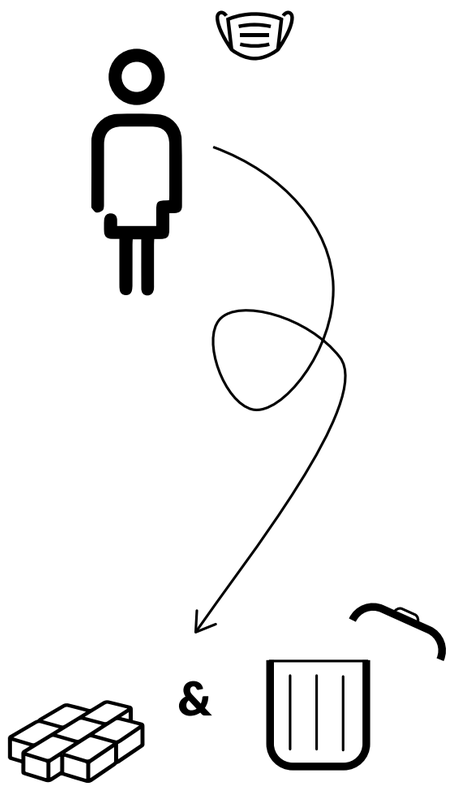
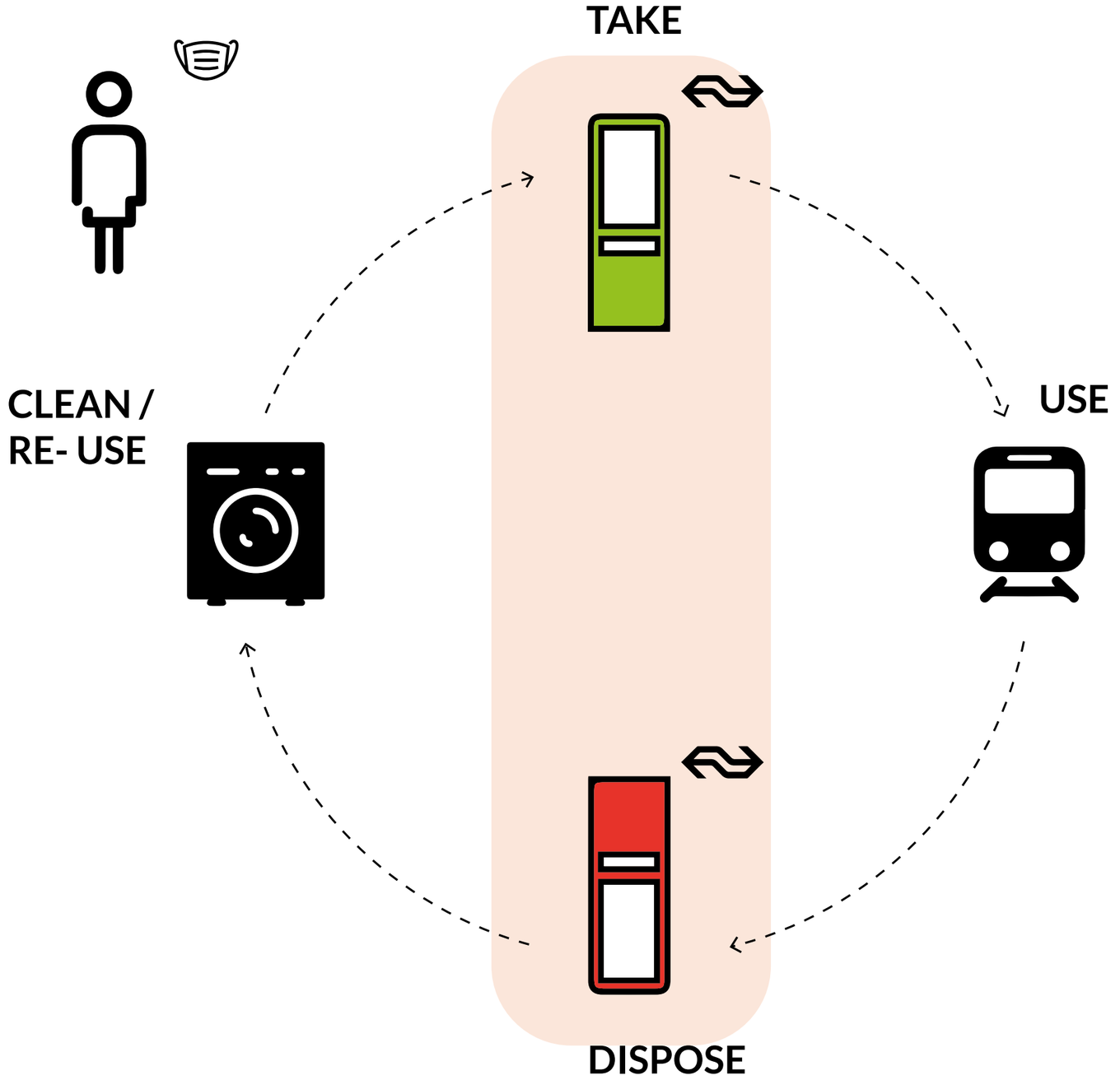
1 | UNMASKING WASTE STREAMS

WHAT HAPPENS TO MASKS AFTER THEY ARE USED?



A SUSTAINABLE & LOCAL ALTERNATIVE



‘CORONAVIRUS: FACE MASKS A GROWING POLLUTION PROBLEM’ - United Nations

United Nations Conference on Trade and Development. (2020, April 20). Environmental impacts of coronavirus crisis, challenges ahead. Retrieved from https://unctad.org/en/pages/newsdetails.aspx?OriginalVersionID=2333

To which flow does the idea belong?
Single use face masks
To which challenge does the idea belong?
Covid - 19 pandemic

Problem Description

After the covid-19 outbreak there has been an increased necessity for hygiene related items. Such items are often imported, made from plastics and ment for single usage. This causes a major flow of unsustainable products ad increases plastic waste streams. These masks may be contaminated with the Covid19 virus and therefore are a hazardous waste stream. Although face masks are mandatory in public transport as of the 1st of June 2020 common infrastructure for disposal is still lacking. Currently mask are discarded in regular waste streams which creates contamination risks.

Our idea

To combat the issues described above we designed a concept for more sustainable face mask usage. The idea revolves around selling reusable masks and facilitate the waste collection. This enables people to quickly and safely obtain a mask when they need one. We take care of the waste collection and the sustainability aspects of the product. Mask will be designed for reuse and cleaned, or recycled, in our local facility. in this way we contain the and hazardous waste stream and simultaneously reduce the plastic waste flow.

Target Group

The main initial target group will be public transport users in the Rotterdam metropolitan area. This group is chosen since it many thousand of people use public transport daily and therefore also need a clean face mask. Through this system we aim to reduce the plastic import, reduce plastic waste and stimulate more sustainable behaviour.

The business concept

Obtaining a mask can be done with a public transport card. This will ensure a seamless incorporation within the public transport system and make it carefree for the user. The business model will be a lease system where the user pays for the mask per day, in this way returning of the mask is incentivised. It is also possible to swap mask if the user feels this is necessary.

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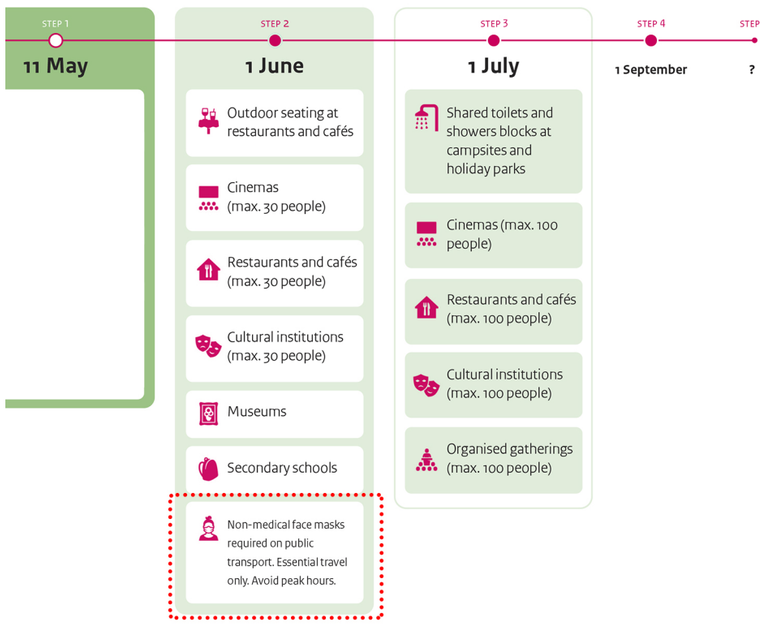
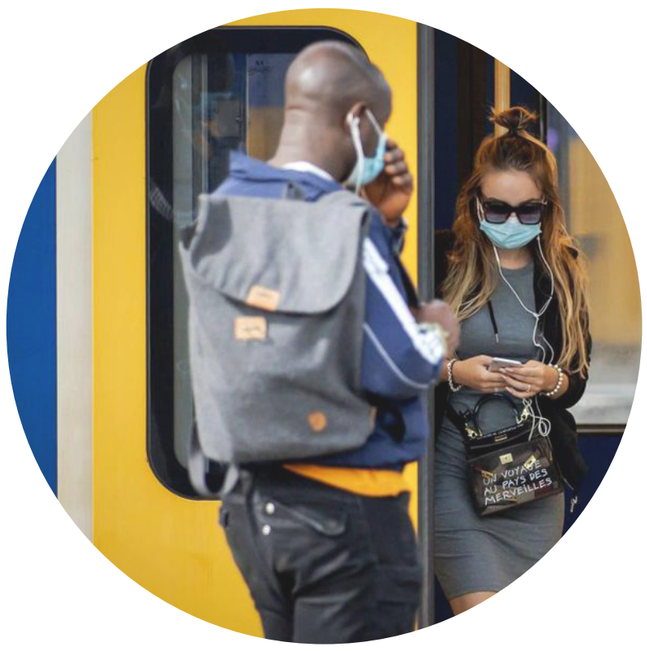
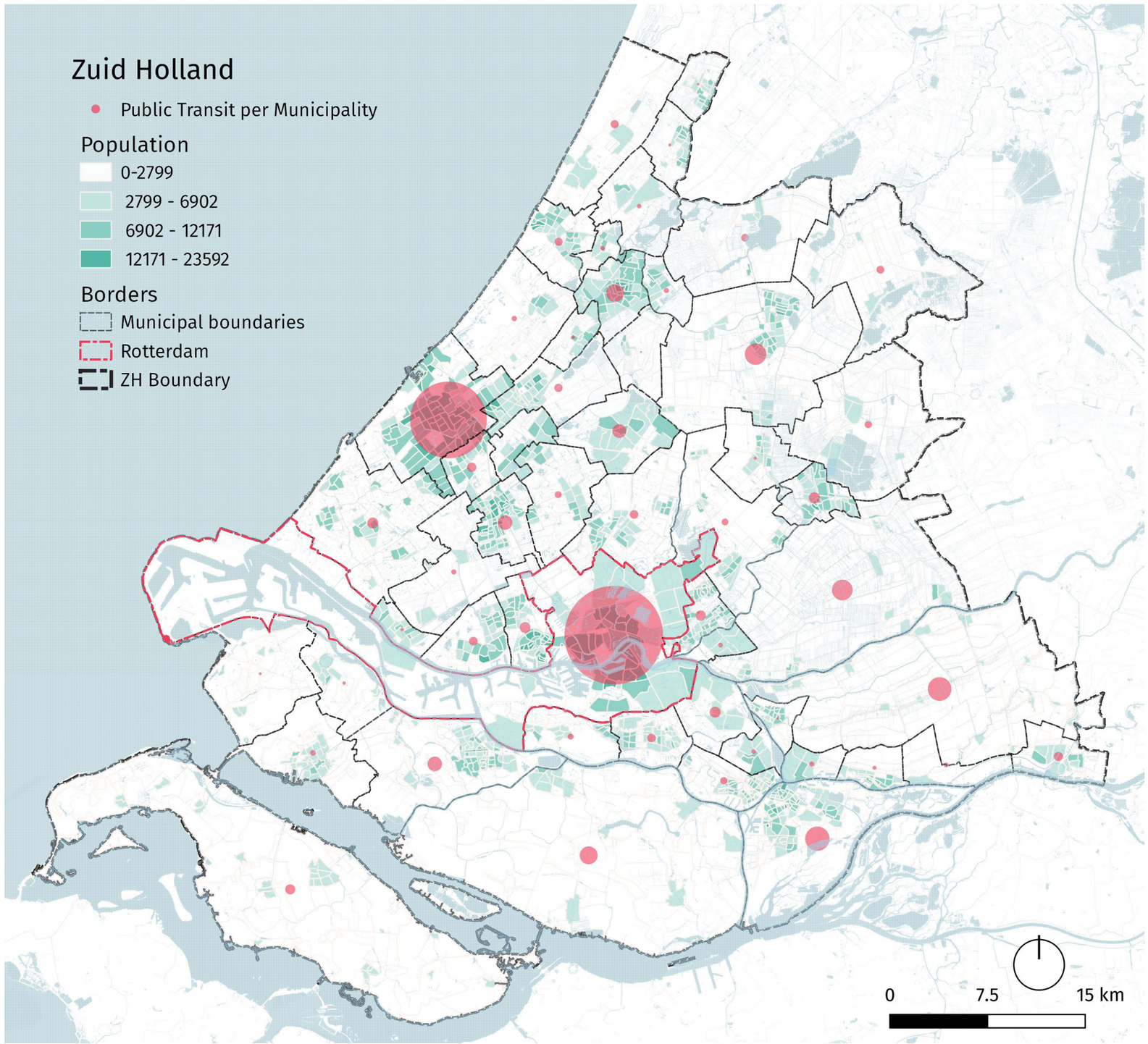
2 | REPRESENTATION MODEL





Nieuws.nl. (2020). NS: mensen goed op de hoogte van verplichting mondkapjes. Retrieved 10 June 2020, from https://nieuws.nl/algemeen/20200601/ns-mensen-goed-op-de-hoogte-van-verplichting-mondkapjes/



Zuid Holland

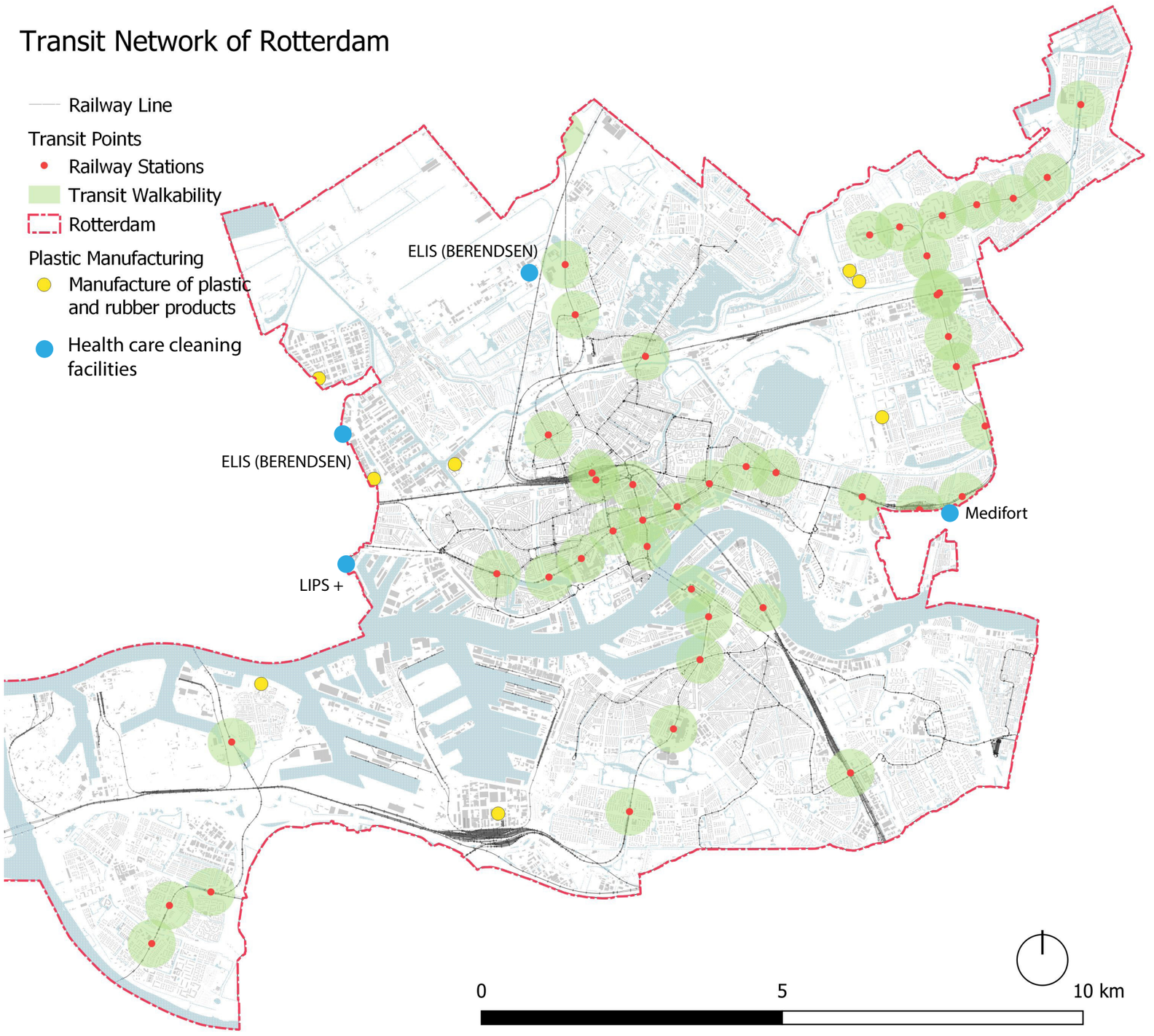
As Zuid Holland transitions to a post-covid reality, there are a few infrastructural gaps that need to be addressed as well.
As masks have been made compulsory while using public transport, the production, management and processing of masks is a newly rising flow of materials and energy.
We need to ensure the availability of them, for the purposes of public health, while also making sure that it is processed carefully at the end of their life.
To focus on a specific case, we are looking at population and number of transit points as a proxy for potential impact and focusing on Rotterdam to start the initiative.

651,446

population of Rotterdam

45

Railway stations in Rotterdam



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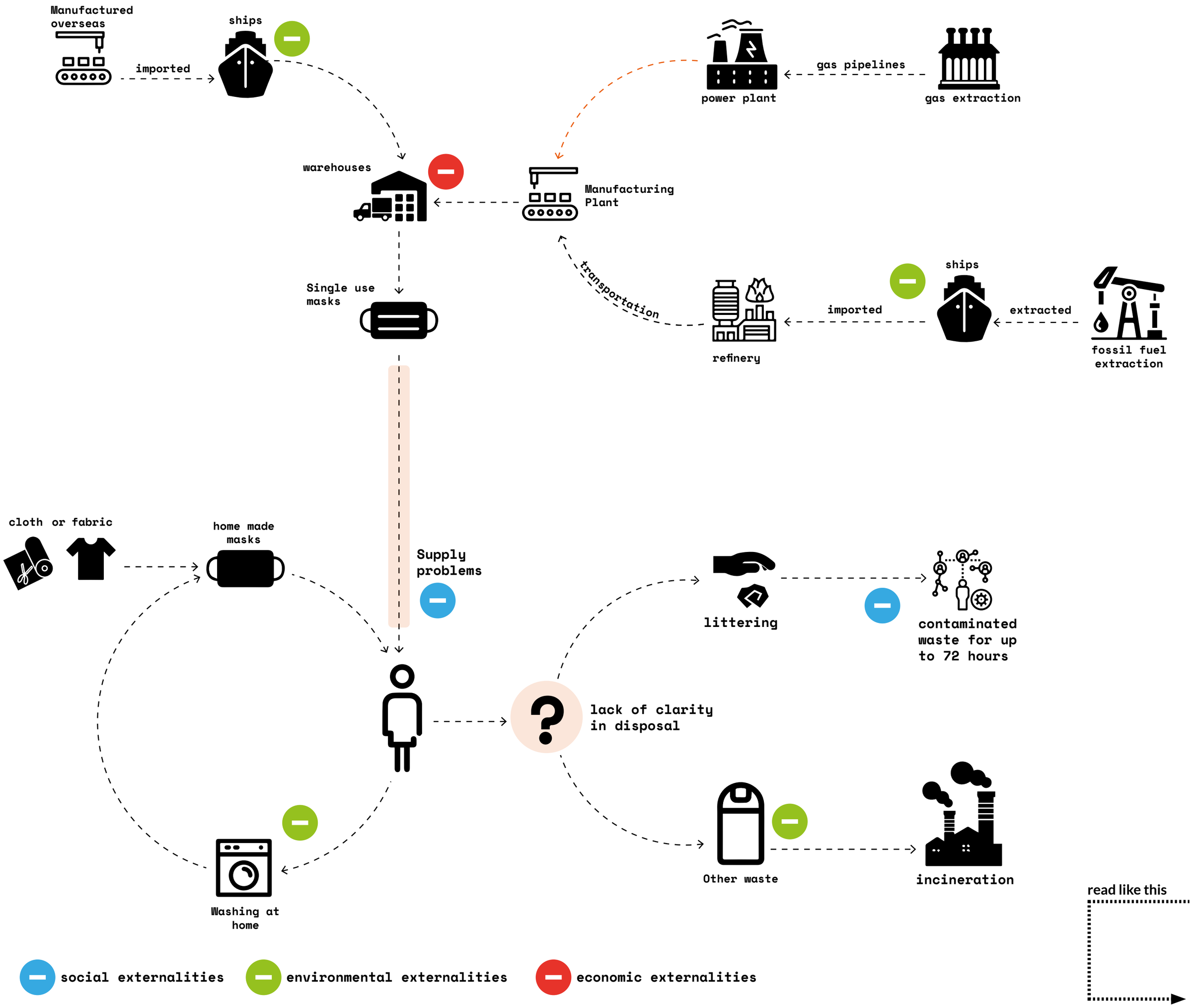
3 | PROCESS MODEL



Current system problems

Linear supply chain

The current system has various problematic aspects. The diversity of products and the design thereoff cause a large quantity of really diverse waste. Mask are currently designed for single usage and are made from a wide variety of materials making proper recycling difficult. In order to become more sustainable the sector has to steer away from a linear supply chain towards a more integrated reverse supply chain.

- Estimated 500 ton CO2 eq / year in Rotterdam alone

- Estimated 22.500 masks per day in Rotterdam

- Re-usage could possibly reduced waste by 95%

Hazardous waste

Since there is no designated collection of the masks a lot of them end up in regular waste streams. This poses a hazardous threat since these masks can remain infectious for up to 72 hours.

Major Impacts of the current system

The processes mentioned above are the ones that contribute the most to the environmental impact of the masks (Allison et al. 2020). The least sustainable scenario is one of imported single use masks. In this case mainly overseas transport contributes to major emissions impacts. Of course such a scenario is also least favourable from a waste perspective.A scenario based on reuse but with people washing them at home seems really sustainable although studies show that the washing of the masks contributes largely to the overall user impact. In a case with replaceable filters such a scenario is even less sustainable than a single use scenario.

Washing accounts for 70% of the environmental impact in a reuse scenario

The three main impacts of the current system are therefore transport, waste generation,material use and washing related energy and water use.

In order to reduce the impact of our proposed solution we therefore apply three main strategies:

Design for Re-use | Produce Local | Wash on large scale

Source: Allison, A. L., Ambrose-Dempster, E., Domenech Aparsi, T., Bawn, M., Casas Arredondo, M., Chau, C., Ward, J. (2020). The environmental dangers of employing single-use face masks as part of a COVID-19 exit strategy. UCL Open: Environment Preprint, 6–44. https://doi.org/10.14324/111.444/000031.v1

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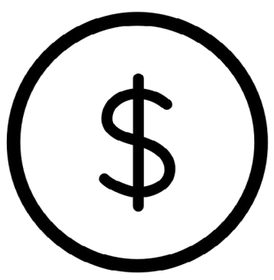
4 | EVALUATION MODEL

ECONOMIC INDICATOR



INDIRECT COSTS

Decrease in economic productivity due to COVID - 19.

+ 200.000 unemployed

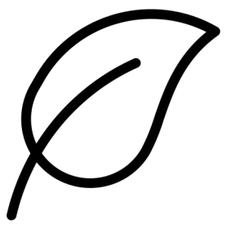
(CBS, 2020).

DIRECT COSTS

Cost (€) of masks usage per person (when masks are mandatory)

€ 0,25 per use

ENVIRONMENTAL INDICATOR



WASTE REDUCTION

Waste production of single - use masks

Rotterdam: 1250 kg / day plastic waste

Masks consist of PP and HDPE plastics in combination with cellulosic fabric, elastics and sometimes even cotton (Allison et al., 2020).

CO2 EMISSIONS

Amount of CO2 ton per year

Rotterdam: 5500 ton CO2 eq / year

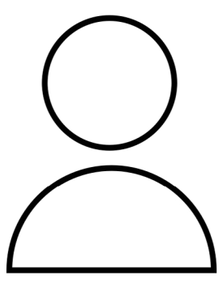
(Allison et al., 2020).

CLEANING PROCESS

Washing at home adds to emissions

Washing by hand is 70% of the environmental impact in a re- use scenario (Allison et al., 2020).

SOCIAL INDICATOR



AWARENESS

% of people using recycled masks

Aim to increase % of people using recycled masks

ACCESSIBILITY

% of station with a mask kiosk in South Holland / % of people within walking distance of public transport station with kiosk

Kiosks are now non-existent

SOCIAL RESPONSIBILITY

% of contaminated people using public transport every day

Contagion probability of 70 %

When two people are not wearing a mask (Chu et al., 2020).

SAFETY

% of reduced conflicts with train or other enforcement

Striking for safety

Enforcement officers are striking in Rotterdam because they do not feel safe without means to defend themselves.

INDICATORS

In this section the essential indicators are formulated which will be used to asses the idea. These indicators are essential for quantifying and visualising the change and impact of the concept. Thereafter these indicators can be used to compare our proposed future scenario with the current situation. The new proposed circular system has various positive as well as some negative impacts. The indicators will be chosen in such a way that all these impacts will be represented in the comparison. The main positive impacts are reduction in material use and emissions but also increased public safety and awareness. Possible negative impacts are mainly associated with risks that can be manifested through faulty design. The system transfers large quantities of possibly contaminated waste which should be handled accordingly and disposed of safely. The system therefore has to be designed with this in mind and reduce the exposure of the user to an absolute minimum.

The chosen indicators are divided in three sections; environmental, social and economic, this allows for a holistic evaluation of sustainability.

ECONOMIC INDICATOR

As a result of the Covid-19 measures the economic activity in the region is reduced. In the last three months the number of people without a paid job grew by 200.000 (CBS, 2020). The majority of this job loss was under young people who generally also do not have any financial buffers. Since many sectors are still running on limited capacity it is also harder to find a (part time) job. Since the production, logistics and washing of our masks are all done within the province there is a gain in local economic productivity. This means there are more jobs created, less need for imported goods and an increased local material flows.

Beside these indirect costs for society there are also the direct costs associated with the usage of the masks. Average usage costs are estimations based on the price and longevity of various different types of masks that are currently available. These prices are a rough estimate and do not include washing costs. This price of 25 cents per usage will serve as a future reference point.

ENVIRONMENTAL INDICATOR

As described in the process model there are three main processes that influence environmental sustainability of face masks; washing at home, single usage and long distance transport of products or materials. The indicators associated with these processes are CO2 emissions and generated waste. In order to analyse the impact of the current system data from a life cycle assessment on facemask usage in the UK was used. These numbers have been extrapolated to the municipality of Rotterdam on a per capita basis (Allison et al., 2020).

SOCIAL INDICATOR

Lastly the social indicators; these indicators reflect the added social benefits of the idea. To validate the social impact of our idea we focus on 4 social indicators; social responsibility, safety, awareness and accessibility. These impacts might be amongst the most influential but are also the hardest to quantify.

Currently face masks are a mandatory part of our everyday life which means the society as a whole has to adjust to new social standards. Everyone suddenly more strongly bears responsibility to contribute to public health and safety. Face masks are an essential part in this since wearing a mask can greatly reduce the possibility of contagion (Chu et al.,2020). Prevention of infections can relieve the health system and reduce the financial burden on society since hospitalization is costly. This risk can be quantified by estimating the fraction of travellers that carry the virus.

These new regulations are designed to facilitate this safety and prohibit people to travel without masks which may hinder mobility. This can lead to moments of conflicts, for example between travellers and the train staff.

Awareness is measured through the percentage of people using a reusable and recycled facemask. The aim is to increase this percentage. In order to be able to make such a change our masks have to be easily accessible. The impact of this indicator will be defined by the portion of stations with kiosks and the fraction of people that live within walking distance of one. The project can only make an impact when a significant portion of the stations is served.

Sources:

Allison, A. L., Ambrose-Dempster, E., Domenech Aparsi, T., Bawn, M., Casas Arredondo, M., Chau, C., Ward, J. (2020). The environmental dangers of employing single-use face masks as part of a COVID-19 exit strategy. UCL Open: Environment Preprint, 6–44. https://doi.org/10.14324/111.444/000031.v1

CBS. (2020, June 18). Ruim 200 duizend werkenden minder sinds maart 2020. Retrieved 17 June 2020, from https://www.cbs.nl/nl-nl/nieuws/2020/25/ruim-200-duizend-werkenden-minder-sinds-maart-2020

Chu, D. K., Akl, E. A., Duda, S., Solo, K., Yaacoub, S., Schünemann, H. J., Schünemann, H. J. (2020). Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. The Lancet, 395(10242), 1973–1987. https://doi.org/10.1016/s0140-6736(20)31142-9

IMPACTS

The main positive impacts are reduction in material use and emissions but also increased public safety and awareness. Possible negative impacts are mainly associated with risks that can be manifested through faulty design. The system transfers large quantities of possibly contaminated waste that should be handled accordingly and disposed of safely. The system therefore has to be designed with this in mind and reduce the exposure of the user to a absolute minimum.

POSITIVE IMPACT

+

- LESS CO2 EMISSIONS
- MORE LOCAL LOOPS
- RE - USAGE
- SAFETY

NEGATIVE IMPACT

−

- LOGISTICS WITH CONTAMINATED MASKS
- NEED FOR SPACE / NEW INFRASTRUCTURE

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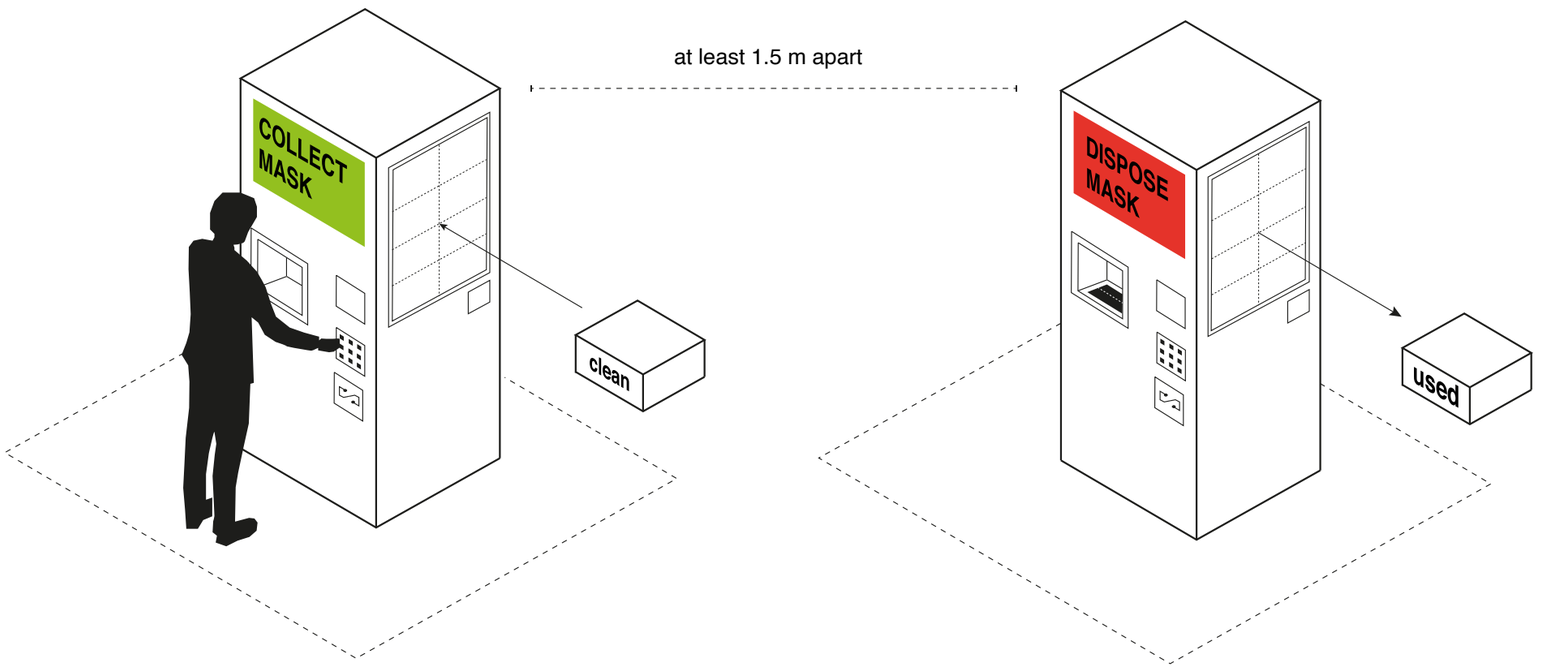
5 | CHANGE MODEL

AT A TRAIN STATION



get a mask

- fixed fee

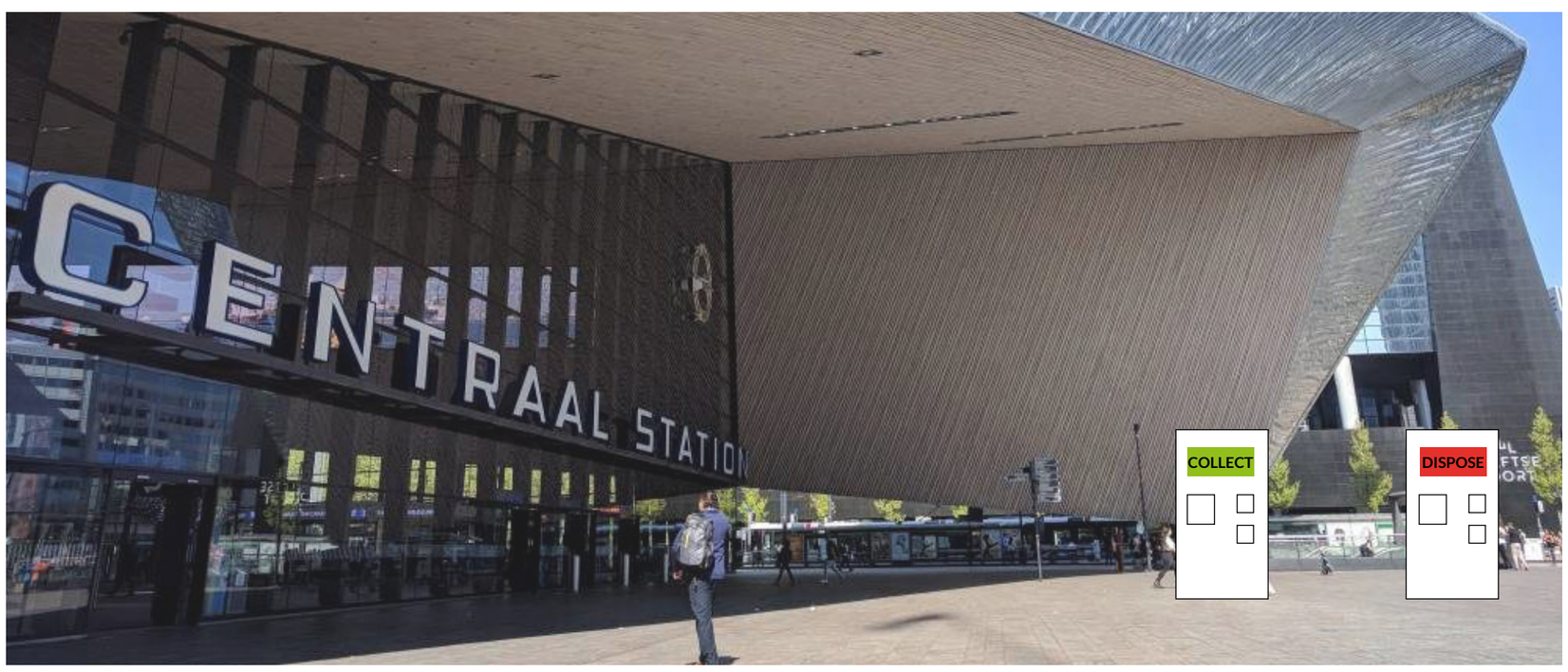
return

- swap for free
- return for refund

re - use

- efficient cleaning
- re - usage
- recycling

PLACEMENT ENTRANCE ROTTERDAM CENTRAL STATION



How it works

Masks are available at vending machines on train and metro stations. Obtaining a mask can be done using a public transport card. A fixed daily amount will be subtracted while the mask is in use, until it is returned. In the meantime it is possible to swap masks for free. Guaranteeing a clean mask on the fly.

Returning the mask will be stimulated through the refund of credit or through coupons for consumptions. If the mask is not returned the fee will continue to be subtracted until the entire costs of the mask is covered.

Firstly, the service is affordable relative to buying a high quality mask. Secondly, it is hassle free and sustainable since the cleaning and recycling is done for the customer. Therefore the service has benefits for both frequent and occasional users.

PZC. (2020). Rotterdam Centraal beste van provincie, stations Zuid en Alexander scoren juist heel laag. Retrieved 10 June 2020, from https://www.pzc.nl/rotterdam/rotterdam-centraal-beste-van-provincie-stations-zuid-en-alexander-scoren-juist-heel-laag~a6d92dbd/?referrer=https://www.google.com/

ROTTERDAM CENTRAL STATION

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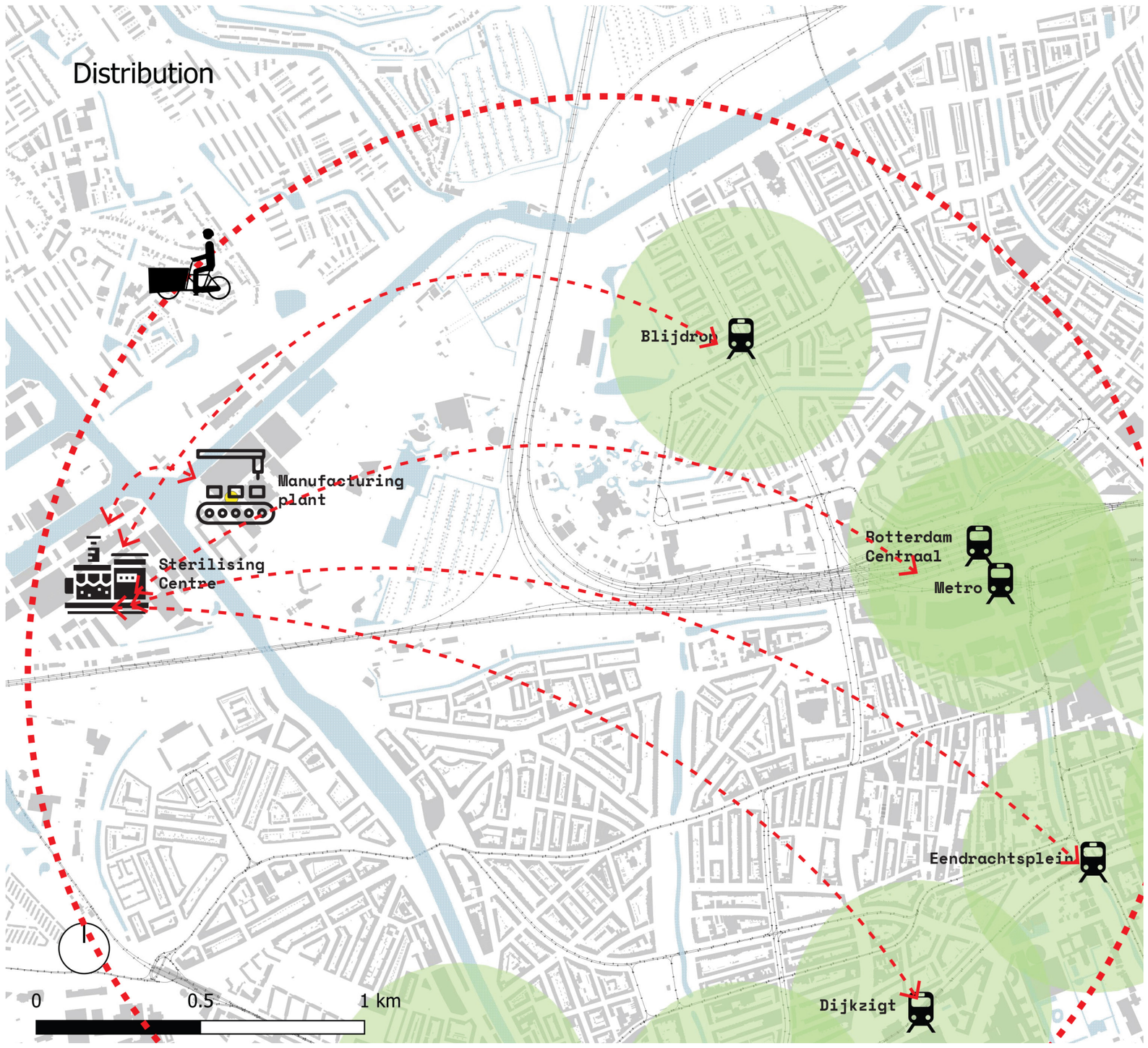
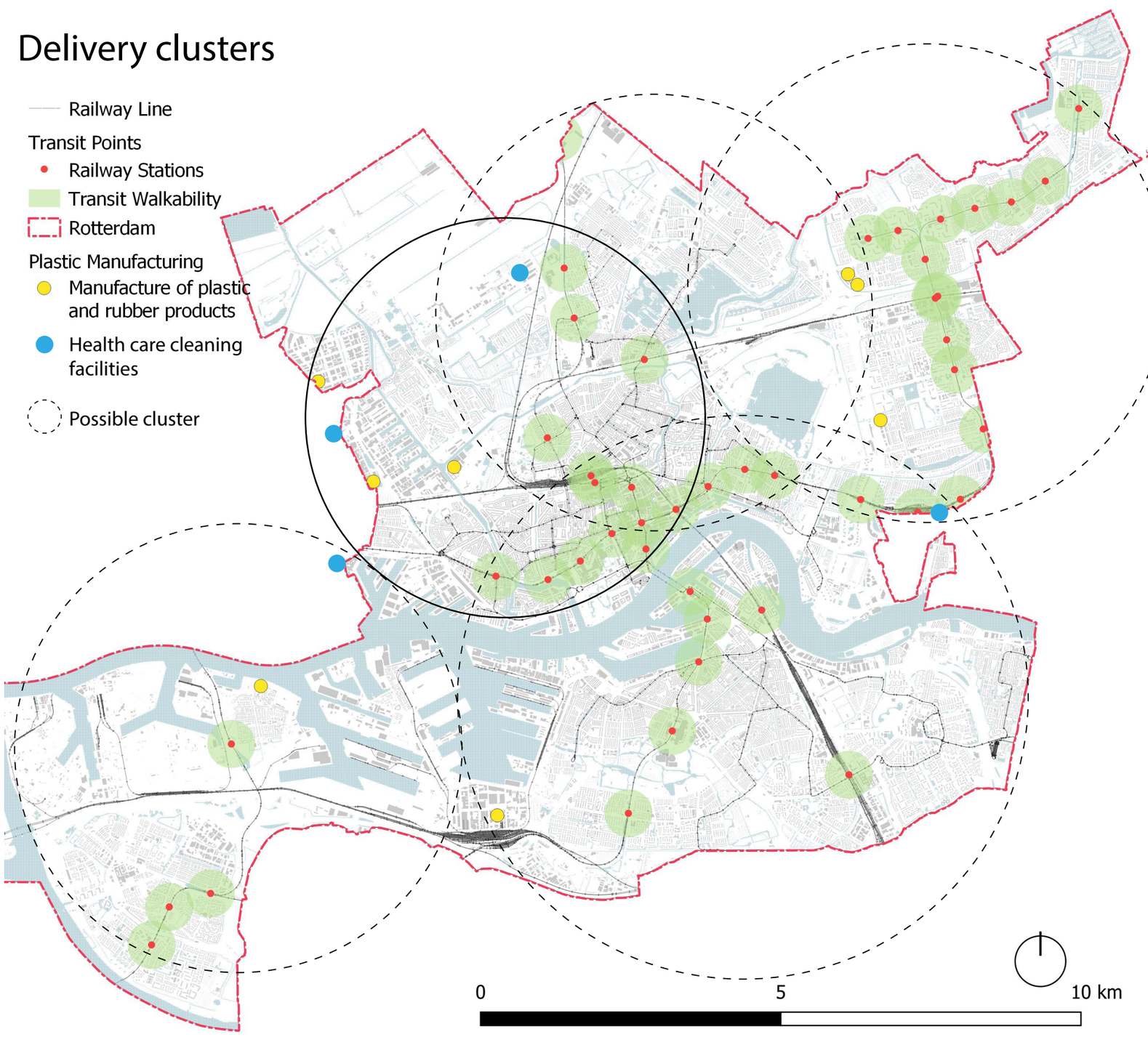
5 | CHANGE MODEL



Clusters

One station with a large footfall and a few smaller stations are part of one cluster with a manufacturing plant and a mask sterilising partner. This is to be determined based on the volume of masks processed everyday and optimising for the transportation involved in the entire life cycle of the masks.

Logistiek. (2018). Elektrische bakfiets PostNL nu ook in Rotterdam. Retrieved 24 June 2020, from https://www.logistiek.nl/distributie/nieuws/2018/11/elektrische-bakfiets-postnl-nu-ook-in-rotterdam-101165950?_ga=2.260699981.1159088552.1593254746-707061016.1593254746



Scaling up

The clusters are expanded to cover the entirety of the city based on the identified partners for the sterilising of the masks across the city. These clusters are tentatively shown on the map, but have to be strategically restructured based on the volume of masks that need to be processed everyday. In case of increased demand, they could be adapted accordingly.

LIPS+. (2017). Over LIPS+ : Diensten. Retrieved 24 June 2020, from https://www.lipsplus.nl/diensten/

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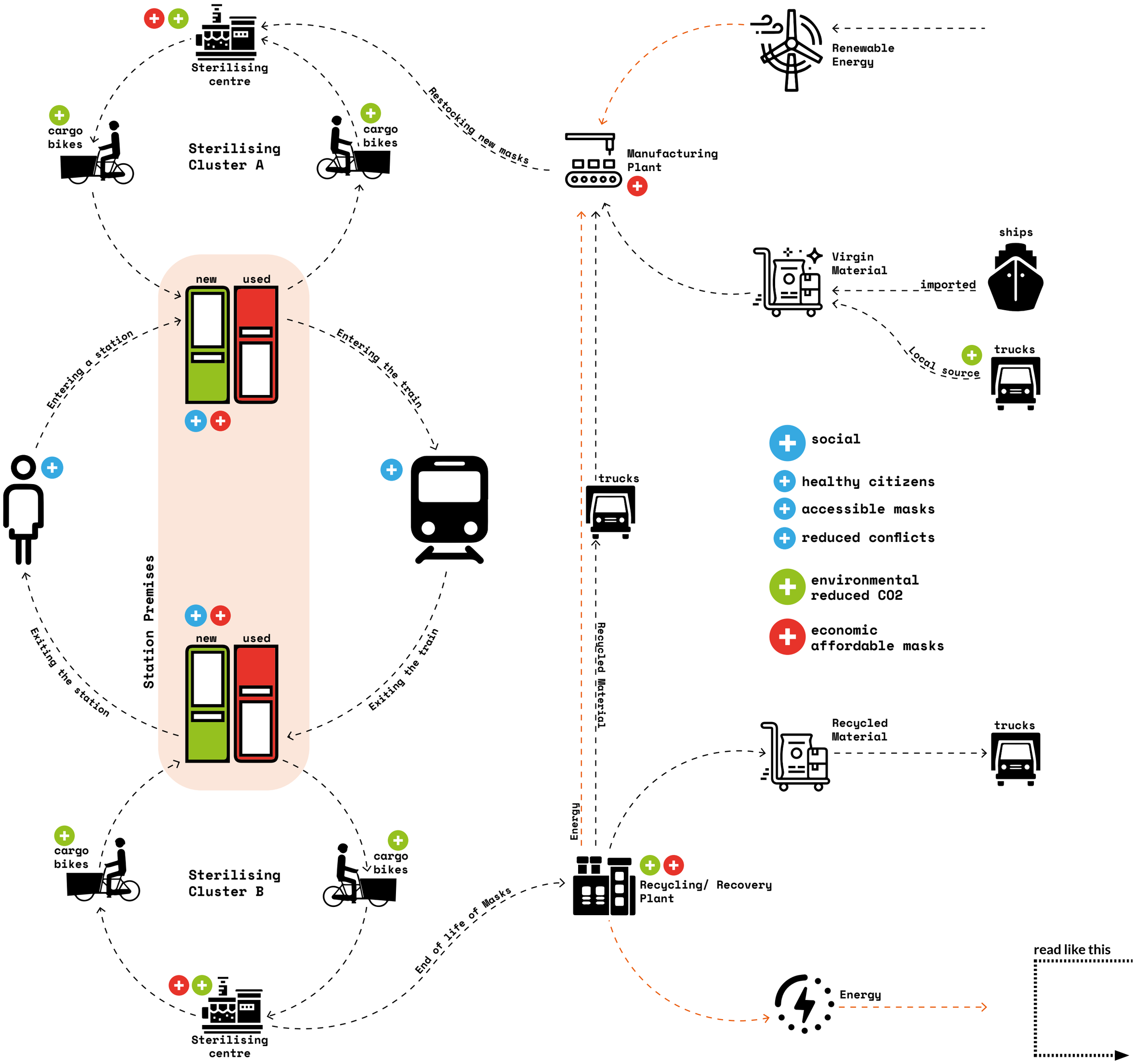
6 | IMPACT MODEL



IMPACT

In our proposed new system there will be several stages that alter the solely linear supply chain and incorporate local material loops. Our masks are made from recycled materials, designed to be reused and designed to be easily recycled at the end of life stage. Based on the impacts described in the process model and the indicators described in the evaluation model we tailored our service with both social, financial and environmental sustainability in mind.

Environmental Impacts

The main reductions in environmental impact are mainly due to reduction of the need for masks. This has the largest impact on the emissions since this reduces the imported materials and also reduces the embedded externalities from the product.
Secondly we try to reuse as much masks as possible since direct reuse is favourable over recycling or incineration. This directly adds the benefit of large scale cleaning which saves approximately 70% of the emissions compared to a scenario where people wash their own masks at home.

Only when masks went through multiple cycles they will eventually be recycled or in the worst case incinerated.

Social benefits

In the new scenario travellers no longer have to worry about cleaning their masks or forgetting it in general. Everyone has the guarantee that there will be a place to obtain one at every station. Even if only a marginal fraction of the travelers is served this would still cover a large amount of people and have a significant impact. Especially since it adds a certainty to all travelers equally. Throughout our branding we want to communicate the relevance of choosing for more sustainable alternatives as well as taking responsibility for one another.

Economic benefits

At the end of the day our solution aims to be a hassle free and viable option for travellers. Saving money on the usage of facemask and enables a sustainable alternative.

synergy existing companies
- no need for new infrastructures

cargo bikes - POST NL
employers - employment agency

sterilising centre - existing
health care washing facilities

manufacturing plant - existing
plastic manufacturing companies

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7 | DECISION MODEL

ECONOMIC INDICATOR

BEFORE

INDIRECT COSTS

Decrease in economic productivity due to COVID - 19.

+ 200.000 unemployed

(CBS, 2020).

DIRECT COSTS

Cost (€) of masks usage per person (when masks are mandatory)

€ 0,25 per use

AFTER

INDIRECT COSTS

Increase in economic productivity due to COVID - 19.

Increased job opportunity

Temporary job opportunity during COVID - 19 outbreak, available via employement agency.

DIRECT COSTS

Cost (€) of masks usage per person (when masks are mandatory)

Aim for best price / quality ratio

ENVIRONMENTAL INDICATOR

WASTE REDUCTION

Waste production of single - use masks

Rotterdam: 1250 kg / day plastic waste

Masks consist of PP and HDPE plastics in combination with cellulosic fabric, elastics and sometimes even cotton (Allison et al., 2020).

WASTE REDUCTION

Waste reduction through re-use

Re-usage can reduce waste by 95 %

CO2 EMISSIONS

Amount of CO2 ton per year

Rotterdam: 5500 ton CO2 eq / year

(Allison et al., 2020).

CO2 EMISSIONS

Amount of CO2 ton per year

Emissions transportation & manufacturing decreased

Through using bikes, local products and renewable energy.

CLEANING PROCESS

Washing at home adds to emissions

Washing by hand is 70% of the environmental impact

In a re- use scenario (Allison et al., 2020).

CLEANING PROCESS

Washing at a central cleaning facility

Washing industrial scale 3 - 5 times more sustainable

(FTN, 2018).

SOCIAL INDICATOR

AWARENESS

% of people using recycled masks

Aim to increase % of people using recycled masks

AWARENESS

% of people using recycled masks

Re-use of 7500 masks / day

For Rotterdam central station alone.

ACCESSIBILITY

% of station with a mask kiosk in South Holland / % of people within walking distance of public transport station with kiosk

Kiosks are now non-existent

ACCESSIBILITY

% of station with a mask kiosk in South Holland / % of people within walking distance of public transport station with kiosk

Kiosks at train and metro stations Rotterdam

Busses and trams are not included yet.

SOCIAL RESPONSIBILITY

% of contaminated people using public transport every day

70

When two people are not wearing a mask (Chu et al., 2020).

SOCIAL RESPONSIBILITY

% of contaminated people using public transport every day

50

When two people are wearing a mask (Chu et al., 2020).

SAFETY

% of reduced conflicts with train or other enforcement

Striking for safety

Enforcement officers are striking in Rotterdam because they do not feel safe without means to defend themselves.

SAFETY

% of reduced conflicts with train or other enforcement

Reduced moments of conflict

EVALUATION

Size and Scale

The scale of the project is of great importance for the overall success. This poses a trade-off since it is most likely for a start-up to start on a modest scale but significant size is needed to make the service viable. Therefore larger stations with a high number of daily passengers will ideally be used as pilot cases.

A good starting case would be Rotterdam central station with around 150.000 travelers per day. Although these numbers can be expected to stay significantly lower than this in the near future. For our assessment we estimate 50% of the pre-corona commute.

As a test case we aim to have the capacity to serve 10% of the total travelers on the station. This would come down to approximately 7500 masks per day for Rotterdam central station alone.

The density of machines is not only dependent on the capacity of the kiosk but also on the foot traffic though the station. The spatial aspect seems to be more limiting than the physical capacity of the machines. An average vending machine is approximately 1.6m3 which is enough space to tightly pack a large number of masks, at least enough for multiple days. Our aim is to place 5 collection and 5 disposal machines on the station, as shown in the change model. Note that these estimations above are rather arbitrary and solely service for context of scale.

The design of the disposal machines is rather important since it should be extremely safe and hygienic but they also need to be able to store large amounts of masks. This could pose a design challenge and significant thought should go into this.

Washing

The average weight of a reusable mask is approximately 15 gr (Allison et al., 2020). Therefore the 7500 masks per day mentioned above would result in approximately 115 kg of masks that have to be washed daily. This would only cover 10% of the travelers on Rotterdam Central station only. If the scale would be increased to 10% of the total travellers in Rotterdam this number could increase with multiple factors.

If people separately hand wash their masks this will greatly increase the environmental impact, up to 70% of the total impact can be accounted to hand washing (Allison et al., 2020). Machine washing the masks along with other laundry greatly reduces this impact. However washing at a industrial scale could further reduce this impact as this proves to be 3 to 5 times more sustainable than washing at home (FTN, 2018). The Dutch Federation for Textiles (FTN, 2018) made agreements with the Ministry of Financial Affairs to further reduce the energy usage, pollution and environmental impact of the sector (Cleanlease, 2020). These laundry companies also have the added benefit that they already have advanced logistic systems in place and are already prepared to process large quantities of possibly contaminated items.

Logistics

Cooperation with existing businesses would be ideal so their existing logistic systems and services can be utilized to reduce the needed investments. For the logistics local cargo bike networks will therefore be utilized. These companies use electric vehicles which helps to reduce transport related emissions. This also eliminates the need for a separate storage facility since the contaminated used masks can be transported directly to the designated washing facilities. This makes the design of the disposal containers is extra important to ensure safe extraction and transport even through conventional logistic services.

Production

The aim is to produce the mask from recycled materials within the province, and thereby reducing transport related emissions. These emissions account for approximately 70% of the total emissions in a single-use scenario (Allison et al., 2020).

Sources:

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