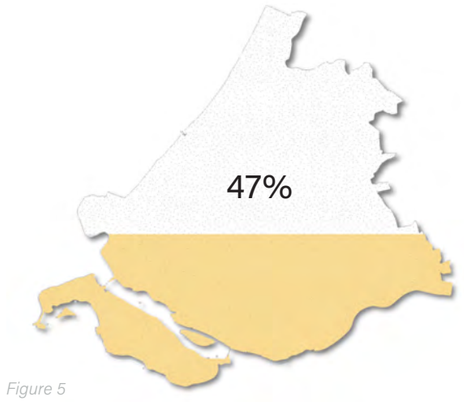


Figure 5
Percentage of agricultural land

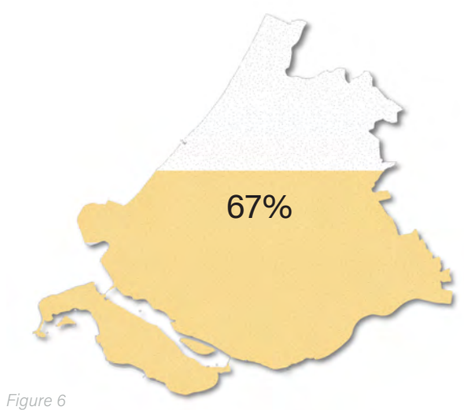


Figure 6
Percentage of land to fulfill current bioplastics demand

Research question

As the current traditional plastic production is unsustainable, a more sustainable and recognised alternative would be to switch from oil based to biobased plastics. However, as stated before, simply using biomass as raw material for the production of plastic instead of oil is spatially not feasible in the province of Zuid-Holland. Therefore, transitioning to a more sustainable cycle will require a circular model with an integral approach on all different scale levels.

Research question

How can regional planning and design stimulate circularity throughout the plastic network in Zuid-Holland?

Sub Questions

What are the spatial implications of the transition to biobased raw materials for the production of plastics?

How can the Port of Rotterdam remain important for the plastics industry when transitioning to biobased raw materials?

What kind of spatial interventions can reduce the footprint of plastic flows within the province of Zuid-Holland?

What socio-economic interventions can limit/ reduce the consumer use of plastic packaging?

What socio-economic interventions are needed to increase the percentage of recycled plastics?

What kind of spatial interventions could accelerate the transition to a circular plastics economy?

Research question

How can regional planning and design stimulate circularity throughout the plastic network in Zuid-Holland?

Integrated framework

An integrated framework is created to analyse how regional planning and design can stimulate circularity throughout the plastic network in Zuid-Holland.

The framework consists of three main dimensions who are interrelated, and all interact with and/or on different scales (figure 7). The dimensions are: spatial interventions, as a means of regional planning and design; circular economy, to gain inside in the types of flows and its needed change; and the plastic network, as stakeholders are of great importance in driving transitions. The interaction of these dimensions is viewed over scales ranging from households to the province. Within the analyses and in our proposed future, actions are linked to scales in combination of the three dimensions.

In our design, we aim to create a responsible plastic cycle where the three dimensions work together to create a liveable, safe and prosperous environment. We find that, in order to solve the possible future problems we need to combine the different dimensions within and over scales. To get a better understanding of each dimension, they are explained separately.

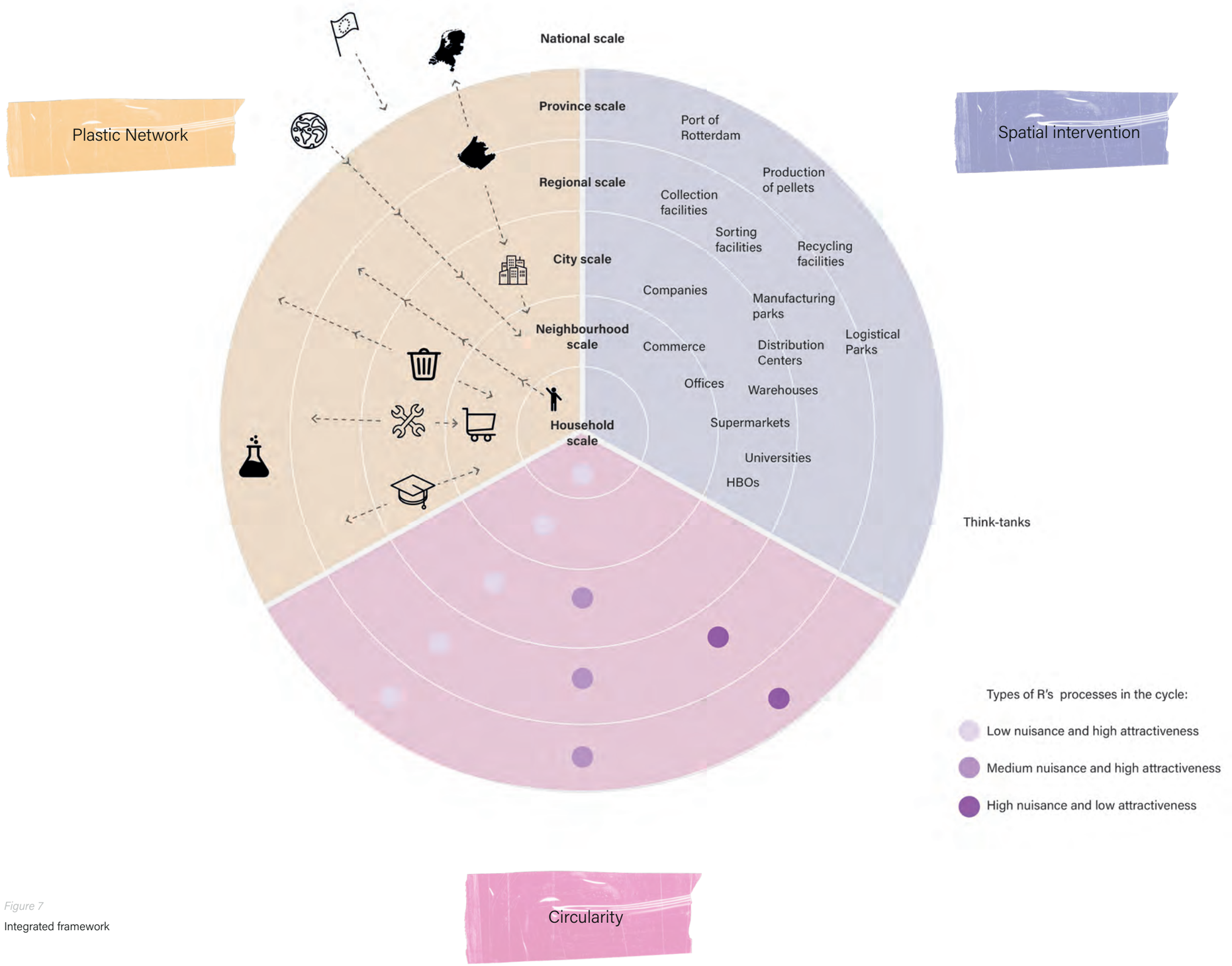


Figure 7
Integrated framework

Spatial intervention

Spatial interventions are an element of spatial planning which concerns the spatial implications but also how space can play an active role in the needed transition, in this report regarding the transition towards circular plastics economy. Spatial interventions have effect within and between different scales (Morphet, 2010), moreover, place specific and multi-scalar interventions can enhance circular transitions (Marin & De Meulder, 2018). Local and regional spatially circular interventions can create productive pathways towards sustainable product service systems (Hobson, 2020). Hence circular spatial interventions are needed to improve in the sustainability of the plastics cycle.

Nonetheless, a single spatial intervention can have a large effect which should be carefully considered. When spatial interventions are coupled with other initiatives and/or policies it has been predicted to have a higher benefit, regarding economic and social outcomes (Morphet, 2010). When spatial interventions lead to more sustainable alternatives, it could also have increased environmental benefits.

Spatial interventions can coordinate the flow of waste and raw material into and can facilitate in raising citizen awareness and usage regarding plastics. Zuid-Holland is, with the Port of Rotterdam, ecologically and economically a central node because of large chemical plastic industry (Port of Rotterdam, 2019), its change of flows can therefore have large impact on many scales and have a large positive influence on the circular plastics economy.

Therefore, within this project we look at needed spatial interventions to improve social, environmental and economic outcomes for the plastic cycle. Within the proposed future with plastics these spatial interventions are combined with policies to achieve the envisioned outcome. As spatial interventions have effect within and between different scales, we take into account different scales to propose the most suiting interventions.

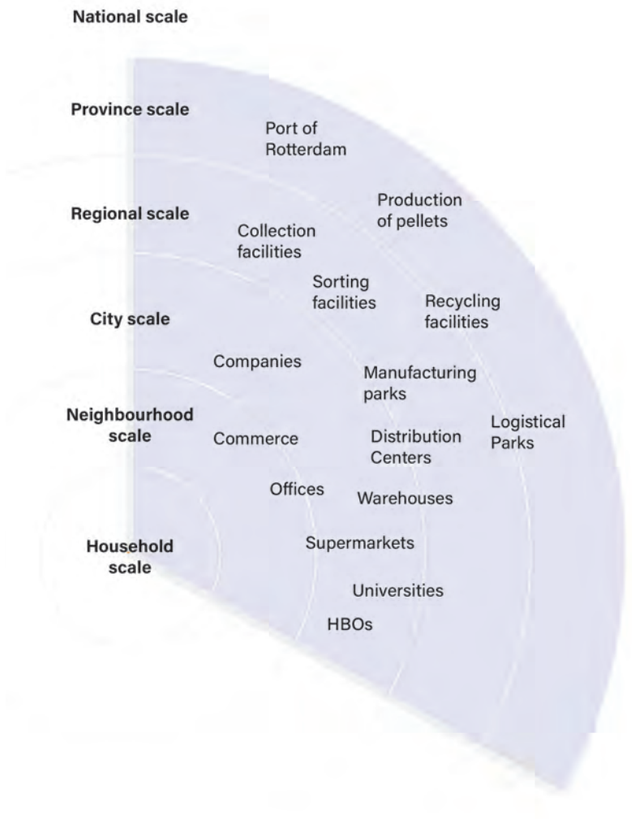


Figure 8

Spatial part of the integrated framework

When spatial interventions are coupled with other initiatives and/or policies it has been predicted to have a higher benefit, regarding economic and social outcomes (Morphet, 2010).

Circular economy

The circular economy (CE) is a contested concept which is changing and is dependent on various factors like context and time. Kirchherr et al. (2017) consider it as the practical operations behind sustainability, whereas thinkers such as Pauliuk (2018) consider it as a version of a sustainable economy which strives for resource efficiency rather than being rooted in an idea of environmentalism. In this report we consider the circular economy is used as a means to achieve sustainability, hence the circular economy is used to realise a balanced integration of economic performance, social inclusiveness, and environmental resilience, to the benefit of current and future generations (Geissdoerfer et al., 2017). The circular economy itself is viewed as a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops (Geissdoerfer et al., 2017). This can be done by applying the 10R strategies (Figure 9). The strategies are placed in order of priority, of the most sustainable outcome. Moreover, circularity can be improved by solar, wind, biomass and waste-derived energy utilization throughout the product value chain and cradle-to-cradle life cycle (Korhonen et al., 2018).

Regarding the plastic economy, it has large potential as there are great opportunities to transition to a circular model. There are large potentials in redesigning the current chain, the products itself and the manner in which these are viewed. Circularity for plastics can be improved by; redesigning products, usage of more environmentally friendly alternatives, closing the loop by connecting different actors, improving and promoting resource efficiency and increasing the value of a product by better quality plastics (Hahladakis et al., 2020).

However, not one of the potential changes can make the life cycle sustainable by itself. Plastics are used for various purposes with different requirements like safety, flexibility and strength (Hahladakis & Iacovidou, 2018), hence particular changes in the life cycle are not applicable for all different kinds of plastics. Therefore, a combination of different strategies is needed to achieve a circular plastic economy.

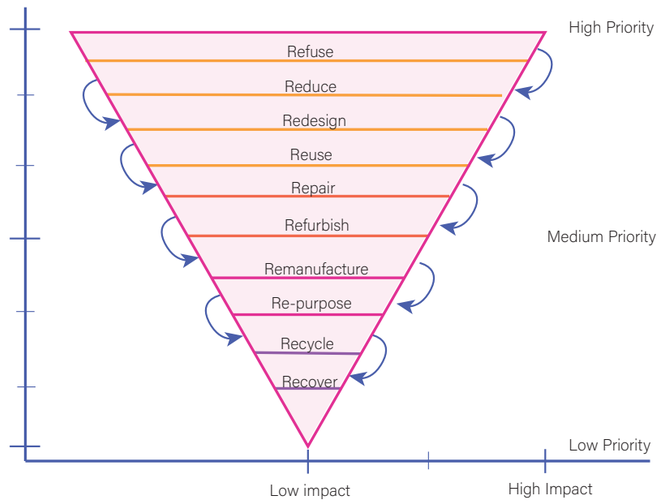


Figure 9

The 10R Framework of Circular Approaches with the production chain in order of priority. Source: Adapted from Potting et al., (2017, p. 5)

Circularity five strategies

1. Design for long life products
2. Design for product life extension
3. Design for a technological cycle
4. Design for a biological cycle
5. Design for resource efficiency

Hahladakis et al. (2020) suggest the following five strategies to make it possible for plastics to circulate back into technical and biological cycles:

1. Design for long life products
promoting the design of durable and reliable products that will function without breaking down or losing some of their properties (e.g., car dashboards)
2. Design for product life extension
promoting product maintenance in a useable state where its functional capabilities can be retained and that products can be standardized to fit other purposes (e.g., plastic Tupperware, PVC windows)
3. Design for a technological cycle
promoting the design of products that can be recycled to produce new products (e.g., plastic bottles for personal care products)
4. Design for a biological cycle
promoting the design of products from biomass that are renewable and biodegradable (e.g., compostable cups)
5. Design for resource efficiency
promoting the design of products with the aim of using less material (e.g., lightweight plastic products)

These strategies are interventions of current systems when we frame them as redesign, hence an improvement of existing systems can take place. With the combination of designing responsible alternatives and redesigning current irresponsible flows, circularity is present and sustainability is improved.

Within this project we therefore take a look at flows of resources, to what extent these are currently circular and how their circularity can be improved according to the 10R strategy. The five strategies of Hahladiks will be used for possible changes to redirect flows.

With regards to the design of a technological cycle and a biological cycle, it is of great importance to connect different actors to create a cradle-to-cradle life cycle (Hahladakis et al., 2020). As the flows of resources are taking place due to the connection of particular actors.

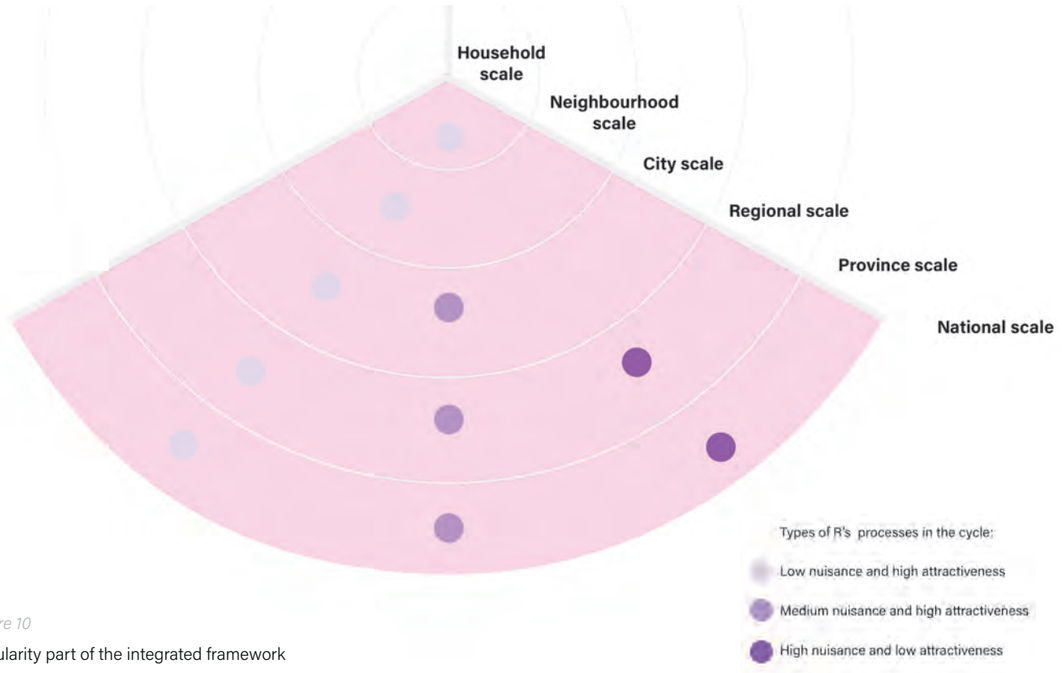


Figure 10

Circularity part of the integrated framework

Plastic network

To get an understanding of what the plastic network is, first the term network needs to be explained. According to the Cambridge Dictionary (2021) a network is: 'A large system consisting of many similar parts that are connected together to allow movement or communication between or along the parts, or between the parts and a control centre.' The plastic netwerk can therefore be explained as a large system where all the different phases of plastic are connected and interrelated. Although different, the plastic network has some similarities with the CE, because they both consist of analysis of different plastic flows. However, where the CE is about the process of making plastic, the plastic network is about the social side of the process. It is about the actors involved in the making, using, disposal and upcycling of plastic.

A connected plastic network is necessary as actors need to collaborate to circulate present resources (Kraaijenhagen et al., 2016; Brown et al., 2020). Moreover, collaboration is needed in an early stage of realising the circular plastics economy, as it improves creativeness and innovation, but also it decreases the complexity of the system as knowledge is shared from across value networks (Brown et al., 2019). The stakeholders must be connected to interested and innovative stakeholders so that it increases the structures for niche innovations to scale-up and local action to influence citizen behaviour on a larger scale. The cooperation will strengthen social, economic and environmental bonds in the region and portray a way to live that coexists with the planet and nurture future generations' livelihood.

Within this project we therefore take a look at existing and missing stakeholders related to plastics and in relation to each other, followed by their positions regarding power and interest. Moreover, for the future with plastics we propose what position stakeholders should have to provide a circular plastics economy.

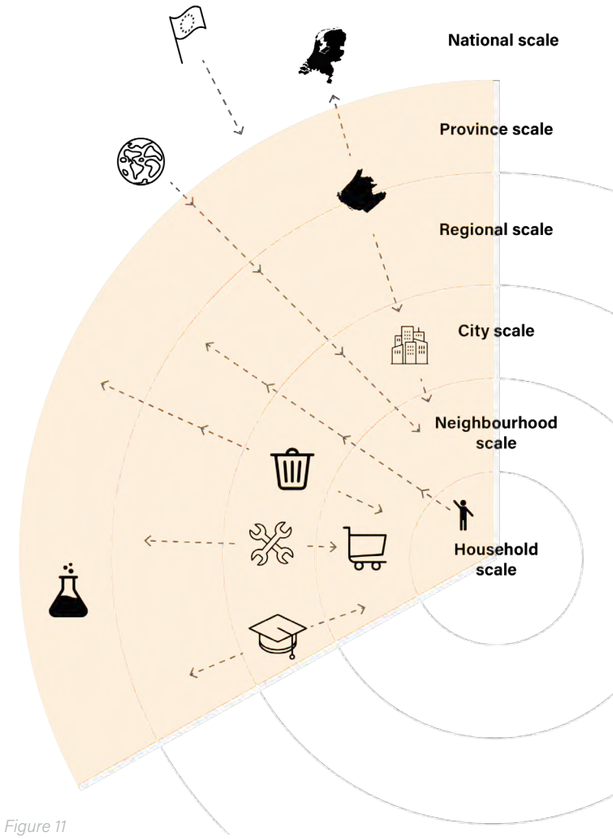


Figure 11

Plastic network part of the integrated framework

The plastic network

where the circular economy is about the process of making plastic, the plastic network is about the social side of the process.

The cooperation will strengthen social, economic and environmental bonds in the region and portray a way to live that coexists with the planet and nurture future generations' livelihood.

Methodology

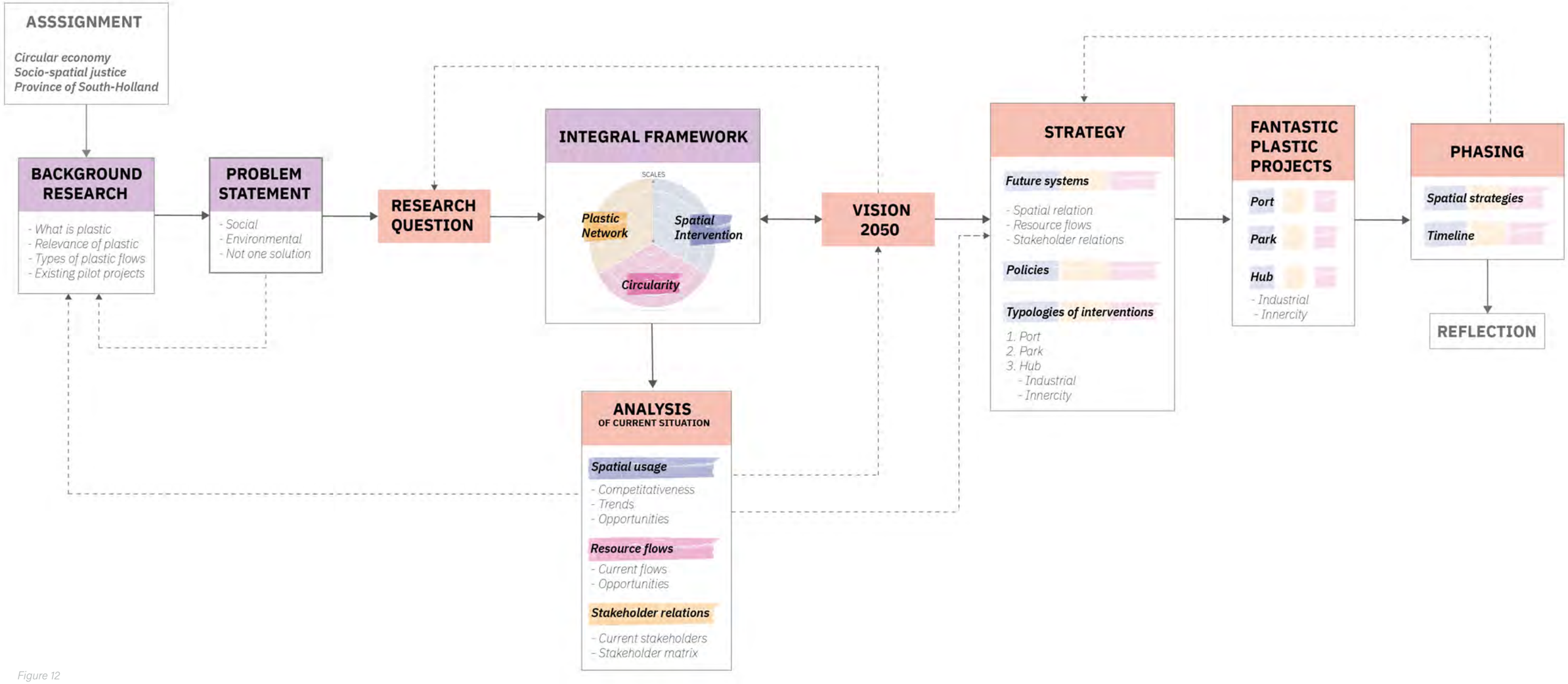


Figure 12
Methodology

As shown on the figure above, the starting point of our project was the question of how to make the plastic chain of Zuid-Holland circular. We used literature to gain insights into plastics and the sector, as described in previous chapters. From this research a problem statement was made and followed by a research question for the circular plastics economy in Zuid-Holland.

Through our integrated framework we analysed the three dimensions separately to gain an insight on the current situation and to find out which elements should be improved. Thereafter, we propose a strategy which is in line with our vision, goals and core values. For our strategy, we used the idea of transition management. Based on this theory we developed a strategy for alternative future systems, policies and typologies. We propose four strategic projects that kick off a regional transformation. In addition, each pilot project is phased through a timeline with applicable steps and toolkits.

2

Analysis of the region plastics in Zuid-Holland

Spatial analysis

Land-use in Zuid-Holland

A general examination of the land dispersion within Zuid-Holland, as is mapped on figure 13, immediately shows us the spatial competitiveness of the province. Currently, less than a tenth of the land area within the province remains natural (CBS, 2019). That encompasses elements like forestry, wet deltascapes for the rivers and dune landscapes among others. Recreational land, that could be perceived as being somewhere in the range between natural and man-made, would add up to just an additional five percent. It is clear that man-made urban areas (23,4 percent) and agricultural rural areas (47,6 percent) cover the largest parts of the province. Establishing the possible spatial threats and opportunities that exist within these areas requires a more detailed investigation of composition, history and trends.

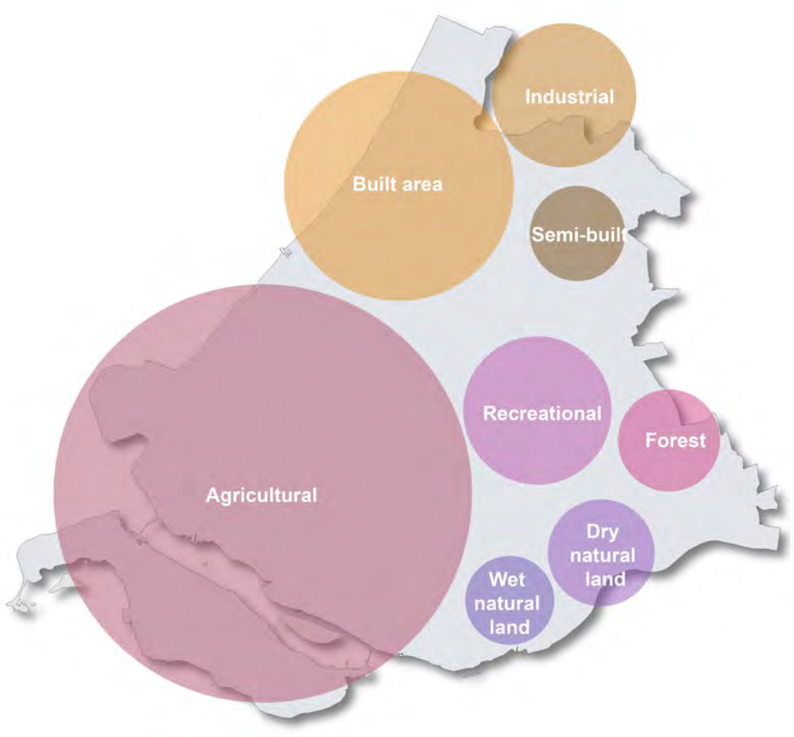


Figure 13

Dispersion of types of land

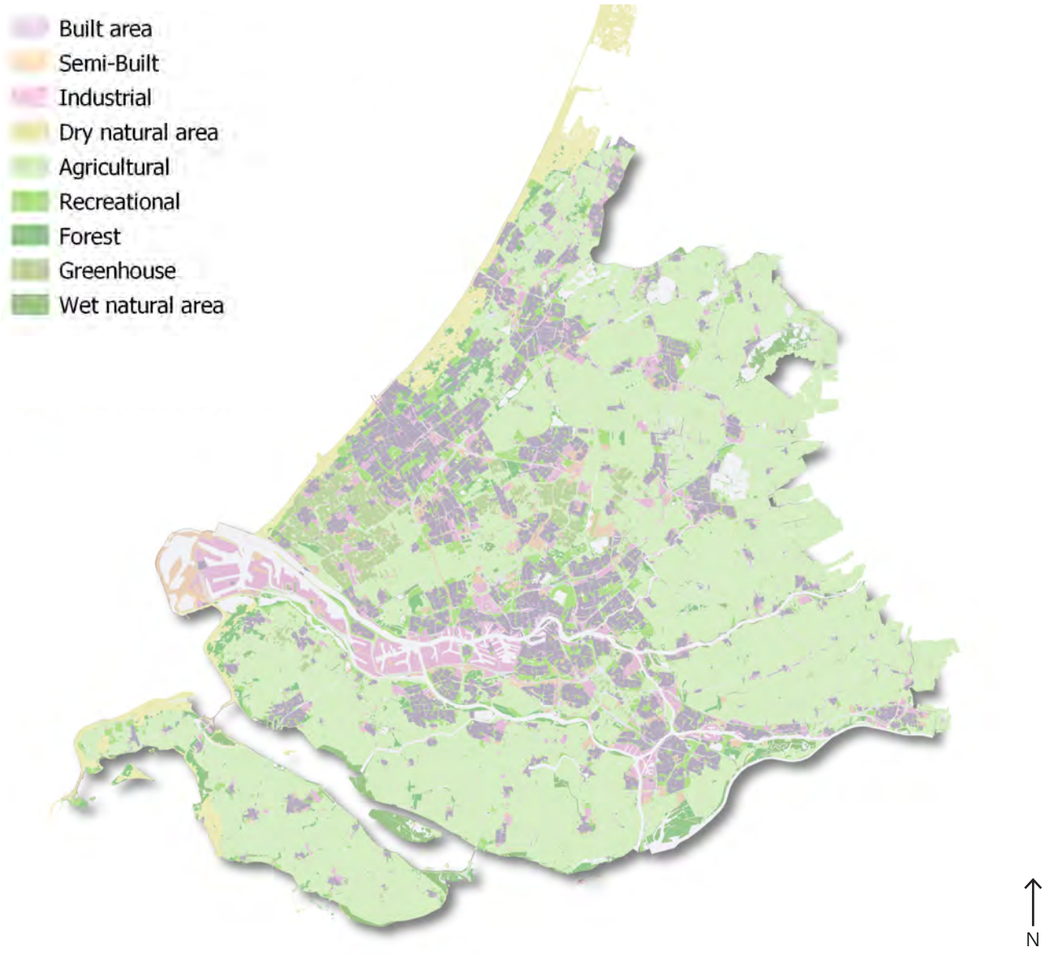


Figure 14

Land-use in Zuid-Holland

Agriculture

Culturally speaking the agricultural industry in Zuid-Holland is highlighted by the infamous greenhouse scapes of the Westland and Boskoop. However, when looking into the overall composition of agricultural functions for the province (figure 14), we see that greenhouses make up just a small percentage of agricultural land area. The majority of land area is used as grassland: pastures often meant for the grazing of cattle.

An interesting paradox has become visible when looking into spatial mutations within the sector. Figure 15 shows that in about a decade, almost a tenth of agricultural land has been transformed into something else, and over a tenth of the grassland has been dissolved. Meanwhile, the export value of agricultural produce has grown by 30 percent. These trends show quite simply how Dutch agricultural systems are becoming more and more efficient. Economic advantages through increased efficiency have given Zuid-Holland (and the Netherlands in general) the chance to become a leader in export of agricultural produce. However, the next step for this industry is moving on from purely economic efficiency to a sustainable model that incorporates ecological efficiency as well (Wageningen University, 2021). Ideally, sectors within the agricultural industry work together more consistently to for example interchange residual material flows. This is also where the potentials for the plastics industry come in: the production of raw materials for bioplastics is an untapped market for Zuid-Holland at the moment, but could be implemented within the transition towards a sustainable agricultural system.

Biomass scapes

Potential exists for the implementation of new biomass scapes into the province of Zuid-Holland. However, careful considerations need to be made to make this implementation a success. This is because this industry can be considered to still be quite a niche: production is low scaled, not fully efficient, and economically speaking, unviable (Pei et al., 2011). Besides purely governmental actions like subsidies and other benefits, spatial strategies could be used to stimulate this sector. Two main ideas have been considered and they can be seen as the location criteria for these biomass scapes. Firstly, the transition from an original function to biomass must be spatially viable. This means that there is no interference with current land use (e.g. not using expensive urban land or protected natural land) and that the transition has several benefits (e.g. helping farmers transition towards a sustainable business model). Secondly, the transition must be strategically viable. Preferably, this means a strategic position near either the consumer or the producer. This reduces traffic flows, adding to both environmental and economic sustainability. The maps on the right shows several analyses that use criteria like current land use and strategic location to determine which areas are most suited for the implementation of biomass scapes in Zuid-Holland.

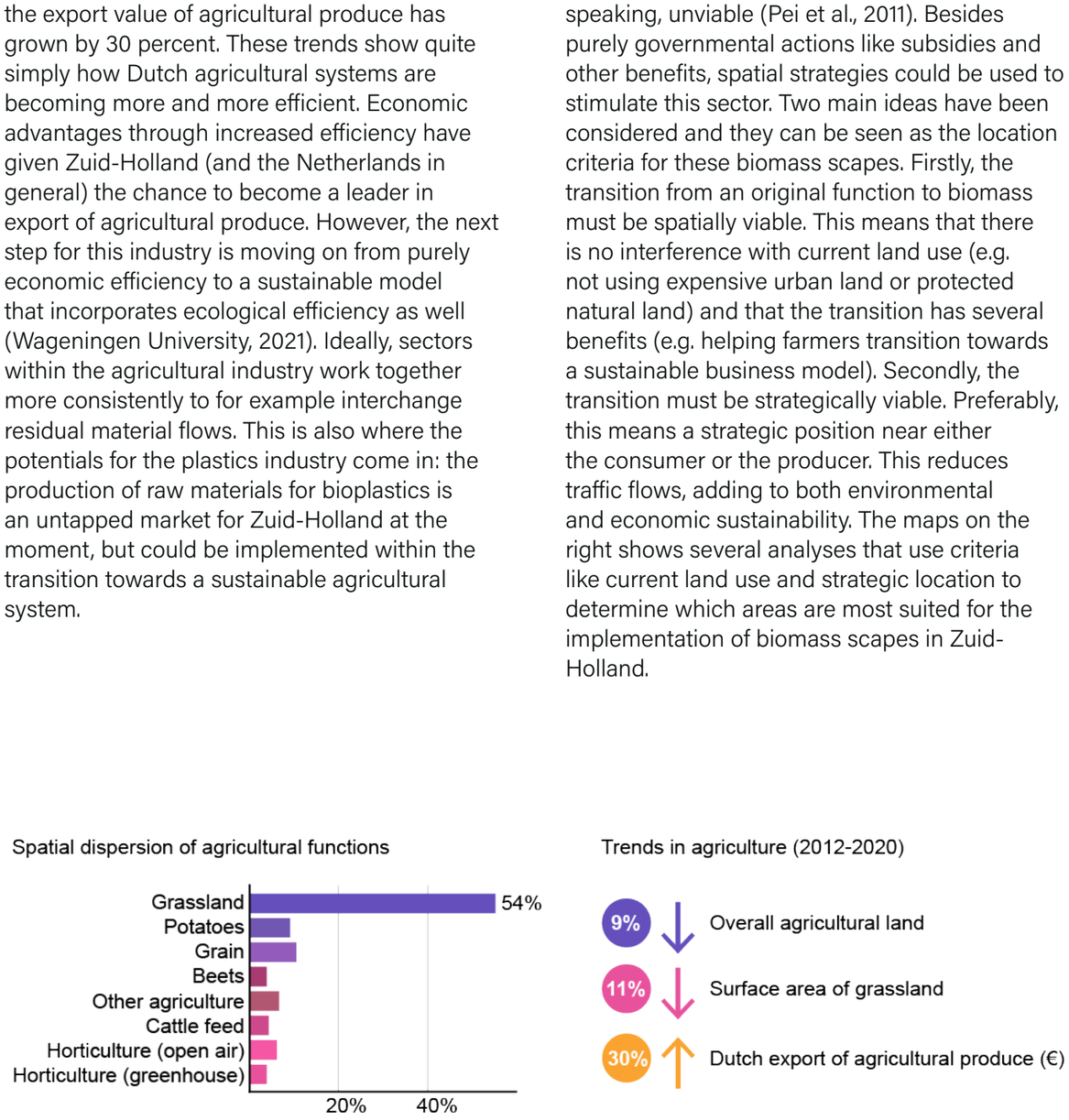


Figure 15

Spatial dispersion and trends in agriculture

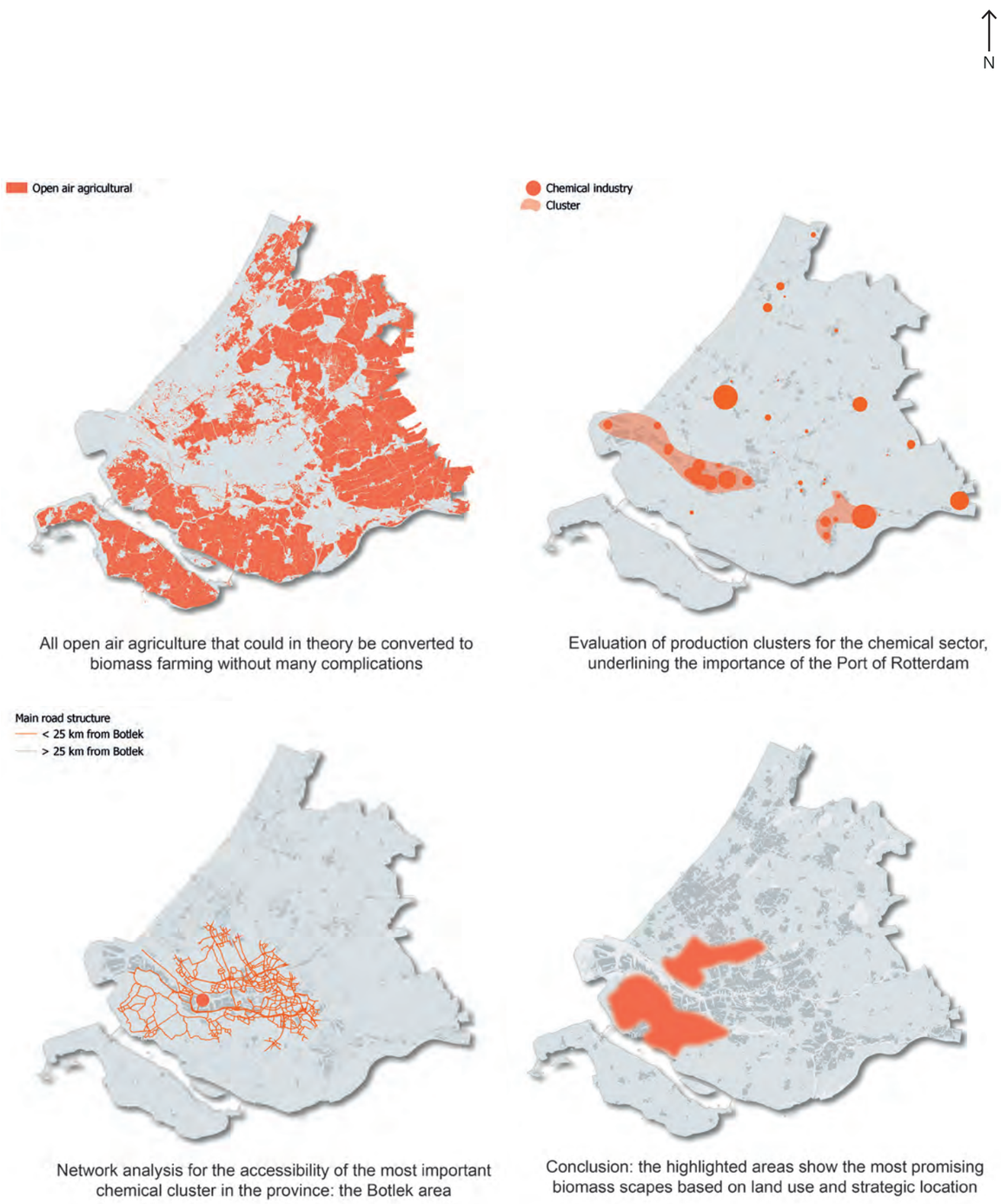


Figure 16

Urbanization

As mentioned earlier, Zuid-Holland is a very urbanized province. Besides hosting several of the largest cities of the Netherlands, it also has a lot of man-made surface area in for example the Port of Rotterdam (figure 17). In recent times, several problems with the way Zuid-Holland has been urbanized have arisen. The first problem is the significant demand in housing for the province, and how to spatially organise this (PZH, 2021). Secondly, there is the current configuration of industrial areas. These have been historically valuable for the province as they formed the core of employment, but many are now prone to decay (MRDH, 2020). Thirdly, there is the problem with the Port of Rotterdam and how to make this immense and economically important area future proof. Although these are all rather general spatial issues for the province, solutions for these problems could become part of the transition strategy for the plastics industry. Therefore, these issues will be firstly examined in general. In further chapters, solutions for these issues will be related to our strategy for the plastics industry.

Figure 17

Man-made surface areas

Solving the demand for housing

The Province of Zuid-Holland is aiming at building up to 17 thousand new dwellings per year until 2025 (Provincie Zuid-Holland, 2021). As mentioned, the need for housing is significant. It is however also vital that this will not conflict with other spatial needs, like that for the agricultural demand of space. Although we have seen that the decline in agricultural land has not created a reduction in production value, a realistic threat is that rural spatial competitiveness will increase in the transition towards sustainable use of raw materials - as is the case with the use of biomass. Therefore, although this report will not cover strict solutions for the housing problem in Zuid-Holland, there has been some investigation into what areas within the urban fabric are most feasible for solving this issue.

Transforming decaying areas

30 percent of jobs in Zuid-Holland come from industrial zones (Gebiedsontwikkeling, 2019). Therefore, these monofunctional areas have a significant importance for employment and the economy of the province. However, there are also major problems with these types of urban spaces: they are deemed to be unattractive, monofunctional, they take up a lot of valuable space in the urban fabric and they're found to be unsafe (CCV, 2020). The Metropolitan Area of Rotterdam and the Hague has already established plans to tackle parts of the industrial envelope that are prone to decay. They see opportunities to restructure current industrial scapes. New development can transform industrial areas into mixed functional areas, or revitalize areas that show considerable vacancy. These interventions have several beneficial outcomes. Firstly, undoubtedly, they tackle the formerly mentioned issues of limited attractiveness and safety. Secondly, they may contribute to tackling the housing demand. Adding to this, they can form the basis of introducing new types of industry and commerce to the urban fabric. Ideally, they could harbor new functions in the plastics sectors, like makers industries, innovation hubs, educational facilities, and commerce. Analyses based on which industrial and urban areas to transform can be seen in the maps on the page on the right.

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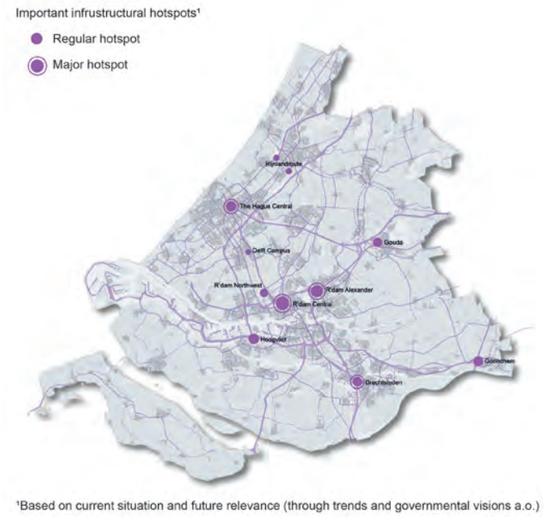
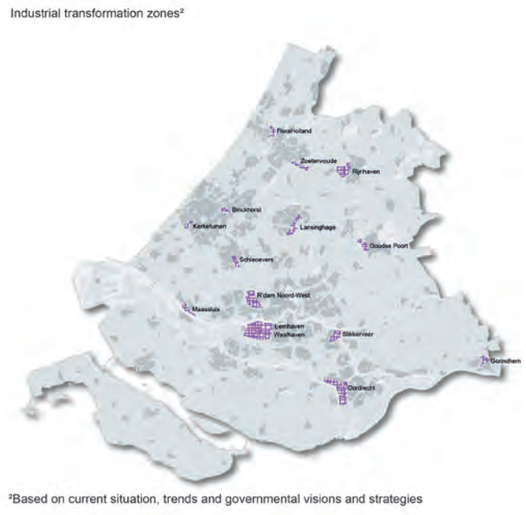


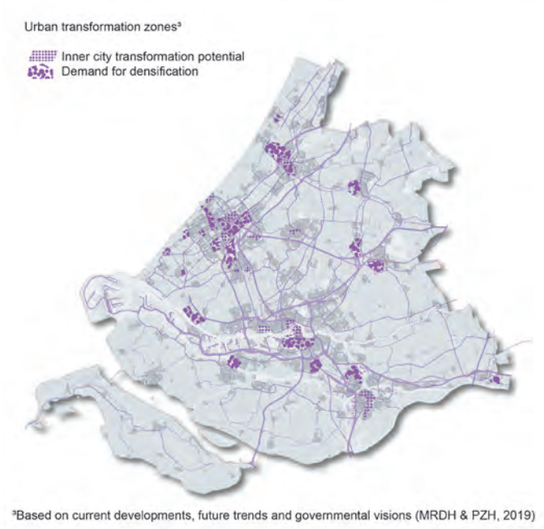
¹Based on current situation and future relevance (through trends and governmental visions a.o.)

Several infrastructural spots that are relevant now and will remain so with developments in the future (PZH, 2019)



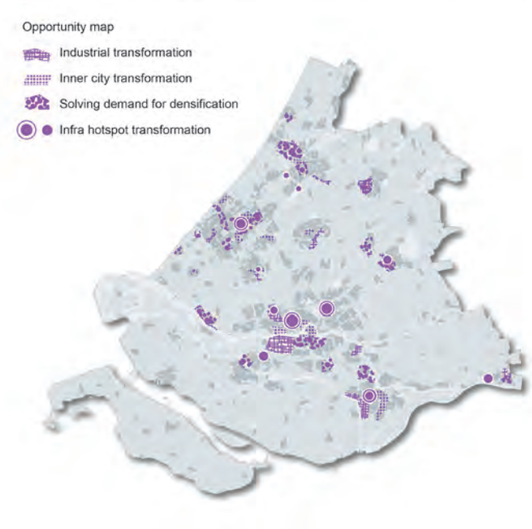
²Based on current situation, trends and governmental visions and strategies

A summation of industrial areas that might be prone to decay. Some of these could be transformed soon (MRDH, 2020)



³Based on current developments, future trends and governmental visions (MRDH & PZH, 2019)

Several inner city areas are prone to transformation and many urban areas will have a demand for densification

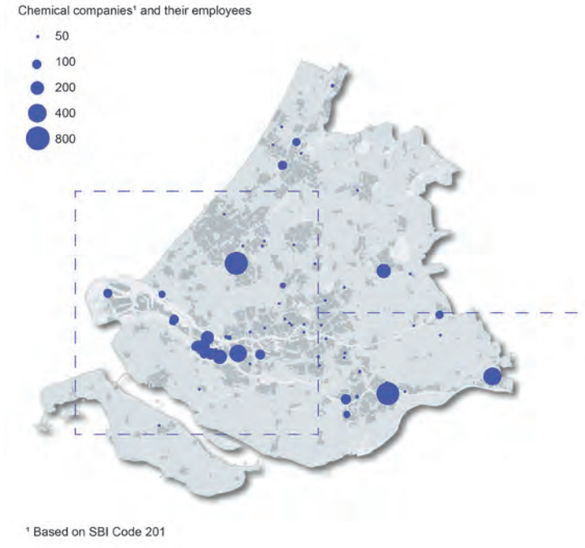


There are manifold opportunities within the urban fabric to incorporate the plastics industry while transitioning towards new urban systems

Figure 18

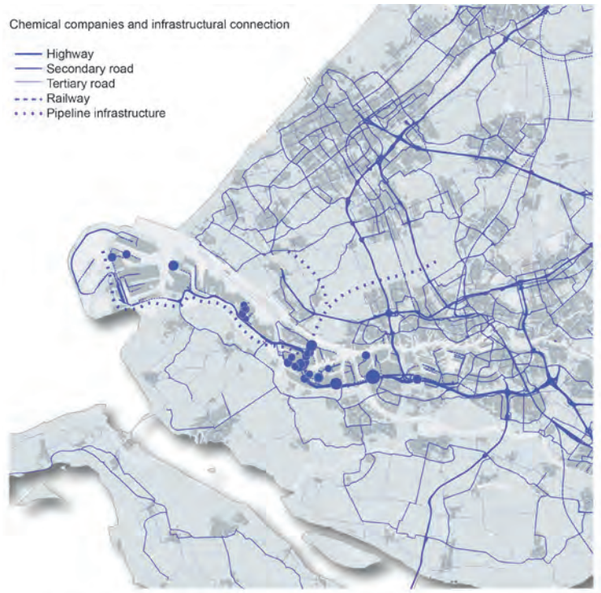
Future proofing the Port of Rotterdam

The Port of Rotterdam can be considered to be one of the most vital economic dependencies of Zuid-Holland and even the Netherlands in general. In 2019, it is economic production was valued at around five percent of the Dutch total (Erasmus UPT, 2020). Historically, the port has known many developments, from its origins in the city centre of Rotterdam to the completion of the Tweede Maasvlakte in 2013. In general, these transitions have taken place to help maintain the economic viability of the port. The next transition, towards sustainability and circular industries, should aim to do the same. Concretely this means that industries that are currently deemed unsustainable (like the chemical industry) will have to transition away from this unsustainability. This can be achieved through transforming industrial scapes, designating places that can harbor innovation, and finding new uses for port areas that might lose their functions. Figure 19 shows analyses of the current functionalities in the port area, infrastructure, and potential opportunities within the transition towards a sustainable and future proof Port of Rotterdam.

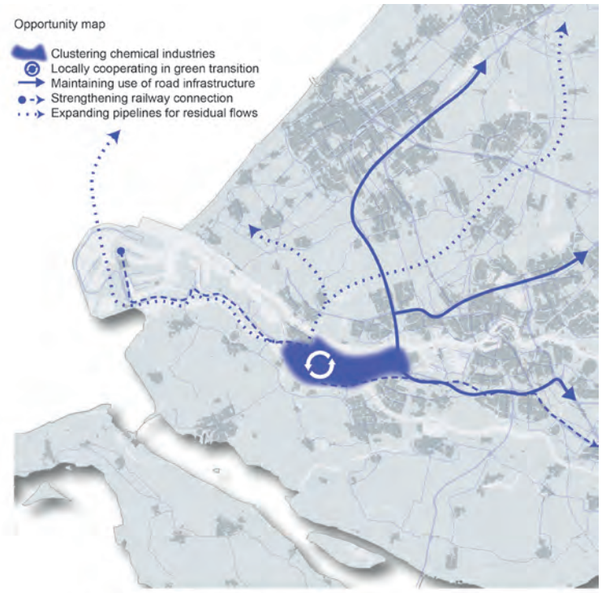


The largest clusters of the chemical sector have formed around Dordrecht and the Port of Rotterdam

Within the largest chemical hotspot, the Port of Rotterdam, this industry is clustered around the Botlek area



The Botlek area has a strategically advantageous position near infrastructure and urban areas



In regard to function, position and infrastructure there are several opportunities for this area to efficiently transition towards a sustainable model

Figure 19

Conclusion

Biomass scapes

Spatial competitiveness is an issue within rural areas. However, increased efficiency and shifts in agricultural trends allow for new opportunities. Ideally, new biomass scapes can be introduced around the port of Rotterdam area. There, innovations within the industry could occur, and cooperation and co-creation between different types of agriculture could be stimulated.

Urbanization

The demand for housing is significant within the province. Additionally, many urban areas have become more prone to vacancy, neglect or decay. Because of this there are manifold opportunities (and necessities) for the large scaled transformation of urban areas. These developments could go hand in hand with the introduction of new industries, flows and systems within the plastic sector.

Port of Rotterdam

The Port of Rotterdam is a vital economic region for both Zuid-Holland and the Netherlands in general. To remain viable in the future, the port area must transition towards circular industries. The plastic sector, as part of the chemical industry, could undergo this transition within the Botlek area. This area already has a chemical cluster, is centrally located near urban (consumption) and rural (production) hotspots, and profits from high quality infrastructure that goes into the hinterland.

Circularity analysis

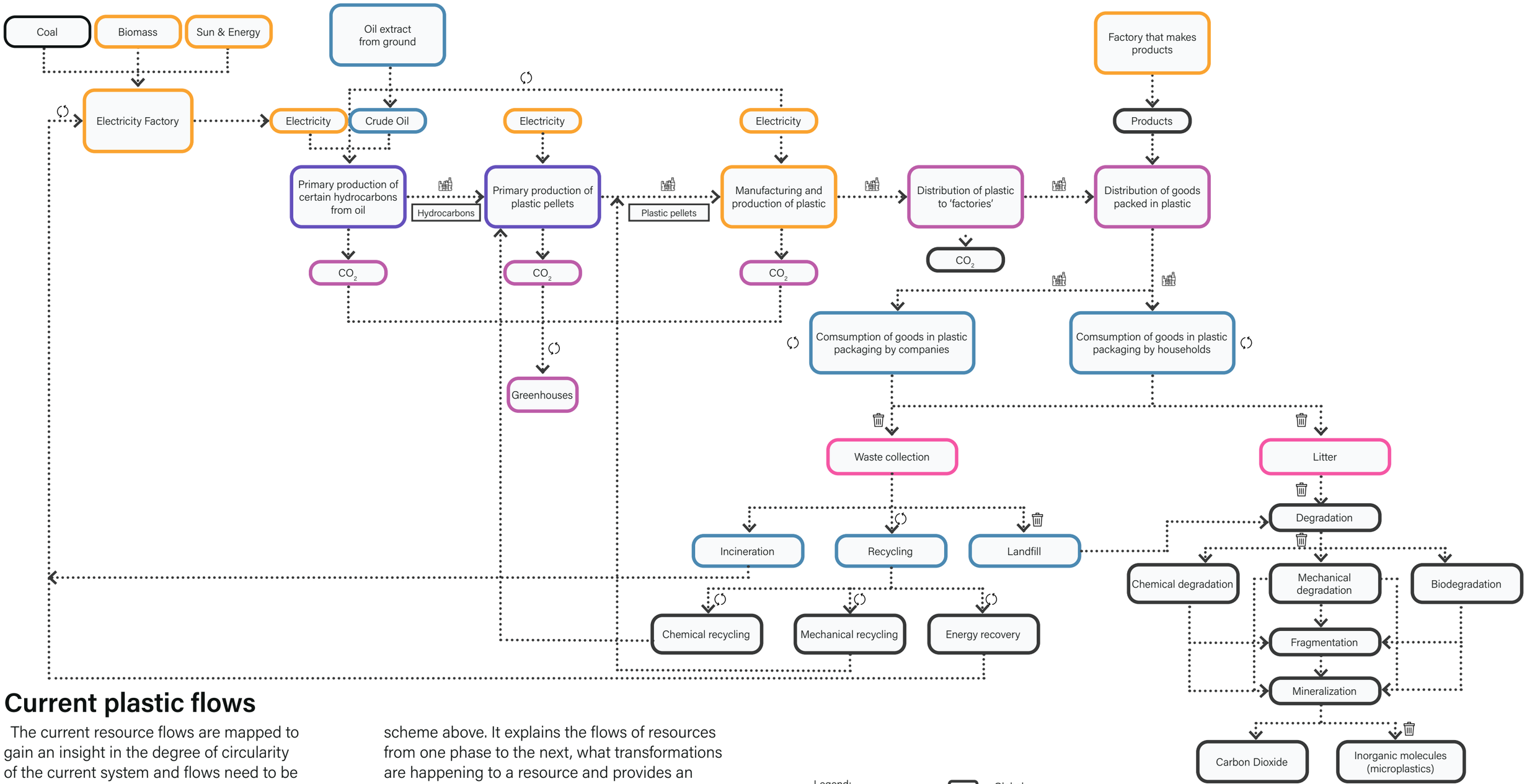


Figure 20
Current plastic flows

Current plastic flows

The current resource flows are mapped to gain an insight in the degree of circularity of the current system and flows need to be altered, realised or scaled up to realise a circular plastics economy. Based on Actieplan biobased kunststoffen (2020), Hahladakis (2017) and Ellen Macarthur foundation (2017) we made an overview of current resource flows, shown in the scheme above. It explains the flows of resources from one phase to the next, what transformations are happening to a resource and provides an overview of the circulation of resources. To identify which resource flows need alteration we analyse problematic flows, to identify which flows need to be realised and/or scaled up we analyse opportunity resource flows.

Problematic resource flows

By identifying problematic flows, appropriate changes can be proposed to improve the sustainability of a flow. Figure 20 shows resources are 'lost' - not circulating back - after the flows of litter and landfill, the resources are not used anymore. These plastics potentially have large negative effects on the environment. They cause air pollution and end up degrading into microplastics (Demetrious & Crossin, 2019). Resource recovery to landfill are the three types of recycling, of which mechanical recycling would be the most sustainable option, and possibly incineration which has its own downsides (Hahladakis, 2017).

A large amount of waste is incinerated, this may seem as a circular option as energy is retrieved from it. However, the waste could be used for higher quality purposes, thus a higher usage according to the R-strategy. The plastics can for example be remanufactured or recycled. Moreover, incineration of plastics causes diverse types of emission including carbon monoxide (CO) and carbon dioxide (CO2), which have negative effects on the environment (Hahladakis, 2017).

These resource flows should therefore be altered towards more sustainable flows.

Besides the loss of resources, it is also important to view where resources come from. Oil and coal are most often used for the energy used in factories related to the plastics cycle (Port of Rotterdam, 2021), these should be replaced by renewable energy resources to make the cycle more circular (Korhonen et al., 2018). When analysing the origin of current plastic resources, the vast majority is from oil (Ellen MacArthur Foundation, 2016). This is a finite resource, which causes multiple negative effects for the environment due its extraction and transport (North & Halden, 2013). An alternative resource would therefore be of great value to improve the sustainability of plastics.

When analysing the current plastic products it becomes clear that many products are single use or only used for a short period of time (Ellen MacArthur Foundation, 2016; Gibb, 2019). When analysing the possibilities for plastics this usage is fairly odd, as the material could last for a long time (Ellen MacArthur Foundation, 2016). Hence, a (re-)design for long life products and (re-)design for product life extension would reduce the current consumption and therefore production, thereby improving the sustainability of plastics.

Opportunity resource flows

Current flows with circularity opportunities are the flows of recycling, particularly mechanical recycling followed by chemical recycling (Hahladakis, 2017), and the production flow from biomass as a resource instead of resources from finite resources (Kawashima et al., 2019).

In line with our strategy, (re-)design for the technical cycle can enhance circularity (Hahladakis et al., 2020). Recycling of both fossil-based and bioplastics plays an important role in efficient utilization of resources of used plastics (Kawashima et al., 2019). The recycling assures that resources are not lost but find a new purpose. Nonetheless, even with the recycling of plastics their potential to contaminate soil, air, water and food can still be at hand (Hahladakis, 2017). Therefore, sound recycling should be performed in such a way that negative effects are avoided, to ensure environmental and human health protection.

In addition to recycling, biomass as a resource for plastics is an opportunity flow. The (re-) design for a biological cycle is also recognised as a strategy to enhance circularity (Hahladakis et al., 2020), bioplastics will have a positive social and environmental impact if a closed system is established (Kawashima et al., 2019). Biodegradable and bio-based plastics present a viable and attractive alternative to traditional finite plastics (Karan et al., 2019). Moreover, a diversity of bio-based feedstock provide an opportunity to produce a range of bioplastics (Karan et al., 2019), which could potentially be used to create different kinds of plastics as is required by the market.

By analysing the size of current resource flows in the plastics economy in Zuid-Holland, it becomes clear that approximately 9 percent of current plastic packaging is recycled and 1 percent of plastic packaging are bioplastics (Van Schaick et al., 2018). Hence, the majority of the flows need to be altered in order to become circular.

Besides reducing and altering problematic flows and upscaling of opportunity flows, (re-) design for resource efficiency of all resources would improve the circularity as less resources would be needed. When resources are not recycled, resources are not used efficiently (Landon-Lane, 2018), thus to use resources more efficient recycling should be done for more and if possible all plastics. Moreover, through designing products using less material would decrease the total amount of plastics used. This would be a better alternative, as there is currently a significant amount of plastics which could be left out as they don't have a highly valuable addition (Ellen MacArthur Foundation, 2016).

The most circular option would be if resource flows would not be present at all, as the consumption and production is refused. This is however hard to measure which plastics are refused, an analysis of a comparison over time would be the best alternative. Current measurements show there is an increase in total usage of plastics and this is also expected to continue over time if changes are not made in behaviour and cycle of plastics (Ellen MacArthur Foundation, 2016). Hence, there is a large opportunity for refusing, reducing and reusing plastics.

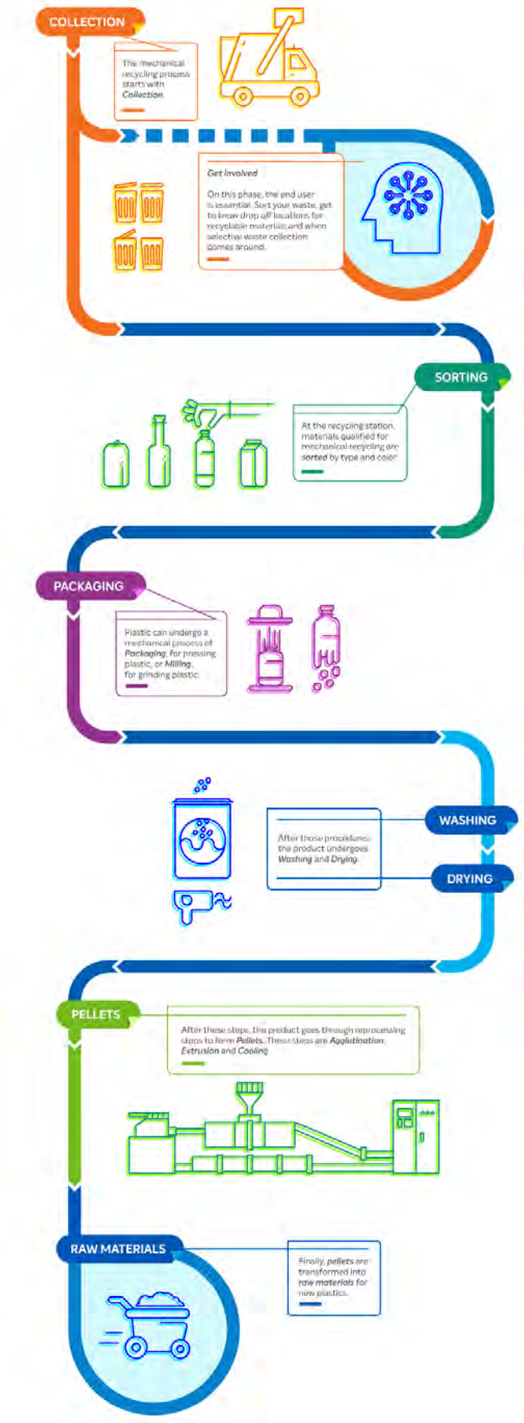


Figure 21

Mechanical recycling. Source: Bluevision (2018)

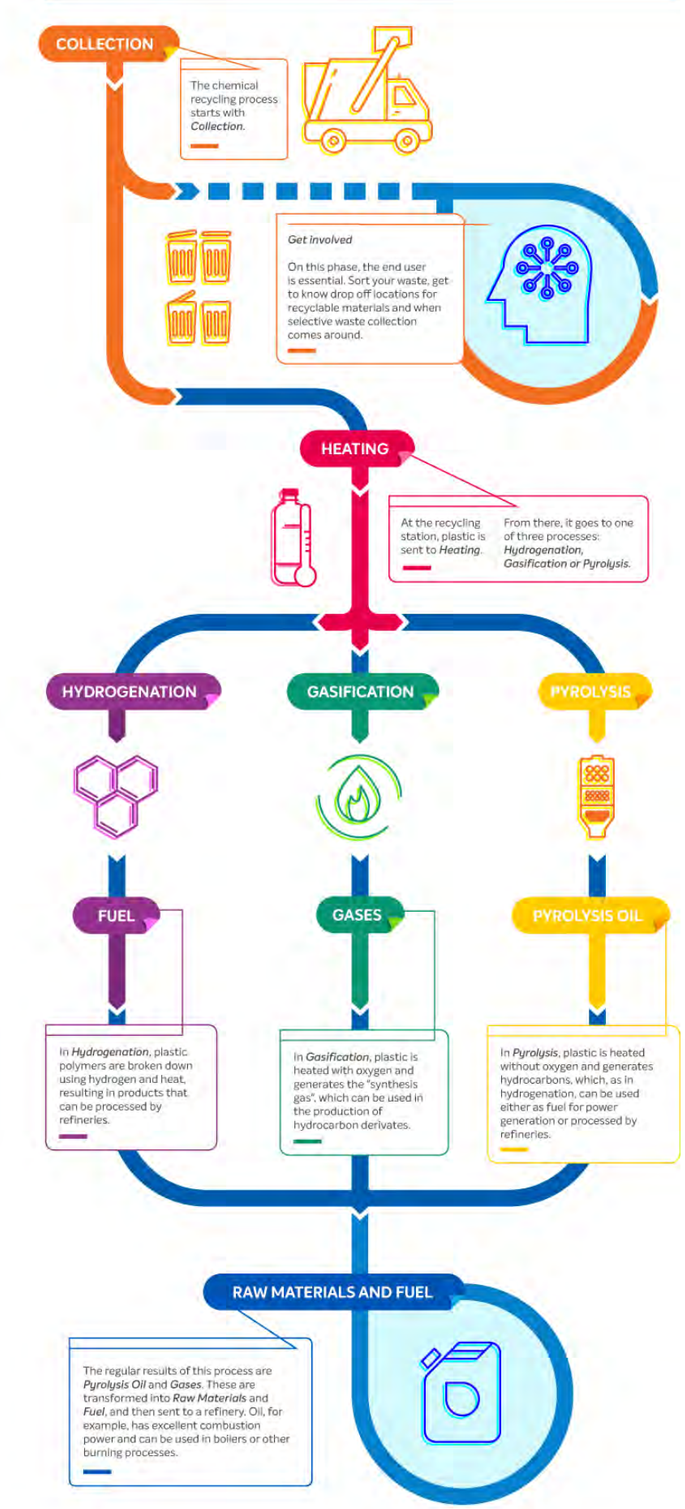


Figure 22

Chemical recycling. Source: Bluevision (2018)

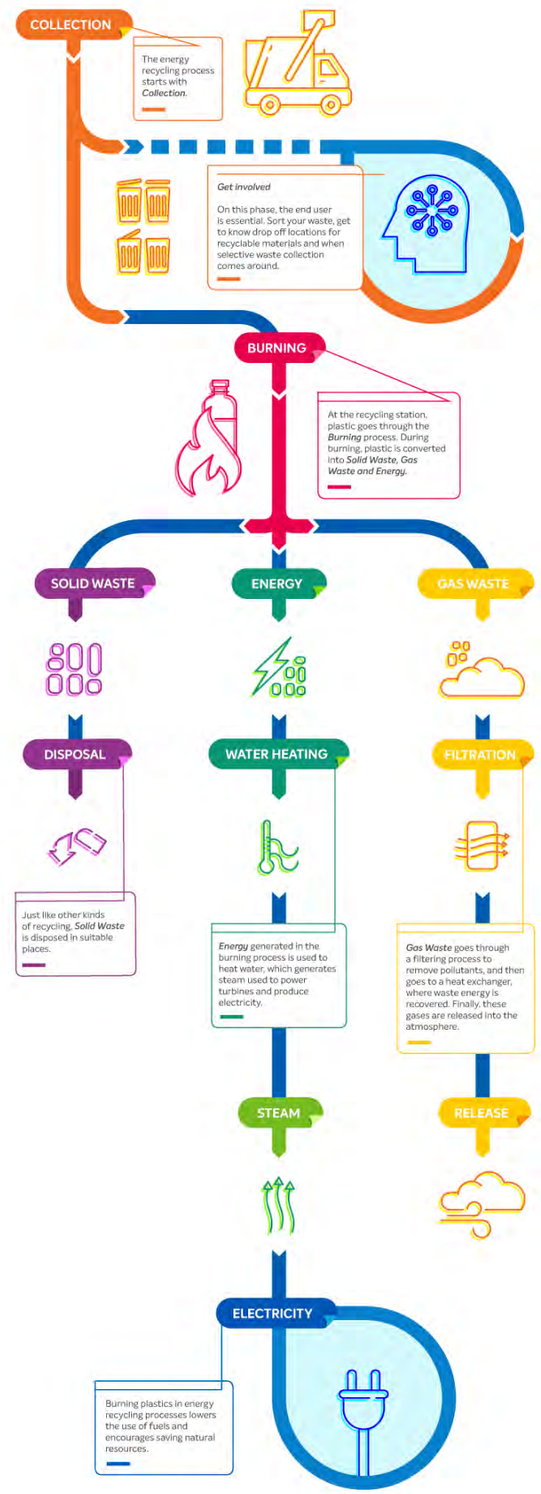


Figure 23

Energy recovery. Source: Bluevision (2018)

Conclusion

Through analysing the current resource flows, we identified problematic flows to be able to perform a strategy to decrease the flows with a negative impact. The problematic flows of finite resources of oil and coal should be replaced by renewable energy resources. And a desired replacement of oil as a resource for plastics by biomass, to enhance a biological plastics cycle. Moreover, we identified the resource loss due to landfill and litter, and the resource decrease by burning plastics waste. Both could be made more circular by recycling the resource, to make it in the future possible move more up the R-strategy to have a greater sustainability.

Plastic network analysis

Current situation

Currently there is a disconnection among various actors in the plastic network (Shen, 2011). The disconnection is often explained as a gap between product design, material supply, marketing, production and materials return (Briassoulis et al., 2020), but also as a disconnection between producers, composters and other actors in the network (Shen, 2011). An integral plastic network is about connecting these dots, changing processes and changing the behavior of people so that the plastic network will be more transparent.

In the plastics network there are many different actors involved. We highlight the most dominant actors in the chain in the manufacturing, usage and after usage stage.

Manufacturing of traditional plastics

The actors involved in the making of plastic are diverse and widespread. First off all there are the producers of the raw materials, which is mainly oil, that are needed for the production of plastic. In the Netherlands we import 174.000.000 liters of oil per day (Index Mundi, 2020), whereby approximately twenty percent comes from Russia and fifteen percent from Saudi Arabia (CBS, 2021). This means that the Netherlands is partly dependent on these countries for our oil and thus for the production of plastic. Both countries have multiple times violated human rights (Human Right Watch, 2019). This also has political implications, for example the killing of the journalist Jamal Khashoggi at the embassy Istanbul in 2018 by Saudi Arabia, whereby the USA has imposed certain sanctions (BBC, 2018) (Van den Enden, 2019). The oil that is imported from these countries is then transported by ship by a transport company to the port of Rotterdam. The oil is then loaded off the ships and goes to the company that 'cracks' the oil so it can be used to make plastic or to be used as fuel for cars or planes. It then goes to the next company that makes plastic grains out of it, that can be molded into plastic by another company. In Zuid-Holland alone there are 163 companies that are involved in those three steps in the making of plastic (LISA, 2018).

Usage

After the manufacturing plastics are distributed by companies like Ahold or Unilever to serve as packaging material or as disposable items. These companies decide what kind of packaging and how the packaging will look like. Many of these companies have made promises to decrease their plastic footprint. For example Coca-Cola, who promises that by 2030 they will collect and recycle the same amount of bottles the company sells, however no statement has been released about reducing the amount of newly produced plastic (Plastic Soup Foundation, 2020). Another actor in the network is as important as the whole early life, namely you, the consumer. The consumer buys products with a plastic plastic package and thereby stimulates the production of these plastics. Every year an average person produces 29 Kilograms of plastic waste (Plastic soup foundation, 2021).

After use

After the usage of plastics, most of it is currently identified as waste. When you throw away this plastic waste it will get collected by your local municipality's waste collectors. Depending on your municipality you can sort out the plastic yourself or not (Milieu centraal, 2021). Then the waste will go to a local waste disposal company, who sorts out the waste. A part of this waste will get burned and a part will be recycled. This recycling will be done by other companies that transform the old material into new ones. At least that is the idea, but the Netherlands sends 361.000 Kg of plastic waste annually to other countries to be recycled, that one-third of the annual plastic consumption (Geurtsen, 2019). Most of the waste is transported to European countries like Germany or Belgium, but also Vietnam, Indonesia and Bangladesh are on the list of countries that accept our plastic. China used to be one of the biggest importers of plastic but in june 2017 they announced to accept no more plastic waste because of the pollution and the poisonous particles that are released when the plastic is burned (Geurtsen, 2019).

sector	actor	interest/goal	problem perception	resource	relevance
	People	Changes must be suitable and viable	Minimum effort	Change from fence sitter to agent and partner of the new plastics economy	not replaceable high dependancy critical actor: yes
BUSINESS	Brands and super-markets	Cheap labour and land Resource instead of waste management	Shift in business model Subjected to the demand of its clients	Distribution centres are strategically positioned nearby infrastructure in peri-urban areas. Set the demand and use CE products.	replaceable high dependancy critical actor: yes
BUSINESS	Waste manage-ment	Collection becomes a logistical service. Sorting becomes effective. Reycling becomes streamed. Partnerships with other sectors	Low cooperation Low awareness and sorting capacity Subjected to the demand of its clients	Present in every stage of the loop.	replaceable high dependancy critical actor: yes
BUSINESS	Manufac-turers	Lower production (converters) costs Reduce the use of plastics Partnerships	Discontinuity and low-quality of feedstock Slow innovation	Innovate in the use of plastic as resource	replaceable high dependancy critical actor: yes
BUSINESS	Chemical	Formulate the right processes to upgrade production and recycling	Need to transition Finite feedstock	Production, recycling and recovery knowledge	replaceable high dependancy critical actor: yes
SOCIETAL AND NGO'S, TRADE & INDUSTRY ASSOCIATIONS, AND PARTNERSHIPS	Port of Rotter-dam	Perform the transition without losing its competitiveness in local and international spheres	Laws that force the transition Finite feedstock	Main operator of port area where processes for plastics take place Organisational side of the transition	replaceable high dependancy critical actor: yes
SOCIETAL AND NGO'S, TRADE & INDUSTRY ASSOCIATIONS, AND PARTNERSHIPS	Societal Organiza-tions	Disseminate knowledge and lessons learned, with respect to, for example, innovations in technology and logistics	Jobs must be kept with the transition Environmental pollution	Act as mediators between private and public sectors Assess for improvement	replaceable high dependancy critical actor: yes
ACADEMY & EXPERTS	Academy & Experts	Incubation Connection to a network Supporting facilities Growth funding	Wasted potential	Invest in talent and idea generation	replaceable high dependancy critical actor: yes
LEGISLATORS	Munici-palities	Coordinating role in connecting regional and local activities	Keep the social and economical bonds during the transition	Fiscalization Implement policies Funding	not replaceable high dependancy critical actor: yes
LEGISLATORS	Province Zuid-Holland	Enabling frameworks Coordinating role in connecting regional and local activities	Achieve circular economy that include plastics Keep the social and economical support during the transition	Fiscalization Maintenance Initiate action and knowledge-sharing between partners	not replaceable high dependancy critical actor: yes
LEGISLATORS	National govern-ment	Enabling frameworks and the required collection, sorting and recycling infrastructure	Achieve circular economy that include plastics Comply to EU regulations	Promote partnerships Support demonstration projects Eliminate potential legislative barriers	not replaceable high dependancy critical actor: yes
LEGISLATORS	EU	Integration between european nations	Achieve climate goals	Funding Stimulating & containing policies	not replaceable high dependancy critical actor: yes

Table 1

Table to understand the agenda of relevant actors

Stakeholder analysis

People
Consumers of goods involving plastic by individuals.

Business sector (use)
Plastics are not their end product. Consumption of goods that contain plastic.

E.g.: Supermarkets (Albert Heijn, Jumbo, Lidl, Dirk, Ekoplaza, Pieter Pot, etc), brand owners (Coca Cola, Quaker, Heineken, Unilever) and companies.

Manufacturer sector (convert)
Product design, engineering and production of plastic products for later in the chain or straight to the consumer.

E.g.: De toekomst plastics, Heineken, Unilever, Phillips

Waste sector (collect, sorting, recycling)
Collect, sorting, recycling and overall waste management and transportation.

E.g.: Suez, Irado, RAD, HMS, Klein Recycling, Peute Recycling and municipality's waste services

Chemical sector (producer)
Use feedstock for the production of plastic pellets. Also interested in energy recovery methods.

E.g.: Indorama, Cumapol, LyondellBasell, Covestro, DSM, etc.

Societal and NGO's, trade & industry associations and partnerships
Organizations that facilitate, mediate or push for specific agenda related to a sustainable goal for their resources. Actors of the other sectors can participate, but have to align values.

E.g.: Port of Rotterdam, Rotterdam-Moerdijk Industry Cluster, Plant One, Innovation Quarter, Blue City, Waste to Chemicals, Greenpeace, Dutch Sustainable Growth Coalition, Circle Economy and others.

Academics & Experts
Research, knowledge generation and innovative processes for plastics.

E.g.: Universities (TU Delft, Erasmus University), HBOs (Zadkine, Hogeschool Rotterdam), think-tanks (Ellen MacArthur Foundation), start-ups (Ioniqa) and companies (Metabolic).

Legislators
Draw, enforce and assess with legislations and enabling frameworks with the objective to contain, stimulate, support or facilitate actions inside their jurisdiction.
E.g.: Municipalities (Rotterdam, Delft, Den Haag, etc), Province of Zuid-Holland, the Dutch national government and the European Union.

Conclusion

The current plastic network is still not sharing the same values, or, understanding how to weight the responsibility and action of actors in an integrated approach towards the plastic cycle and its stages. The business model of many sectors and actors need to address clearer targets.

The next part of this report will address the lack of integration and clarity over the roles and responsibilities of actors in the circular plastics economy.

Figure 24
Stakeholder power interest matrix in the current situation

- Proponents - have resources that allow to produce change (e.g.: financial, knowledge, capacity to influence and attract other stakeholders).
- Blocking power - ability to block the transition (e.g.: mobilise protest, refuse permits, block processes.
- Fence sitters - without a clearly defined position at the present. Can act as proponent or opponent.

3

Proposal
a fantastic future for plastics

Vision for 2050

By 2050, the way we use plastics within the province of Zuid-Holland has changed drastically. The plastics industry, which is primarily linear at the moment, will shift to a circular model. The province will no longer rely on the import of non-renewable resources as raw materials for this industry, or rely on the export of excess plastic waste as an end of pipe solution - to plastic waste issues. Consumption has been limited to a minimum through socioeconomically fair and viable alternatives. End-of-pipe solutions shift to recycling and, perhaps, composting - diminishing the environmental impacts and closing the loop of the plastic cycle. In thirty years, the circular model will entail fair and viable solutions throughout the plastic lifecycle.

Goals

Furthering this vision, a series of goals have been formulated that represent an ideal future with plastics. They resemble a sustainable way of living with plastics through different scale levels, types of material flows, and stages of the plastic lifecycle for the province of Zuid-Holland

Engagement

Environmental awareness has been growing significantly in recent times. Increasing awareness has been a vital driver for change as it activates society and creates support for paradigm shifts. Awareness through engagement is therefore imperative for the transition towards a circular sector. By 2050, people actively engage in the plastics cycle.

Fair use

Zuid-Holland is a very densely populated province. Adding to this is the spatial competitiveness of other functions, like the large scale agricultural network. With the population still growing and the demand to find sustainable alternatives, attention needs to be paid towards the distribution of space and resources. By 2050, space and resources are used in fair, inclusive and efficient ways.

Locally circular

Through globalization, the world has become interdependent on areas such as economy, culture, technology and indeed, sustainability. Although this can be considered to be beneficial in regards to for example efficiency, a regions strength must be marked its local skills, know-how and production power: its ability to be in fact, self sustainable. Zuid-Holland already shows its qualities for several branches - ranging from agricultural to technology from knowledge institutes. To add to this, by 2050, all plastics in Zuid-Holland are produced and processed locally.

Redefined dependency

That the plastic consumption rate is currently too high to be sustainably feasibly has been established from the problem statement. For this reason fundamental changes need to occur to redefine the way plastics are used - and to safeguard a sustainable future with this material. Advancements in technology, policy and engagement among others will reshape plastic usage through all parts of the cycle by 2050, so that plastic use is reduced to a minimum whilst remaining material flows are either recycled or fully compostable - closing the plastic loop.

Zero waste

A transition towards a closed loop will further reduce the environmental impact of the plastics sector. It will demand less raw materials as input and strongly counter the accumulation of waste streams that have the potential to fill up precious space or harm the environment through pollution. Therefore, by 2050, recycling should be the norm for end of life plastics.

SDGs in the Fantastic Plastic

These goals not only align to needs on a regional scale. In 2015, the United Nations presented seventeen Sustainable Development Goals (SDGs) for a planetary scale effort to achieve more responsible and future-proof ways of development. In the Fantastic Plastic project, some goals are frontally addressed. Such as:

SDG 9 - Innovation and infrastructure:
- spatial just infrastructure
- inclusive design
- fostering upscaling of innovations
- catalysing existing ones
- spreading technologies that can be used in small scale around the city

SDG 12 - Responsible consumption:
- less consumption
- biodegradable and/or recycled materials
- circular production -> using resources most efficiently as possible
- connection actors with the product and making them aware of the effects of the product

SDG 17 - Partnerships for the goals:
- it is crucial to find the right partnerships (in other sectors also) that will enhance each other in the transition to a circular economy with plastics.

Other goals are also achieved as a consequence of other efforts:

SDG 8 - Good jobs and economic growth:
- growth of local (small scale) processing
- careful on jobs transition

SDG 11 - Sustainable cities and communities:
- support positive economy
- resource efficient

SDG 14 - Life below water:
- activities to clean plastics from the waterfront and open water in Zuid-Holland

SDG 15 - Life on land:
- Reducing litter
- Increase degradability of waste through innovations (maybe even compostable plastics)

Figure 25

SDGs that are address by this report

Goals and values

Cooperation

Cooperation between actors is very important (Narayan & Tidström, 2020) moreover cooperating in a CE cycle would entail connecting material flows, responsibilities and sharing benefits (Leising et al, 2018). Value creation and appropriation take place within the realm of inter-firm dependence, which makes way for partially convergent interests whereby cooperation and competition occur simultaneously. A well-functioning CE requires participation of both upstream and downstream supply chain partners to be successfully implemented (Zhu et al., 2010).

Within our proposal for the future, we believe it is important to enhance this cooperation as suggested throughout the plastic network. Within all actions attention should be paid to the cooperation between actors, the ability of sharing knowledge, information and possibly resources.

Responsibility

Due to value co-creation, due to cooperation, shifts taking place in responsibility of many, a collective responsibility is created of the participating population tasks (Pouri & Hilty, 2020). Responsibility and ownership strongly correlate (Velis & Vrancken, 2015), hence stakeholders who have ownership of resources or power in the plastic industry should take responsibility. Responsibility is key to a circular economy, as stakeholders take responsibility for their effects and for the effects related to their action circularity and hence sustainability can be improved (Velis & Vrancken, 2015). A method to improve the taken responsibility is extended producer responsibility, which increases the responsibility taken by plastic producers (Kunz et al., 2018). Besides the responsibility of producers, the responsibilities of consumers should also be present to assure the consumers also act responsibly Pouri & Hilty, 2020).

Within our proposal for the future, we believe it is important to address and improve the responsibility of all stakeholders related to plastics. By improving their feeling of responsibility, we believe the position of stakeholders and their interaction with plastics will become more circular.

Spatial Justice

According to Soja (2009), spatial justice has an emphasis on geographical and spatial effects of justice. "Spatial justice can be defined as a fair and equitable distribution of space of socially valued resources and the opportunities to use them" (Soja, 2009). Rocco (2014) expands the meaning to spatial justice to: "general access to public goods, basic services, cultural goods, economic opportunity and healthy environments through fair, inclusive and efficient spatial planning, design and management of urban and rural spaces and resources". Moreover, spatial justice is of great importance to assist fair and more equitable societies and support achieving full human potential (Rocco, 2014).

Within our proposal for the future, we believe it is important to realise spatial justice. This will be done through including different types of stakeholders and connecting them throughout the cycle, multi-purposing of areas and at all times aiming to improve the situation for all but in particular the most vulnerable.

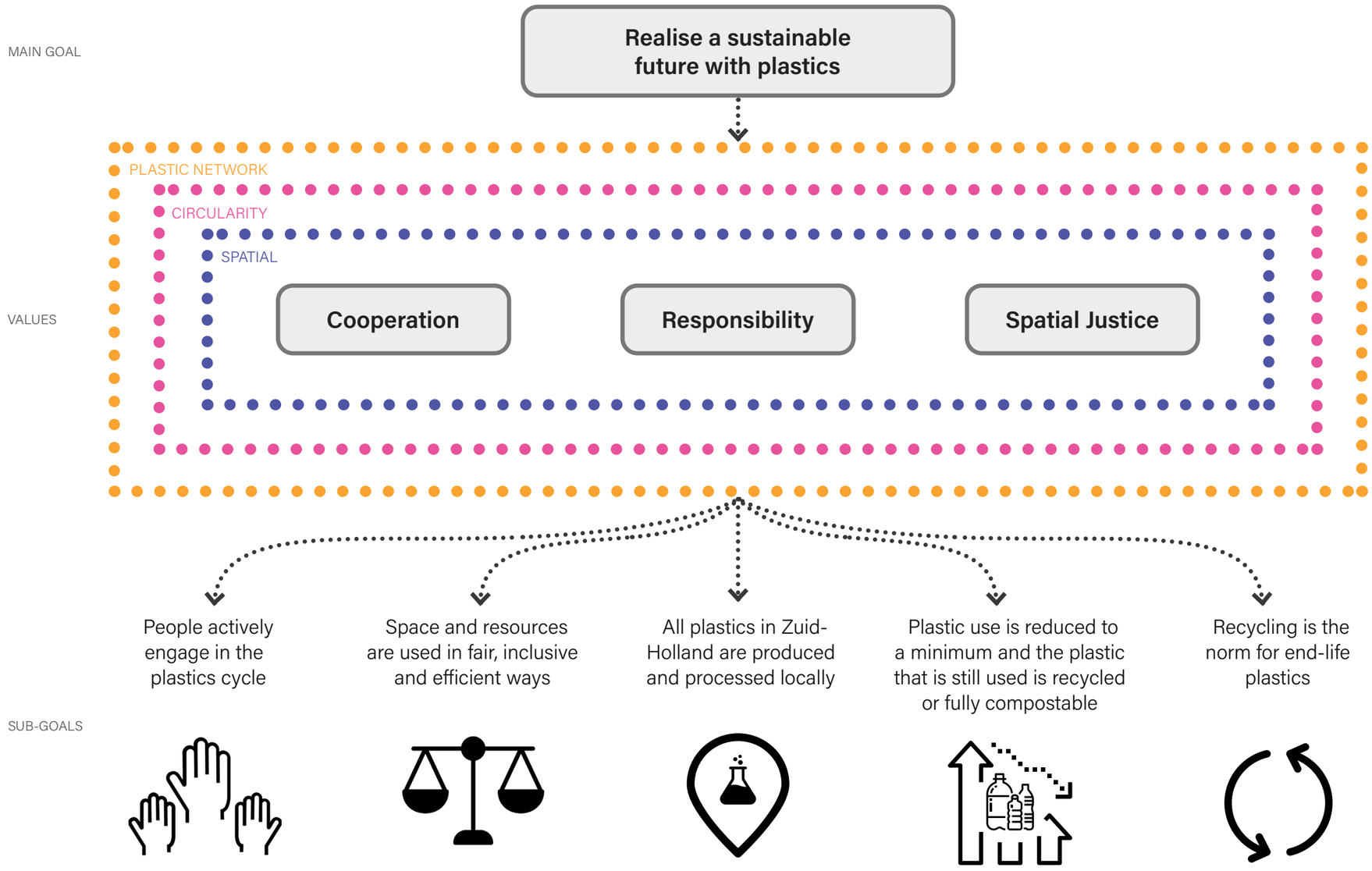


Figure 26

Scheme with main goal, values and sub-goals

Spatial drivers to support the vision

The chemical sector can be seen as a rather non-spatial industry. Production takes place in small isolated clusters like the Port of Rotterdam and consumption can often only be indicated through material flows (e.g. distribution to supermarkets). Existing spatial drivers for change have been envisioned to support the transition of the plastics industry towards a circular model in the spatial sense. By doing this, the transition of this rather non-spatial sector will be backed by spatial trends that can be substantiated more easily for the future of the province of Zuid-Holland. The most relevant spatial drivers will be mentioned shortly.

Spatial competitiveness in Zuid-Holland

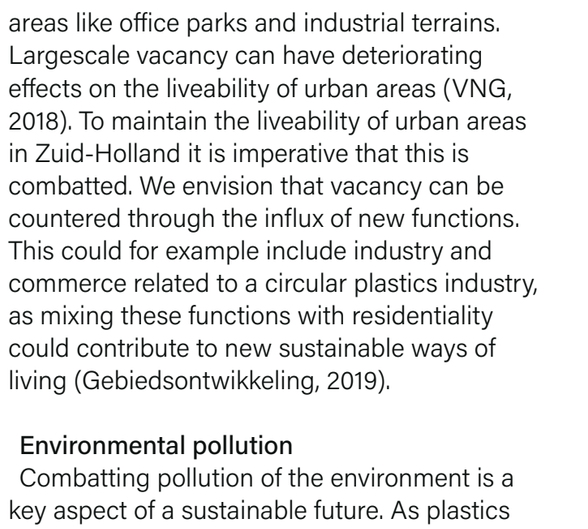
Currently, 23,4 percent of the land area of Zuid-Holland is urban (CBS, 2019). This percentage is the highest of any Dutch province, and has been growing slightly throughout the last decades. As has been explored in the spatial analysis, the remaining land area of the province is used up mainly by agriculture and recreational zones. Essentially, a very limited amount of actual natural land remains, and this increases the spatial competitiveness of land within the province. If the plastics sector were to become circular within the province, it should not (significantly) interfere with this competitiveness of land use. Therefore, it is envisioned that the land that will be allocated for this transition will be available through external spatial trends. An example of this would be a decrease in demand for cattle farming - freeing up space for biomass farming.

Vacancy in urban areas

Although the need for housing is significant in Zuid-Holland, vacancy of buildings has become more apparent in recent years. For both commerce and offices, the rate of vacancy has grown to about 8 percent (CBS, 2019). Interestingly, vacancy within the commerce sector was highest within city centers (Locatus, 2019). Trends in growing vacancy can be seen in both central urban areas and more peri-urban areas like office parks and industrial terrains. Largescale vacancy can have deteriorating effects on the liveability of urban areas (VNG, 2018). To maintain the liveability of urban areas in Zuid-Holland it is imperative that this is combatted. We envision that vacancy can be countered through the influx of new functions. This could for example include industry and commerce related to a circular plastics industry, as mixing these functions with residentiality could contribute to new sustainable ways of living (Gebiedsontwikkeling, 2019).

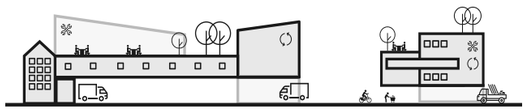
Environmental pollution

Combatting pollution of the environment is a key aspect of a sustainable future. As plastics are unfortunately notorious for their negative environmental effects, it is relevant to investigate what drivers can help to reduce these. Examples on the side of plastic material pollution are waste harvesting initiatives or new spatial elements to counter littering. On the side of plastic emission pollution we envision that the transition towards green energy (e.g. through wind and solar parks) and the reuse of emission streams like CO2 (e.g. through pipeline infrastructure) will facilitate the shift to a circular industry.



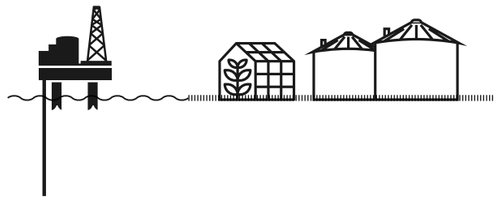
Spatial competitiveness

Trends will allow to redefine functions inside the city



Creating new typologies that revitalize urban and peri-urban areas

Establishing policies for better plastic harvesting



Repurpose streams of CO_2

Figure 27

Drivers of spatial change

Spatial vision

A map has been created to visualize the vision on the plastics industry in a spatial sense. The vision map (figure 28) shows how the plastic cycle could be redefined for the province of Zuid-Holland. The main focus is a reduction of scale level: allowing for plastic (and plastic alternative) flows to remain and recirculate within city, municipal and regional boundaries before reaching other parts of the lifecycle.

The so-called hubs, marked in purple, are deemed to become strongly mixed functional areas hey could harbor elements like zero-waste wholesale consumption and the handling of residual material flows (e.g. the reuse or repair of materials). This could then both reduce the need and extend the lifecycle of products, on an economically viable upscaled level.

By introducing these hubs the need for massive distribution centers that lack sociospatial relevance should be limited - as they form a new scale level between regional scale distribution centers and local scaled commerce and industry. Instead of boxing up the countryside, new mixed function environments are created within existing peri-urban areas, adding towards sustainable and liveable urban areas.

On the regional scale, the Port of Rotterdam transitions to a circular model. Raw materials and energy come from the region whilst waste streams like CO2 get repurposed within the region. The port functions as a hub that handles flows that are only feasible on the provincial scale level (e.g the production of bioplastics and chemical recycling).

The axes

The map highlights several axes that have been deemed relevant for a feasible transition towards this future vision. The knowledge axis is meant to find new connections between knowledge institutes towards developments within the plastics industry. The innovation axis shows the critical industrial regions of the ports of Rotterdam and the Drechtsteden. During the transition away from non-renewable resources, these ports should harbor innovative qualities like fieldlabs and testing facilities in order for them to become frontrunners towards the green economy. Lastly, the circularity axis entails the region that should become the place that ‘closes the loop’ in the plastic cycle - or even the chemical sector in general. This can be achieved through biobased raw material farming (start of life) and creating industries that tackle the recycling and recovery of residual material flows (end of pipe).

Vision map

- Increase function mix, implementing circular commerce and industry
- Transform decaying (peri-)urban areas into mixed function circular hubs
- Impose the 'R'=philosophy to circulate material flows on lower scale levels
- Further develop strategically placed distribution centers and limit expansion into greenfields
- Stimulate larger scale developments and connections along axes
- Strategically position farmland for biobased innovation potentials
- Establish upscaled plastic hub to strengthen future position of the Port of Rotterdam
- Harvest plastic pollution from ocean and protect shorelines
- Key road infrastructure
- Key water infrastructure
- Knowledge institution
- Technological innovation hubs
- Biobased farming innovations

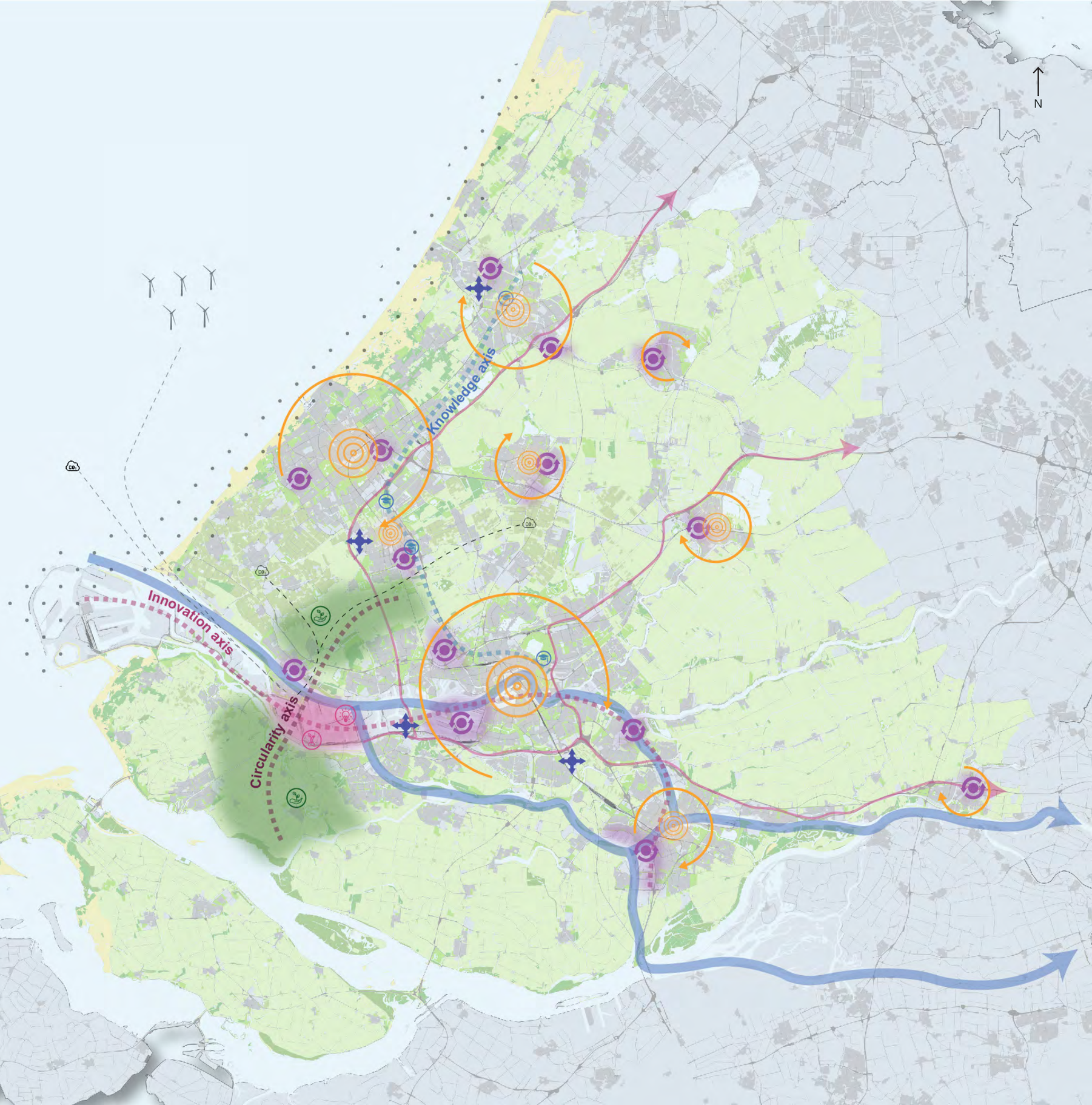


Figure 28

Spatial vision map

Strategy

To achieve the future with plastics, the relevant actors, proposed policies and spatial contexts are articulated in a strategy to perform the transition needed for a circular plastic economy in Zuid-Holland. The strategy aims to align the integrated framework with proposed futures in the shape of spatial milestones. In every milestone, an environment of responsibility and cooperation coupled with spatial justice must be met.

Main objective

The main objective is to reach a full economical, social, environmental and spatial transition to the plastic sector in Zuid-Holland. The transition scheme proposed by Drift (van Schaick et al., 2018) applied to the plastic sector is explained below:

Experimentation x Destabilization
It is very important to provide room for innovation. It is a fact that new technologies make old habits obsolete and we also count that the opposite is true. On the one hand, it is important to show the potential for collaboration and stimulate innovation so that experimentations with cheaper and more efficient methods to keep plastics in the shorter loop possible can have room for improvement. On the other hand, promoting the principles of circularity and giving a space where this experimentation can be visible and experienced will affect people's behaviour towards plastic usage - from refuse and reduce to seeing it always as a resource.

Acceleration x Chaos
To accelerate the transition, legislators must provide the legal framework that facilitates and stimulates. Legislators must provide the legal framework that facilitates and stimulates. The waste sector (with the increasing education of people as the first agent of collection and sorting) improves the collection to drive circularity, turning waste into resources. Academy & experts make use of the new space in the city, peri-urban and port areas that connect their innovation with the current network with the related business sectors. At this phase, the new approach to plastics creates an environment where the pressure is on the actor that is not participating in the change.

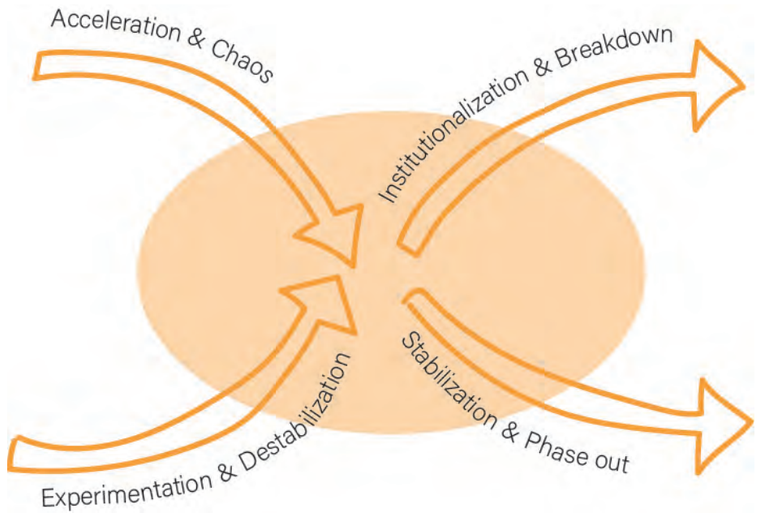


Figure 29
Transition in a X scheme proposed by Drift

Institutionalization x Breakdown
Traditional jobs that are fading must also undergo a transition that makes it possible for workers to learn new skills that are now needed in larger quantities, firstly in the Fantastic Plastic pilot project locations. Currently, introducing plastics to a reuse-repair-recycle ladder is still too ineffective or costly because the resource tends to be complex to manage and/or contaminated. The invested alternatives are hoped now to become efficient and stimulating changes up and down the loop. Ultimately, the system and the pilot projects are becoming landmarks of new qualitative spatialities in the urban, peri-urban and the port areas.

Stabilization x Phase out
The Fantastic Plastic project in Zuid-Holland avoids an outcome where valuable resources escape the circular loop and lose their potential value. It is making all packaging and single-use plastic in the province reusable, repaired or recyclable at increasing competitive costs. Substances of concern are phasing out as the Fantastic Plastic Directive is the new norm for plastics. Win-win situations are achieved across the plastic network in the pilot projects, phasing-out completely the former linear traditional economy. The province of Zuid-Holland thrives in an integral approach to plastics and in applying cutting-edge innovation, thanks to its well-connected location, infrastructure and sectors. It plays a key role in pioneering and becoming a circular plastics hotspot for the Netherlands and Europe.

Main strategy

The strategy develops towards milestones to be achieved by the pilot projects - namely the Fantastic Plastic hubs, parks and port. These spatial interventions are like catalysers for the change that will spread in Zuid-Holland on locations that share the same base conditions - going further in the Netherlands and Europe. Each pilot project articulates the framework for a future with plastics by collectively closing the loop.

The pilot projects are test-bed locations for clearer, practical and more effective policies. They are places to connect waste to resource management systems/streams. They stimulate cutting-edge knowledge and innovation. It is a place to empower sector leaders to push forward a shared vision that promotes circularity principles and see the structural change bringing new life to spaces in and out of the city that need to realise sustainable futures.

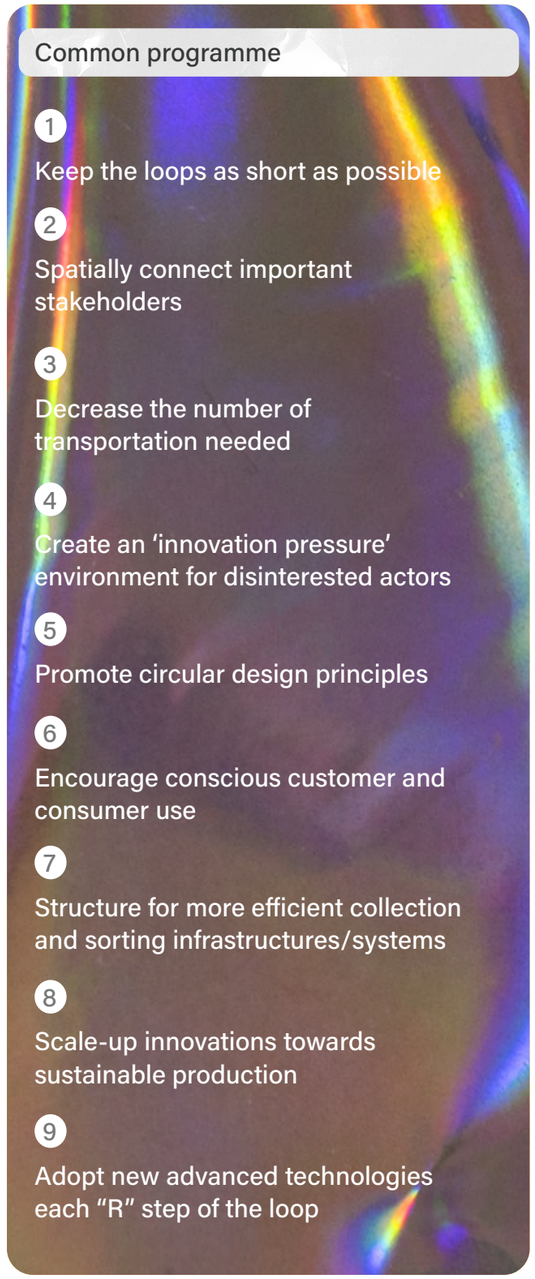
Pilot projects

The pilot projects are envisioned to be realised in current spatial conditions and also future trends identified from the urban centres to the port in Zuid-Holland. Potential locations are identified and proposed to pioneer and realise the project for a sustainable future with plastics.

For the Fantastic Plastic Hub there is a primary distinction in centre and industrial. In city centres, the hubs can initiate in underused locations like vacant office buildings and former industrial areas as well as tap into trends that are already happening and accelerate them, like the zero-waste businesses model transition already happening with supermarkets.

In the Fantastic Plastic Parks, it identifies the distribution centres of supermarkets and the logistic parks in the region. It understands the current conditions that formed them and aims to take advantage of the trend, enhancing the network and proposing new spatial qualities, changing the landscape in those peri-urban areas.

The Fantastic Plastic Port starts at the Botlek area of the Port of Rotterdam. Because of its location and with its many tank storages, chemical sector and the ongoing Plant One activity, it is the location to drive the transition towards carbon neutrality with a new plastics economy and spatial qualities in the Port area.



“If we don’t change the way we produce and use plastics, there will be more plastics than fish in the ocean by 2050”

European Commisson first vice-president Frans Timmermans

Phasing overview

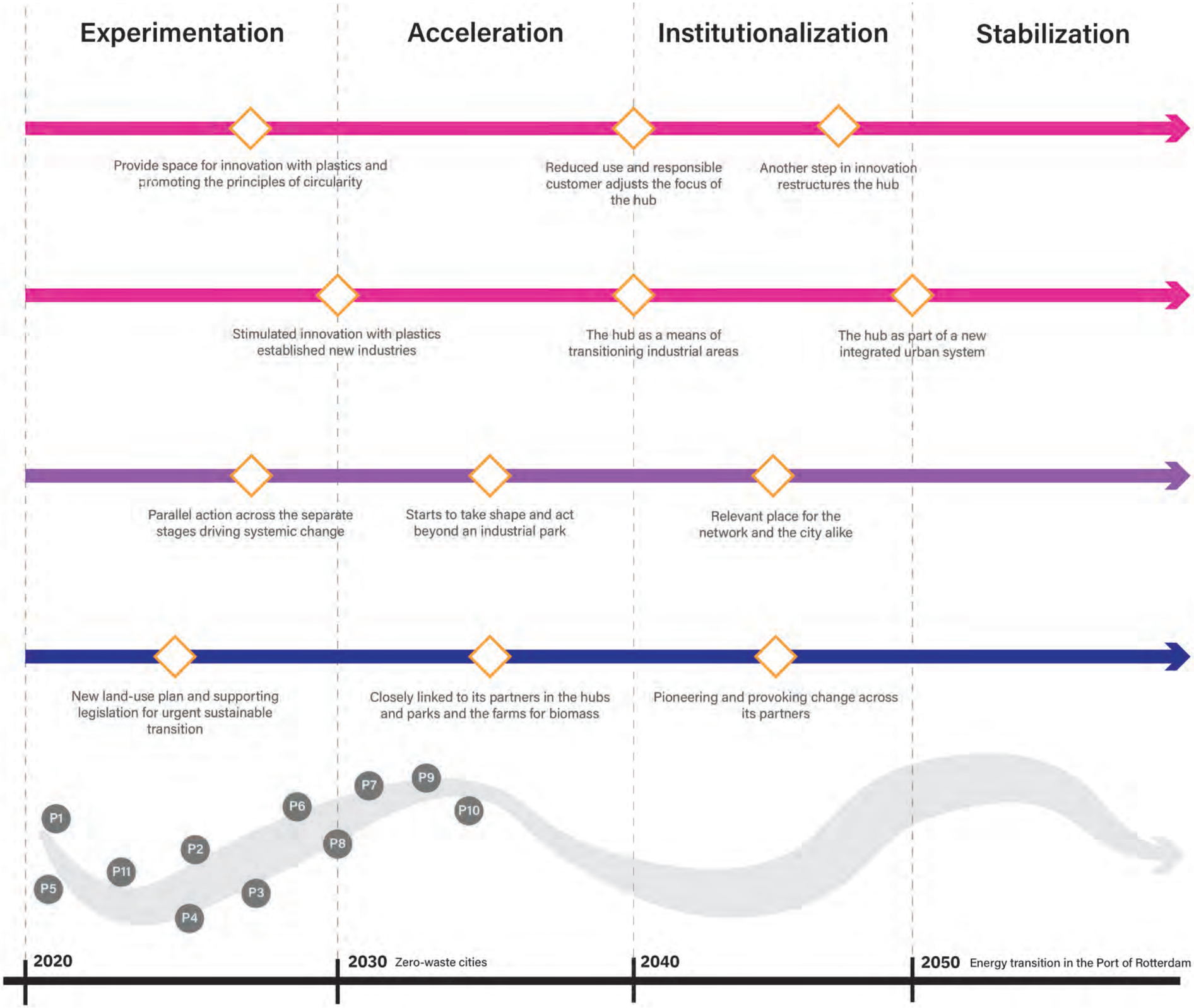


Figure 30

Phasing overview

Accompanying policies

	P1	P2	P3	P4	P5	P6	P7	P8
policy	Packaging background information	Expanding plastic deposit system	Polluter pays	Enhancing plastic production transition	Zoning permits mixed function areas	Responsible plastics	Responsible companies	Waste sorting
about	Obligating producers to provide insides about the product and its packaging. Where it comes from, what it is made of why this type is applicable.	Deposit system for plastic bottles is extended to various types of plastics.	Waste treatment costs are imposed on each polluter based on the amount of waste that is generated.	Financial incentives are present to plastic industries who want to shift and other parties who want to realise sustainable plastic recycling plants.	Zoning permits are used to view if permit holders contribute to the mixed functions of the area.	Illuminating hazardous plastics; only allowing production and consumption of plastics which are either recyclable and/or compostable.	Providing new permits only to companies (in the plastic cycle) who live up the specified sustainability and/or circularity criteria.	Companies need to properly sort out their waste among which are plastics, otherwise they get a punishment (e.g. a fine).
scale	Pilots can be done by one or more companies, and displayed on hub level. Ideally on larger scale to have a large impact, but firstly on national scale to show the effect.	Pilot on neighbourhood scale. Ideally on national and scale to have a large impact.	Pilots can be done by one or more companies, displayed on hub level. Ideally on national and European scale to have a large impact.	Pilot in the Port of Rotterdam. Followed by other industrial areas.	Permits relate to the local scale, but governed by municipalities. Pilots run at all fantastic plastic projects, starting with hub, followed by park and port. Ideally expanding to national scale.	On national level, influencing smaller scales. Future possibility to scale up to European Union.	First pilot can take place in the Hub, as it has lower effort. Followed by pilots in the park and port. Ideally scale up to provincial and national level.	Pilot in Port of Rotterdam. Ideally scale up to the Netherlands and the European Union.
project	Fantastic Plastic Hubs	Fantastic Plastic Hubs	Fantastic Plastic Hubs	Fantastic Plastic Port				Fantastic Plastic Port
start	Pilot in 2022-2025 2025-2030 scale up	Pilot in 2022-2025 2025 scale up	Pilot in 2025 2025-2030 scale	Pilot in 2025 2025-2030 scale	Pilots from 2025 onwards, 2030 scale up	From 2030 onwards	Hub in 2025-2030 Park & Port in 2030 2030-35 other areas	Pilot in 2030 2030-2035 scale up
effect	Improves awareness of consumer and increases the transparancy of the product and packaging.	More plastic products can be reused. Therefore, less plastic waste is generated and a smaller amount of new plastics are demanded. Hence, a smaller flow of resources comes into these plants.	Extended producers responsibility. Total amount of waste will probably decrease, increase in separated waste streams as they are less heavily charged.	This provides opportunities to transition from traditional to bio-plastics.	Areas will be more mixed and functions do not become isolated. People are connected to different elements and regain the connection with cycles they interfere with. This improves responsible behaviour.	Extended producer responsibility. The amount of hazardous plastics will reduce, therefore the negative effects on the environment and in other parts of the cycle decrease.	Positive driver for stakeholders acting circular. Increases amount of responsible stakeholders, decreases non-responsible ones. Boosts an area as responsible and attractive to customers.	Provides opportunities to upcycle high in the R strategy. Decreases amount of non-usable waste. Keep effects of waste/product close to consumption, extended producers responsibility.
possible downside	Insights could show incorrect ‘facts’, e.g. to downgrade negative effects.	It might not be used enough to make it economically feasible.	Companies might move to other areas where they do not have these restrictions.	Feedstock is used for bioplastics instead of food, possible effects on food market and safety.	Over time it might be difficult to have a balance of different actors.	The move to less sustainable packaging material.	Companies might not show their entire impact cycle.	Competition with neighbouring regions who do not have these rules.

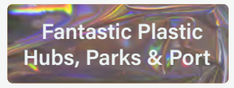
	P9	P10	P11
policy	**Local responsible waste handling**	**Local responsible plastic production**	**Develop quality measures**
about	Waste must be handled within a certain radius of the user.	Plastics should be produced within a certain radius around the user.	Develop labelling, standardisation, certification, and regulatory measures. Include guidelines to be updated based on the latest market developments.
scale	Pilot in Port of Rotterdam. Ideally scale up to the province, Netherlands and the European Union.	Pilot in the port of Rotterdam, expanding to other industrial areas. Future possibility to scale up to the Netherlands and the European Union.	Develop in synergy between staekholders in every pilot project. Ideally scale up to the province, Netherlands and the European Union.
project	Fantastic Plastic Port	Fantastic Plastic Port	
start	Pilot in 2030-2035 2035 scale up	Pilot in 2030-2035 2035 scale up	Pilot in 2030-2035 keep updating
effect	Extended producer responsibility. The waste resources are handled on a smaller scale, therefore taking responsibility for it according to local regulation. Over time the radius can decrease to a regional scale.	nhance local transition, local economy and self reliance. Decrease of importing (and possibly exporting) logistics. And provides more transparency in the cycle.	Fantastic Plastic Directive to be legally binding and possible of legal updates.
possible downside	Could decrease efficiency if it needs to stay within smaller radius. Local handling could be more costly.	Local production could be more costly.	If the plastic network is not strong enough it could not become efficient.

Table 2
Policies

Fantastic Plastic Directive

To improve the quality of plastics circulating in Zuid-Holland, and then in the Netherlands. This directive provides quality grades (acceptance criteria, safety, percentages of plastics in a mixed material and relevant material properties) given to plastics so that the streams can be better directed to the hubs, parks or port. It counts on innovation on technologies that can provide accurate traceability, type and plastic percentages and verification measures on the origin, processing, and more, of secondary raw materials. It will facilitate the development of a market where they are used in a range of high-value applications, such as textiles and packaging. This clear definition contributes to municipalities zero waste targets as well as national recycling targets. Currently, the quality standards are insufficient to provide the necessary clarity for different product categories that stream plastics on every stage of the loop to a process in the framework for a future with plastics. This aims to solve one of the main current sorrows, that high-quality food-grade plastic material is downscaled to low-grade applications.

P4

It is well know that advanced recycling technologies can reduce GHG emissions - by up to 50% in the EU when compared with incineration. Creating co-funding opportunities to scale advanced technologies for the chemical conversion of biomass and complex plastic waste to reduce GHG emissions. And stimulate the competitiveness of sustainable action by rewarding reductions in GHG emissions across the value chain. This reward aims to foster a strong plastic network with circularity principles.

Future systems

Spatial interventions driving the future

The spatial changes work in synergy with the better integrated plastic network and the plastics circular economy. The reduction in the need for plastics and the innovation towards shorter loops will provoke drastic change in the quantity of flows from place to place in the urban areas. At the same time, spatial intervention and new functions will transform each one of these spatilities with new facilities for the use of all relevant stakeholders according to their - transitioned - agendas.

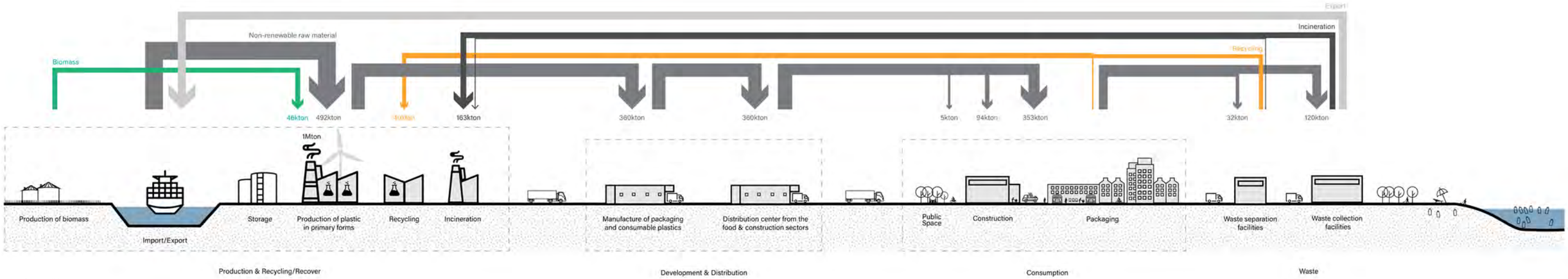


Figure 31

Current systemic section

Source: Circulaire Indicatoren - Een verkenning voor de provincie Zuid-Holland (Metabolic, 2018)

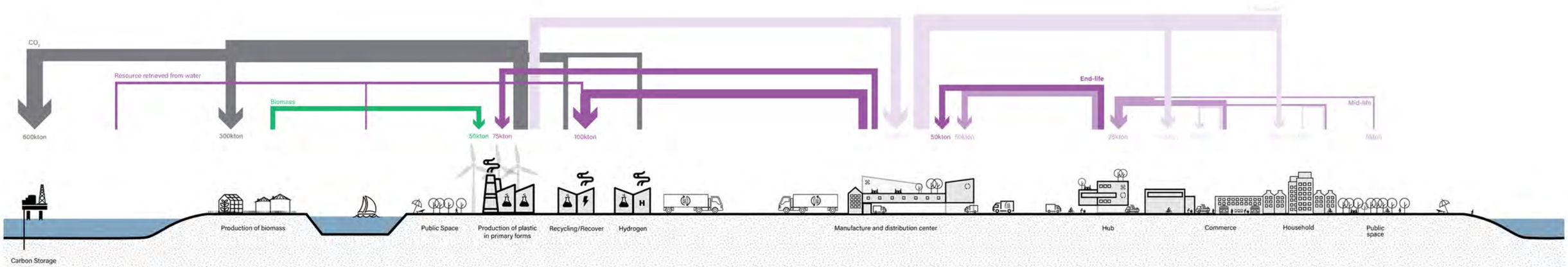


Figure 32

Proposed systemic section

The Fantastic Plastic Circular flows

The resources flows are transformed and adjusted according to the outcomes of the circularity analysis. Hence, problematic flows are illuminated, these have disappeared due to the reduction of demand or are replaced by opportunity flows.

Starting with the incoming flows, all energy used in the process is generated in a renewable manner. Moreover, plastics are only made from biomass, enhancing the biological cycle, or from recycled plastics (both bio- and oil based plastics). In addition, CO2 emissions will not be emitted into the air, as they are distributed to greenhouses and remaining emissions will be stored through subground capture possibly in the North-Sea.

Regarding the distribution of plastics, more sustainable transport is present. Transportation will become CO2 neutral, either through electric or hydrogen powered vehicles.

With regards to plastic products after consumption, many will be reused and repurposed and will hence have a shorter loop. Plastics to which this is not applicable will then be recycled, according to the recycling method that is most suitable to the type and state of plastics according to the 10R strategy. The recycled resources will flow back into the production and become new resources for new products.

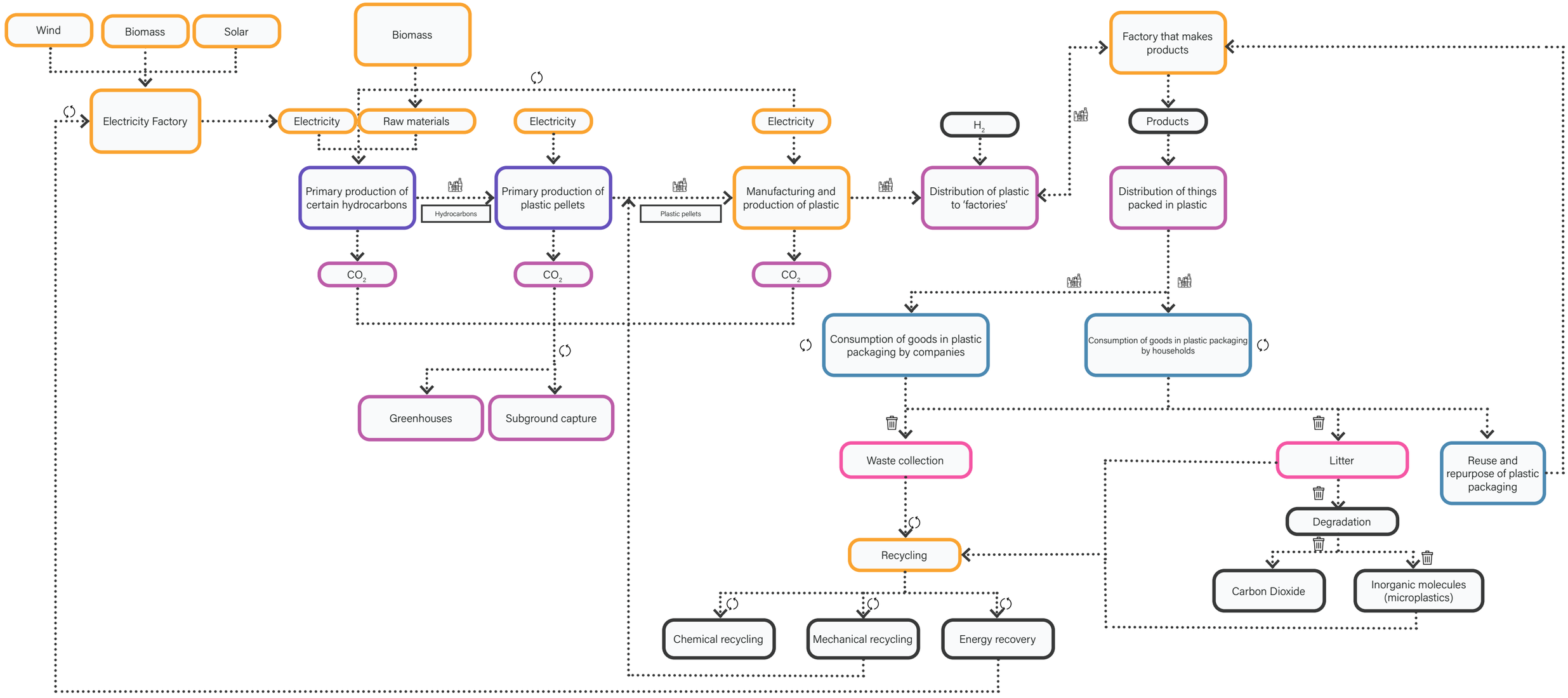


Figure 33

Proposed circular flows

Future plastic network

In the future plastic network, cooperation and responsibility is visible in the approach of each stakeholder and it is more benefitting to be in the Fantastic Plastic circular economy than out of it. The Fantastic Plastic Directive is used and improved by the synergy between the actors and the market-based demands.

For an integrated approach and framework it is key to understand the role and how the actors can benefit from each other:

People
It is important to provoke a responsibility shift towards the population to understand its role as a partner. The people are key to improve the quality and efficiency of collection and sorting and also to refuse and demand reuse-repair-recycle change.

Business sector (use)
The whole business network should shift their material sources and develop a holistic approach that sees the entire loop of products they use, looking beyond their own position and processes.

Manufacturer sector (convert)
The manufacturers should make it their responsibility to develop innovations using a a holistic approach that sees the entire loop of products they create, looking beyond their own position and processes.

Waste sector (collect, sorting, recycling)
Shift towards quality without losing quantity. Their transportation is eased by the spatial interventions and they use the Fantastic Plastic Directive efficiently during their collection and sorting phases to prevent the downcycling of plastics.

Chemical sector (producer)
Accelerating the use of end-life plastics waste as feedstock and cooperating within the hubs, parks and port towards innovative recovery and recycling methods.

Societal and NGO's, trade & industry associations and partnerships
They can ensure that the transition to a circular economy and the necessary solutions become a priority for governments, politicians, knowledge institutions and the business community. They can also provide neutral and independent fora for cooperation to develop and facilitate impactful, innovative solutions. The Port of Rotterdam plays a crucial role in facilitating the transition in the Botlek area.

Academics & Experts
They are essential to initiating new research, collecting and creating new knowledge and insights, and developing a strong knowledge base from which new solutions can emerge.

Legislators
They can support the transition towards a circular economy by developing enabling legal frameworks and creating effective incentives to accelerate change.

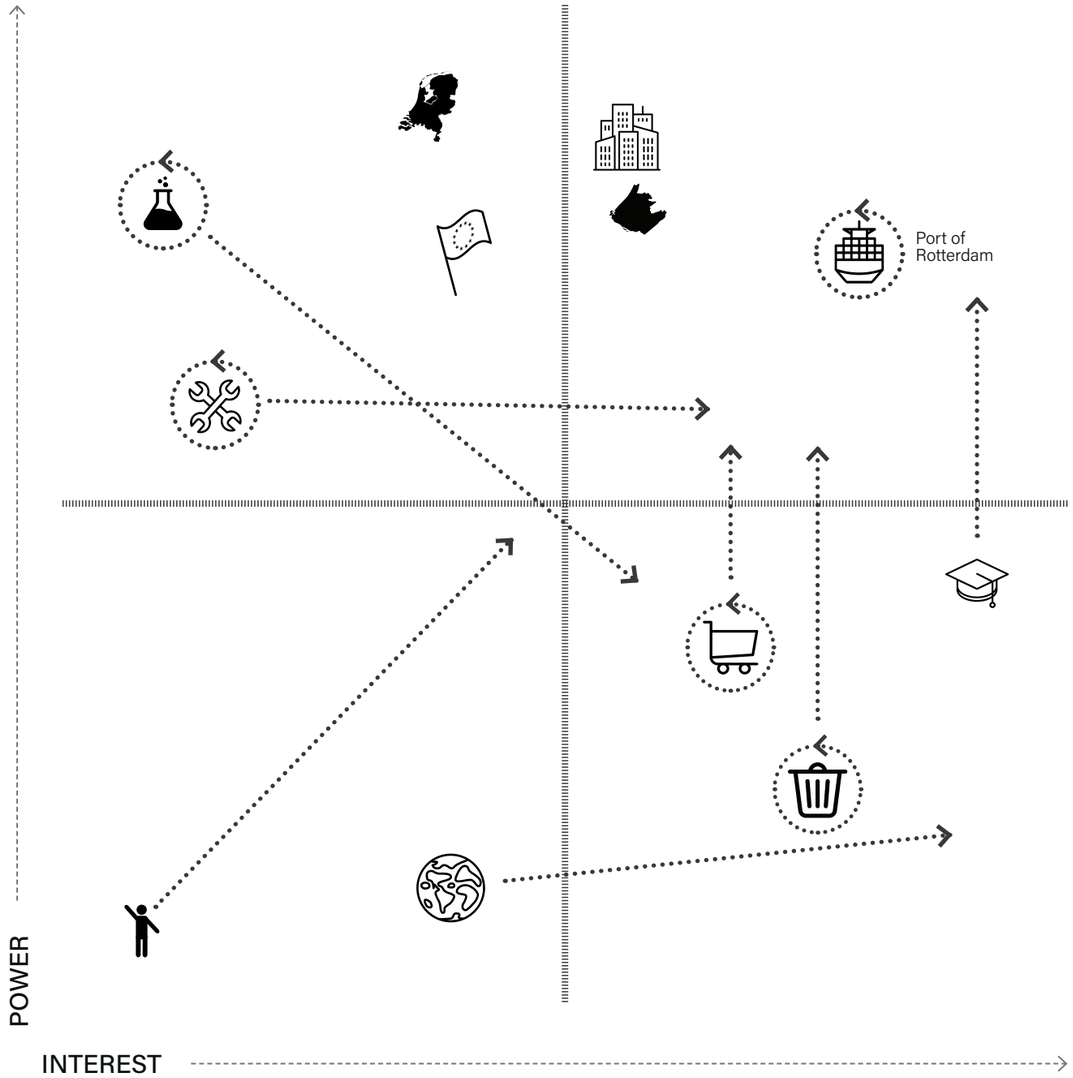


Figure 34

The stakeholder analysis shows the current and future position of the sectors. Our framework aims to increase partnership and cooperation with sectors through their transition to circularity.

Transition to circular model

Typologies

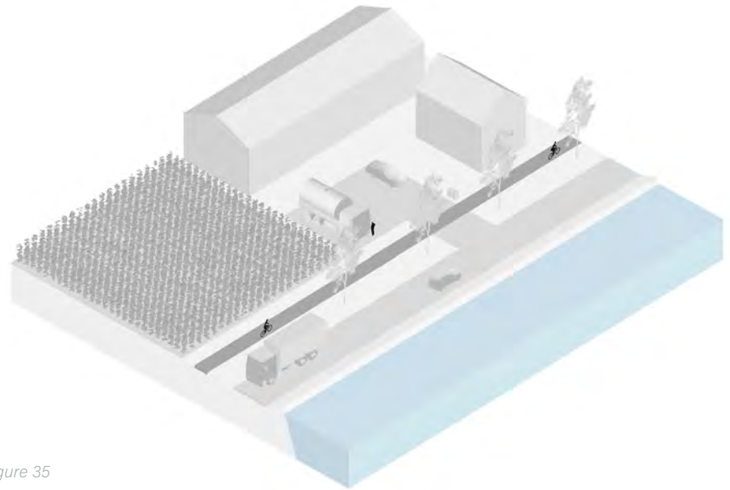


Figure 35

Current situation

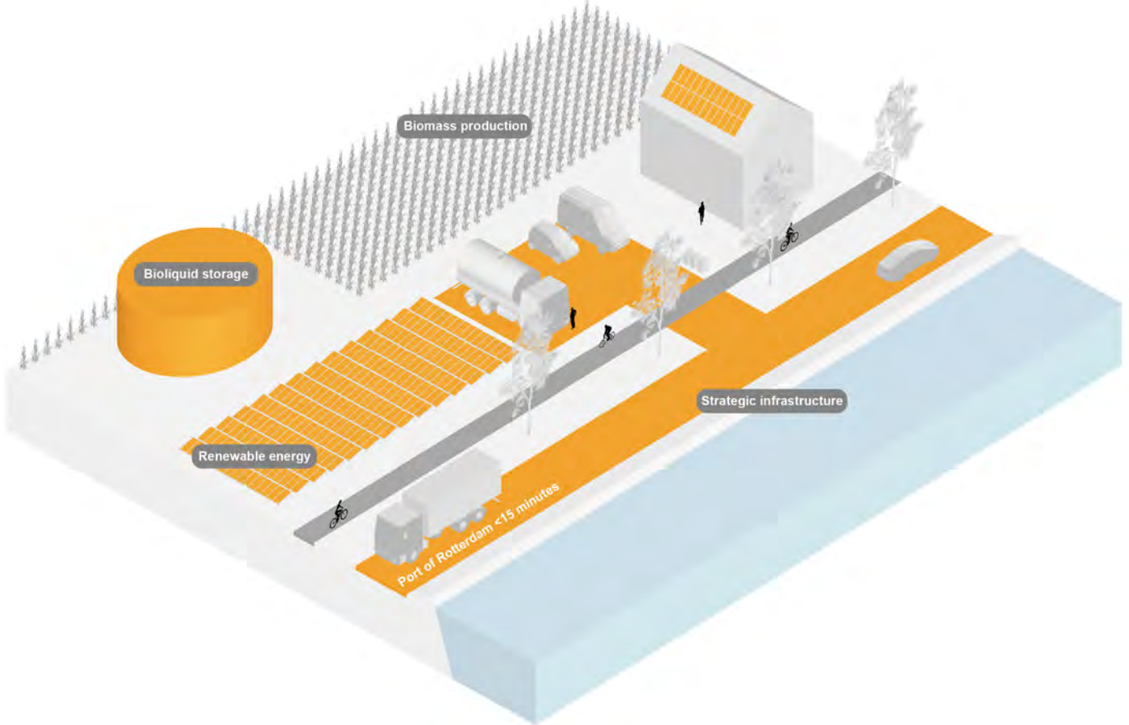


Figure 36

Proposed situation

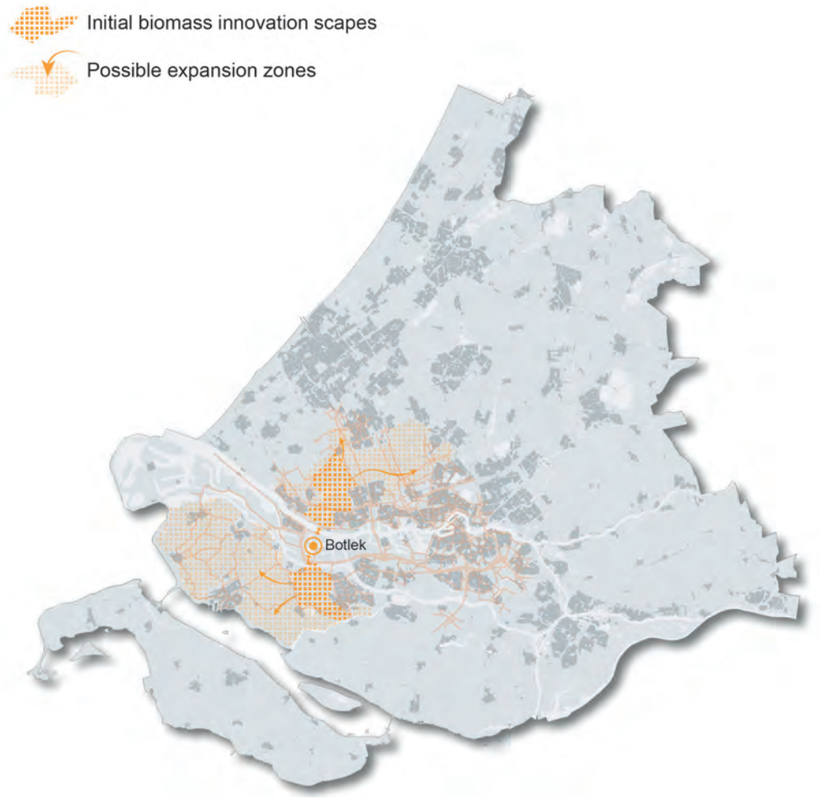


Figure 37

Envisioned locations for biomass farms

Biomass farms

Zuid-Holland is predominantly covered in agricultural land. The most important produce is related to agri-food - after all, supplying the population with enough food has been imperative for a long time. Nevertheless, the future will hold new systems. A transition towards circular models in any industry will entail the input of renewable material flows. This means that more and more land area must be used to produce raw materials like biomass. The biomass farm is the new typology that starts to conquer available land area in Zuid-Holland. Typically, it can resemble conventional farms we see in the province currently. However, a transition to CO2-neutral must occur, and therefore renewable energy is the norm. Instead of silos (for crops) or barns (for cattle) large tanks are used as storage for products like biofuels or liquids that are extracted for the production of bioplastics. Transport emissions are combatted through the use of green vehicles (electric or hydrogen) and limiting travel distance through strategic positioning.

Location criteria

These farms are allocated within areas that are strategically close to production facilities. With the focus being kept on the Port of Rotterdam as a site for industry, this means that most of these farms should arise near the port area. Specifically, land has been selected that is prone to transition due to current trends. An example of this is the likely decrease in cattle farming, opening up the ability to incentivize farmers to transition to biomass.

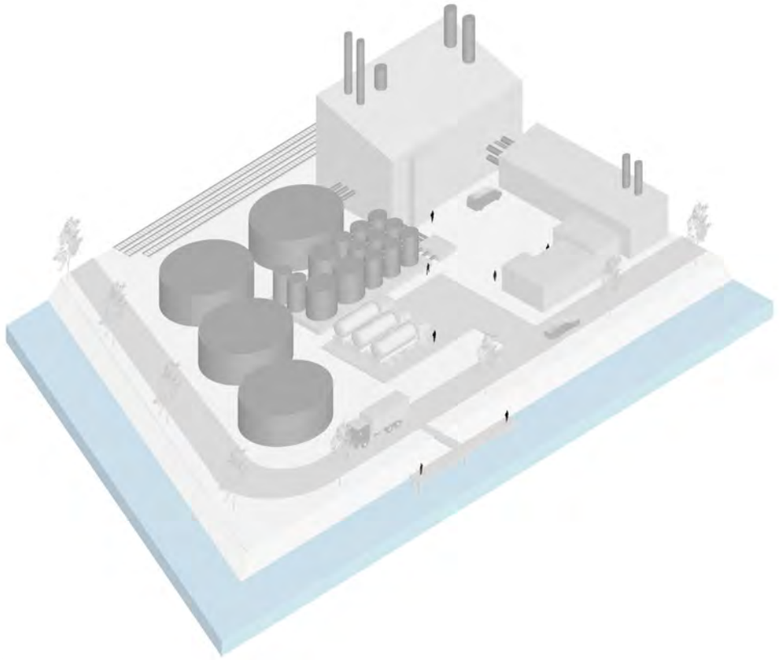


Figure 38

Current situation

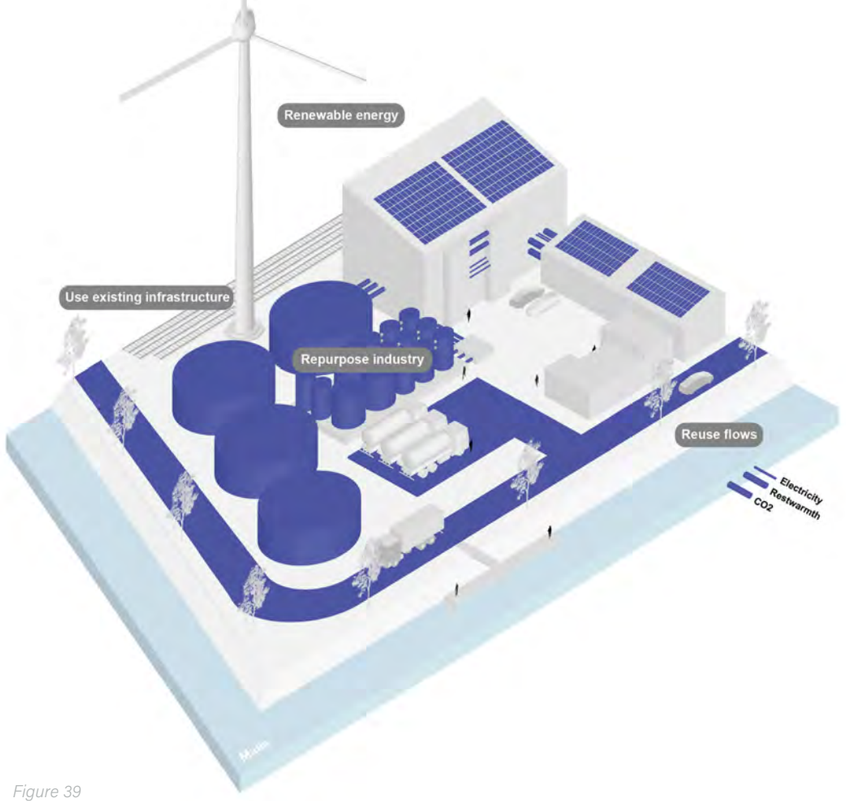


Figure 39

Proposed situation

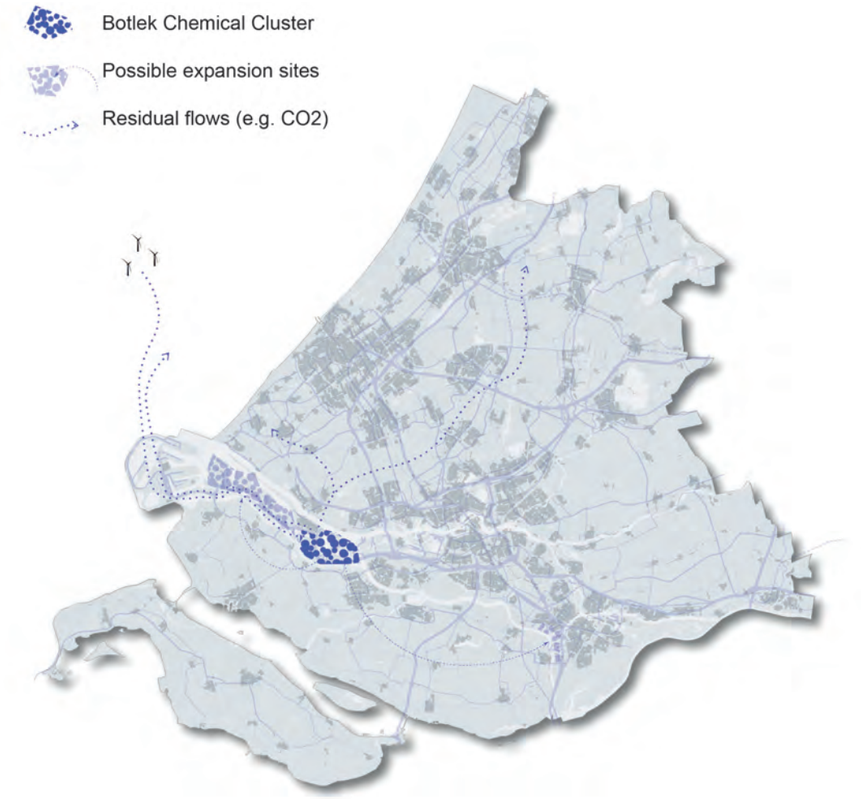


Figure 40

Envisioned locations for sustainable industrial plants

Sustainable industrial plants

The ports of Rotterdam and the Drechtsteden are full of industry. Unfortunately, its industry is currently mainly based on non-renewables and is in general simply not sustainable. If these ports were to maintain their strong economic position during the transition away from fossil fuels, all of its industry must transition as well. Future industrial systems take advantage of the strong position of the port and its infrastructure, and build upon this to stay relevant. A shift to renewable energy is important, as well as the potential interchange of flows like restwarmth and CO2. In this way, the port and its industry can work together with urban areas and increase the efficiency of energy use.

Location criteria

The largest scaled industry might only be able to exist in industrial areas outside the city. This can have several reasons - for example, the scale of the industry, the size of the outgoing flows, or the environmental impact in line with the milieucategorie. For these future industries, the Port of Rotterdam can become a vital nesting place. Specifically, the Botlek area will be designated for these industrial sites. This area has been chosen because it already harbors significant industrial functions that are bound to transition in the coming decades, that it has a strategic infrastructural position, and that it will likely remain a relevant port area whilst current port sites to the east are more closely located near Rotterdam - and might be transformed into mixed functional areas in the near future.

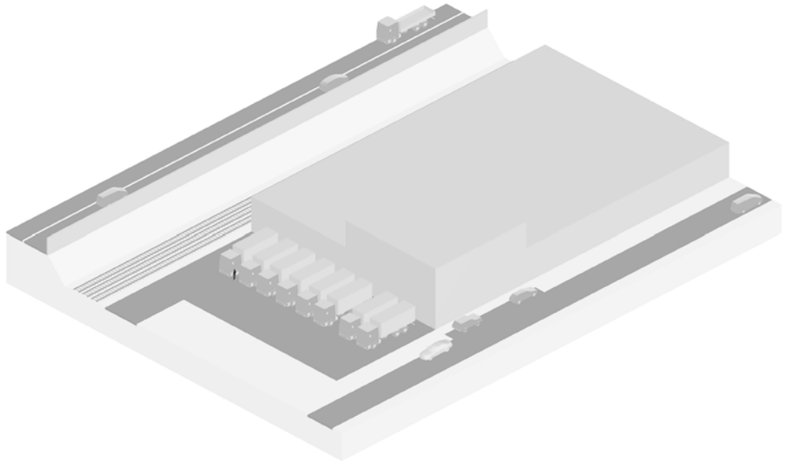


Figure 41

Current situation

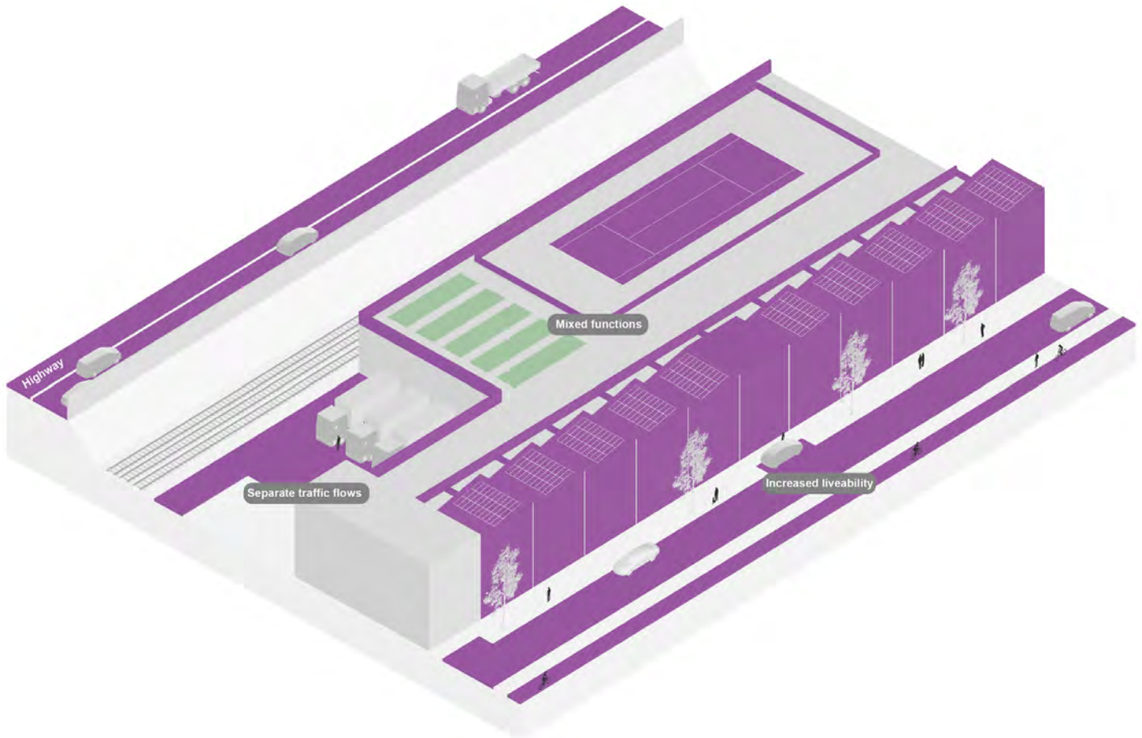


Figure 42

Proposed situation

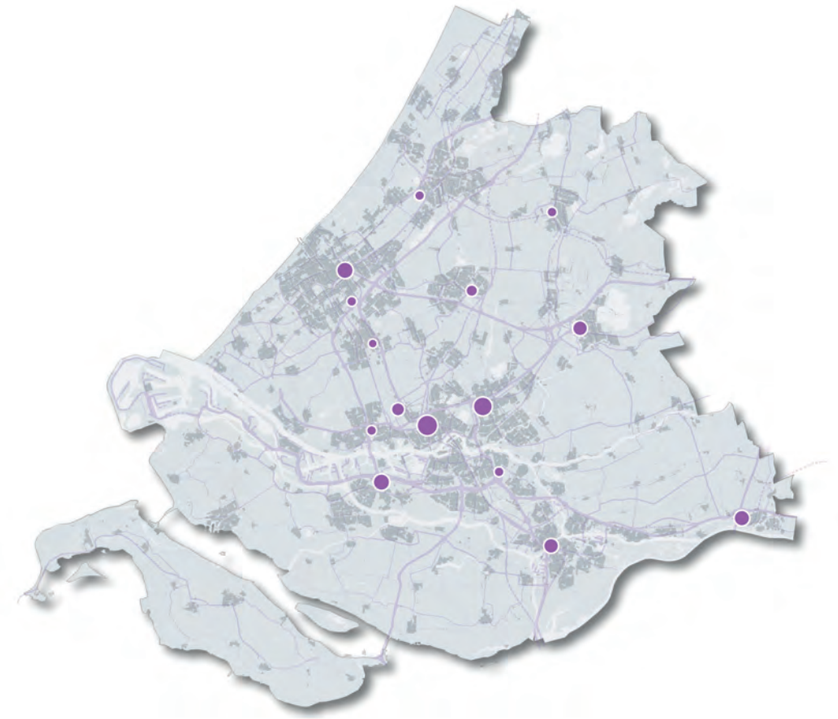


Figure 43

Envisioned locations for plastic distribution parks

Plastic distribution parks

The plastic distribution park is a new way of looking into evergrowing distribution necessities. Currently, more and more open countryside areas have become prone to 'boxification': the phenomenon of establishing large scale distribution centers in rural areas. This should be limited, and the focus should shift to giving more sociospatial relevance to these structures. This means that however large they are, functional mixes occur around and on top of them, making them a part of the integrated urban fabric.

Location criteria

These plastic parks should be very strategically placed to minimize distribution flows. All of them are deemed to become part of the urban fabric. Therefore, they do not simply have an infrastructurally strategic position: they also allow for transformation of the area in line with the spatial goals of the city or municipality they are in.

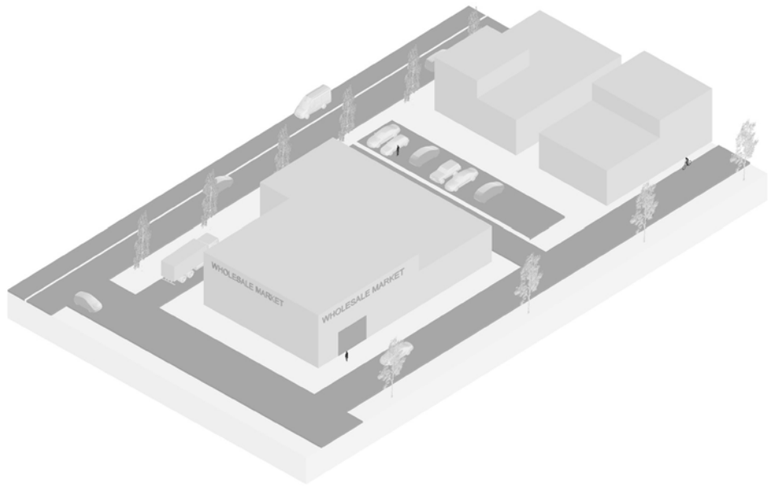


Figure 44

Current situation

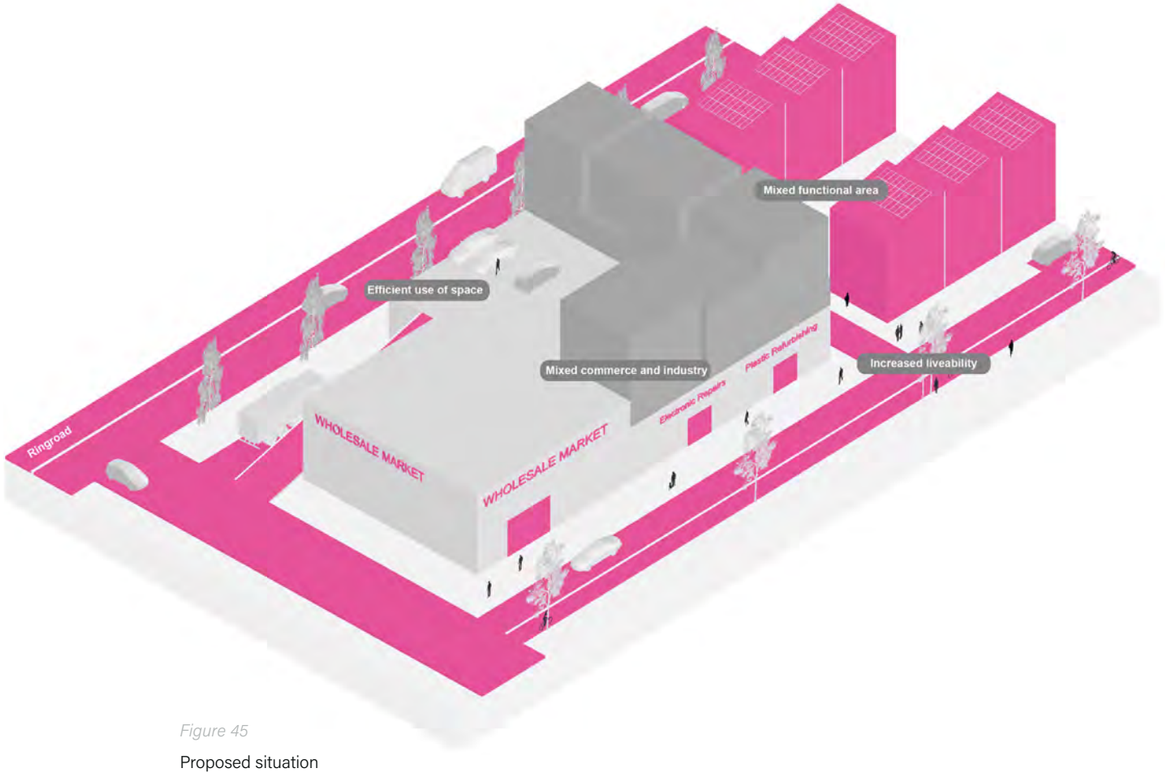


Figure 45

Proposed situation

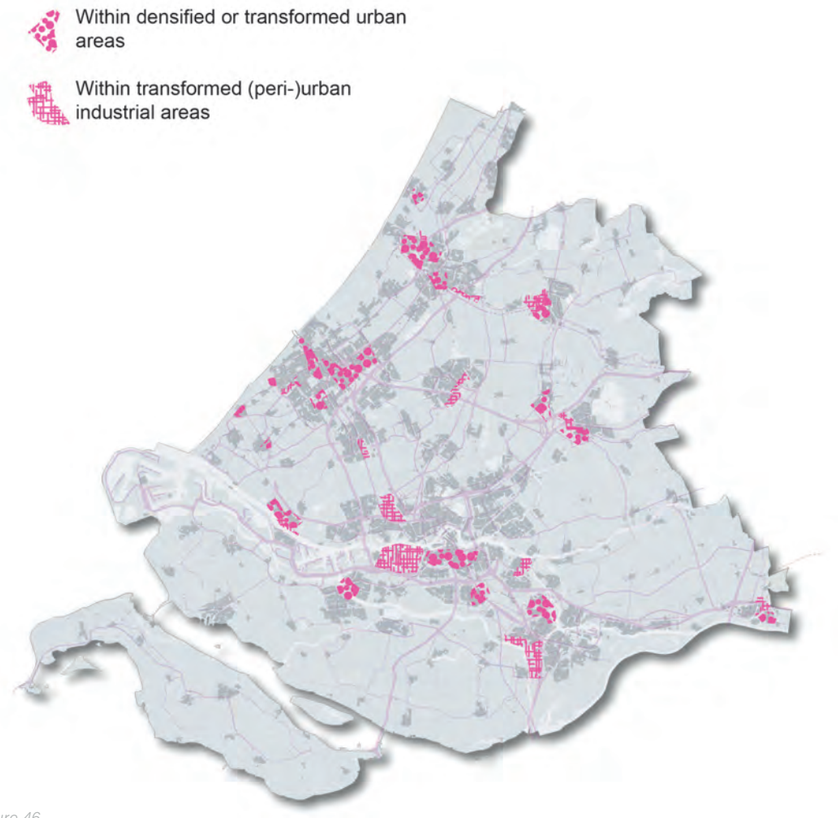


Figure 46

Envisioned locations for mixed functional hubs

Mixed functional hubs

The hub seeks to introduce a new scale level that reduces the flows between the consumer and distributor. The hub taps into the needed transformation of urban and peri-urban areas like aging industrial terrains by forming newly mixed functional areas. In these areas, the focus is put on mixing residentiality, industry and commerce among others. This does not only increase the liveability of these areas, but also reduces material flows and increases awareness, as consumer and producer are brought together.

Location criteria

The hub forms the place to bring together commercial, industrial and residential functions. Urban and peri-urban areas that show the infrastructural benefits and are in demand of transformation can be designated to become hubs. Strategically, the first areas to transform should be the ones that have a strong basis for transformation (growing vacancies, declining quality etc.) and have the best demographics to support it (housing need, available workforce etc.).

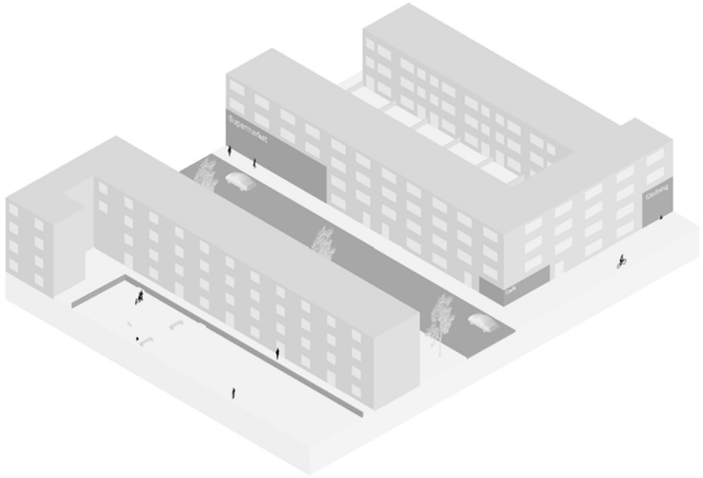


Figure 47

Current situation

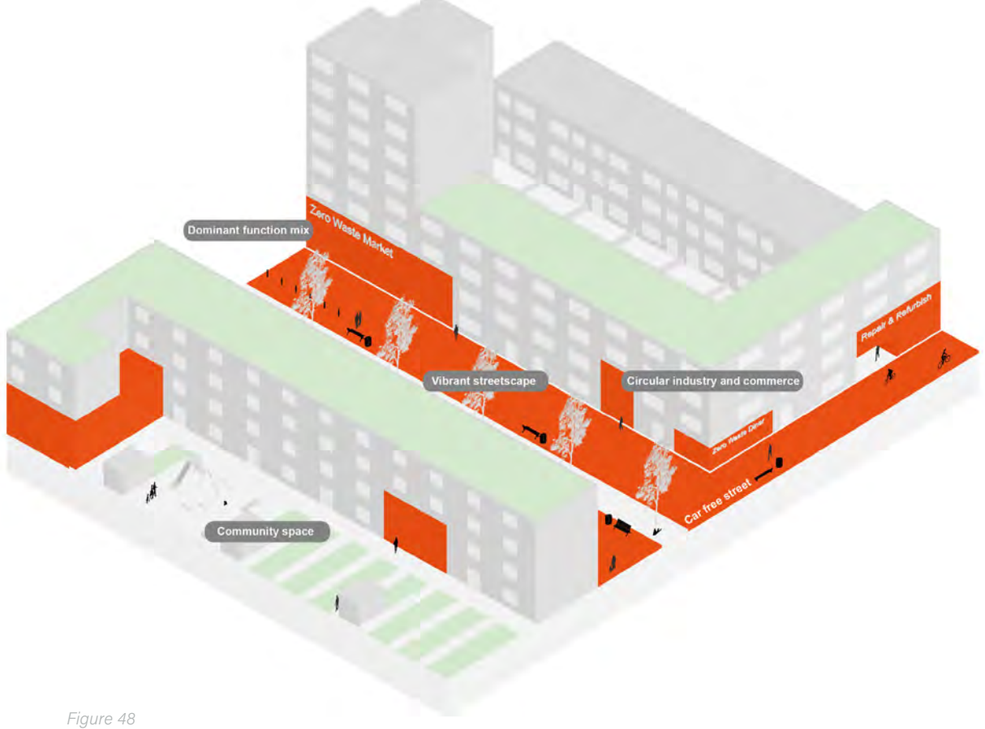


Figure 48

Proposed situation

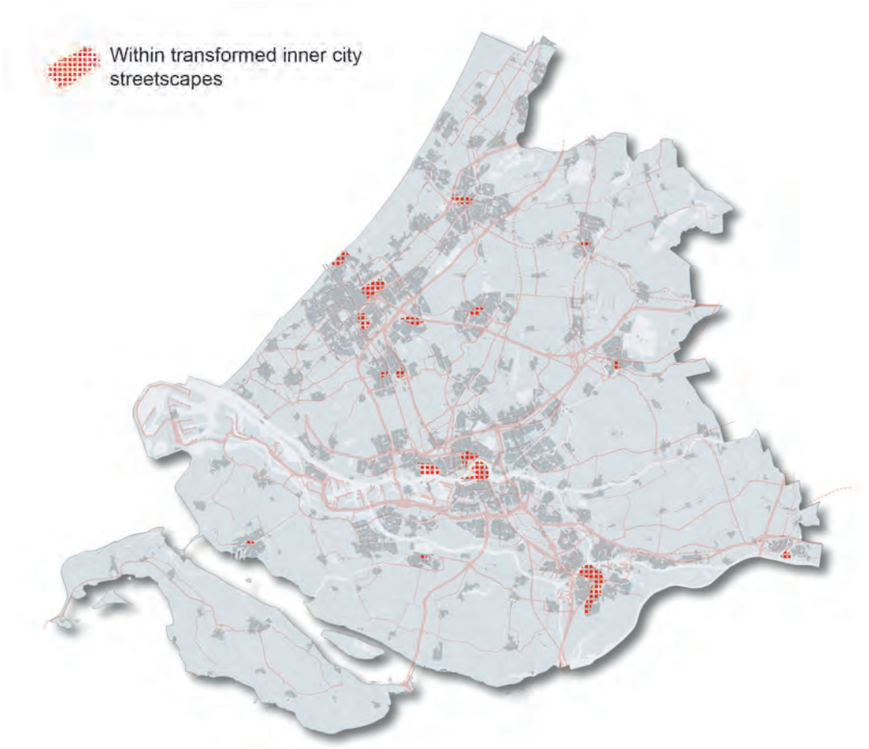


Figure 49

Envisioned locations for mixed streetscapes

Mixed streetscapes

The mixed streetscape shows a transition on one of the smallest scale levels. It is meant to portray streetscapes that have been conventionally popular and attractive, but need to transition along with upcoming trends and shifts in living. Take for example the growth in vacancy due to the disappearance of conventional shops and office needs. These must be combatted to keep these streetscapes properly liveable. Futureproof mixed streetscapes contain liveable public space (e.g. car free streets, community space), new interactive building functions (e.g. shared spaces or room for entertainment and educational functions) and in general, new circular means of commerce and industry (e.g. zero-waste supermarkets and circular industries).

Location criteria

The mixed streetscape resembles many inner city streetscapes we already know today. Ideally, there will be no problem in gradually transforming these areas to make them future proof. To test for this transition however, it is wise to use a step-by-step approach, in which upscaling happens from pilot projects towards full scale implementation. The locations to start with this can then be decided through research on the current (decay in) quality of streetscapes to determine which ones are prone to transformation, and into demographic aspects to determine which ones might have the most public demand for transformation.

4

Spatial interventions future lifestyle with plastics

Pilot projects

Based on the general analysis and our vision for 2050, four spatial interventions are being suggested to transform the plastic chain into the plastic network. These four interventions are: the HUB center, the HUB industry, the Park and the Port. Each of these pilots are placed at a specific location in the province of Zuid-Holland, where the pilot can be tested and when proved to be a success, can move to other suitable places.

As introduced before, vacant spaces are a growing problem for cities. In 2019 3.3 million square meters of office spaces and 2.6 million square meters of shops were vacant in the Netherlands (CBS, 2019). Specifically the agglomeration Den Haag has a high percentage of vacant offices and shops. Where the general average vacancy is 6,3 for offices and 5,8 percent for shops, Den Haag has more than 8,0% of vacant offices and between 6-8% of vacant shops (CBS, 2019). Therefore the center of Den Haag was selected as the favourable place to start the pilot project of the HUB center.

For the HUB industry a thorough analysis was made of current industrial areas and business parks that would be suitable for transformation. The location of Rotterdam Noord-West was in the end selected to be the location for the first pilot project, first of all because of the possible connection with the Port (Botlek) area and the relatively closeness to the city center.

Currently a cluster of chemical companies is located at the Botlek harbor, including innovative companies like plant one (LISA, 2018). Because of this the Botlek harbour seemed most suitable for the Fantastic Plastic Port. The cluster of chemical companies can be used to strengthen and reinforce the new circulair plastic industry.

Boxification is becoming more and more problematic over the past couple years, especially the XXL distribution centers (Logistiek, 2020). Distribution centers are common in the province of Zuid-Holland. Since this report mainly focuses on plastic packaging, a distribution center that had multiple connections with the food and thereby package industry was picked. Multiple supermarkets had their distribution centers at Waddinxveen and therefore this area was selected.

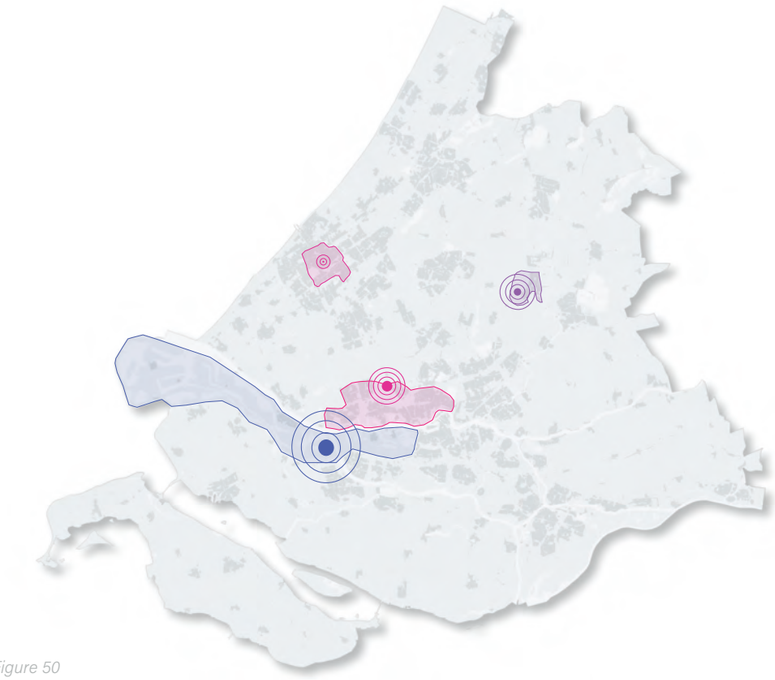


Figure 50

Location for proposed first pilot projects

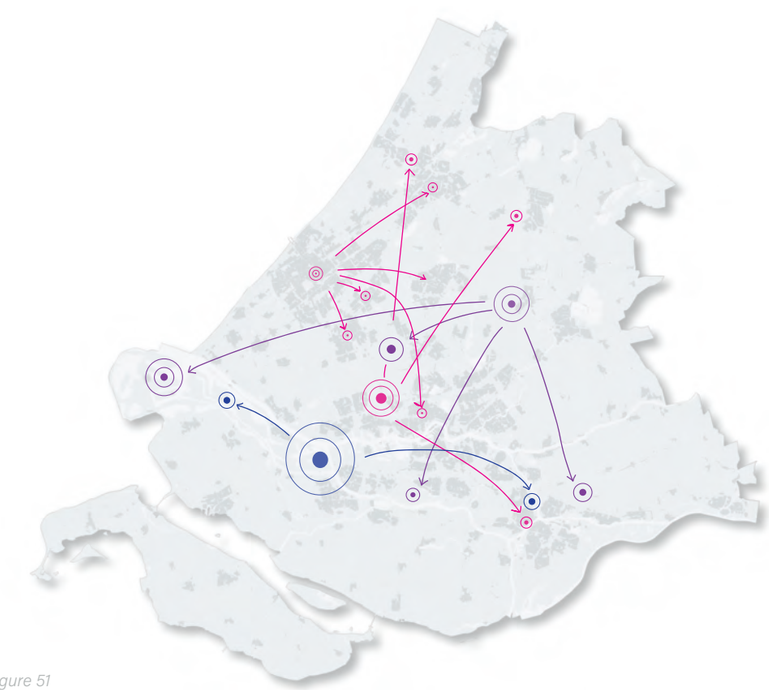


Figure 51

Expansion for proposed first pilot projects

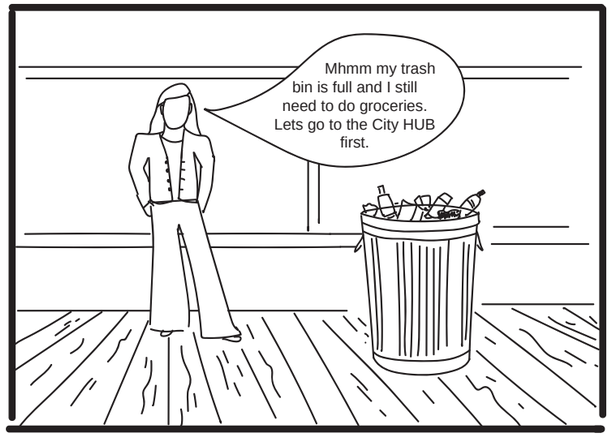
FANTASTIC PLASTIC
hub | centre

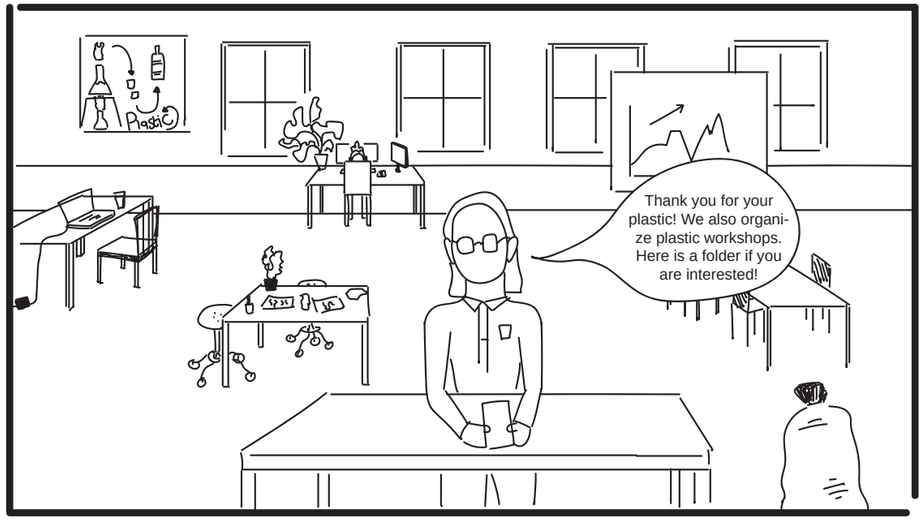
The hub centre is a place in the city center, right outside your doorstep. It is a place where start-ups are located and where you as a citizen can engage in the plastic cycle through workshops, classes and other activities.

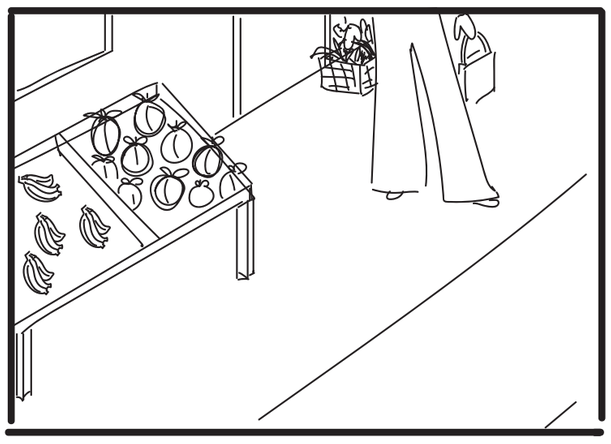
Figure 52

Name: Sigrid Jansen
Age: 43
Occupation: Accounted

Plastic Use 2020: 63 Kg a Year
Plastic Use 2030: 10 Kg a Year







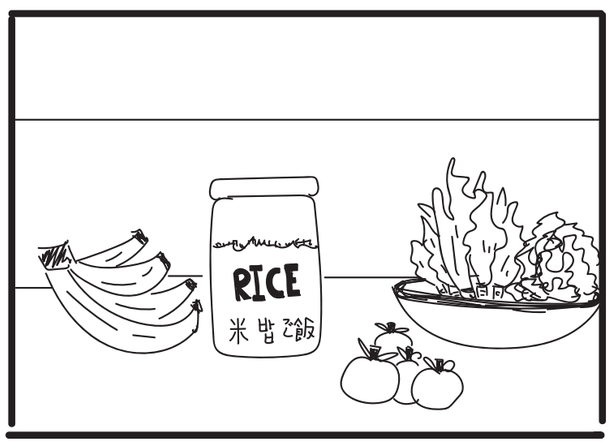


Figure 53

A new lifestyle with the hub centre

Figure 54

Current situation

A big problem in the current streetscape of big cities is vacancy of shops and offices. Although vacancy is a 'private problem', in many cases it is seen by the government as a social problem because of the loss of prosperity that comes with it. The loss of prosperity usually occurs when the vacancy causes negative external effects, like deterioration or nuisance (Planbureau voor de leefomgeving, 2021). The problem of vacancy and deterioration is also happening in Den Haag, as you can see in image above, where more and more shops become empty (Jansen, 2020). However the existing streetscape is very attractive and therefore has high potential. The streets are mostly accessible for pedestrians only and the building types are diverse and interesting. Adding new functions to these vacant buildings could improve the streetscape and prevent deterioration.

Den Haag is a diverse city with a high mix of function, however there is a problem with vacant premises and the deterioration of these vacant premises.

Figure 55

Current situation

The first pilot starts in a vacant shop, supermarket or other interesting business. Here different start-ups can work, do research, improve existing techniques and produce and sell products on a very small scale.

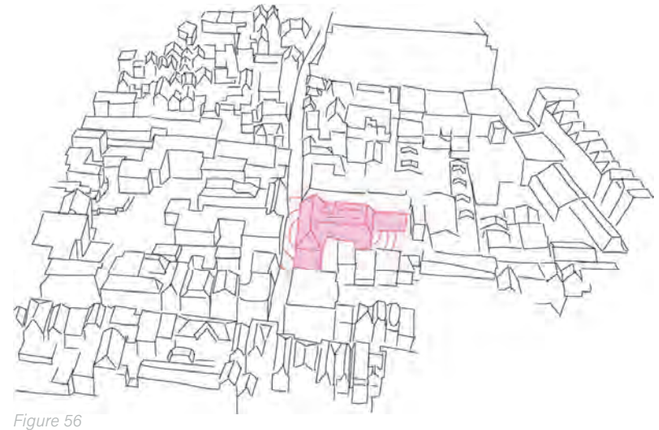


Figure 56

Towards the first milestone

As the pilot success has proved the positive effects, the start-ups spread to other parts of the city. The principle of the Fantastic Plastic HUB is then showcased to other businesses sectors and to the investment of real estate developers.

Figure 57

Towards the second milestone

Figure 58

Towards the third milestone

The Fantastic plastic HUBs and the processes that take place in the HUBs are embedded in the city landscape of all the small and little cities in The Netherlands. New kinds of plastic have been developed and plastic has gained value.

MILESTONE 1

Provide space for innovation with plastics and promoting the principles of circularity

Objective

To have the main stakeholders (waste, commerce, academics & experts, legislators) already working towards a transition to understand the potential of identified locations in the urban city centres to experiment with emerging new technologies that apply to every stage of the plastic loop. An 'innovation pressure' environment creates the background conditions for other actors to join.

Strategy

Announce policies that stimulate the collaboration between academics & experts, business and waste sector so that hubs are initiated. At this phase, the waste sector is a close ally that brings part of their collection and sorting techniques to the city center, so that plastics can be locally used as a resource by the emerging start-ups/companies. Innovation aiming on improving the quality of plastics so they can be used again or in new products are prioritised, as it is a main challenge at the moment.

Actions

- Stakeholder panel discussions: promote the principles and potentials of circularity for businesses. How to transition companies towards a business model that establishes environmentally and socially responsible actions that will make an important contribution to the new plastics economy.
- Align the focus to capture funds from the EU for the new plastics economy.
- Develop innovative technologies to support conscious decision-making: new digital technologies will enable businesses and consumers to track information about a specific product's entire value chain and most adequate processing method. At the same time, make it more appealing so that it enhances the feeling of the participation and ownership to the plastics lifecycle among the people.
- Fantastic Plastic Directive: develop classification criteria to stimulate the reuse and repair of materials in the first place, and support alternative recycle and recovery options that can be locally processed - according to the context possibilities.
- Try-out emerging sorting and collection technologies: improving the quality of sorted waste by introducing more precise quality standards for by-products and clear end-life criteria in the Fantastic Plastic Framework Directive so that resources are staying at the hub or being streamed directly to the Fantastic Plastic Parks.
- Locations for new pilots in the city center (vacant shops, supermarkts & interested businesses)
- Improving quality across the value chain and developing standardised quality grades
- Introduce start-ups from university or HBO

P1	Packaging background information
P2	Expanding plastic deposit system
P3	Polluter pays
P5	Zoning permits mixed function areas
P11	Develop quality measures

MILESTONE 2

Reduced use and responsible customer adjusts the focus of the hub

Objective

To have established cooperation between the main stakeholders replicating to more places and scaling-up their processes, coveting with partnerships to Fantastic Plastic Parks or Port. Disassembly, and thus the sorting and recycling process, is made easier by a better understanding of plastic types and better connected network. On the other hand, people see the hub location and processes as part of the city's landscape.

Strategy

Circular shops (related to the business they are aligned to) are initiated in hubs as a showcase to refuse plastics or to use new plastics aligned with the Fantastic Plastic Directive. Fantastic Plastic workshops display and involve interested people in the circularity process and design of the stakeholders present in the hub (mostly from waste and academics & experts sectors). The hubs that are not thriving are assessed for other methods or partnerships.

Actions

- Improve the network of emerging technologies as proposed innovation with plastics start to scale-up and allure the interest of partners in the Fantastic plastic Parks or Port
- Plastic workshops that engage citizens in plastic cycle (reuse, repair, recycle) and its lowest overall environmental impact
- Stakeholder panel discussions: the Province of Zuid-Holland, in common effort with municipalities, showcase the Fantastic Plastic Hub to other businesses sectors that could be interested and to real estate developers for other sources of investment.
- Fantastic Plastic Directive: in this phase, the certificate/directive is being improved and applied in more and more processes.
- Effective collection and sorting infrastructures: introduce and regulate percentage sorting and collection targets related to the increased mapping of plastics in Zuid-Holland. Set up proper collection infrastructures so plastics can be processed on a large scale. Support transitioning businesses to build their infrastructure systems through the sharing of knowledge between stakeholders and application of innovations from academy & experts.

P6 Responsible plastics

P7 Responsible companies

P8 Waste sorting

P9 Local responsible waste handling

MILESTONE 3

Another step in innovation restructures the hub

Objective

To have a complete new approach to plastic in the urban centres of the province from citizen to businesses - there is a clear stream of plastic resources going from the hub to the park and port and back again in a new shape. The population behaviour towards their excess plastics is to look for a partnership with the hubs in its collection, sorting and innovation pioneering.

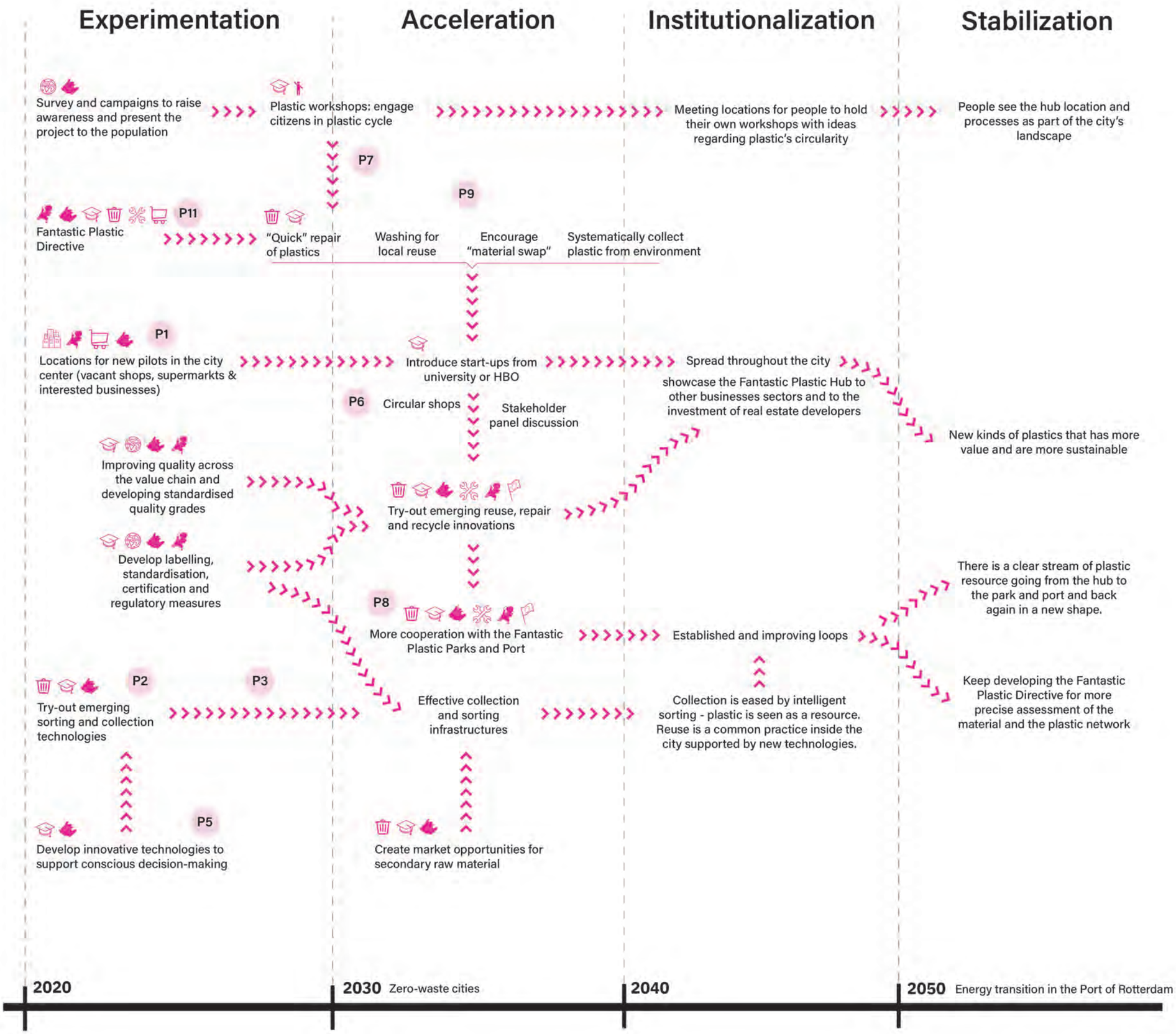
Strategy

Enhance the impact of the Fantastic Plastic Hubs in its surrounding neighbourhood as landmarks of the stabilized plastics economy.

Actions

- More cooperation with the Fantastic Plastic Parks and Port
- As sorting is much better structured, the collection is efficient and a tube connection is created to the nearest Fantastic Plastic Park, where it is stored as a resource. There quantitative high-quality input streams from pre- and post-consumer markets.
- Meeting locations for people to meet and have their own workshops regarding plastic's circularity.
- Collection is eased by intelligent sorting: plastic is seen as a resource. Reuse is a common practice inside the city supported by new technologies. The quality of the plastics are ensured and maximised throughout the loop by new incentives to even higher quality in the sorting and collection - substances that complicate processing, sorting and recycling are addressed earlier in the chain.
- Create market opportunities for secondary raw material
- Fantastic Plastic Directive: keep developing it for more precise assessment of the material and the plastic network.

P11 Develop quality measures



P1 Packaging background information

P2 Expanding plastic deposit system

P3 Polluter pays

P5 Zoning permits mixed function areas

P6 Responsible plastics

P7 Responsible companies

P8 Waste sorting

P9 Local responsible waste handling

P11 Develop quality measures

People

Waste sector

Manufacturers sector

Business sector

Academy & Experts

Societal organizations

Municipalities

Province of Zuid-Holland

National government

European Union

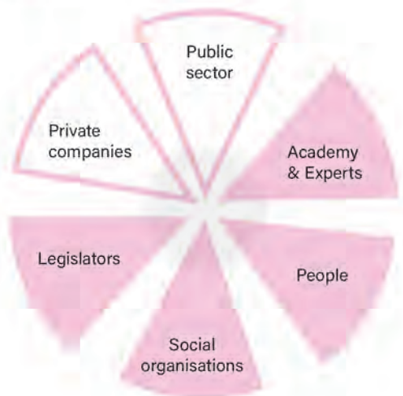


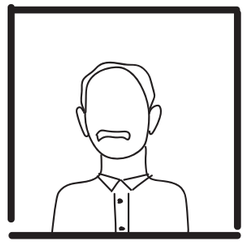
Figure 59

Phasing overview of the Fantastic Plastic Hub | Centre

FANTASTIC PLASTIC
hub | industrial

The hub industry is similar to the hub centre, but the activities and the desired location are different. It is located on the edge of the city where the old car focused infrastructure is transformed into attractive public space. In the hub, people can engage in the plastic cycle and it is a place for start-ups and innovation with bigger scale processes.

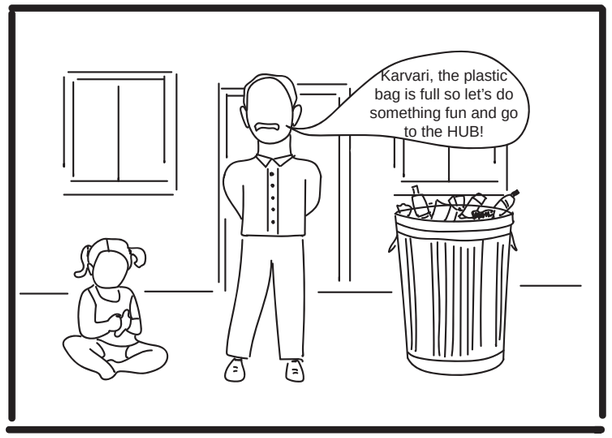
Figure 60

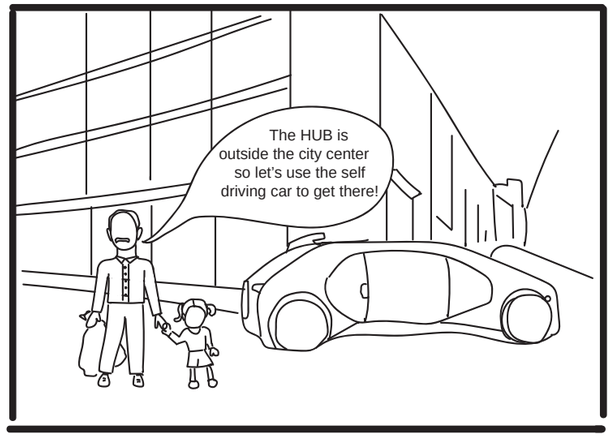


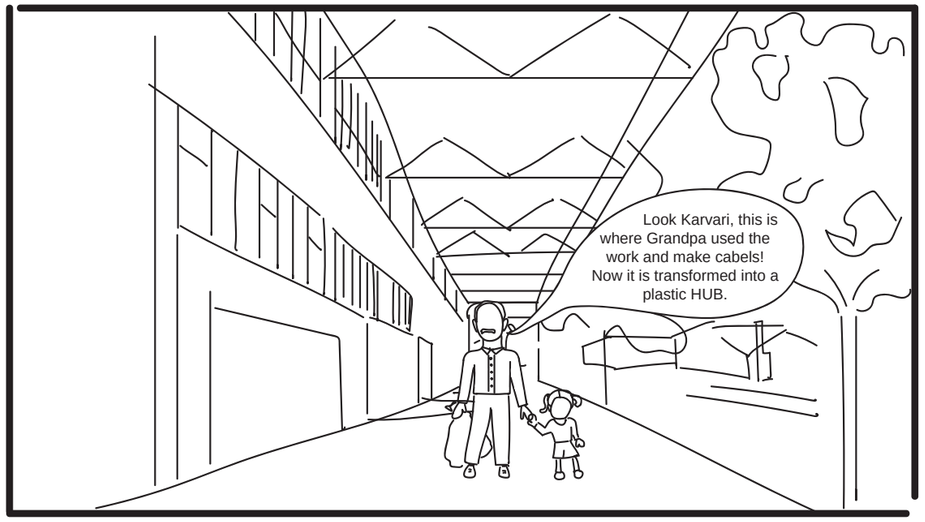
Name: Akaar Nadaraja
Age: 68
Occupation: Retired

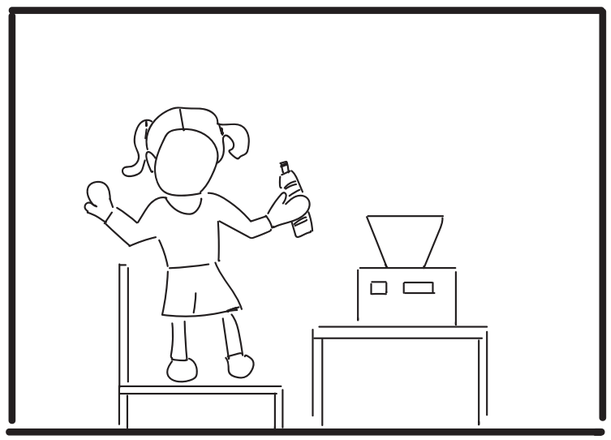
Plastic Use 2020: 63 Kg a Year
Plastic Use 2030: 6 Kg a Year

Name: Karvari Nadaraja
Age: 4
Occupation: None









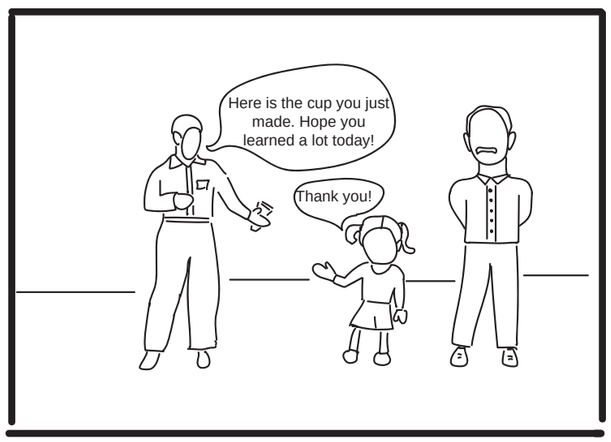


Figure 61

A new lifestyle with the hub industrial

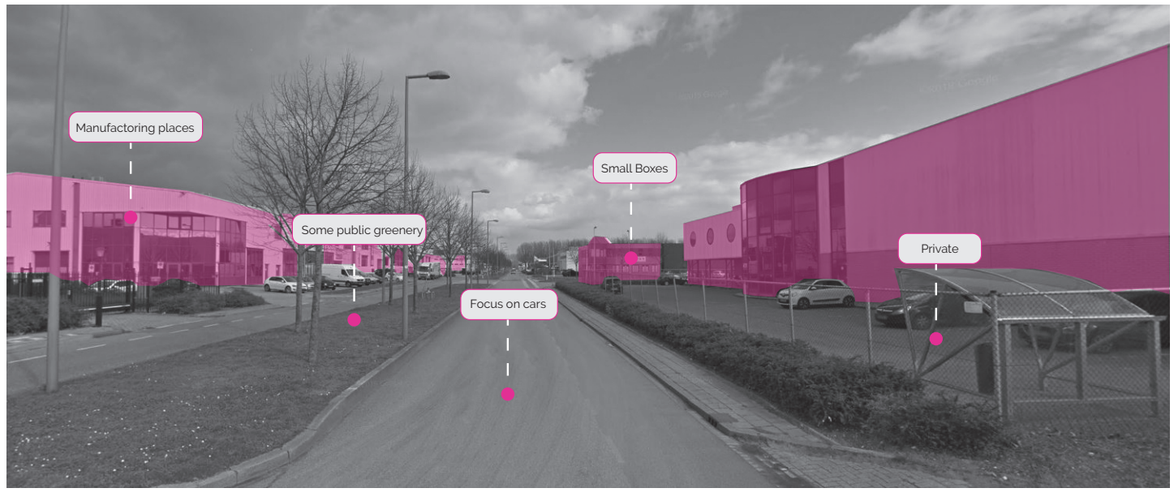


Figure 62

Current situation

Business and industrial parks facilitate one third of employment in the Netherlands. Companies that are located at a business park grow on average faster than companies located elsewhere (Weterings, 2008). However these business parks have some serious downsides, namely they are monofunctional, meaning that there are only companies located in these areas and that during the evening the place is completely empty. Furthermore the infrastructure is entirely focussed on car traffic and is hardly accessible by foot, bike or with public transport. The buildings all have the same look and are like small boxes. And last but not least the quality of public space is poor. However the area has potential, namely the location and the possibilities of growing space, to transform into a multifunctional pleasant area.

The area is monofunctional, exists only of small boxes and the quality of the public space is very low. The current car infrastructure is good and the amount of space in a business premises is large.

Figure 63

Current situation

As a pilot project one of the buildings is used as a place for bigger start-ups that can work, do research, improve existing techniques and produce and sell products on a very small scale.

Figure 64

Towards the first milestone

As the pilot success has proved the positive effects, the start-ups spread to other parts of the city. The principle of the Fantastic Plastic HUB is then showcased to other businesses sectors and to the investment of real estate developers. The first changes are made to improve the public space and the infrastructure.

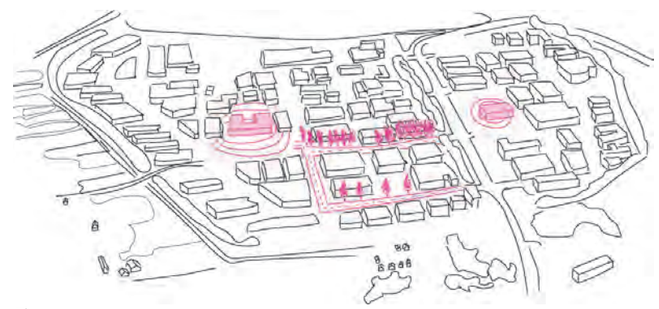


Figure 65

Towards the second milestone

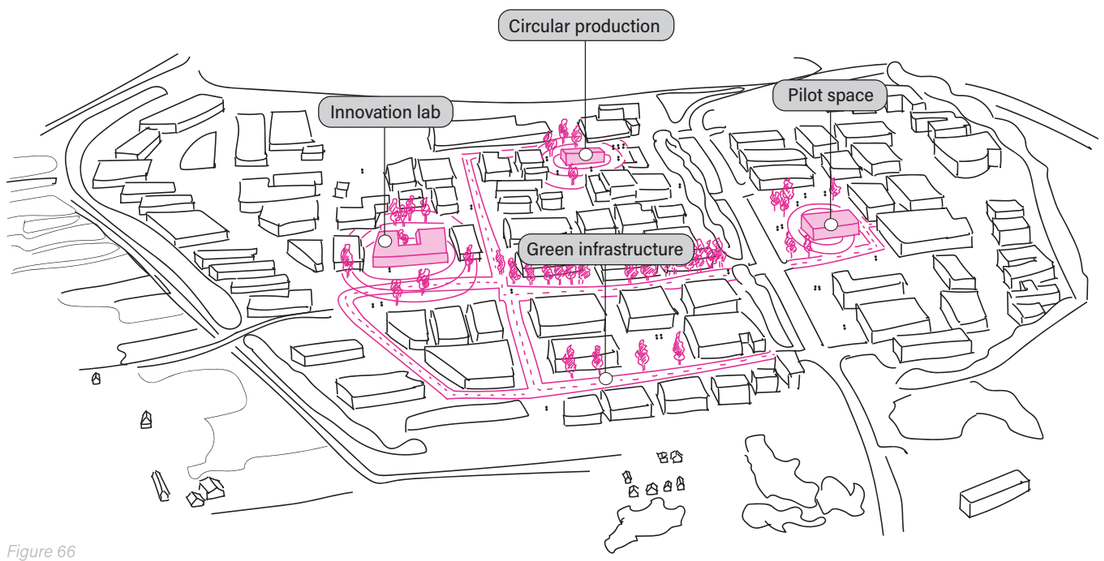


Figure 66

Desired situation

The Fantastic plastic HUBs and the processes that take place in the HUBs are embedded in the city landscape of all the small and little cities in The Netherlands. New kinds of plastic have been developed and plastic has gained value. The public space is attractive and people go there to chill.

MILESTONE 1

Stimulated innovation with plastics established new industries

Objective

To have the main stakeholders (waste, commerce, academics & experts, legislators) understanding the potential of identified (peri-) urban industrial sites. Within these there is room for experimentation with emerging innovations for the plastics sector among others. An 'innovation pressure' environment creates the background conditions for other actors to join these potential makers industries.

Strategy

Announce policies that stimulate the collaboration between academics & experts, businesses and the waste sector so that these hubs are initiated. The waste sector can be a close ally that brings part of their collection and sorting techniques to these (transitioning) industrial areas, so that plastics can be locally used as a resource by the emerging start-ups/ companies. Innovation aiming on improving the quality of plastics so they can be used again or in new products are prioritised, as it is a main challenge at the moment.

Actions

- Stakeholder panel discussions: promote the principles and potentials of circularity for businesses. How to transition companies towards a business model that establishes environmentally and socially responsible actions that will make an important contribution to the new plastics economy.
- Align the focus to capture funds from the EU for the new plastics economy.
- Develop innovative technologies to support conscious decision-making: new digital technologies will enable businesses and consumers to track information about a specific product's entire value chain and most adequate processing method. At the same time, make it more appealing so that it enhances the feeling of the participation and ownership to the plastics lifecycle among the people.
- Fantastic Plastic Directive: develop classification criteria to stimulate the reuse and repair of materials in the first place, and support alternative recycle and recovery options that can be locally processed - according to the context possibilities.
- Try-out emerging sorting and collection technologies: improving the quality of sorted waste by introducing more precise quality standards for by-products and clear end-life criteria in the Fantastic Plastic Framework Directive so that resources are staying at the hub or being streamed directly to the Fantastic Plastic Parks.

P1 Packaging background information

P2 Expanding plastic deposit system

P3 Polluter pays

P5 Zoning permits mixed function areas

P11 Develop quality measures

MILESTONE 2

The hub as a means of transitioning industrial areas

Objective

To have established cooperation between the main stakeholders replicating to more places and scaling-up their processes. With its introduction to more and more (peri-)urban zones, the hub as a place of industry has become better integrated into transitioning mixed functional areas.

Strategy

Circular shops (related to the business they are aligned to) are initiated in hubs as a showcase to refuse plastics or to use new plastics aligned with the Fantastic Plastic Directive. Fantastic Plastic workshops display and involve interested people in the circularity process and design of the stakeholders present in the hub (mostly from waste and academics & experts sectors). The hubs that are not thriving are assessed for other methods or partnerships.

Actions

- Improve the network of emerging technologies as proposed innovation with plastics start to scale-up and allure the interest of partners in the Fantastic plastic Parks or Port
- Plastic workshops that engage citizens in plastic cycle (reuse, repair, recycle) and its lowest overall environmental impact
- Stakeholder panel discussions: the Province of Zuid-Holland, in common effort with municipalities, showcase the Fantastic Plastic Hub to other businesses sectors that could be interested and to real estate developers for other sources of investment.
- Fantastic Plastic Directive: in this phase, the directive is being improved and applied in more and more processes with more precision, so the stakeholders understand their role better.
- Effective collection and sorting infrastructures: introduce and regulate percentage sorting and collection targets related to the increased mapping of plastics in Zuid-Holland. Set up proper collection infrastructures so plastics can be processed on a large scale. Support transitioning businesses to build their infrastructure systems through the sharing of knowledge between stakeholders and application of innovations from academy & experts.
- Create market opportunities for secondary raw material: encourage “material swap” (partners are free to feed from each other end-life plastics) and allocate funding to provide plastic resources to innovation start-ups and companies.
- Actively use of public space (festivals, open air theater)
- Inviting infrastructure for cyclists and pedestrians

P6 Responsible plastics

P7 Responsible companies

P8 Waste sorting

P9 Local responsible waste handling

MILESTONE 3

The hub as part of a new integrated urban system

Objective

To have a new approach to the integration of function mixes. Industries like those in the plastics sector thrive in mixed areas, bringing industry closer to the consumer. The industry is visible: there is a clear stream of plastic resources going from the hub to the park and port and back again in a new shape. The population behaviour towards their excess plastics is to look for a partnership with the hubs in its collection, sorting and innovation pioneering.

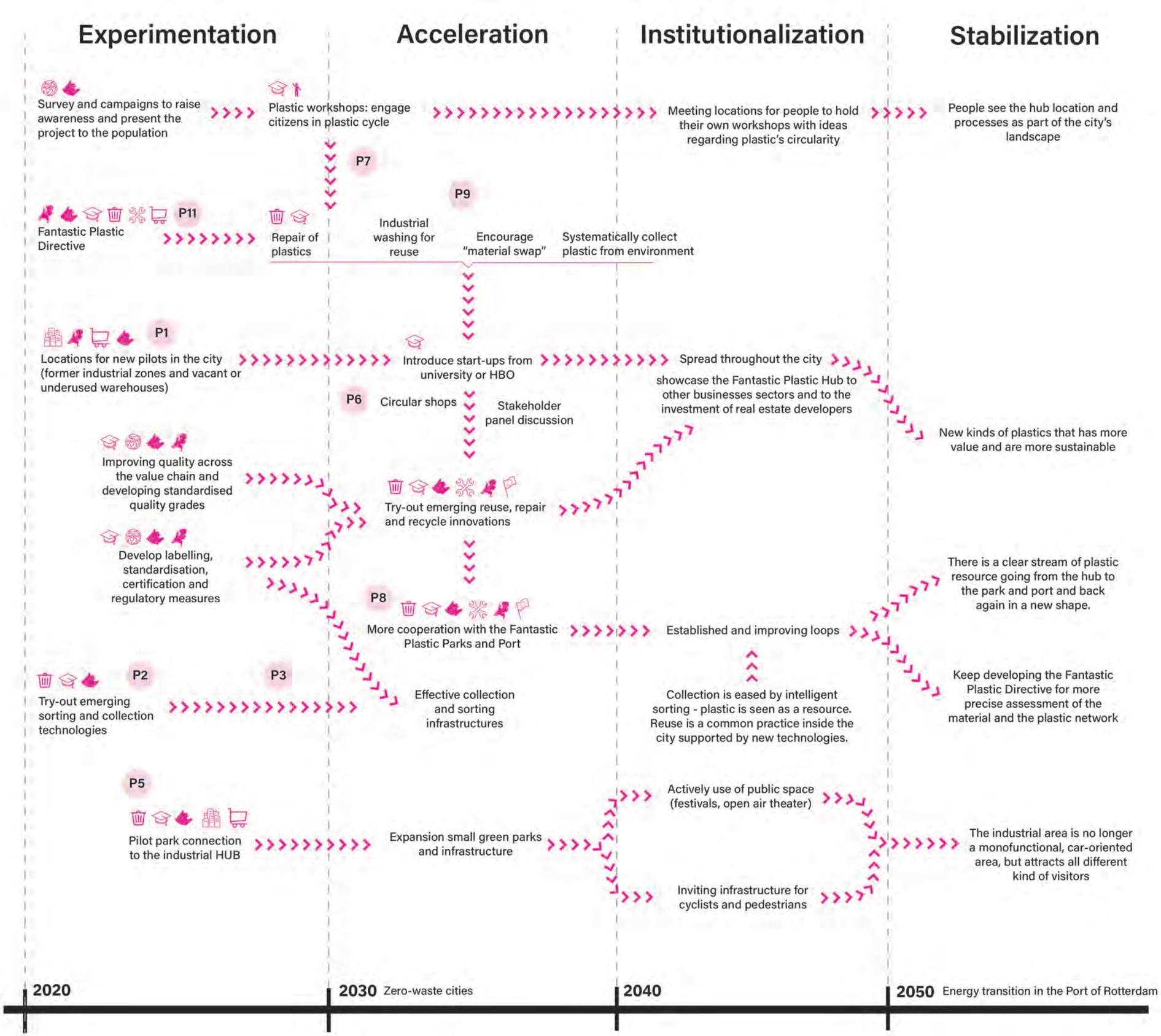
Strategy

Enhance the impact of the Fantastic Plastic Hubs in its surrounding neighbourhood as landmarks of the stabilized plastics economy.

Actions

- As sorting is much better structured, the collection is efficient and a tube connection is created to the nearest Fantastic Plastic Park, where it is stored as a resource. There quantitative high-quality input streams from pre- and post-consumer markets.
- Meeting locations for people to meet and have their own workshops regarding plastic’s circularity.
- Collection is eased by intelligent sorting: plastic is seen as a resource. Reuse is a common practice inside the city supported by new technologies and improved material flows.

P11 Develop quality measures



P1 Packaging background information

P2 Expanding plastic deposit system

P3 Polluter pays

P5 Zoning permits mixed function areas

P6 Responsible plastics

P7 Responsible companies

P8 Waste sorting

P9 Local responsible waste handling

P11 Develop quality measures

People

Waste sector

Manufacturers sector

Business sector

Academy & Experts

Societal organizations

Municipalities

Province of Zuid-Holland

National government

European Union

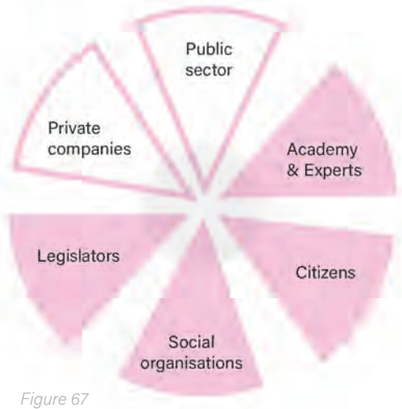


Figure 67

Phasing of the Fantastic Plastic Hub | Industrial

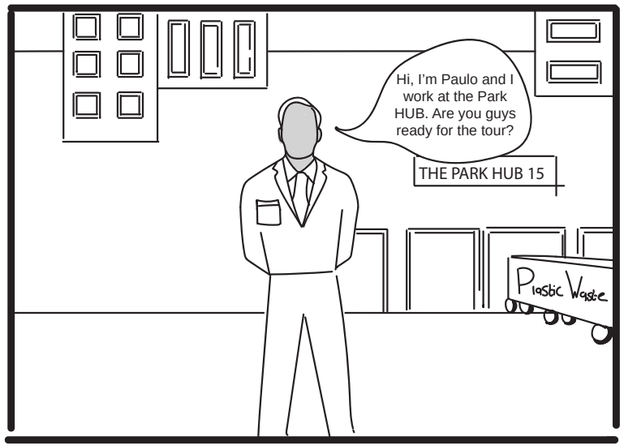
FANTASTIC PLASTIC park

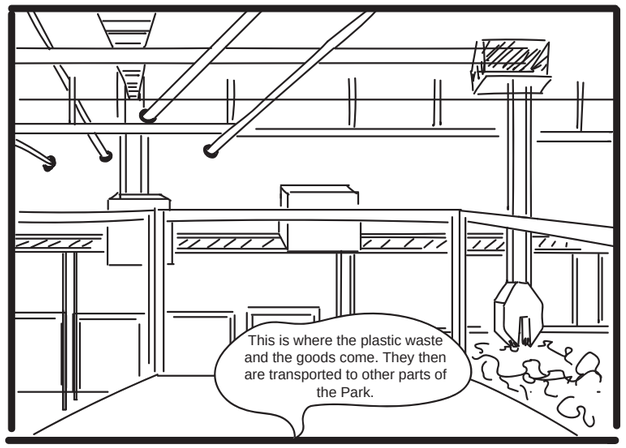
At the Park, all different kinds of activity take place, namely, the distribution of goods, the researching of technologies, the recycling of plastic packages but also living and relaxation. The Fantastic Plastic Park is a place where spatial quality and new functionalities mix with the peri-urban areas.

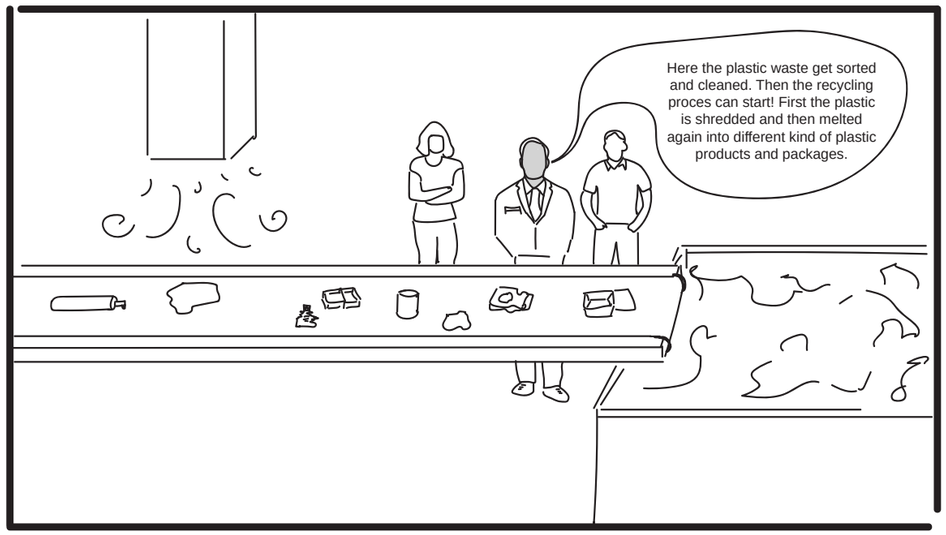
Figure 68

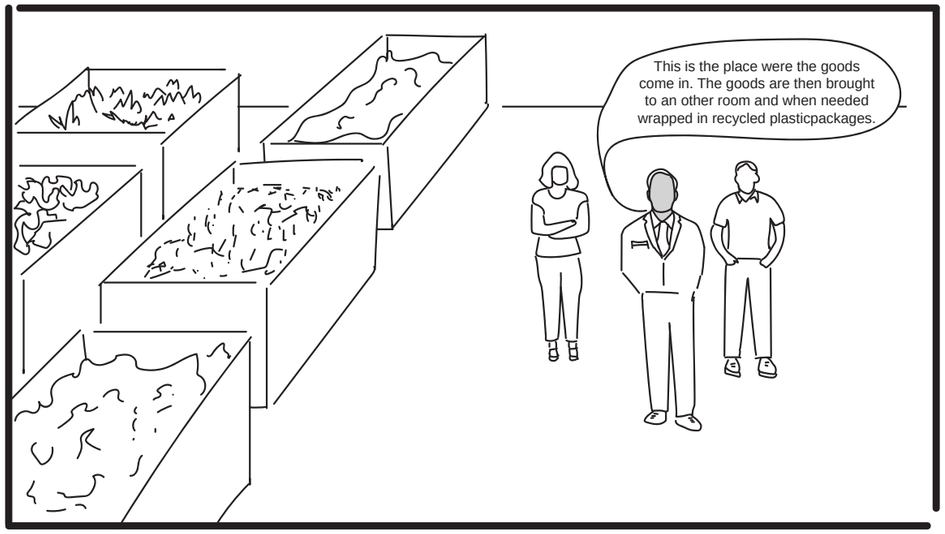
Name: Paulo Coetzee
Age: 28
Occupation: Logistic manager

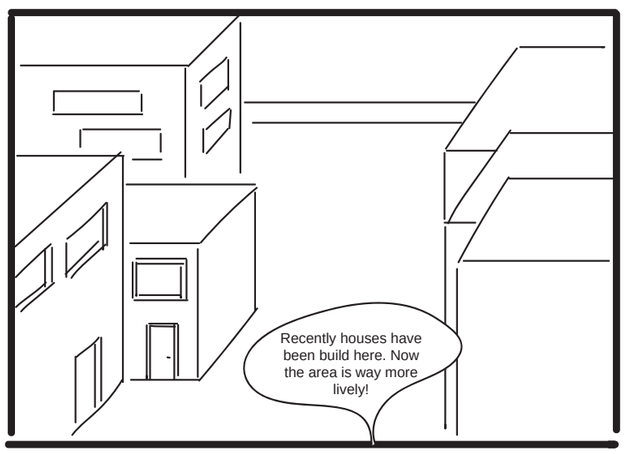
Plastic Use 2020: 63 Kg a Year
Plastic Use 2030: 10 Kg a Year

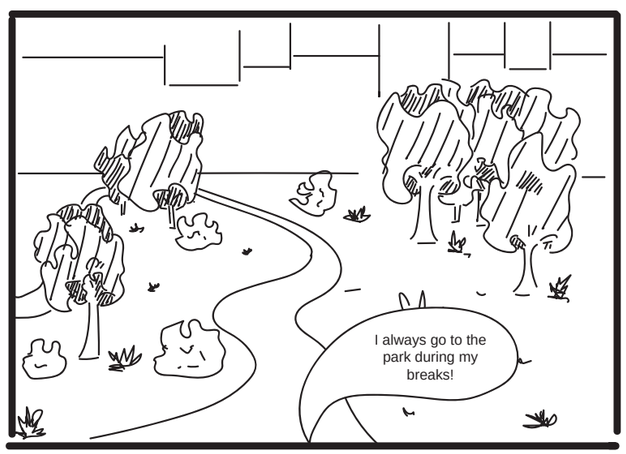












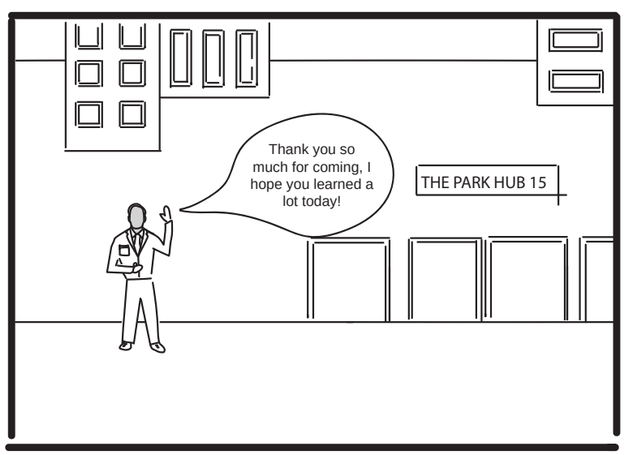


Figure 69

A new lifestyle with the park

Figure 70

Current situation

With the current trend of online shopping and with the ever growing amount of products that are needed to be transported the amount of distribution centers is growing (NU.nl, 2021). As distribution centers are expanding the onrest about these big boxes is also growing. Namely these distribution centers are monofunctional, only trucks and cars come to these areas making them very unfriendly for people. Because the only function these areas have is transportation and logistics the infrastructure is entirely focussed on car traffic only and is hardly accessible by foot, bike or with public transport. The buildings all look the same apart from the color of the box and there is no actual public space or even the slightest bit of green space. However the area has potential, namely the area is very well connected by car roads and train tracks and the space that is available is big.

The area is monofunctional, exists only of big boxes and the quality of the public space is very low. The current car and train infrastructure is good and the amount of available space is large.

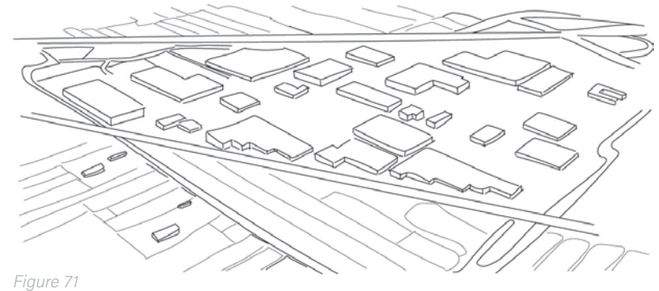


Figure 71

Current situation

A location for the pilot start-up is created at the distribution area, where the start-up can try-out emerging reuse, repair and recycle innovations that best fit the stakeholders' collaboration.

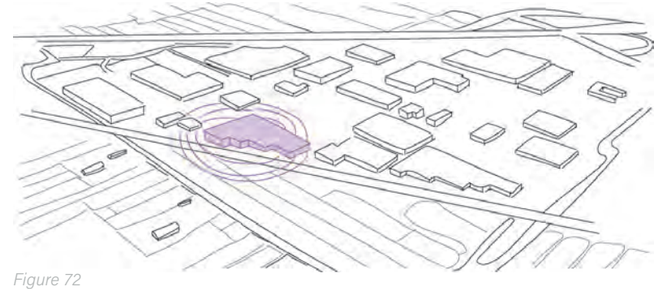


Figure 72

Towards the first milestone

Mixed functions are implemented and the first part of a high quality public park is being released. A solid cooperation between the recycle and the logistic function is established.

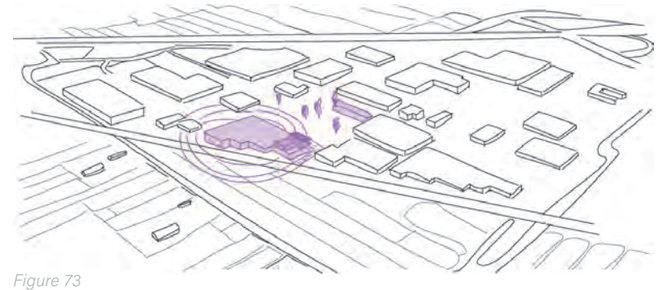


Figure 73

Towards the second milestone

More functions are added and the Fantastic pastic park is finished. A learning center is added and the pilot is spreading to other areas and locations.

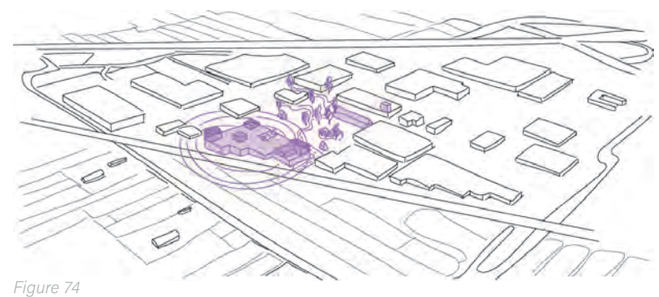


Figure 74

Towards the third milestone

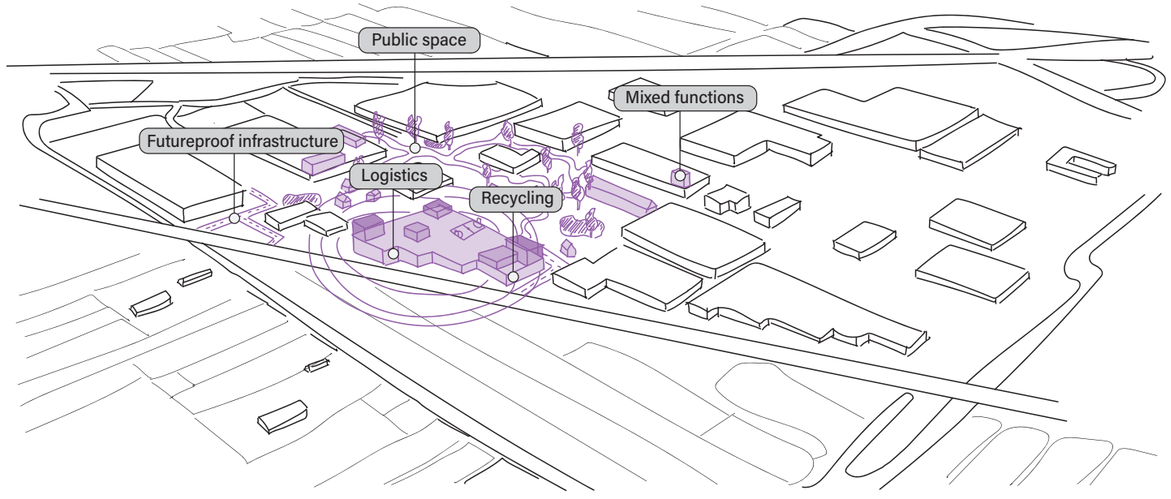


Figure 75

Desired situation

The fantastic plastic parks are manufacturing the plastic with the lowest environmental impact in Europe.The area is part of the efficient streams of resources and thereby brings spatial quality and new functionalities to the peri urban areas.

MILESTONE 1

Parallel action across the separate stages driving systemic change

Objective

To have the main stakeholders (waste, producers, manufacturers, commerce, academics & experts, legislators) already working towards a transition to understand the potential of identified locations in the peri-urban areas to experiment with emerging new technologies that apply to every stage of the plastic loop. An 'innovation pressure' environment creates the background conditions for other actors to join.

Strategy

Announce policies that stimulate academics & experts, business, manufacturers and waste sector to move their processes to logistic parks so that a location transition is also initiated.
At this phase, the manufacturers sector is encouraged by the shared ambitions of legislators, academy & experts and businesses to jointly push for innovations and drive a circular economy for plastics. The waste sector also place their collection and sorting warehouses in the Fantastic Plastic Park, so that plastics can be locally used as resource by the emerging start-ups/companies, manufacturers and business sector.

Actions

- Stakeholder panel discussions: promote the principles and potentials of circularity for businesses interested in this location for their work. How to transition companies towards a business model that establishes environmentally and socially responsible actions that will make an important contribution to the new plastics economy.
- Try-out emerging reuse, repair and recycle innovations that best fit the stakeholders collaboration
- Locations to initiate the transition to the Fantastic Plastic Park model: use land-use laws to push for spatial change
- Attractive facilities for people so that idea of people towards those places start to change.
- Focus on the types of plastics that have more potential to remain valuable as a material after recycling and improve the cycle on a large scale.

P5 Zoning permits mixed function areas

P11 Develop quality measures

MILESTONE 2

Fantastic Plastic Park starts to take shape and act beyond an industrial park

Objective

With the continuous improvement programme the area is attractive for the plastic network. The investment in innovation is improving the stream and the quality of plastics. It phases out types of plastic based on an impact assessment and the constant new availability of more sustainable alternatives. Facilities relevant for the city are being implemented and start to run.

Strategy

The Fantastic Plastic Park Learning Centre provokes a responsibility shift towards the population to understand its role as a partner for the change to the new plastics economy. The Fantastic Plastic Directive is being constantly updated and improved by the joint efforts of legislators, industry and experts, and based on the latest market developments. It is possible to design roadmaps to introduce new plastics and practices as it captures and transforms traditional plastics.

Actions

- Pilot houses next to or on top of a distribution center: spatial sciences students make proposals for new ways to understand these locations in relation to the urban city centre and the port, proposing other spatial functionalities and usages.
- Improving the quality of the public spaces in and around the parks
- The Fantastic Plastic Park Learning Centre: a crossover between a museum and a laboratory that portrays the innovations happening all across the hubs, parks and the port. It aims to educate and provoke a responsibility shift towards the population to understand its role as a partner for the change to the new plastics economy.
- Encourage “material swap”: partners are free to feed from each other end-life plastics.
- Fantastic Plastic Resource Storage: well known sorting techniques (sifter & conveyor belts, magnets, ballistic separator & wind shifters, sink-float, scanners, etc) adds to innovative ones to better stream the large inflow of resources to the hub, port or stay in the park.
- Industrial washing for province scale reuse

P6 Responsible plastics

P7 Responsible companies

MILESTONE 3

The Fantastic Plastic Park is a relevant place for the network and the city alike

Objective

To have the area of former logistical parks totally repurposed. The new plastics economy in the form of the Fantastic Plastic project transformed peri-urban areas in great learning centres for the city to make sense of its processes that involve plastics. Cooperation and responsibility is shared among the stakeholders and the Fantastic Plastic Parks are manufacturing the plastics with the lowest environmental impact in Europe.

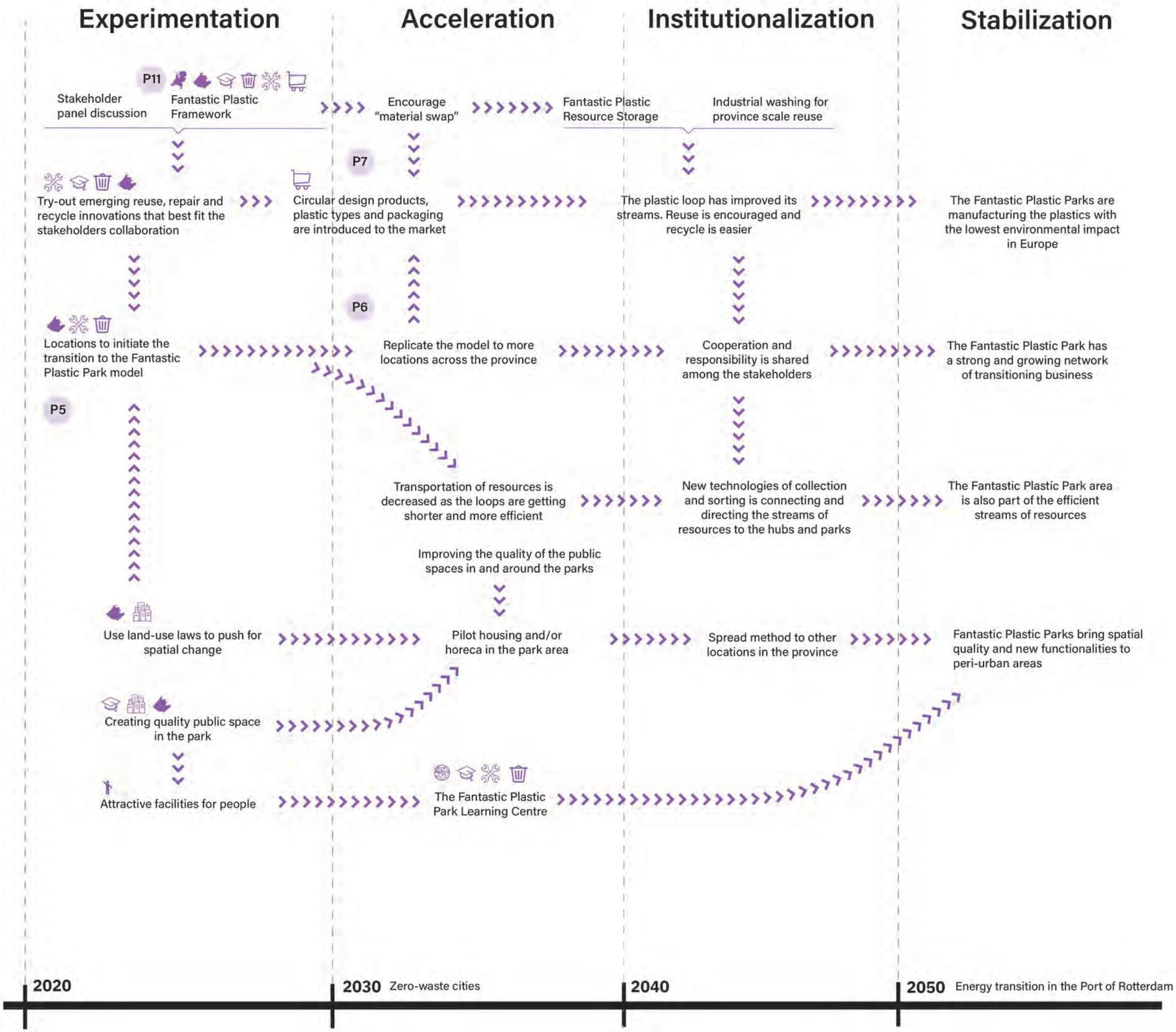
Strategy

The mix of functional and attractive facilities are well balanced and bring business together, as well as, people from the cities in the province and even from further. The method calls attention of other locations in the country and begins to spread and learn from each other’s experiences.

Actions

- Spread method to other locations in the country.
- The Fantastic Plastic Park Learning Centre: is constantly improved and upgraded with more participatory actions to attract people.
- Fantastic Plastic Resource Storage: has to be always restructured (perhaps becoming smaller) for the better streams that come in as a result of the Fantastic Plastic Directive.

P11 Develop quality measures



P5 Zoning permits mixed function areas

P6 Responsible plastics

P7 Responsible companies

P11 Develop quality measures

- People
- Waste sector
- Manufacturers sector
- Business sector
- Academy & Experts
- Societal organizations
- Municipalities
- Province of Zuid-Holland
- National government
- European Union

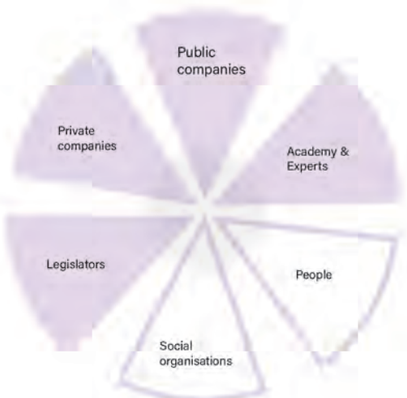


Figure 76

Phasing of the Fantastic Plastic Park

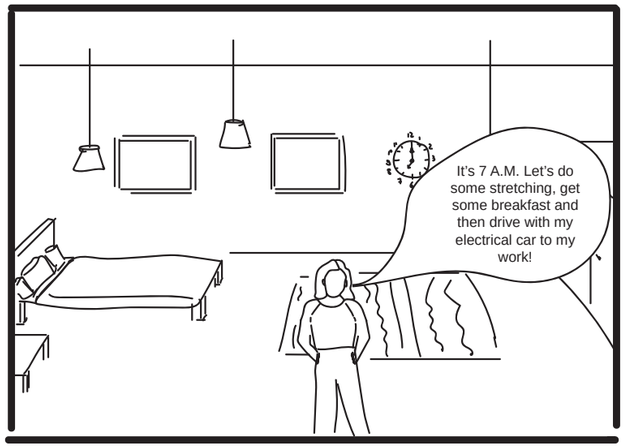
FANTASTIC PLASTIC port

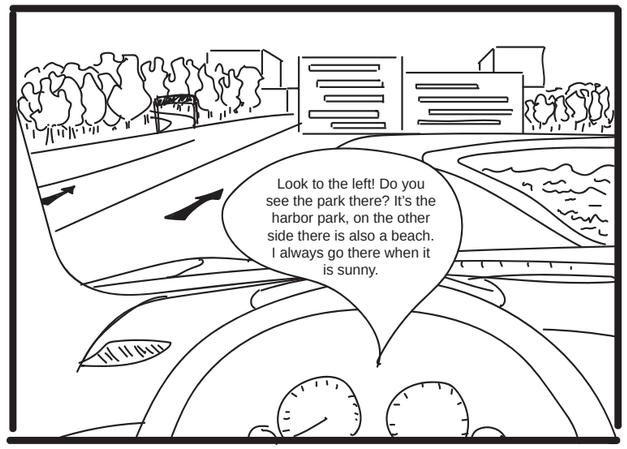
At the port you can have a swim at the Fantastic Plastic harbour beach, have a walk at the park, get a tour at one of the many chemical recycling or biomass plants. The port is a place for innovation, experimentation, production and relaxation.

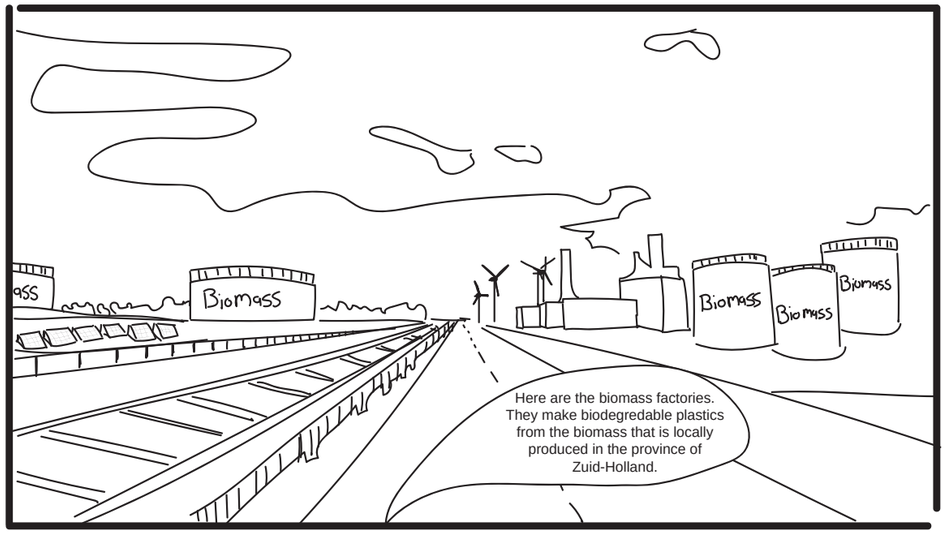
Figure 77

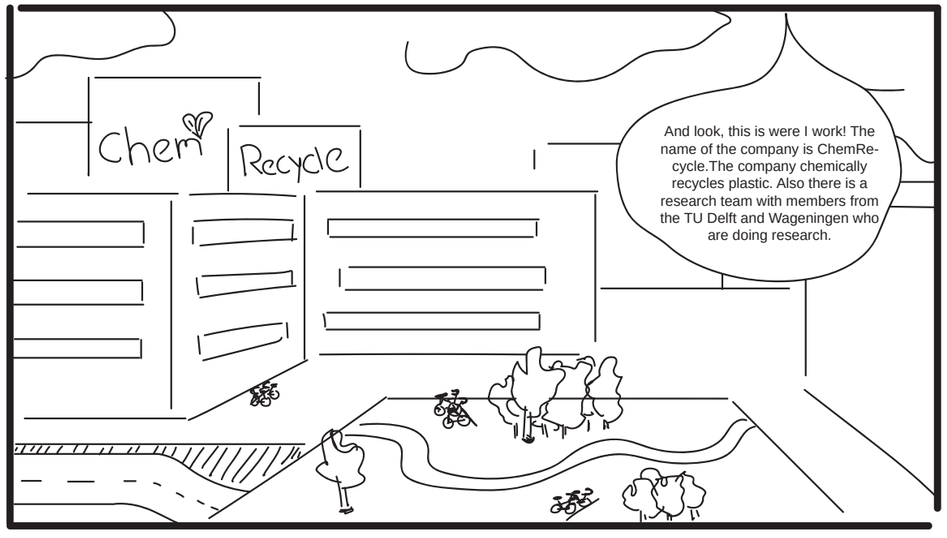
Name: Isabel Flores
Age: 42
Occupation: Researcher

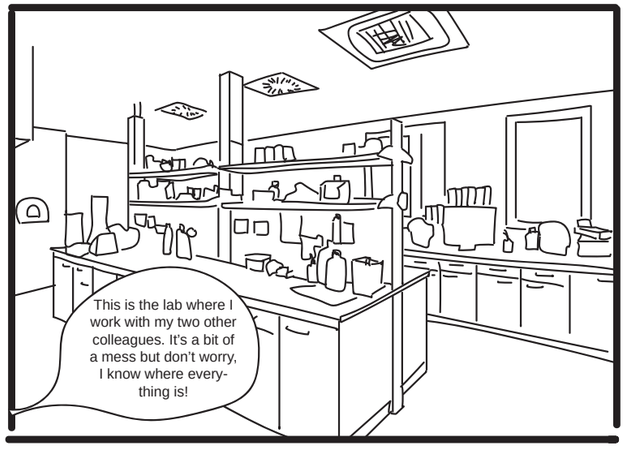
Plastic Use 2020: 54 Kg a Year
Plastic Use 2030: 3 Kg a Year

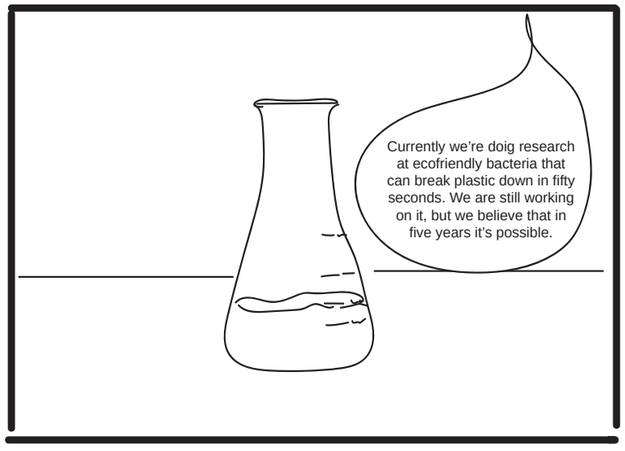












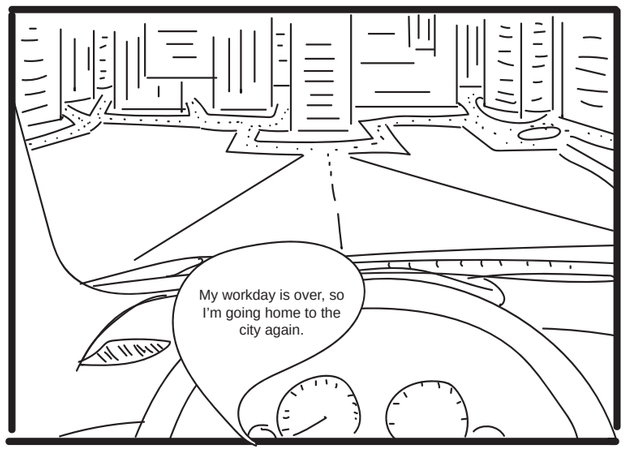


Figure 78

A new lifestyle with the port

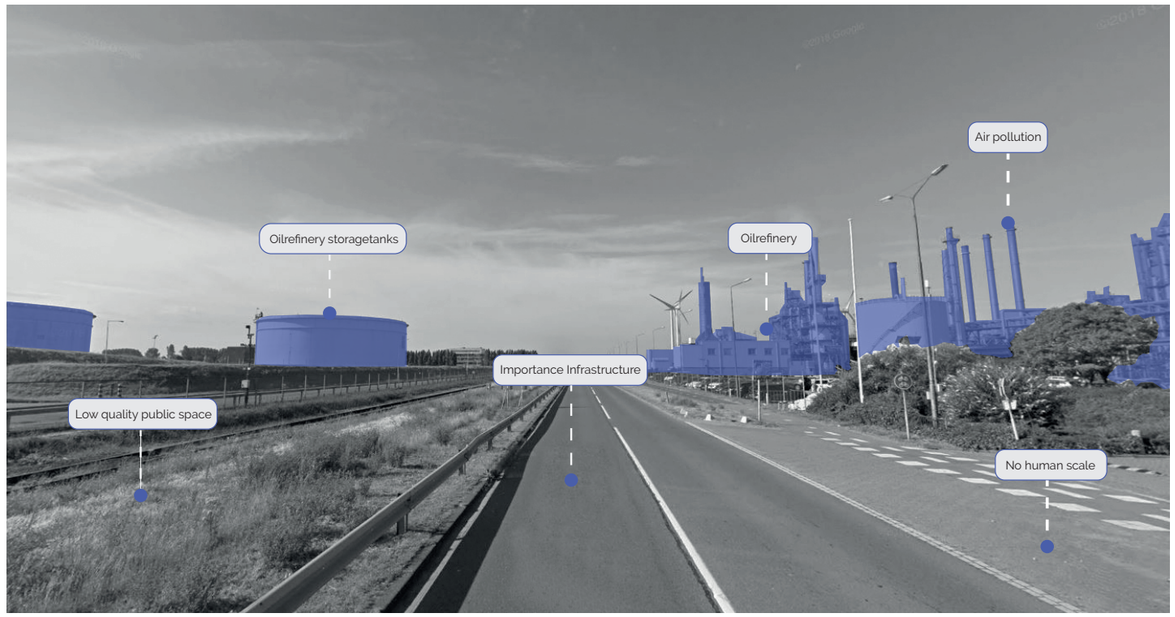


Figure 79

Current situation

The port of Rotterdam has an important function in the international trade. Every year 436,8 million tonnes of goods are transshipped in the harbour of Rotterdam (Port of Rotterdam, 2020). However currently most of the companies located at the harbor are unsustainable and polluting. This results in a low quality of public space, namely the water, air and soil are polluted. The public space is not very inviting and pleasing. The area does have a lot of opportunities, namely the good infrastructure, the amount of companies that are already located in the area and the will of the port to change (Port of Rotterdam, 2019).

The harbor is a monofunctional area with unsustainable polluting companies. There is a good infrastructure and a lot of opportunities.

Figure 80

Current situation

The first pilot location is opened at the Botlek area in cooperation with the universities that experiment with different chemical processes. During the same time research has been done about how to clean the water and soil.

Figure 81

Towards the first milestone

Plastic waste and biomass is actively stored at the pilot location. More locations are open. More factories switch to a sustainable plastic industry. The water and the soil are being cleaned. The recycled feedstock is distributed to the Fantastic Plastic Parks.

Figure 82

Towards the second milestone

The public waterfronts are a safe way ro recreate in the port. The amount of pilots and sustainable plastic factories keep increasing.

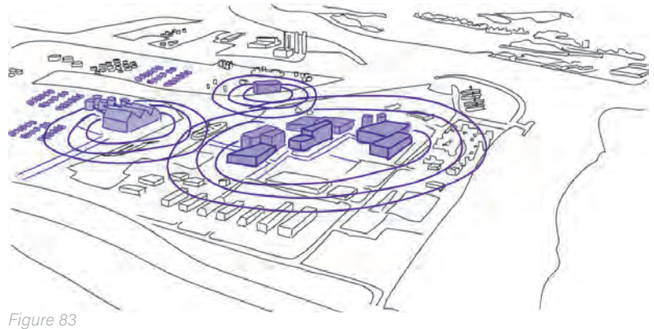


Figure 83

Towards the third milestone

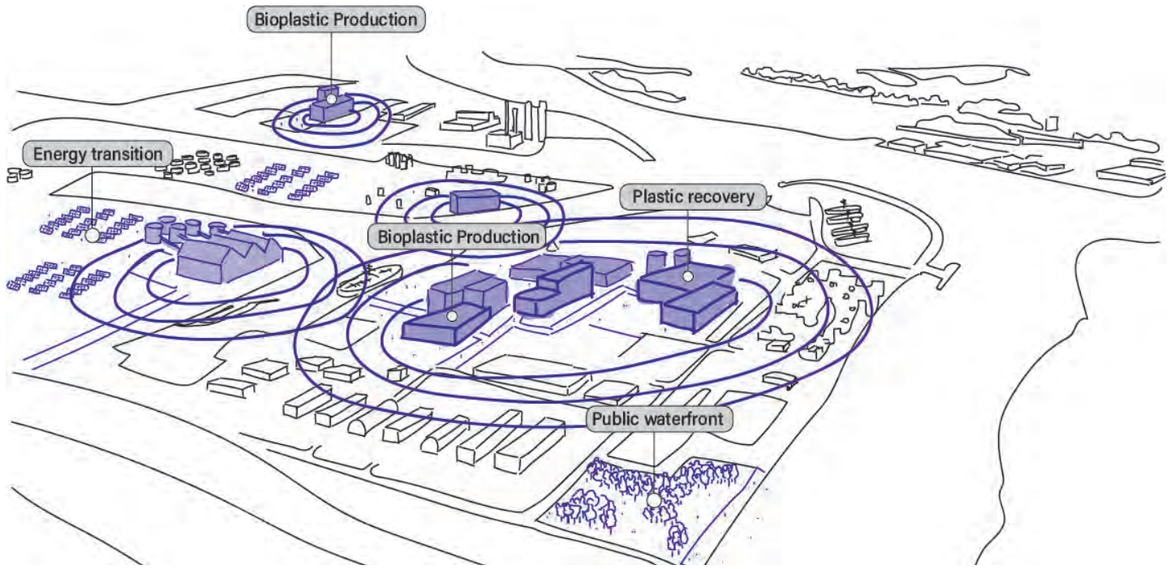


Figure 84

Desired situation

The Fantastic Plastic port is transformed into a mixed function area and the factories that are located at this area only produce plastics that are made from recycled plastics or make new plastic from renewable resources that are degradable.

MILESTONE 1

Botlek area has approved new land-use plan and supporting legislation for urgent sustainable transition

Objective

To have the main stakeholders (waste and chemical sector, academy & experts and Port of Rotterdam) already working towards a transition to understand the potential of the Botlek area to experiment with emerging new technologies that apply to every stage of the plastic loop. An 'innovation pressure' environment creates the background conditions for transition or replacement of the current chemical sector.

Strategy

Facilitate the future-proof transition of the business models of companies in the Botlek area by funding good practices and upscaling of reuse-repair-recycle that offer a range of potential solutions to the limitations of plastics as a circular material, providing a way to close the loop.

Actions

- Pass more strict laws for landfill reduction, GHG emissions and to reduce leakage of plastic waste to the environment.
- Stimulate new, higher-quality plastic grades through mechanical recycling, advanced recycling or bio-based plastics.
- Funding from the EU that supports the recycling of end-life plastics: Legislators recognise advanced recycling as an innovation that can contribute to achieving EU recycling targets and SDGs.
- Up-scale P2P conversion technologies: Advanced recycling technologies, defined as plastic-to-plastic (P2P) so that it is possible and cheaper to recycle mixed plastic waste streams that contain PE, HDPE, LDPE, PP, and mixed PP.
- Develop P2F solutions that are focused on cleaner outputs: plastic-to-fuel (P2F) processes (like gasification) can offer a solution for plastics that prove to be impossible to reintroduce to the loop and couple with CCS technologies to capture the CO_2 produced in the process.
- Fantastic Plastic Directive: partners to contribute to the classification criteria to stimulate the reuse and repair of materials in the first place, and support alternative recycle and recovery options that can be locally processed - according to the context possibilities.
- Try-out emerging sorting and collection technologies: improving the quality of sorted waste by introducing more precise quality standards for by-products and clear end-life criteria in the Fantastic Plastic Framework Directive so that resources are staying at the hub or being streamed directly to the Fantastic Plastic Parks.

P3 Polluter pays

P4 Enhancing plastic production transition

P5 Zoning permits mixed function areas

P11 Develop quality measures

MILESTONE 2

Fantastic Plastic Port is closely linked to its partners in the hubs and parks and the farms for biomass

Objective

The whole sorting and collection leading to recycling is more efficient and to have the production of Fantastic Plastics advanced and scaled up so that is economically competitive to replace completely fossil-based plastic in Zuid-Holland. Initiaties to clean the harbour waterfronts, polluted soil and capturing CO2 are working in tandem with the processes in the harbour.

Strategy

Waste sector makes the link to the city center and peri-urban areas run smoothly, providing enough feedstock for plastic production - from recycling methods. The Fantastic Plastic grade (plastic produced from new bio-based or recycled in the Fantastic Plastic loop) is certificated so that the manufacturing and business sectors, in turn, can also sell their sustainable products with the grade.

Actions

- Working towards zero landfill: There is a significant risk that the EU will not meet its plastic packaging recycling targets for 2025 and 2030. It is important to invest in technologies and accelerate the process for former landfill areas to be regenerated and undergoing cleaning methods for soil pollution
- Storages are being redirected to store biomass and plastic resources
- Recycled plastic feedstock is distributed to the Fantastic Plastic Parks
- More efficient production and recycling processes: Mechanical recycling, solvolysis, depolymerisation and pyrolysis are advanced and accompanied by new methods to recycle that were proposed in the hubs, parks and even directly in the port.
- No need anymore for “mass balance” system.
- Collaboration with acedemy & experts to use the biomass inflow more efficiently.
- CCS technologies are better connected to the Port of Rotterdam processes
- The Innovation axis is taking shape in the industrial regions of the ports of Rotterdam and the Drechtsteden.

P6 Responsible plastics

P7 Responsible companies

P8 Waste sorting

P9 Local responsible waste handling

P10 Local responsible plastic production

MILESTONE 3

Fantastic Plastic Port is a pioneering and provoking change across its partners - ports and business

Objective

To have a complete new approach to plastic in the urban centres of the province from citizen to businesses - there is a clear stream of plastic resources going from the hub to the park and port and back again in a new shape. The population behaviour towards their excess plastics is to look for a partnership with the hubs in its collection, sorting and innovation pioneering. On the other end, public waterfronts are safe way to recreate in the port as public parks add quality and human scale to the port.

Strategy

The Port of Rotterdam is organizing and prioritizing partnerships that contribute in making the port area more sustainable in shorter time frames. It is addressing GHG emissions and also repurposing its space for the population, providing access to waterfronts and creating quality public parks.

Actions

- Whole sorting and collection leading to recycling is more efficient: as sorting is much better structured, the collection is efficient and a tube connection is created to the nearest Fantastic Plastic Park, where it is stored as a resource. There quantitative high-quality input streams from pre- and post-consumer markets.
- The making of biodegradable plastics is more efficient: higher crop yield and innovative farming techniques make better use of the land on the circularity axis of the spatial vision.
- The production of new plastics are made mainly from recycled and the amount that is lost in recovery is substituted by Fantastic Plastic type: the innovation axis is strong and stimulating the acceleration of start-ups harboring fieldlabs and testing facilities in order for them to become frontrunners towards the green economy.

P11 Develop quality measures

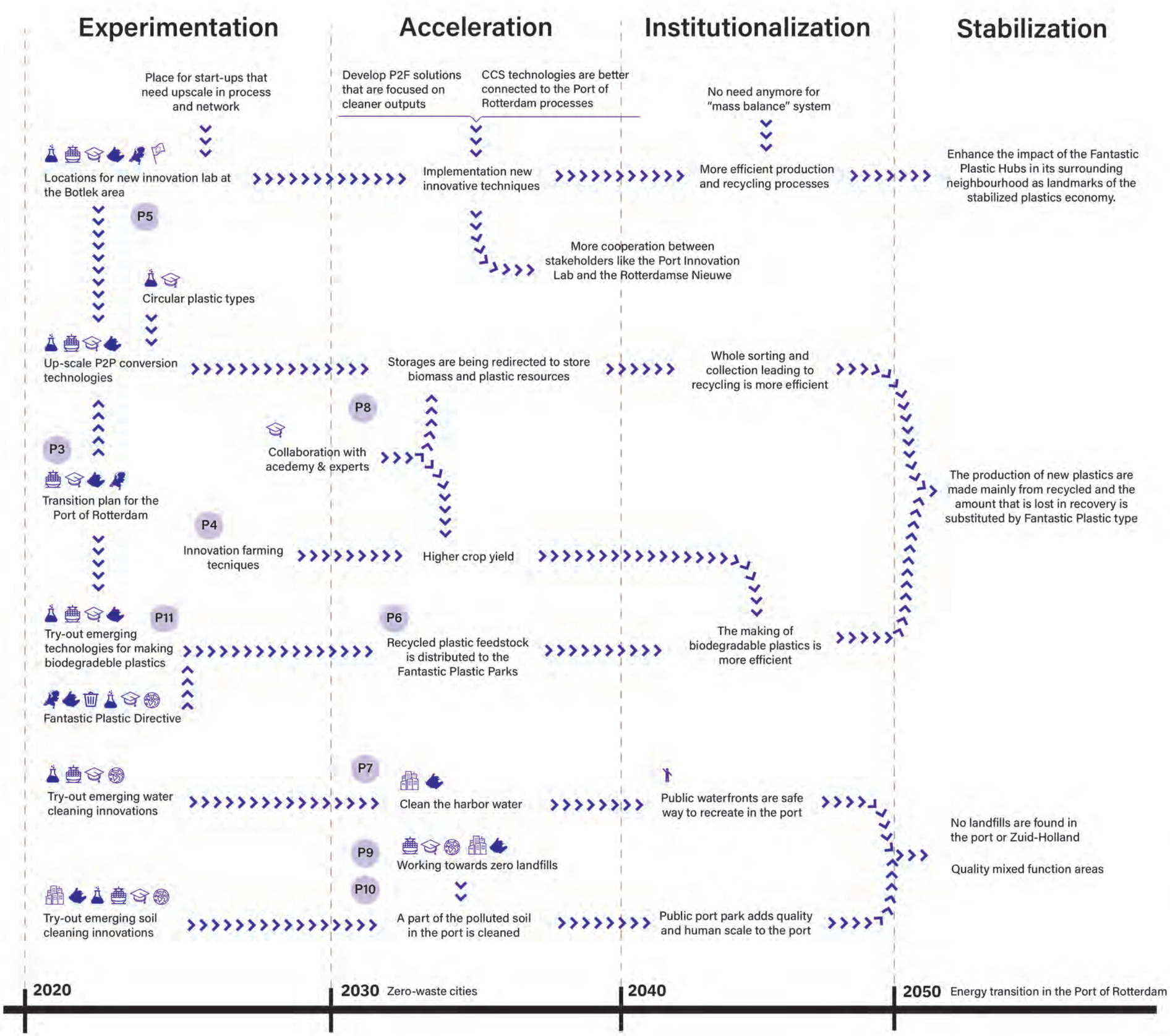


Figure 85

Phasing of the Fantastic Plastic Port

5

Concluding remarks

General conclusion

Like water, food and air, plastic has become vital for our day to day way of living. It might not be the biggest in its sector, yet its impact is enormous. Socially, we are dependent on the use of plastics for everything from fruit packaging to lawn chairs. Economically, this industry is entangled in manifold production and consumption sided sectors, with its industry accounting for thousands of jobs in Zuid-Holland alone. Environmentally, the effects of this industry are portrayed through its carbon footprint and material waste streams, functioning as pollutants of our air, land, and water.

The national ambition of becoming a circular economy has underlined the fact that several current problems within the plastics sector have a spatial relevance. One example is the large scale on which material flows occur, putting economical and environmental stress on the industry. A second example is the increased spatial competitiveness that will arise when land must be allocated for the production of biobased raw materials for this industry. Because of the spatial relevance, solutions for these issues can be found using spatially oriented development strategies. Therefore, to resolve these, this report formulated a spatial vision and defined spatial strategies to transition towards a socially, economically and environmentally sustainable plastics sector in Zuid-Holland.

Several goals have been formulated to adhere to the vision: raising awareness through engagement in the sector; assuring space and resources will be used in fair and efficient manners; allowing for the industry to become circular within the boundaries of the province; fundamentally redefining the way plastics are used through the R-philosophy; diminishing the environmental impact of plastics through new end-of-pipe systems. To achieve these goals, research has been done into three important R&D fields: spatiality, circularity, and plastic network. Here, the spatial field denotes external and internal spatial factors like spatial competitiveness, land use and urbanization. The circular field covered research into current resource flows and the transition to a sustainable industry. The network field was used to do research on the stakeholders within the plastic sector. The research showed that an interdependent approach between these fields towards the strategy had the potential to solve issues and reach the envisioned goals.

The report identified four potential types of location that are crucial to make the plastic chain circular and thereby transforming plastic into Fantastic Plastic. They are the port, the park (in peri-urban areas) and industrial and inner city hubs. Each of these are strategised to initiate a possible transition through policies, pilot projects and spatial interventions. The port denotes the crucial role of the Port of Rotterdam. In the port's transition to a circular model, it can become the frontrunner of a sustainable plastics and chemical industry. The park is a new way of looking at distribution. It brings together stakeholders on larger scale and flow levels, supports innovation in technology, and is a basis for introducing awareness through educational facilities. The hub functions as an incubator for new smaller scaled innovations, activities and commerce. Next to these, innovations in the countryside (biobased farming opportunities) and developments on the smallest scale levels (rethinking household consumption and waste) close the loop within the plastics sector.

Through the implementation of this strategy, the way we use plastics within the province of South-Holland could have changed drastically by 2050. The plastics industry will shift to a fully circular model. The province will no longer rely on the import of non-renewable resources as raw materials for this industry, or rely on the export of excess plastic waste as an end of pipe solution. Consumption has been limited to a minimum through socioeconomically fair and viable alternatives. End-of-pipe solutions shift to recycling and, perhaps, composting - diminishing the environmental impacts and closing the loop of the plastic cycle. In thirty years, the circular model will entail fair and viable solutions throughout the plastic lifecycle.

Group reflection

The title of 'Fantastic Plastic' immediately showed our ambition to rebrand the plastic sector. Although awareness of the negative impact of plastics has increased greatly in recent times, it has been our goal from the start to not simply examine how to squash this industry: on the contrary, we set out to find ways to live sustainably with this fundamental material.

Again, the reason we state that plastic is so important is because of the impact it has on our daily lives. Resolving the main developed issues with this industry could, in theory, make the industry and ourselves, more sustainable: socially, economically, and environmentally. Unfortunately, a hiccup from the start was the discovery that this industry was particularly hard to turn spatial. This is because in the current situation, the plastics sector is primarily based on flows: import of raw materials, distributed packaging and recovered waste streams are examples of these. The spatial elements are there, but are either insignificant or isolated: from industrial plants and factories, to garbage bins and landfills. Hoping to fully examine the sector, whilst also connecting it to spatial strategies, the initial framework had been divided into three elements: spatial, circular, and network.

This integral approach helped us firstly divide and thereafter connect the elements we deemed to be significant in tackling this problem. The spatial analysis gave us insight into general spatial problems, trends and opportunities. The investigation into circularity examined the plastics sector and revealed the possibilities of making this sector circular. The network analysis highlighted the specific stakeholders. The result of this approach was that it gave an integrated spatial meaning to the sector. Not only was a transition to a circular model examined; it was then linked to both the region specific stakeholders involved, as well as region specific spatial strategies that were deemed necessary to resolve the issue.

The goals that relate to the vision and strategy were also not simply sector specific. Instead, they reach beyond the plastics sector, for example incorporating the fair use of space and resources. Furthermore, they also relate towards several Sustainable Development Goals (or SDGs): UN formulated goals that exceed the specifics of the region. Examples are those of inclusive infrastructure, responsible consumption and fair and coordinated cooperation between stakeholders. Focus has been put on at least 7 of the 17 SDGs, as well the overall development goal of creating a circular plastics economy.

To bridge the non-spatial essence of the plastics sector, and the demand for spatial solutions, the main strategy involved the use of pilot projects. These are projects that are envisioned to be placed strategically, according to a specific phasing schedule, and supported by policies. One of the most essential strategies for establishing a circular plastics sector was to reduce the size and scale of material flows throughout the entire plastic cycle. Therefore, these pilot projects consisted of strategic interventions that operate on different scale levels: the port on the scale of the province, the park on the scale of the region, and several hubs that operate between municipal and local scales. These interventions have been envisioned to go hand in hand with larger scaled, more general spatial transitions of urban areas. An example of this is an industrial hub becoming part of a newly transformed peri-urban area: an area that was prone to decay, and therefore needed revitalizing. The transformation is a greater spatial intervention in itself. However, the introduction of functions related to the plastics industry is part of the transformation of the area. Interventions like these tried to emphasize the spatial effect of our formulated strategy.

Although the focus - and aim - has been to envision a future with plastics, it must be stressed that this report also tries to highlight that there is space for other sectors to thrive in the future too. After all, the main goal has been to strategise a circular model through reduced and redefined material flows. This can be beneficial for many other sectors as well, whether it relates to plastic alternatives (like cartons or glass products) or even completely different industries (like agri-food or construction). As we can never be completely sure what the future will hold, we hope that this report can offer a basis for non 'Fantastic Plastic' futures too.

It is fairly safe to say that this report does not yet give a full answer towards the development of a spatial strategy for this sector. Simply put, research has been limited, and the sector itself is hard to spatialize to begin with. This doesn't mean that this is impossible. A first attempt has been made to connect spatial problems, trends and opportunities to important systems and stakeholders. For a sector like this one, the most important research is arguably based on practice. Small scaled innovations, pilot projects, field labs and living labs are all elements that can be used to examine new ways of living with plastics. A recommendation would certainly be to use these elements to strategise and experiment with in future research. This research may show how new ways of living with this non spatial sector will affect our spatial way of producing, consuming, and living in general. They might highlight the importance (or possibly, the insignificance) of living with plastics. For now, and for the future.

Individual reflection

Francien Fons

Introduction

I believe that spatial strategic planning is part of a countries, governments and peoples identity. The preference for a certain type of planning depends on a person's own preference. That being said I also believe that although every country, government and individual has their own preference for a certain type of spatial strategic planning, only with global and nationwide planning problems like global warming, inequality and health can be tackled.

Framework

This report is part of the course Research and Design: Spatial Strategy for the Global Metropolis and focuses on a proposal for a regional design that transforms the current plastic chain into a circular plastic network. I found the topic of plastic difficult, mainly because plastic itself is hard to spatialize, because it is mainly flow oriented and more intertwined with behaviour of people than with space. The biggest impact on the circularity scale is the refusal or reduction of plastic, which is hard to stimulate with only spatial interventions. This resulted in hardship with formulating the research question and coming up with spatial strategy. Happily with help of the SDS lectures where we learned some useful tools and got the possibility to have some discussions.

Fantastic Plastic

In the end we came up with the regional design strategy Fantastic Plastic. This strategy addresses the problem of the current unsustainable plastic chain in combination with the current trends of urbanization, spatial competitiveness and land use. Our solution is to implement four 'plastic pilots' that work on different scale levels. The location for these would be in currently vacant buildings. At Industrial and distribution sites new functions like housing, shops and start-up space would be added so that in thirty years the province of Zuid-Holland will no longer produce oil based plastics and consumption has been limited to a minimum through socioeconomically fair and viable alternatives.

Conclusion

The SDS lectures explained multiple very topical subjects that came handy during the making of the report. In the end the SDS lectures gave me a strong basic framework and space to discuss and therefore to make the best report that was possible.

Hugo Lopez

Transitional spaces

Circular economy & spatial strategy

Circular economy, a term that evolved from human, industrial and urban political ecology is still to develop terms and practices related to the built environment. I believe its main potential is to be the articulator and the contention plan at the same time. I mean, to show that regenerative actions are economically viable, and that harming practices will fade in disuse. The transition towards this model is still in course. When developing a spatial vision and a development strategy for the plastic sector in Zuid-Holland, it came as a challenge as one of the main problem with plastics is, concomitantly, its ubiquity and its lack of visibility. So how to make a plan for a material that is hard to realize that it is everywhere?

Networked governance

The idea of urban governance as "the software that enables the urban hardware to function" came in as something to help drawing the strategy that articulates the phases of the material with everyone that is in contact with it. I became very interested in understanding what we called "the plastic network" and the barries to a transition in agendas and businesses models. One way to see the Fantastic Plastic project is that it aims to tackle the governance challenge that is "multi-scalar, multi-sectoral and multi-actor" (Obersteg et al., 2019). Each pilot project is to test how locations influence - and is also open to be influenced - the actions of each actor (from the least to the most powerful) and can shape their attention towards the circular plastics agenda.

New imaginaries

To be realistic, we can refuse to use plastics but the amount that we already have in our environment will not fade away. It is invasive and harming nature - humans included. We need to imagine a future *with* plastics, however very different from our present. We need to imagine a transition related to a lifestyle change. I believe that our project touches upon the need for representation change, as Carola Hein said in her lecture to our group of students. It was important to include the individual level of the people, and provide means that individuals could be a partner for greater responsibility and cooperation throughout the plastic loop. "Without engaging the society we will fail" (Frantzeskaki et al., 2016) in our proposals of future.

Conclusion

Having the Province of Zuid-Holland bringing the regional scale perspective was personally very exciting. I would like to keep learning about an Urbanism of that scale, being a bit more of a strategic planner and exploring future scenarios based on trends and data. In the Fantastic Plastic project we were challenged in relating a material to space, and spaces to a network, and the network to an economically viable way to deal with the environment. It felt like the three pillars of sustainability are not enough and we needed to add spatial strategy so it could stand and become a framework to create the future we want to live.

Joaquim Boendermaker

The idea to research a sector that was not particularly familiar interested me from the start of this quarter. The chemical sector immediately presented itself as the 'odd one out', so to say: an, albeit immense, industry that seemed to have less of a spatial interpretation. Still, I had already figured that in regards to the industry of Zuid-Holland the chemical sector must be very relevant for the province. The presence of the chemical sector in the port of Rotterdam exemplified this. Within the initial group discussions, the plastics sector quickly stood out as a specific system to investigate. Even though plastics alone aren't that relevant for solving complete environmental issues (it's only a small part of the total emission rate), the fact of the matter is that plastics are very important for our daily lives. Therefore, we thought that altering this industry could have significant consequences on the way we live - and the way the sector is organised spatially.

Through this, the 'Fantastic Plastic' pitch was born. An idea that with research and strategy, we could redefine the sector to make it sustainable by 2050; socially, economically and environmentally. This led us to fully dissect the sector at first: investigating early life, mid life and end of life systems. Additionally, we looked into spatial, circular, and network fields to see how the sector was organised and what spatial strategies would be needed to reorganise it. This examination proved to be rather difficult, as the research fields were considerable in size and any outcomes required careful finetuning between all the group members. This was often quite a struggle. It showed us that on even the microscale (of working in a group of four), managing all elements, factors and stakeholders that operated within the province was very demanding.

To further ourselves in this R&D studio, it was imperative that we each progressed within our exploration and implementation of the vision and the strategy. Personally, I looked more into the spatial side of the story. I was interested in looking at external spatial threats and opportunities. I thought these could help us substantiate decisions we made regarding the plastics sector without developing drastic spatial strategies that would simply not be feasible. Unfortunately, it has been hard to very concretely connect these to our final vision and strategy: the plastic sector remains to be quite distinctly non spatial. I think we tried as best as we could to define our new envisioned future with plastics, and I think we definitely achieved this to some extent. In future projects, I believe it will be imperative to grasp the subject in an earlier stage and find stronger, more coherent connections to link up research in different fields and outcomes through visions and strategies.

Marit Vuyk

Reflecting on the relation between research and design throughout our project

Importance of planning and design

Regional design and planning are important steps for every urbanist to comprehend more in depth the challenges and necessity of working across scales. I engage to it because I believe that it is essential for creating a more sustainable future with spatial justice, environmental preservation, and better living conditions. Moreover, I gained the inside of the value of making effects of planning and design spatial, I understand it is of great importance to be able to see the possible effects as it can speak more to a non-expert.

Research and design process

The development of our strategy was not a linear process of research leading to design, but a constant interaction between both, in a sense you could say the process was circular. Throughout the process new research let to new designs who let in their turn to new questions which required new research, and so on.

Our personal interest and existing knowledge guided us towards a multi-dimensional and multiscale approach. This approach provided a broad and I believe extensive overview of the current and proposed future situations. From my perspective, this approach is our designs strength and can really help to reach a full economic, social, environmental, and spatial transition to a circular plastic sector in Zuid-Holland.

Roles of the designer

We identified our group as a combination of different types of planners, described by Sehested (2010). Our main type of planner would be manager, followed by market and strategic planner. Nonetheless, we discussed the importance of inclusiveness and concluded we wanted to create a design that would be beneficial for all. Moreover, since most of us were more focusses on research versus design, a good environment was present to create a visionary design based on theory.

Implication of research on design

Spatial planning and design should consider different dimensions throughout processes (Cardoso, 2021). Hence, throughout our project we tried to gain insight from different fields related to the plastics economy. However, I feel that apart from our best intentions, we were not able to pay attention to all the possible conflicts and possibilities for the design. I believe that it would be very interesting to examine our project now by presenting it to different stakeholders and find out which aspects of the design we didn't foresee and how we could improve it.

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