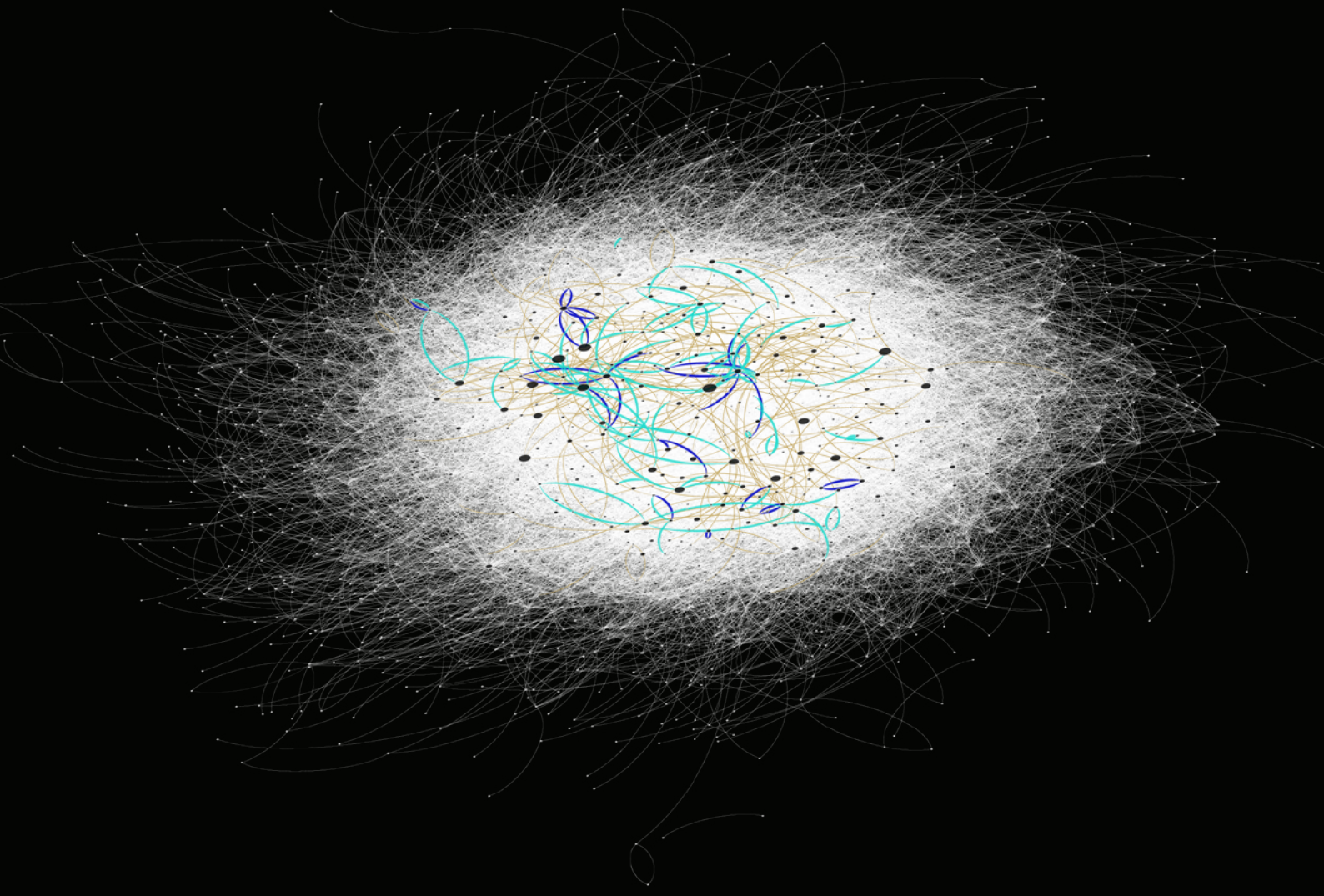
FROM DATASPHERE TO DATASCAPE

Development of the data infrastructure, as a catalyst of the energy transition and the circular economy



4348125 || Karlou Westerbeek 4490983 || Kelvin Saunders 5001595 || Sorawit Pattarasumunt 4295153 || Jurriënne Heijnen

Delft University of Technology - MSc Urbanism (Architecture, Urbanism and the Building Sciences)
AR2U085 R&D Studio - Spatial Strategies for the Global Metropolis

Tutors

Alexander Wandl Diego Sepulveda Carmona Luisa Maria Calabrese Daniele Cannatella

Delft University of Technology - MSc Urbanism (Architecture, Urbanism and the Building Sciences)
AR2U085 R&D Studio - Spatial Strategies for the Global Metropolis

4295153 || Jurriënne Heijnen
4348125 || Karlou Westerbeek
4490983 || Kelvin Saunders
5001595 || Sorawit Pattarasumunt

Tutors: Alexander Wandl | Diego Sepulveda Carmona | Luisa Maria Calabrese | Daniele Cannatella
April 2020

Note: All images, graphics, diagrams are made by the Authors unless otherwise mentioned. Source for all maps: QGIS Data
Sources for additional data in the maps are mentioned in the caption of the maps.

This report is for the perusal of the recipient only. Nothing from this file may be reproduced or used without the permission of the above-mentioned authors.

CONTENTS

00
ABSTRACT

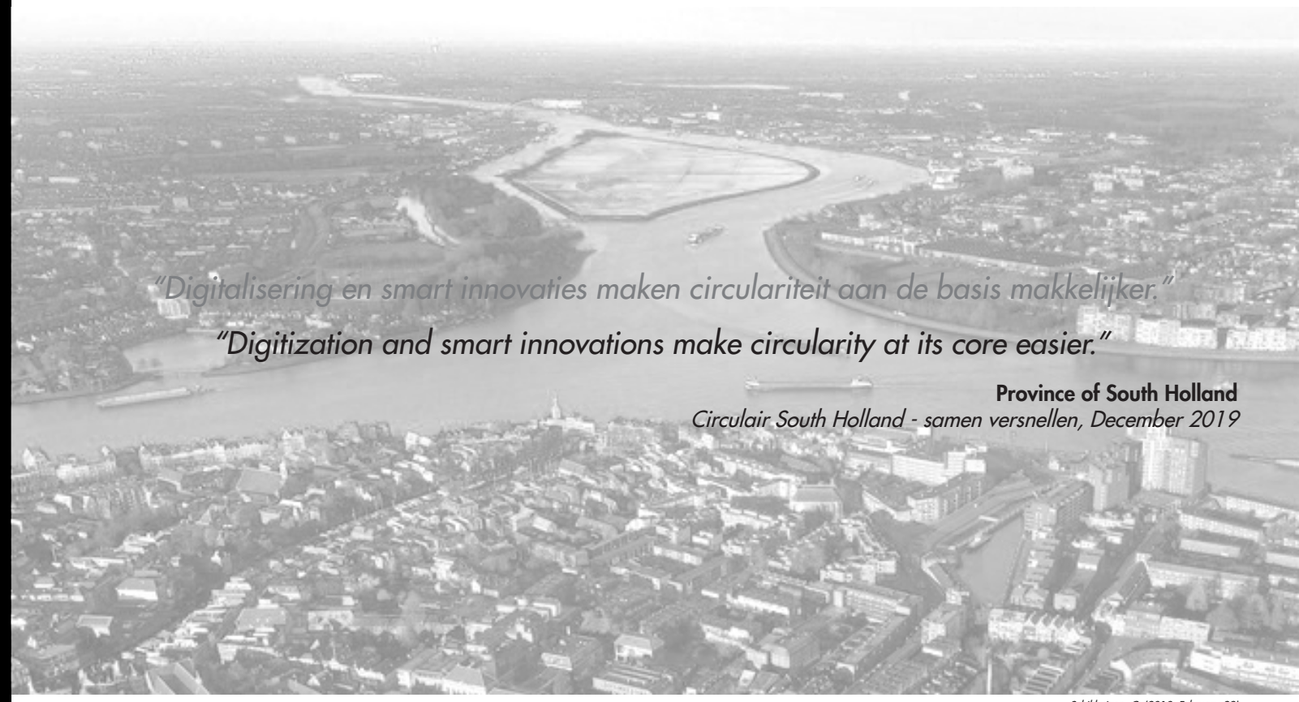
Abstract - Economy and technological innovation have always shaped the Dutch landscape and society. The evolution of the Internet has led to a new economy based on digital information and communication. New production, consumption and business models are mushrooming, especially in the Province of South Holland. This fast development is facilitated by the massive exploitation of construction materials, energy and data flows. The flows that support the sector are linear, consuming amounts of energy and producing a lot of waste.
The Province of South Holland aims to be circular in 2050. The strategic and integrated development of the digital economy into the (urban) fabric of South Holland can function as a catalyst for the circular Province. To kickstart the road towards this goal, a regional design strategy is proposed, consisting of a future vision, spatial development framework, local interventions, phasing strategy and a stakeholder action plan.
This report explores how a connected and resilient datascape in South Holland can be developed while preserving the global economic value and increasing the local economic, social and environmental value. Data clusters are brought forward as a platform for awareness, participation and knowledge exchange. These platforms will either function as a creator or a transformer of the local environment. The development of these datascapes is circular, (energy-)efficient and creates value throughout the different scales. The structure of data clusters and network will form the base of a sustainable and resilient circular economy in the Province. The digital economy supports the interventions needed to move towards the goal for 2050. This strategy promotes the shift from linear flows to circular cycles, creating a safe, equal, diverse, healthy, prosperous and participatory world.

Keywords
circular economy, digital economy, energy transition, data cluster, Internet, datascapes

01
INTRODUCTION

- Introduction
- Research Questions
- Methodology
- Conceptual Framework

THE GOAL: A CIRCULAR SOUTH HOLLAND IN 2050



"Digitalisering en smart innovaties maken circulariteit aan de basis makkelijker."

"Digitization and smart innovations make circularity at its core easier."

Province of South Holland
Circulair South Holland - samen versnellen, December 2019

Schilthuizen, C. (2018, February 23)

A growing population and increasing prosperity lead globally to a scarcity of raw materials. The flows in the current, linear economy are exploiting (material) resources, producing a lot of waste and not being used to their full potential. A new type of economy is needed globally: the circular economy. The Ellen MacArthur Foundation (2020) explains the concept of the circular economy as:

A circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital.

The European Commission sees the transition towards a circular economy as an opportunity to strengthen the global position of Europe in the new and sustainable economy (Planbureau voor de Leefomgeving, 2020). To facilitate the shift from a linear to a circular economy, a system transformation is needed, supported by many socio-technical transitions (Planbureau voor de Leefomgeving, 2020).

The Province of South Holland sees the digitizing world as an opportunity to kickstart the implementation of the circular economy. But the digital economy needs to be adapted too, because a linear system can not function as the supportive basis for a circular system.

Both the development of a circular, global economy and the expansion of the digitizing world have consequences on many scales, from the global to the local scale.

A future vision and design strategy on a regional scale that stimulates the global economic position of the Province, while adding more local value with each intervention, can contribute to the goal of a circular Province in 2050. Interventions and policies cover many fields of interest, focusing on the development of data clusters, renewable energy landscapes that facilitate the energy transition, infrastructure changes for the mobility transition and adaptations of the built environment.
With these interventions, linear flows are changed into circular loops.

In this report, the project 'From Datasphere to Datascape' is presented to you. In the first part, the concept of Internet and all its elements are analyzed. The Province of South Holland is presented next, explaining the opportunities and characteristics of the region ***where*** the (intangible) flows of the Internet land. From the analysis follow the problem and vision statement. This future vision represents ***what*** South Holland will look like in 2050. The next chapters present ***how*** the vision can be implemented, describing the functionality of the new system and the proposed strategic interventions. The spatial implementation is depicted on a local scale by two case studies. The phasing strategy shows ***when*** and by ***whom*** the interventions will happen. Finally, a future forecast of risks and externalities reflect on the vision.

RESEARCH QUESTIONS

The digital economy can facilitate and shape the transition towards a circular Province in 2050. This report presents the conducted research that investigates what interventions are needed to establish a well-functioning West-Holland data cluster that promotes local values and strengthens the global economic position of the Province.

The guideline for the research is the following research question:

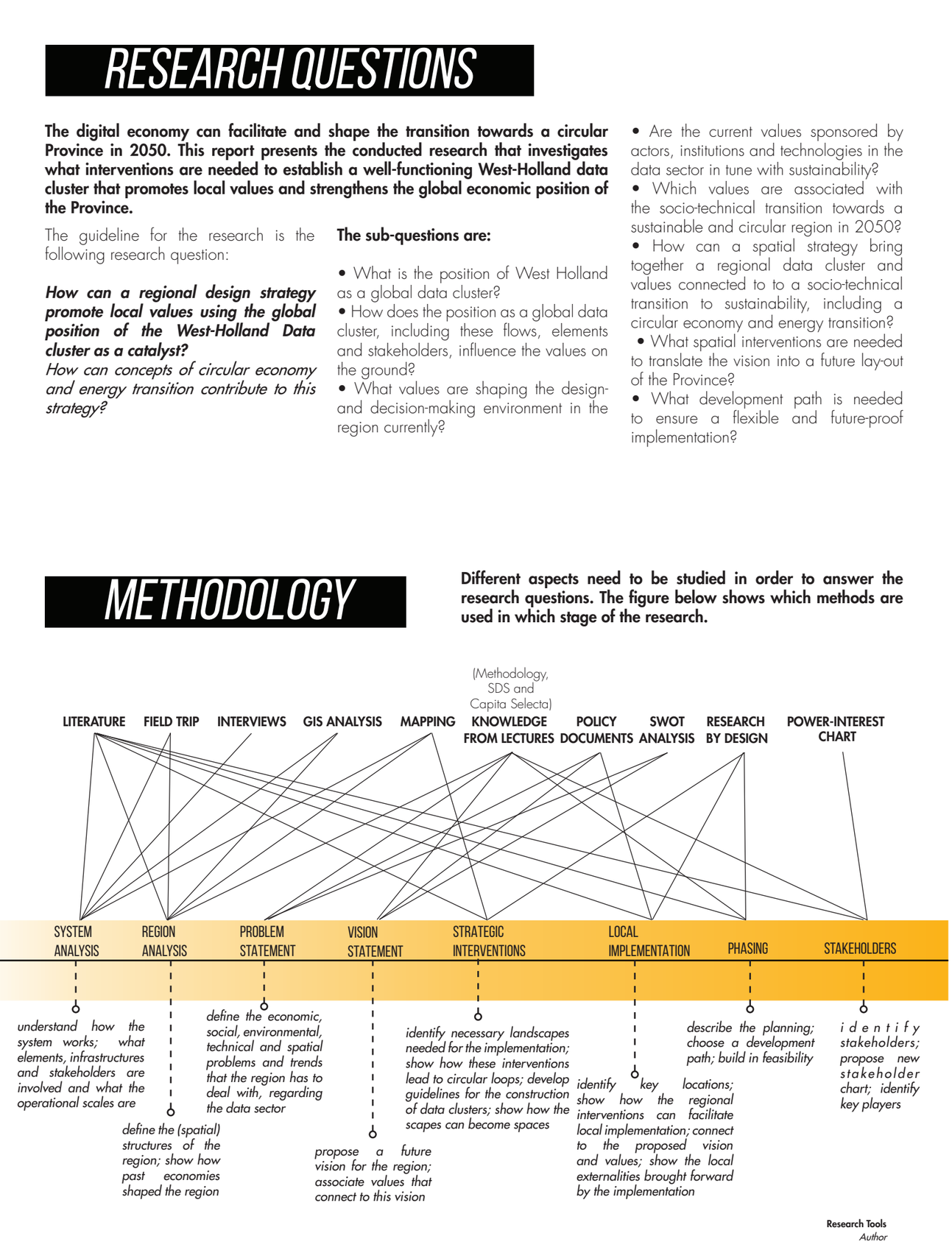
How can a regional design strategy promote local values using the global position of the West-Holland Data cluster as a catalyst?
How can concepts of circular economy and energy transition contribute to this strategy?

The sub-questions are:

- What is the position of West Holland as a global data cluster?
- How does the position as a global data cluster, including these flows, elements and stakeholders, influence the values on the ground?
- What values are shaping the design- and decision-making environment in the region currently?
- Are the current values sponsored by actors, institutions and technologies in the data sector in tune with sustainability?
- Which values are associated with the socio-technical transition towards a sustainable and circular region in 2050?
- How can a spatial strategy bring together a regional data cluster and values connected to to a socio-technical transition to sustainability, including a circular economy and energy transition?
- What spatial interventions are needed to translate the vision into a future lay-out of the Province?
- What development path is needed to ensure a flexible and future-proof implementation?

METHODOLOGY

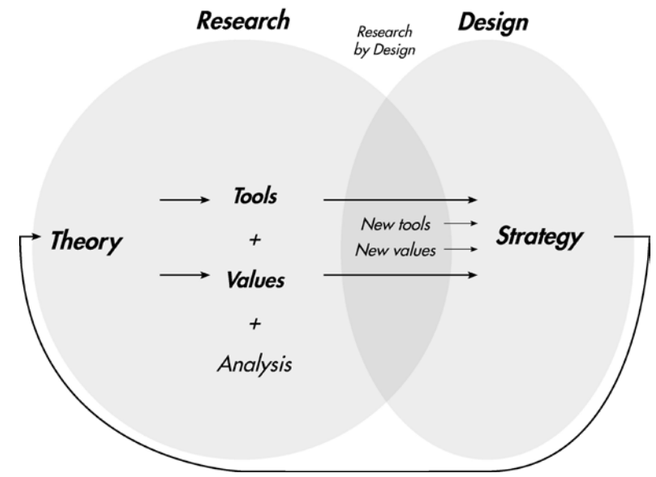
Different aspects need to be studied in order to answer the research questions. The figure below shows which methods are used in which stage of the research.



Research Tools
Author

CONCEPTUAL FRAMEWORK

Theory is the foundation upon which the research and design is based that enables the strategy for the South Holland region to address its socio-spatial problems. Insight in theory on various topics provides relevant values and tools needed to develop the regional strategy for a circular South Holland. Together with analysis of the South Holland region, that provides a context to consider these tools and values, they support the process of research by design. The vision and strategy are a product of (theory) research, research by design and design. In this process, theory lies at the base of the strategy, which provides new insights and in this way adds again to the body of knowledge.



Theoretical Framework
Author

Values

The spatial development strategy for the South Holland region is developed base on the six values of safety, equality and justice, diversity, health, prosperity and participation. These values reveal what is regarded as important or problematic. Theory on sustainability and spatial justice support those values. The concept of socio-technical transitions provides an understanding of how these values might change. Lastly, theory on the smart city explains how digitization can be valued.

Sustainability

Sustainability is a widely discussed and defined term [Dresner, 2008]. Costanza and Patten [1995, 194] state that a sustainable system is a system that is able to survive and persist over a long period of time. Our current economic system is not sustainable because, by depleting finite resources, it is not able to survive and persist any longer. Within five to forty years from now, we will run out of water, oil and gas, crucial elements to not only our economic system [The Guardian, 2011]. In this report we refer to sustainability as the ability to exist, persist and thrive without resulting in harming externalities. All six values, some more than others, represent the need and urgency for a sustainable region of South Holland. As stated by the province of South Holland [2019] achieving circularity by 2050 is a big step towards a sustainable province.

Socio-Technical transitions

Hodson and Marvin (2010) demonstrated that there is a need for an effective coordination of capacity and capability to initiate and attempt to enact systemic socio-technical transitions. The transition from a linear to a circular South Holland thus requires a high level of effort and collaboration throughout all scales.

Additionally, Raven et al [2012] conceive of socio-technical change as being configured and emerging out of interactions between actors situated in structures with different temporal dynamics that are spatially heterogeneous. Therefore, locality and proximity matter, just as time and structure matter, in explaining why and how change occurs in socio-technical systems, and why it occurs in some places and not in others. This report elaborates on what, where, when and by whom is necessary to reinforce the socio-technical transition towards a circular South Holland. Phasing, stakeholders and guidelines are closely integrated and taking into account the uncertainty of distant scenarios by remaining flexible.

Data and Smart Cities

Nam and Pardo, [2011] conclude that many definitions of the smart city concept exist and that they can differ quite a lot. They all refer to the Smart City as a city in which a form of digitization is used as a tool to enforce certain values. In most cases these values are economic prosperity, safety or livability. According to the province of South Holland [2019] digitization lies at the base of a circular and thus sustainable province. Digitization is in this case viewed as a crucial tool used to achieve sustainability. The development strategy proposed in this report evolves around the development of digitization. It reveals which values it enforces and what externalities may arise.

Spatial Justice
Soja [2009] refers to spatial [in]justice as an intentional and focused emphasis on the geographical and spatial aspects of justice and injustice. This involves the fair and equal distribution in space of socially valued resources and the opportunities to use them. Essentially, this means the access to important resources such as jobs, education or healthcare. Cass, Shove and Urry [2003] refer to spatial injustice through the concept ofo socio-spatial exclusion. They relate mobility to socio-spatial exclusion and define the notion of this phenomenon as a lack of access to values, activities or goods. The access to resources in the shape of values, activities or goods can be determined by the spatial configuration of our environment. This report reveals current [in]justices that occur in the province of South Holland and how accessibility to valuable resources can be promoted by the development of the data infrastructure [digitization].

Tools

Theory on different tools gives insight in methods to develop and implement a strategy for the South Holland region bases upon the values mentioned earlier. Literature about circular economy sheds light on achieving sustainable economies and how they operate. To better understand the transition into a new sustainable economy, the X-curve concept provides a better understanding of how a transition from a linear to a new, circular system, can be stimulated. The flexible city theory provides insight in planning-, legal-, financial- and spatial- tools that make a flexible city. Which is a resilient city, able to adapt to socio-technical transitions such as the one into a circular economy, making it sustainable. As digitization lies at the base of a circular South Holland, theory on the smart city and smart citizenship concepts provides a better understanding of the possible synergies or pitfalls concerning the interaction between people and the internet.

Circular Economy
The concept of the circular economy provides an alternative, sustainable relationship with our goods and materials (Stahel, 2016). The Ellenmacarthur Foundation describes the circular economy as a generative or restorative industrial system [2013]. This system uses renewable energy and aims for the elimination of waste and use of toxic chemicals. This is achieved through the superior design of material, products, systems and business models.

The concept plays a key role in making a sustainable South Holland as the province aims to be circular by 2050 [Provincie South Holland, 2019]. Within the sectors of the built environment, plastics, biomass, the food industry and the makers industry, the following strategy is applied:

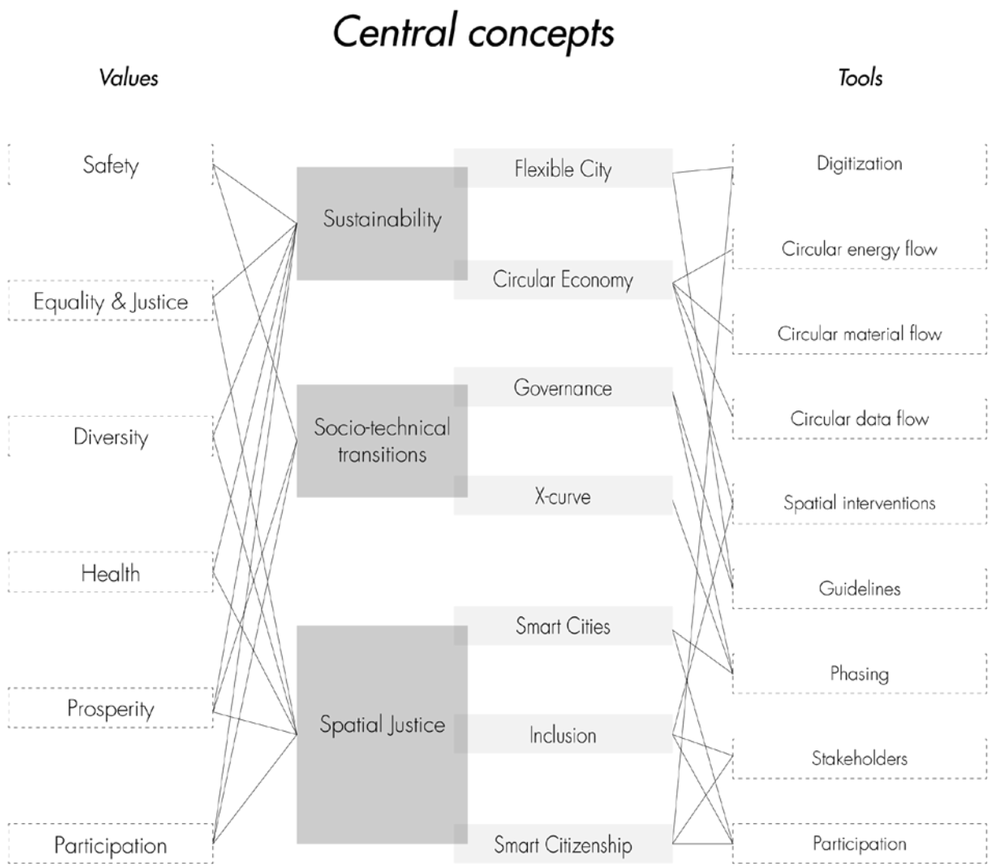
- They are promoting network- and chain- collaborations
- Sharing and development of knowledge and innovation
- Implementing policy and legislation
- Shaping the living environment
- Acquisition and tendering

The strategy aims to achieve a breeding ground where upon a circular economy can thrive. However, as Stahel [2016] mentions, not only governments but people of all ages and skills are central to this economy model. Local communities play a large role in the last-mile distribution, consumption and disposal of goods [Ellenmacarthur Foundation, 2013]. The development strategy for South Holland as proposed in this report addresses interventions throughout all scales that fit within the concept of the circular economy.

Socio-Technical transitions
Smith et al (2004) describe that the legitimate authority to push change through, or the resources available to build consent, to raise informed dissent, or even to block change, will depend on power relations across the networks of actors involved in a regime. Governance processes can be seen as acting as an independent influence to 'manage' or modulate regime transformation for sustainable development. Governance must thus be seen as an important tool to push a socio-technical transition such as the transition from a linear to a circular economy. As mentioned before, people on all scales are central to the circular economy model. Nevertheless in achieving such a large transition, the top-down contribution must act as a driving force as becomes apparent in this report.

The X-Curve
The X-Curve model describes transition patterns and how they can possibly be influenced [Ladder et al, 2016]. This theory about transition enables a better understanding of promoting the transition from a linear towards a circular economy. In this report, the phasing refers back to this model as it provides more insight in what needs to happen, where, when and by whom.

Flexible City
Bergevoet and van Tuil [2016] state that a sustainable city is a flexible city. Instead of building new spaces outside city limits, nowadays the more urgent task is making what already exists sustainable. Changes are not standalone events; they are emphatically part of a process of continual transition. New developments do not lead to a fixed blueprint, rather they emerge from future-oriented, dynamic flexible planning. Only then can truly sustainable solutions be found. They describe planning, legal, financial and spatial flexibility tools for a flexible city. These tools are adopted on throughout the report to strengthen the strategy, making it flexible and able to adapt to different temporalities and scales.



Conceptual Framework
Author

Socio-spatial justice
According to Madanipour [1998], exclusion is a form of controlling access to spaces, resources, information and activities. When this kind of exclusion is balanced with inclusionary processes, it maintains a healthy social fabric. However, it all becomes a negative state of affairs when there is an absence of the inclusionary processes. Inclusionary processes are described by the UN [2016] as improving terms of participation, especially for disadvantaged people. For example, by enhancing access to resources, increasing opportunities, voice and respect for rights. Madanipour [1998] thus argues that the exclusion of access to spaces only becomes problematic when terms of participation are not considered. In order to obtain the values as proposed in this report, it is essential to consider these terms of participation. The strategy focusses on promoting inclusionary processes and good terms of participation. Top-down and bottom-up approaches are alternately used to achieve accessibility on all scales and to create local value.

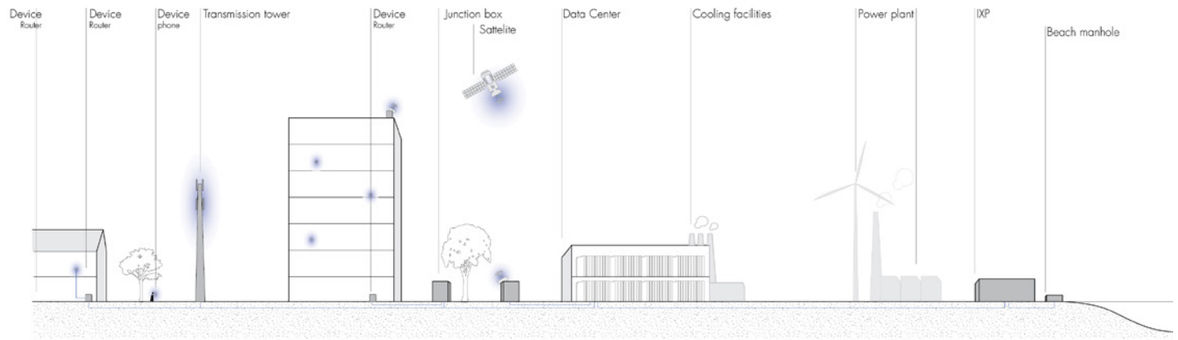
Smart Citizenship
Ferronato and Ruecker [2018] state that open and decentralized practices, like open design, can help in developing not only smart cities, but also smart citizens. Moreover, design can shape the rise of smart citizens avoiding more exclusion due to the differences on the access of technology. The concept of smart citizenship can be used as a tool to reach goals resulting out of spatial justice values. In the strategy for a circular South Holland, the development of the data infrastructure promotes digitization and smart citizenship. By creating more access, integration and participation are enabled.

02
ANALYSIS OF THE CHALLENGES
CONNECTED TO THE DATASPHERE

- What is the Internet?
- Global Internet Infrastructure
- What is the Problem?
- The Footprint of the Internet
- Linear Energy System
- Linear Heat System
- Linear Material System
- Linear Data System
- Linear Flows
- Controllers and Consumers
- Social Flows and the Impact of the Internet

WHAT IS THE INTERNET?

The global system of connected devices that allow people to share information and communicate with each other [Sample, 2018].



Schematic section of the physical elements of the internet and how the are connected
Author

Mobile device
Digital Trends.com

Router
Routershop.nl 2020

Street junction box
Bijvank Glasvezeltechniek, n.d.

Transmissiontower Rotterdam Harbour
Author, 2020

Data Center Delft Campus
Author, 2020

Cooling Facilities Data Center Rotterdam
Author, 2020

Transatlantic cable
Author, 2020

MATERIAL FLOW

ENERGY FLOW

DATA FLOW

The internet, as invisible as it seems, is actually quite visible in our landscapes. It consists of many elements, reaching from the small devices such as smartphones in our pockets, to large submarine cables and satellites. All these elements that allow us to communicate with each other lie at the base of our society and are crucial in the transition from a linear to a circular economy. Within the structure that consist of the elements shown above, the three main flows of material, energy and data are defined.

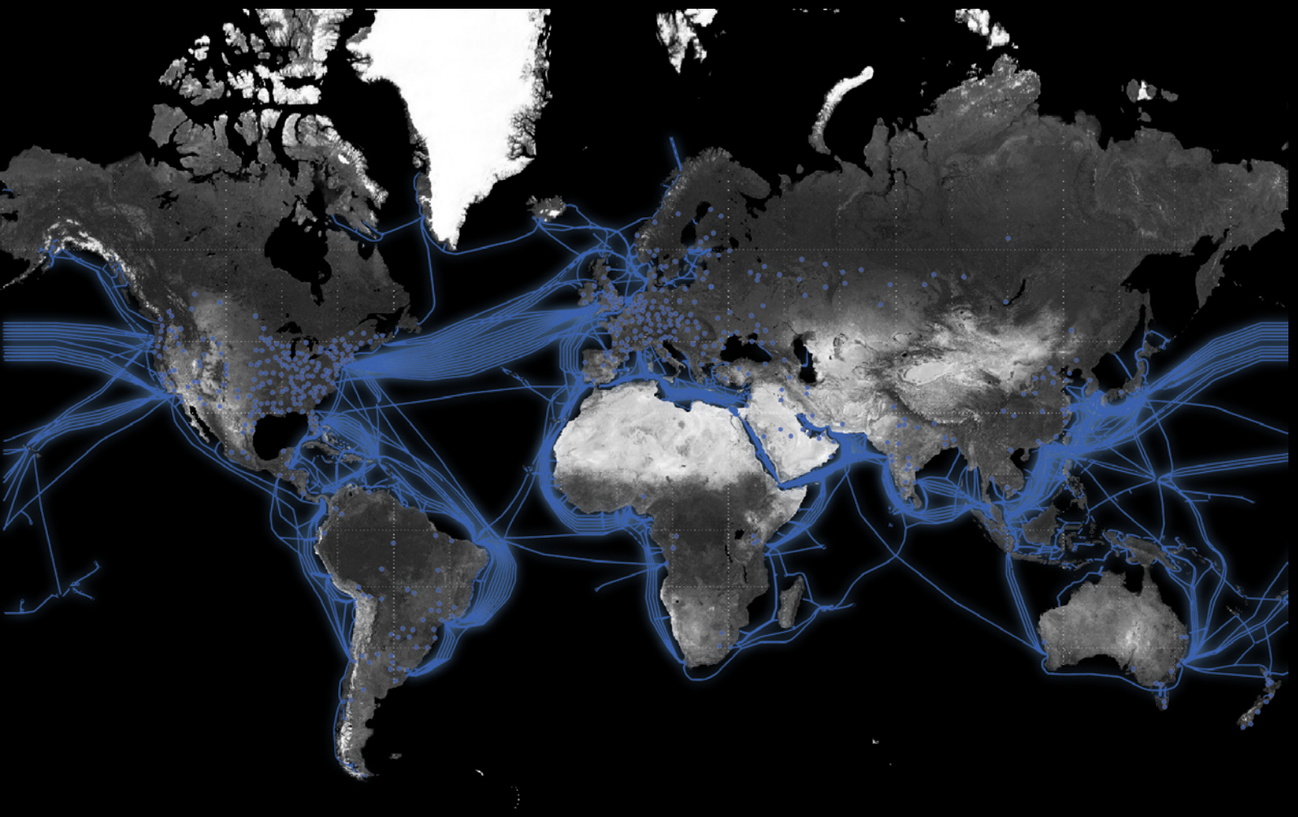
Material flow
This flow embodies the manufacturing and shipping of the built environment and hardware The production of the structures and devices of which the internet consist requires a lot of energy and material resources.

Energy flow
Not only the manufacturing of the internet requires a lot of energy, running it costs a whole lot too. The powering and cooling of the servers within the data centers requires an enourmous amount of energy.

Data Flow
This flow consists of bits, 0's and 1's that travel inbetween the physical elements of the internet. They are less tangible than material and energy and exists only within the internet structure. However, with the ability to read this dual entity, data becomes valuable. It becomes information and communication.

GLOBAL INTERNET INFRASTRUCTURE

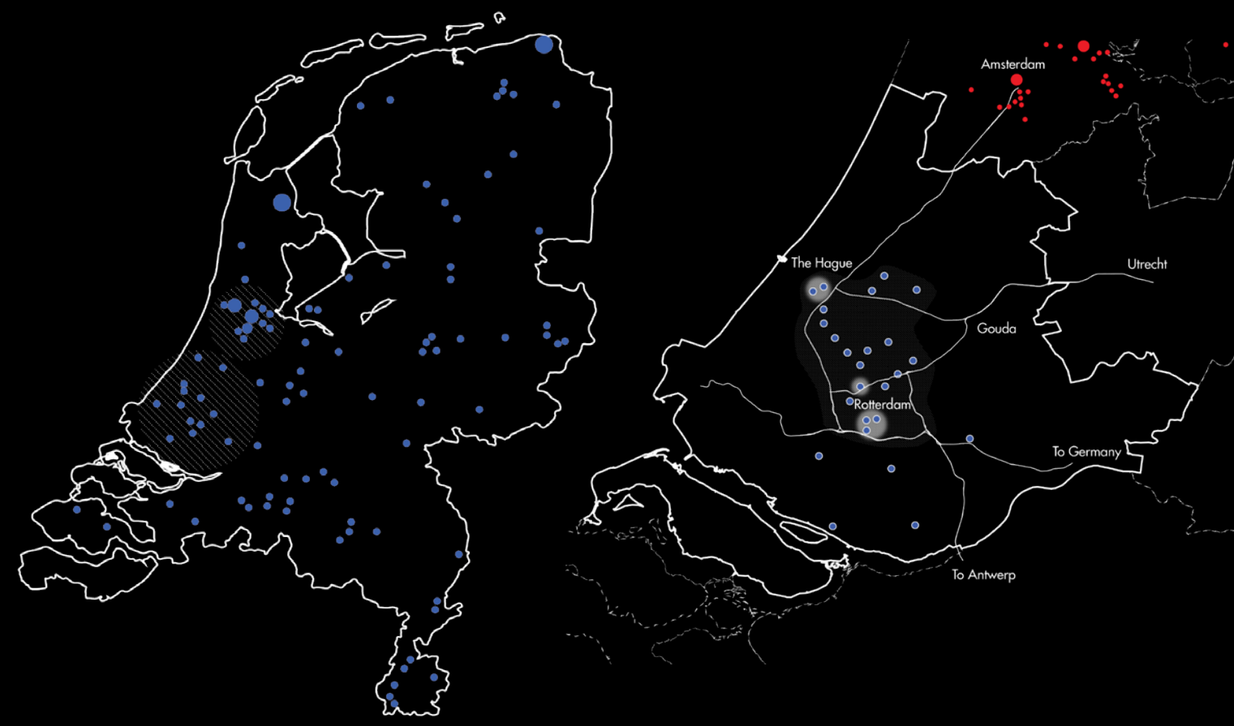
Data infrastructure: *All the physical elements that together facilitate the data flow.*
Data cluster: *A collection of geographical adjacent functions, of which the activity is closely related to or dependent on the internet.*
Data sector: *Economic activities relating to the internet, also known as the ICT- sector.*
Data hub: *A function that houses a datacenter and at least two different functions*
Data center: *A facility that houses computing and networking equipment for the purpose of collecting, processing, storing and distributing large amount of data.*



Global Submarine Cables and Data Centers
Author
Based on Telegeography (2020)

Submarine cables

The mapping of the global internet structure of submarine internet cables and data centers reveals the two internet clusters on the global scale. Most data centers are located in the United States and in Europe, these are also the areas that are the most connected.



Dutch Data Centers
Author
Based on Telegeography (2020)

Dutch Data Centers

Within the Netherlands, the data cluster in the Amsterdam region is the largest and very centralized. The cluster located in South Holland is more dispersed. This difference between Amsterdam and South Holland, centralized versus polycentric becomes very relevant concerning the footprint of the internet.

South Holland Data Cluster
Author
Based on Telegeography (2020)

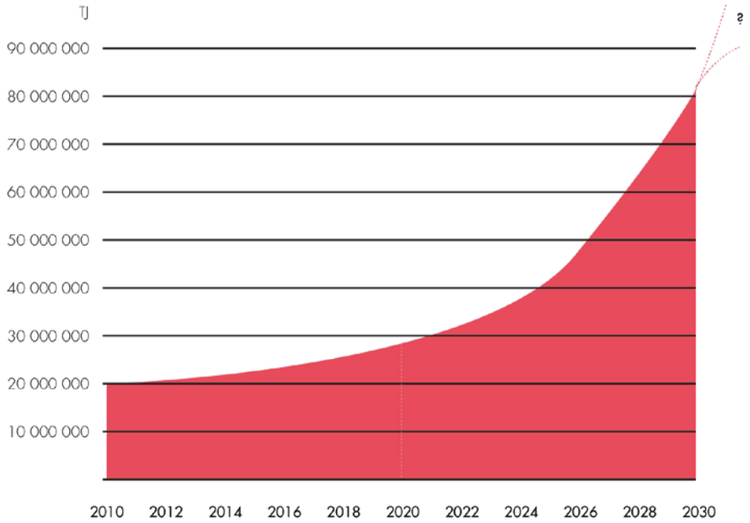
South Holland cluster

By taking a closer look at the locations of the data centers within this region, it appears that they are placed within and along the main infrastructure and at the edges of the dense urban areas.

WHAT IS THE PROBLEM?

The footprint of the internet has a lot of impact on our environment and society. Facing an increase in pressure on the current internet structure raises the urgency to reduce the externalities of the internet even more.

ENERGY CONSUMPTION



Andrea, 2015
Energyconsumption Data & Communications Industy

Global Energy use	580.000.000 TJ
Global Internet Energy use	**28.800.000 TJ**
Total Energy use Netherlands	3.100.000 TJ
Construction	2.632 TJ
Plastic Industry	10.245 TJ
Food Industry	54.210 TJ
Data Centers	**14.400 TJ**

CBS, 2019
Energieverbruik 2018

Roemers et al, 2019
South Holland Circulair

Rijksdienst voor ondernemend Nederland, 2016
MJA-Sectorrapport 2015 Rubber- en kunststofindustrie

Bakker, 2019
Datacenters gebruiken drie keer zo veel stroom als NS

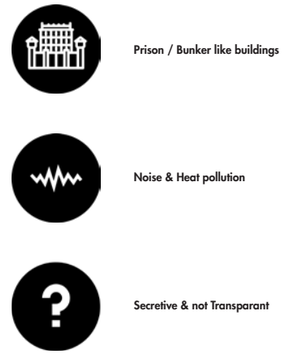
ECONOMIC PARADOX

DDA Anual Report, 2019
Economic value of the Dutch Data sector

LOCAL DISRUPTOR

The data center group Delft, 2012
Datacenter located in Delft, designed by Cepezed.

Volkskrant, 2019
Cruciale Nederlandse datacenters steeds vaker in handen van Amerikanen en in dat erg



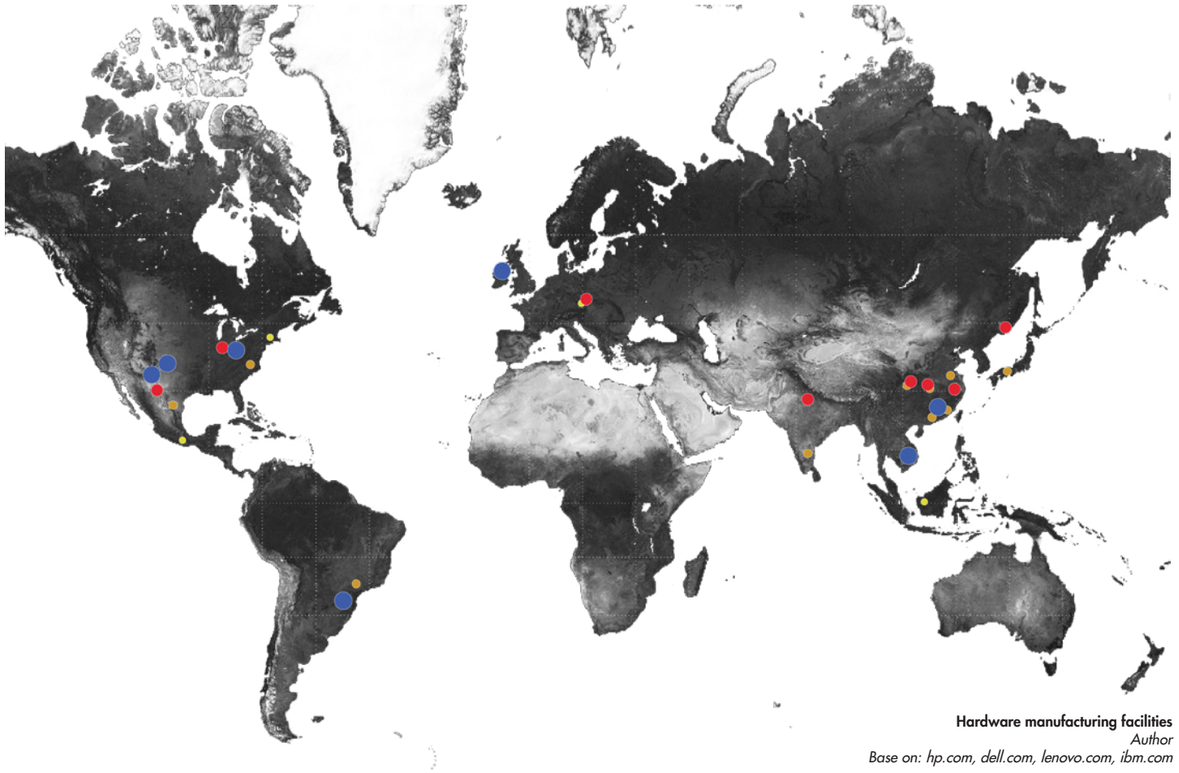
Energy consumption
The internet has a very large footprint. It requires a massive amount of energy and as the data infrastructure expands, the energy use is estimated to grow exponentially. This can be seen in the energy consumption graph.

The economic paradox
The sector generates a lot of money and fulfills an important role in the Dutch economy. However, 30% of the data infrastructure is owned by companies located abroad, in the United Kingdom and the United States. A lot of the economic value does not end up locally.

Social disruptor
Besides a lack of local economic value, most datacenters do not provide social, environmental or spatial qualities to their local context. This becomes apparent when looking at the datacenters of South Holland such as the one in Delft as shown in the picture above. They appear as quickly built closed boxes that are unbound to their context, mostly located in businessparks at the edge of urbanized areas.

THE FOOTPRINT OF THE INTERNET

The vast majority of physical elements of the internet such as the servers, computers and routers are mainly produced by a just a few large companies. Their manufacturing facilities are mostly located in China. The necessary materials such as precious minerals and chemical elements, are mined all over the world in sometimes unethical circumstances [Dell, 2002]



Hardware manufacturing facilities
Author
Base on: hp.com, dell.com, lenovo.com, ibm.com

Hewlett-Packard Enterprice is by far the largest supplier of hardware. Dell, Lenovo, IBM and Cisco follow therafter.Their manufacturing facilities are mostly located in China and secondly in the United States.

The chemicals and minerals that are necesarry to manufacture the hardware for the internet are mined all over the world. This is shown on the two maps on the next page.

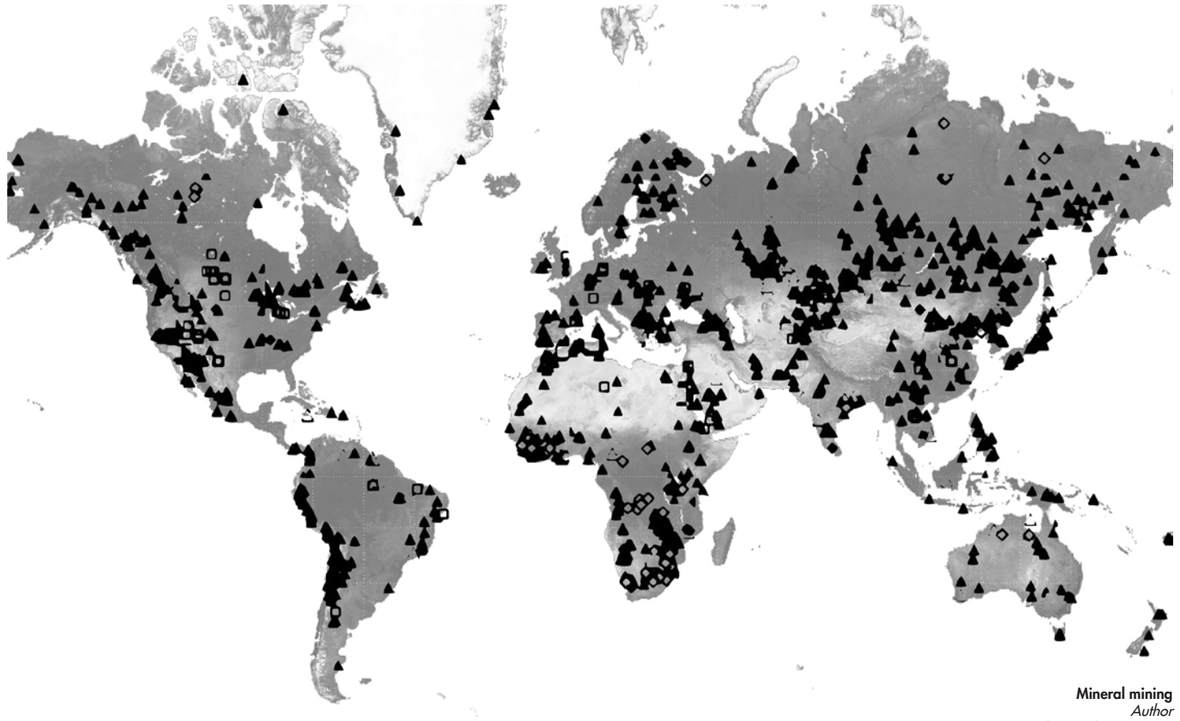
Extracting these materials from the hardware to reuse or upcycle them is often a complicated process. However, mining from this hardware has a lot of potential that is currently overlooked [Concept Management ltd., 2016].

Nowadays it is cheaper for companies to invest in new material than it is to upcycle their old material. [Metselaar, 2020]

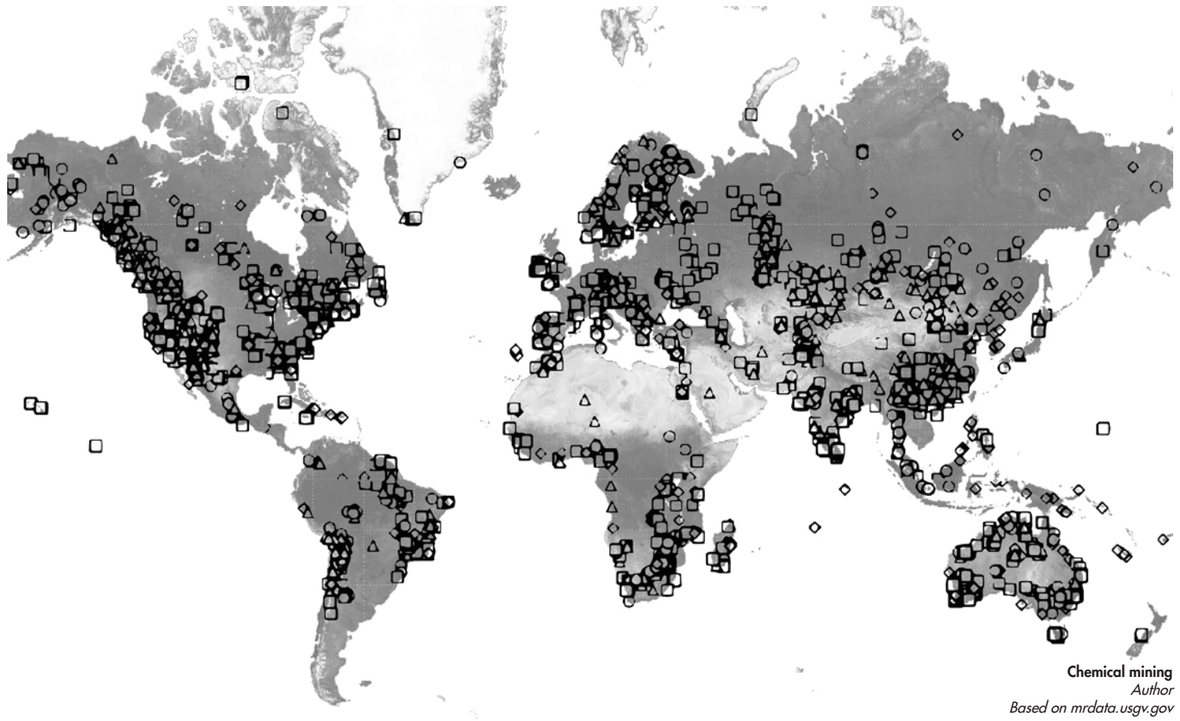
The following chemicals are necessary for the manufacturing of the hardware that makes up the internet [Concept Management ltd., 2016].

Precious minerals
Gold, Silver, Platinum, Palladium, Copper, Tantalum, Cobalt, Aluminum, Tin, Zinc and Neodymium.

Chemicals
Magnesium, Radium, Barium, Niobium, Osmium, Cobalt, Manganese, Titanium, Hafnium, Tungsten, Germanium, Gold, Silver, Copper, Mercury, Bismeth, Silicon, Gallium, Zinc, Iron, Sulfur, Phosphorus, Cadmium, Palladium, Tantalum, Platinum, Aluminum, Carbon, Lead, Nickel, Boron, Chromium, Potassium, Fancium, Casium, Sodium, Lithium, Calcium, Nitrogen, Oxygen , Arsenic, neodymium, Selenium, and Tin.



Mineral mining
Author
Based on mrdata.usgv.gov



Chemical mining
Author
Based on mrdata.usgv.gov

LINEAR ENERGY SYSTEM

The data sector demands a lot of energy. In this map the current state of energy landscapes in the region are presented. The current energy supply in the region is mainly produced in an unsustainable way, making the data sector a fossil-fuel based sector. Initiatives for renewable energy production, such as wind turbines, are being developed in suitable locations.

Stakeholders

Electricity
Uniper
Engie
WKC Air Produtct
Eurogen
Pergen
Intergen

Waste to energy
AVR

Cable
Stedin

Wind Turbine
GE wind
ChevronTexaco
BP
Eneco
Greenchoice

Legend

- Management and operation of natural gas and hot water
- Distribution of electricity and gas fuels via pipes
- Trade in electricity and gas via pipelines
- Production of biogas
- Production of electricity by thermal and nuclear installations
- Production of electricity by thermal wind energy
- Production of electricity by solar cells and hydropower
- Existing wind turbines
- Planned wind turbines
- Energy production - wind turbine
- Energy production - biomass
- Energy production - gas
- Electricity network
- Storage CO^2 in former gas fields

0KM 2.5KM 5KM 10KM

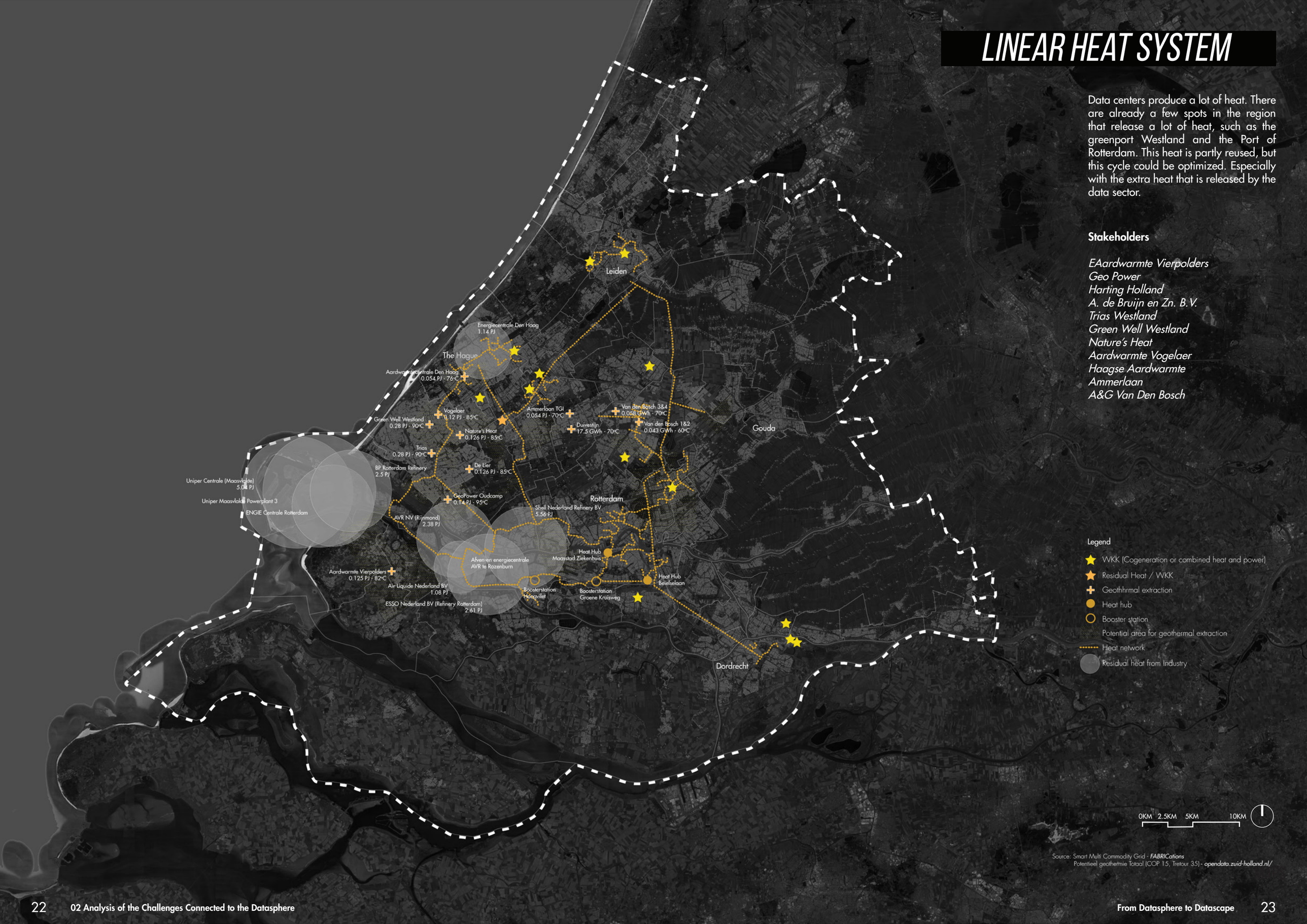
Source: BEDRIJVENREGISTER_LISA_2018
Kaart met Windparken - ***windenergie-nieuws.nl/kaart-met-windparken***
Dutch Offshore Wind Energy - ***offshorewind.rvo.nl***
Porthos project - ***rotterdamccus.nl/en/the-project***
Smart Multi Commodity Grid - ***FABRICations***

LINEAR HEAT SYSTEM

Data centers produce a lot of heat. There are already a few spots in the region that release a lot of heat, such as the greenport Westland and the Port of Rotterdam. This heat is partly reused, but this cycle could be optimized. Especially with the extra heat that is released by the data sector.

Stakeholders

EAardwarmte Vierpolders
Geo Power
Harting Holland
A. de Bruijn en Zn. B.V.
Trias Westland
Green Well Westland
Nature's Heat
Aardwarmte Vogelaer
Haagse Aardwarmte
Ammerlaan
A&G Van Den Bosch



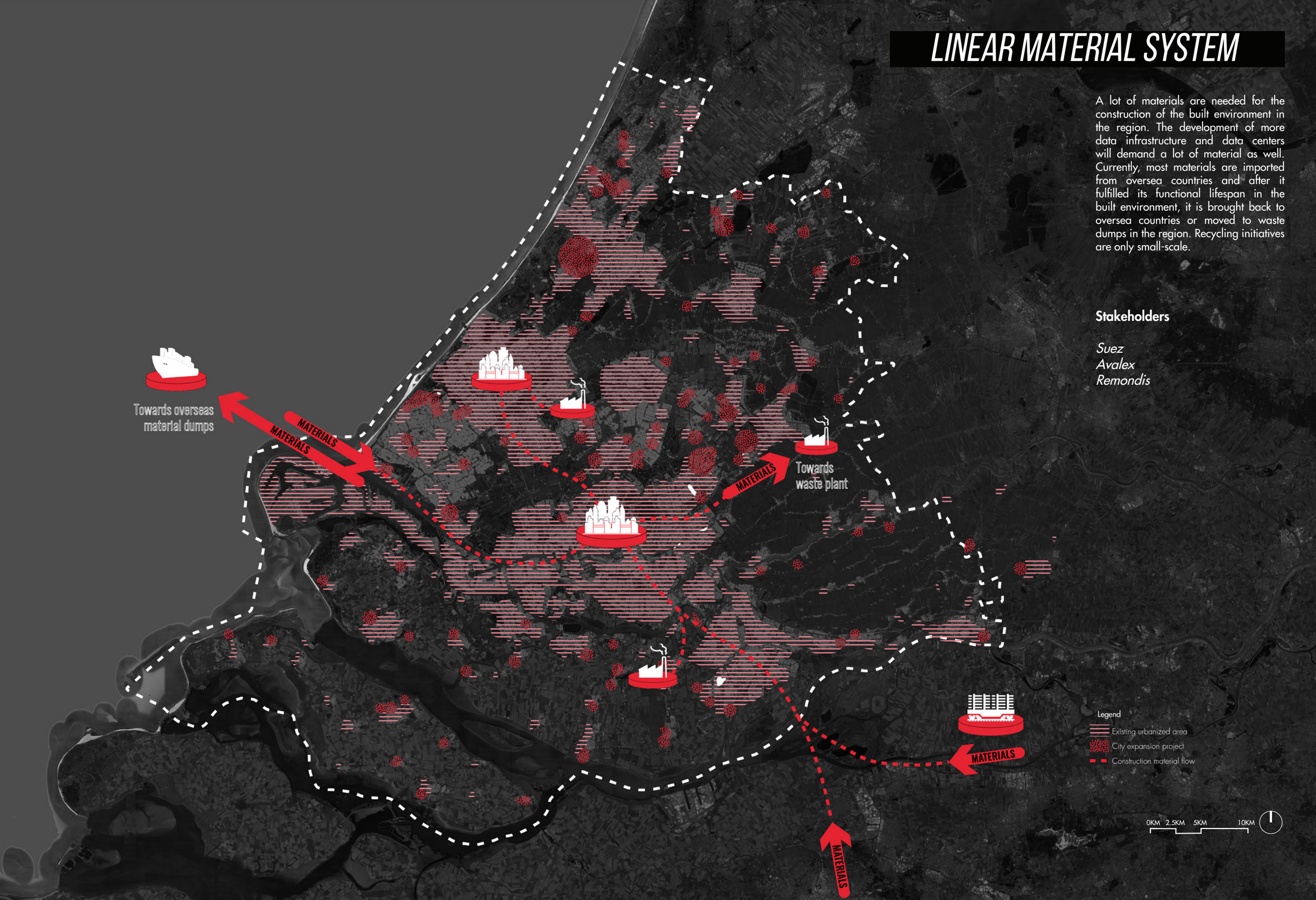
Source: Smart Multi Commodity Grid - ***FABRICations***
Potentieel geothermie Totaal (COP 15, Tretour 35) - *opendata.zuid-holland.nl/*

LINEAR MATERIAL SYSTEM

A lot of materials are needed for the construction of the built environment in the region. The development of more data infrastructure and data centers will demand a lot of material as well. Currently, most materials are imported from oversea countries and after it fulfilled its functional lifespan in the built environment, it is brought back to oversea countries or moved to waste dumps in the region. Recycling initiatives are only small-scale.

Stakeholders

Suez
Avalex
Remondis



LINEAR DATA SYSTEM

This map shows the data usage in the region. The growth of the Internet will put more pressure on the current structures. Most of the data usage is already in the urban areas, so the increased amount of internet use will add even more pressure to this system. They need to be adapted.

Stakeholders

Dutch Data Companies
DataCenterGroup
SmartDC
NL|DC
Data Place
Bytesnet
Nedzone
Colt
Cellnex

International Data Companies
GlobalSwitch
CenturyLink
IronMountain
EdgeConnex
Interxion
Yondi
Keppel DataCenters
E-shelter
Digital Reality
MainCubes
CyrusOne
Equinix
Colt
Google
QTS
Mircosoft

Legend

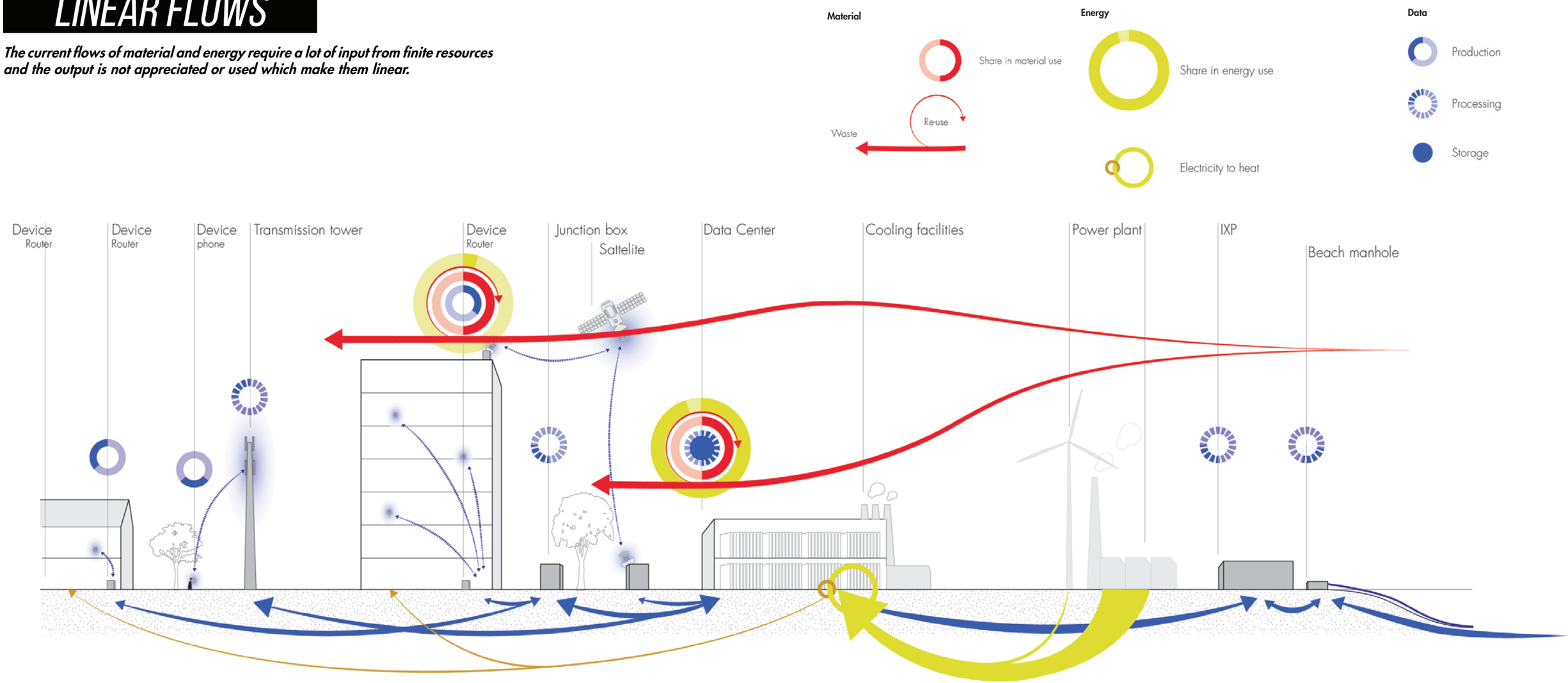
- Data center size
- Internet data usage (average 50Mbit/s)
- Internet data usage (average >150Mbit/s)
- Data network (fiber optic cable)

0KM 2.5KM 5KM 10KM

Source: SMAR MULTI-COMMODITY-GRID
https://staatvan.zuid-holland.nl/smart-multi-commodity-grid
www.eurofiber.nl
www.dutchdatacenters.nl

LINEAR FLOWS

The current flows of material and energy require a lot of input from finite resources and the output is not appreciated or used which make them linear.



Flows of material, energy and data
Author

The flows of material and energy are currently linear for the large part. Even though some minor examples of circularity do exist, they can not compete with the current global, linear systems.

The material flow
The flow of material necessary to compose the the physical elements of the internet, is the flow of elements of the built environment and hardware. They consist, among other things, of datacenters, transmission towers, routers or mobile devices. As shown before, the hardware is manufactured mostly in China and the required raw materials are mined all over the world. Datacenters are mostly quickly built facilities, located in businessparks, however, there are very few examples of small datacenters located in transformed buildings.

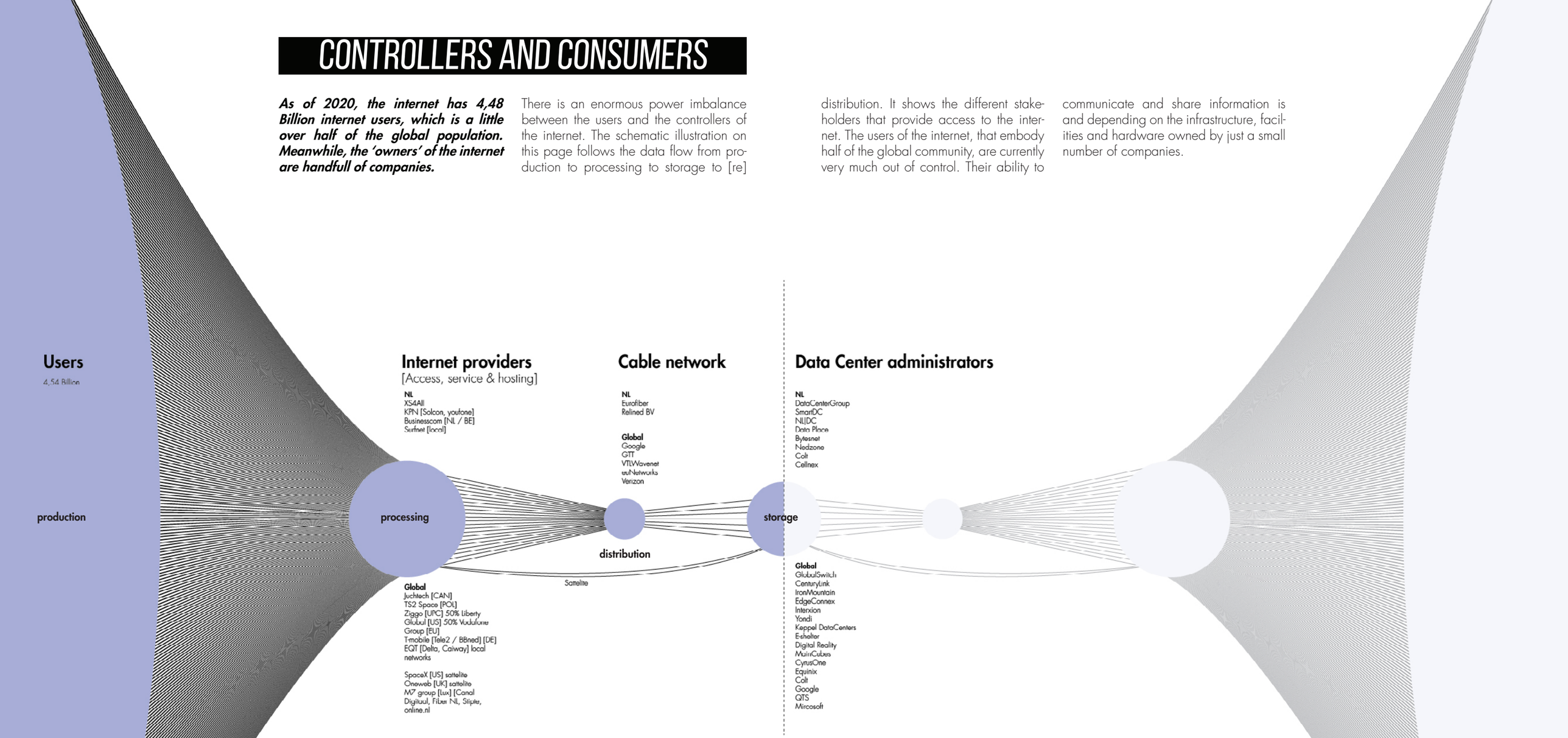
The energy flow
The current energy flow of the internet is not optimally used. The demand for energy is very high and is transmitted into heat. This generated heat is generally not repurposed, only a few best practices show that a non-value loss from energy to heat is possible.

The data flow
The data flow is inherently circular. The 0- and 1-bits of data can be processed, stored and distributed endlessly and their state will or core value will not deteriorate. However, the way we store our data is quickly changing and current methods and technologies will most likely be irrelevant in the future. This might result in large amounts of important data being unaccessible. Bits of 0's and 1's are much more difficult to encipher without the correct technology, unlike cavepaintings or books. This phenomena is often referred to as the digital dark age [Smit et al, 2011]. Even though the data flow might seem circular, awareness of possible fragilities and assigning value to our data is of importance.

CONTROLLERS AND CONSUMERS

As of 2020, the internet has 4,48 Billion internet users, which is a little over half of the global population. Meanwhile, the 'owners' of the internet are handfull of companies.

There is an enormous power imbalance between the users and the controllers of the internet. The schematic illustration on this page follows the data flow from production to processing to storage to [re] distribution. It shows the different stakeholders that provide access to the internet. The users of the internet, that embody half of the global community, are currently very much out of control. Their ability to communicate and share information is and depending on the infrastructure, facilities and hardware owned by just a small number of companies.



Data Controllers and Consumers Chart
Author

SOCIAL FLOWS AND THE IMPACT OF THE INTERNET

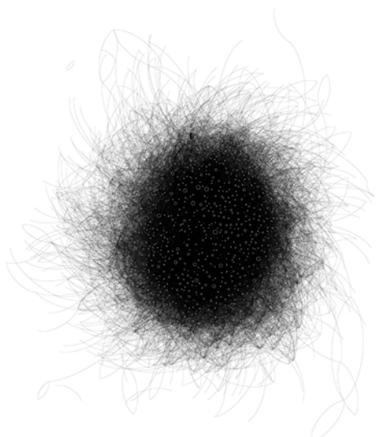
Those with access to the internet are able to communicate and share information with each other more frequently and faster than those without. The two diagrams show this difference. Each dot represents a person and each line represents a social connection between two people.

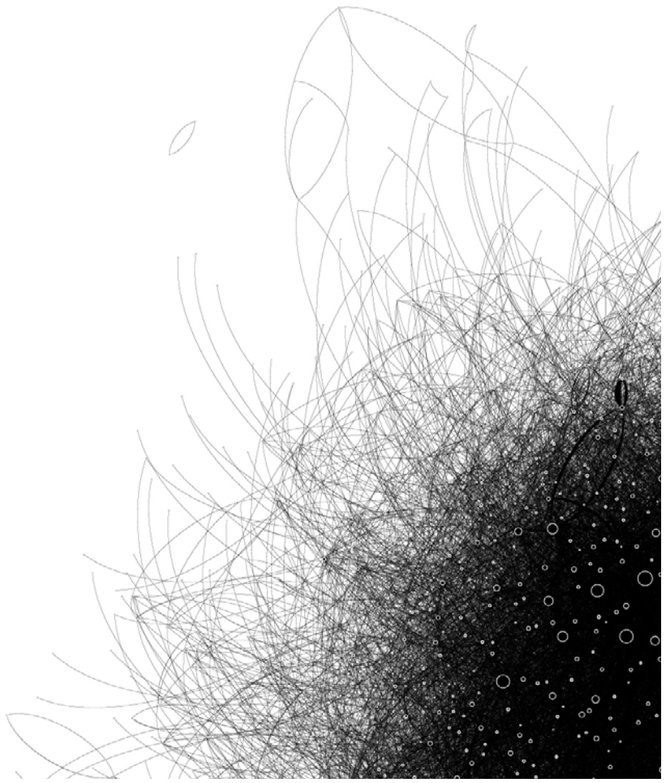
The first graph shows the interactions between characters of the 'Les Miserables' novel that takes place in a fictional pre-internet era. Every form of communication between two characters is represented by a line and the larger the dot, the more communication one person had. The graph shows that only a few characters have a highly integrated social network, others are only connected to one or two other characters. Of course this example represents a fictional social network with only a few people, nevertheless it is still an example of a social network where the internet is absent.

The second graph shows the online interactions between over a thousand students and employee at the Univeristy of California in 2009. Each line represents either a personal message between two people or a forum post to all students. The online social network creates a different graph than the offline social network. It shows that connections are made more easily and more frequent.

Although both graphs are not an exact representation of the online and offline social networks, they are usefull in understanding and visualizing the differences between them.

Knuth, 1993
GEPHI graph of the social network of the characters in Les Misereable





Opsahl & panzarasa, 2009
GEPHI graph of the online social network of the University of California, Irvine, showing personal messages and forum posts.

03
ANALYSIS OF THE REGION

- General Analysis
- Duality of the Region
- Challenges & Possibilities

Functional Zones in Randstad
Author

The Randstad

The Randstad is spread over four Dutch provinces and characterized by a conglomerate of medium- and large-sized cities. Four large cities, nine medium-sized cities and many small villages form the urbanized structure of the region. Large infrastructures shape the landscape, ranging from highways and train tracks to airports and national flood protection systems.

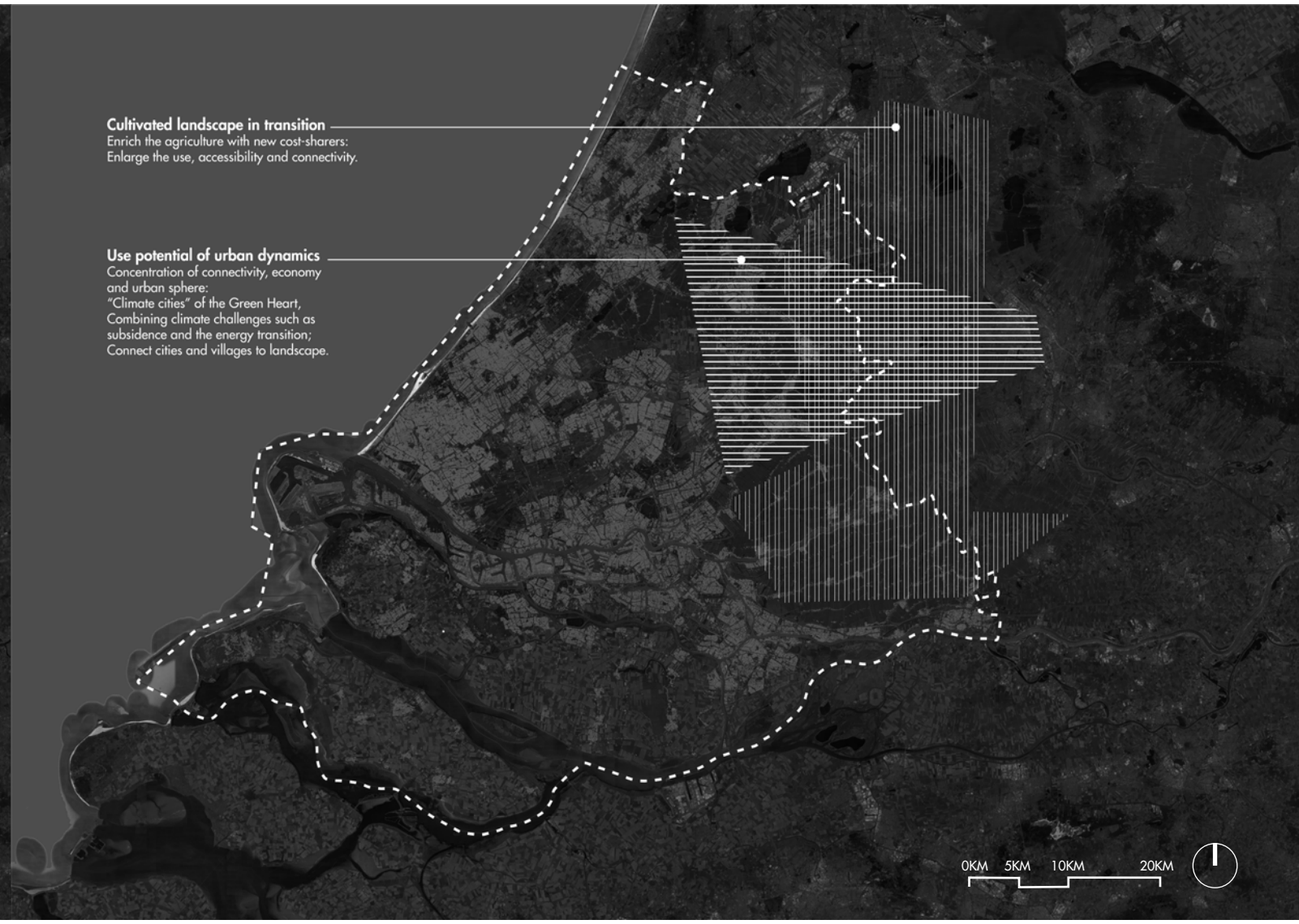
The four cities stand alone but altogether, these cities have the facilities and amenities to play an important role on the global stage. A function division between the important cities characterizes the region. The capital Amsterdam does for example not house the governmental institutions and the Royal Family. These functions are situated in The Hague, together with the International Court and Justice cluster. The city of Rotterdam is economically driven by its port and Central Business District and characterized by rapid urban renewal and architectural developments. The city on the eastern boundary of the Randstad, Utrecht, houses the largest railway node of the Netherlands and many knowledge institutions.

More than half of the Dutch gross national product is earned in the Randstad (Huis van de Nederlandse Provincies), and the Province of South Holland is responsible for almost 25% of the total Dutch gross national product (Provincie South Holland, 2020).

This emphasizes the economic importance of the region, housing the largest port of Europe and many agricultural clusters that produce food for global distribution.

To strengten this global economic position and at the same time promoting local values a just implementation of the digital economy in the region is essential. The digital economy could support existing economies and systems, but also generate new types of economies.

GENERAL ANALYSIS



The Green Heart Map
Based on: results Gebiedsdialoog NOVI Groene Hart (Programmabureau Groene Hart, 2018)

The Green Heart

The four large cities of the Randstad enclose an important ecological structure: the Green Heart. Agriculture and recreation are the main functions of the area. Two areas are described in the future vision for the area.

An east-west section of the Green Heart, containing medium-sized cities such as Woerden, Gouda and Alphen aan den Rijn, present urban dynamic potentials that can be utilized more. The challenges for this zone are the concentration of economic activity, accessibility and urban sphere. This concentration has benefits, but also negative externalities, such as pressure on the traffic structures and the subsoil networks.

A goal for the cities in this zone is the creation of 'climate cities', in which climate challenges such as subsidence and the energy transition can be explored and kick-started (Programmabureau Groene Hart, 2018).

The development of the digital economy in this zone can therefore focus on traffic safety and contribute to the energy transition.

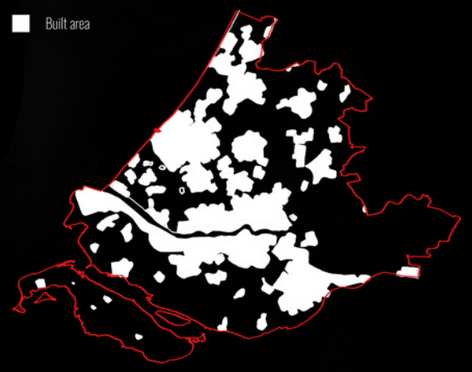
The north-south zone that entails cultural landscape in transition has two important goals.

First, to enrich the economy that is based on agriculture with new cost-sharers. The economy will be more robust and adaptive to changes. Farmers are responsible for a lot of challenges in this area (Programmabureau Groene Hart, 2018) and spread of the responsibilities over multiple stakeholders can generate benefits for all.

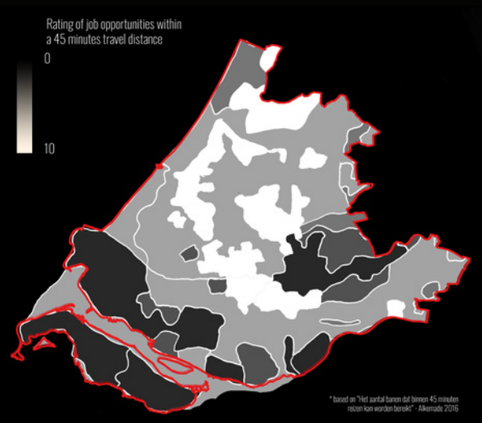
The second goal is to enlarge the use, accessibility and connectivity (Programmabureau Groene Hart, 2018).

The development of the digital economy in this zone can therefore focus on facilitating the emerge of new economies and businesses. The construction of the data network and data centers itself contribute to the enlargement of use, accessibility and connectivity.

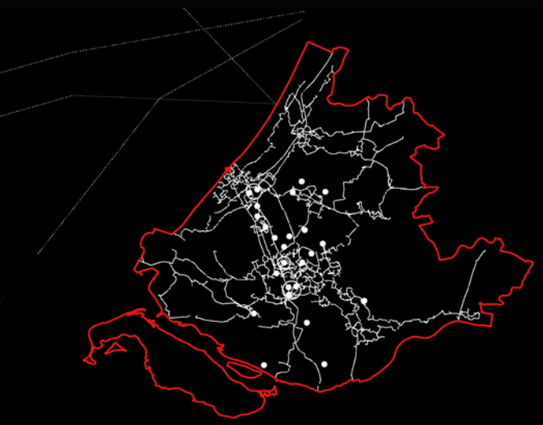
THE CONTEXT: DUALITY OF SOUTH HOLLAND



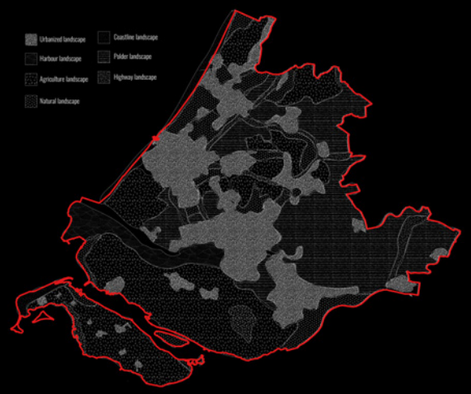
Urbanization



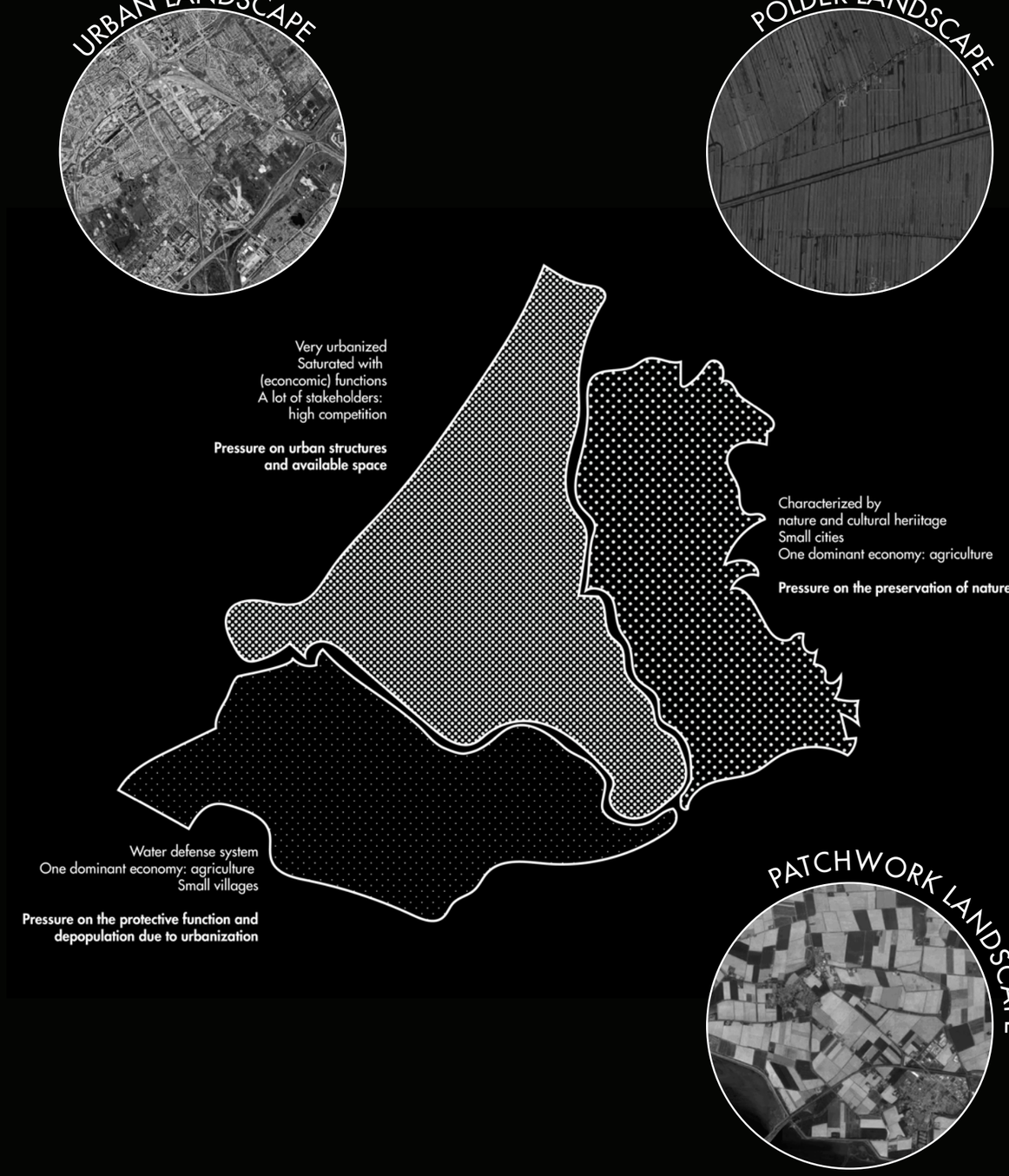
Employment



Data Infrastructure



Landscape



Spatially, a duality in the region is visible. The urbanized part, housing two of the largest cities in the country, and the hinterland. This duality is visible in the amount of built-up space, the employment opportunities, the presence of data infrastructure and the variety in landscape types. Three zones can be distinguished, with their own type of pressure due to current trends.

- **The urbanized area**, which is very saturated with functions and economies. The amount of stakeholders leads to high competition. Trends lead to pressure on urban structures and available space.
- **The Green Heart**, situated on the eastside of the province. This area is characterized by nature and cultural heritage, with polder structures shaping the landscape. Agriculture is the dominant economy. In this area, there is pressure on the preservation of nature.
- **Beijerland & Goeree-Overflakkee** plays an important role in the flood defense system of our entire country. Small villages and agriculture land shape the landscape. In this area, pressure on the protective function and depopulation due to urbanization can be felt.

CHALLENGES & POSSIBILITIES

What is a SWOT overview?
In order to perform a SWOT analysis, an objective for a sector, company or project is specified. The next step is to identify the internal factors (strengths and weaknesses) and external factors (opportunities and threats) that will influence achieving the objective (Professional Academy, 2020).

SWOT analysis South Holland
The structure and functionality of the region define the challenges and possibilities in that are related to the implementation of the digital economy in the landscape. The objective of the project is to transform the linear flows of material, energy and data into circular loops. Making these flows circular will contribute to the goal of a circular Province in 2050. The SWOT analysis tool can therefore also serve as a self-assessment tool in the reflection.

This SWOT overview shows the strengths, weaknesses, opportunities and threats in the region, concerning the implementation of the digital and circular economy.

STRENGTHS

strong global economic position

presence of knowledge institutes

high-quality production processes

high-quality subsoil and surface infrastructures

connectivity between urban areas

global internet connection cable

amount of concurrence

stable business climate

WEAKNESSES

energy-intensive industry clusters

already a high-risk environment

pressure on urban structures

lack of cooperation between chains concerning innovation

global production and consumption chains

OPPORTUNITIES

presence of multinationals

security expertise

amount of particular recycling initiatives

diversity in built environment and economy types

logistic expertise

concentration of businesses

clustering benefits for businesses

connect different levels of education

gateway to Europe

THREATS

increase in regulations

pressure on ecological structures by expansion of built environment

air pollution from industries

growing inequalities

flood risk

cyber-terrorism

Images: ANP, Hollandse Hoogte, Hartog & Het Kontakt

04
PROBLEM STATEMENT

- Summary of Problems
- Problem Statement Map
- Problem Statement

SUMMARY OF PROBLEMS

Massive exploitation of materials
generating global distribution and waste streams

High energy demand
relying on a fossil-fuel-based energy production

Increasing amount of data
increasing safety and ownership issues

Neglect of local value
developing from a global perspective

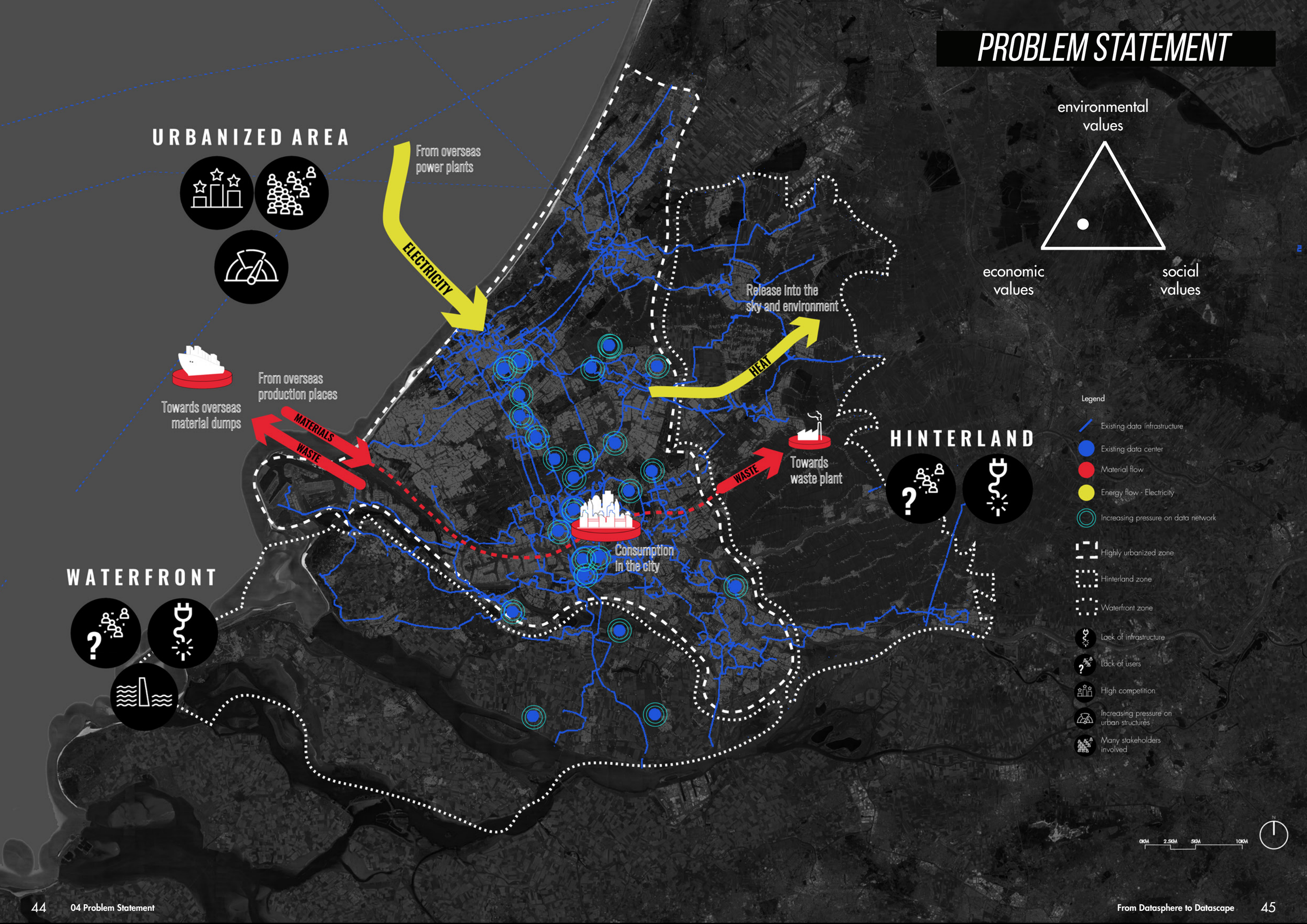
Decision-making based on economic values
environmental and social values are lacking in decision-making

Sector facilitated by linear flows
not aligning with the circularity goal for 2050

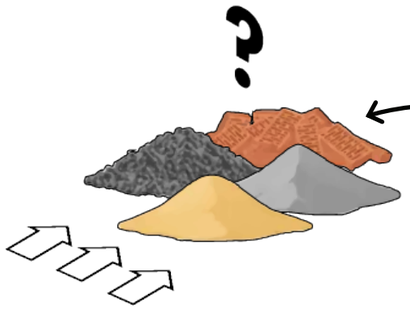
United Nations
Sustainable Development Goals for 2030

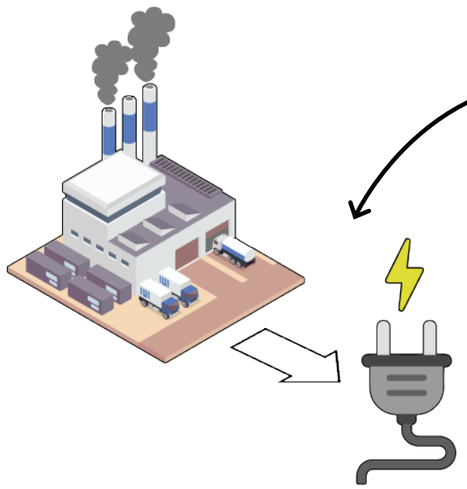
These problems are not just affecting the regional scale. In 2015, the United Nations presented seventeen Sustainable Development Goals (SDGs). In order to build a better world, these goals should be strived for in each development and in each field. Six of the SDGs are directly applicable to the development of the West-Holland Data Cluster.
Affordable and clean energy should fuel the powerful grid for the sector. Economic growth should follow from the implementation of the data cluster, facilitating new economy types. Industry, innovation and infrastructure should be developed in a sustainable and future-proof way. Inequalities between people, and areas, should be reduced. Inaccessibility and disconnectivity are problems that need to be solved. Sustainable cities and communities should represent the new urban living. And lastly, responsible consumption and production patterns should be stimulated through the way our systems are developed.

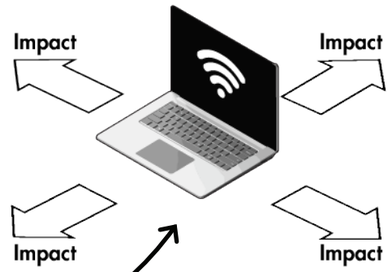
PROBLEM STATEMENT

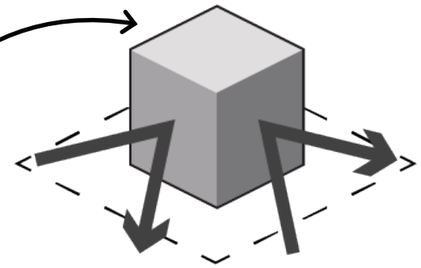


PROBLEM STATEMENT









CONTEXT - The economy and technological innovations have always shaped the Dutch landscape and society. The evolution of the Internet has led to **new economies** based on digital information and communication. Similar to the economic developments of the past 200 years, this economic development has a large **economic, environmental, spatial and social footprint**.

PROBLEMS & CHALLENGES - The fast-changing sector is characterized by **massive exploitation of construction material, energy and data**. The flows that facilitate the sector are **linear** and produce a lot of digital and physical waste, because materials [and data] in this industry have a short lifespan.

In 2025 the expected energy use of the Information- and Communication sector will be **21% of the global energy production** (Vidal, 2017). Since not enough renewable energy is produced yet, it is **a fossil fuel-based sector** and in the nearby future it will surpass the CO2-footprint of the aviation and shipping indusry.

The construction of data centres and the corresponding infrastructure as **closed boxes** is seizing patches of land, without adding quality to the local environment. The global and national importance are clear, but in most cases the **local value is neglected**.

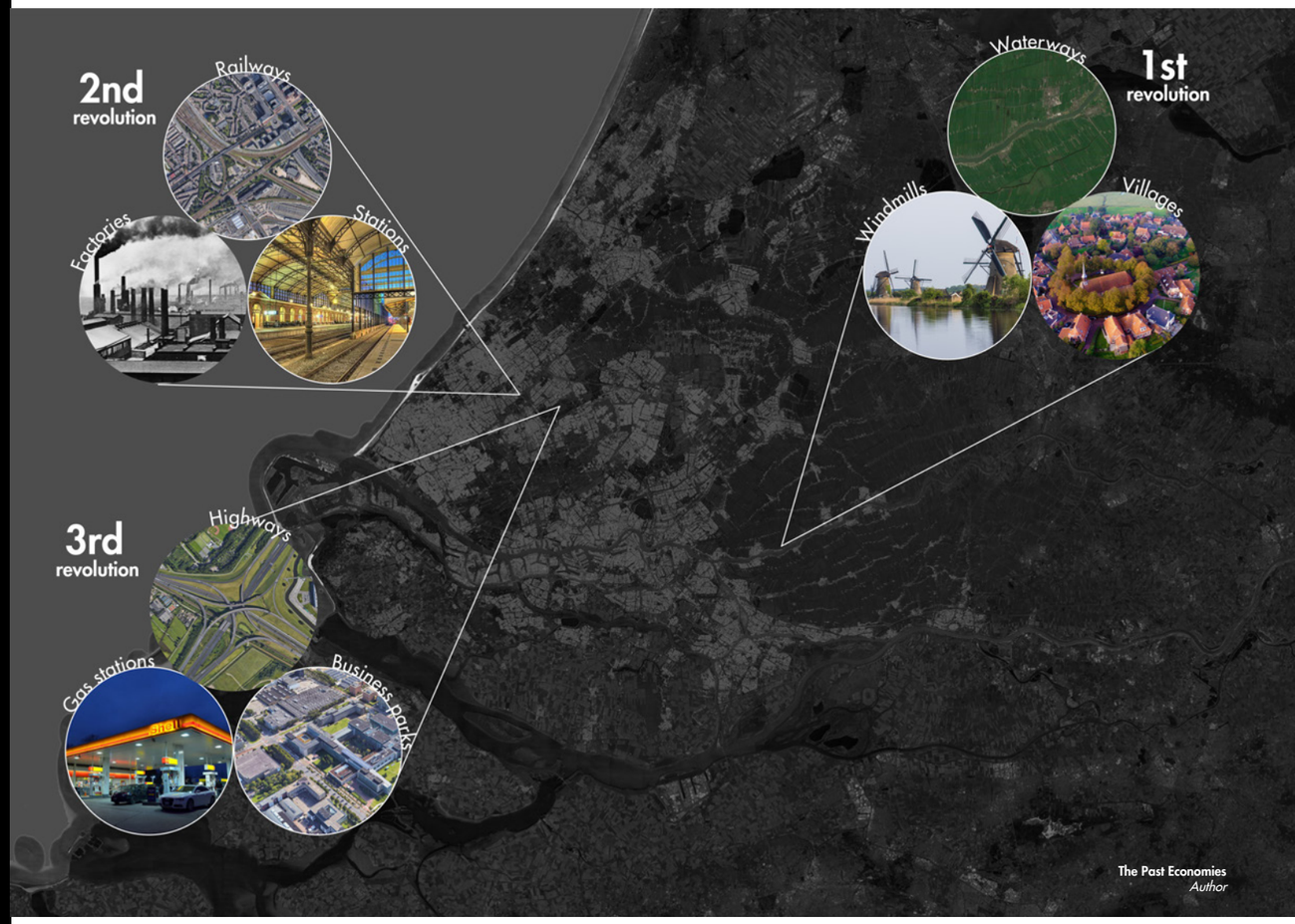
Regarding the goal of the Province to **be circular and energy-efficient in 2050** and the will to use digitization as a keyplayer in this transition, the development of a regional datacluster that lies at the core of this transition needs to be steered in the right direction.

With **a strategic approach, focused on a circular and sustainable development of the new economies** brought to us by the data sector, the region can profit from the positive externalities that data clusters pose.

05
HOW ECONOMIES SHAPED THE REGION

- How did the past economies shape the region?
- How will this new circular economy, based on data, shape the region?

HOW DID THE PAST ECONOMIES SHAPE THIS REGION?



The Past Economies
Author

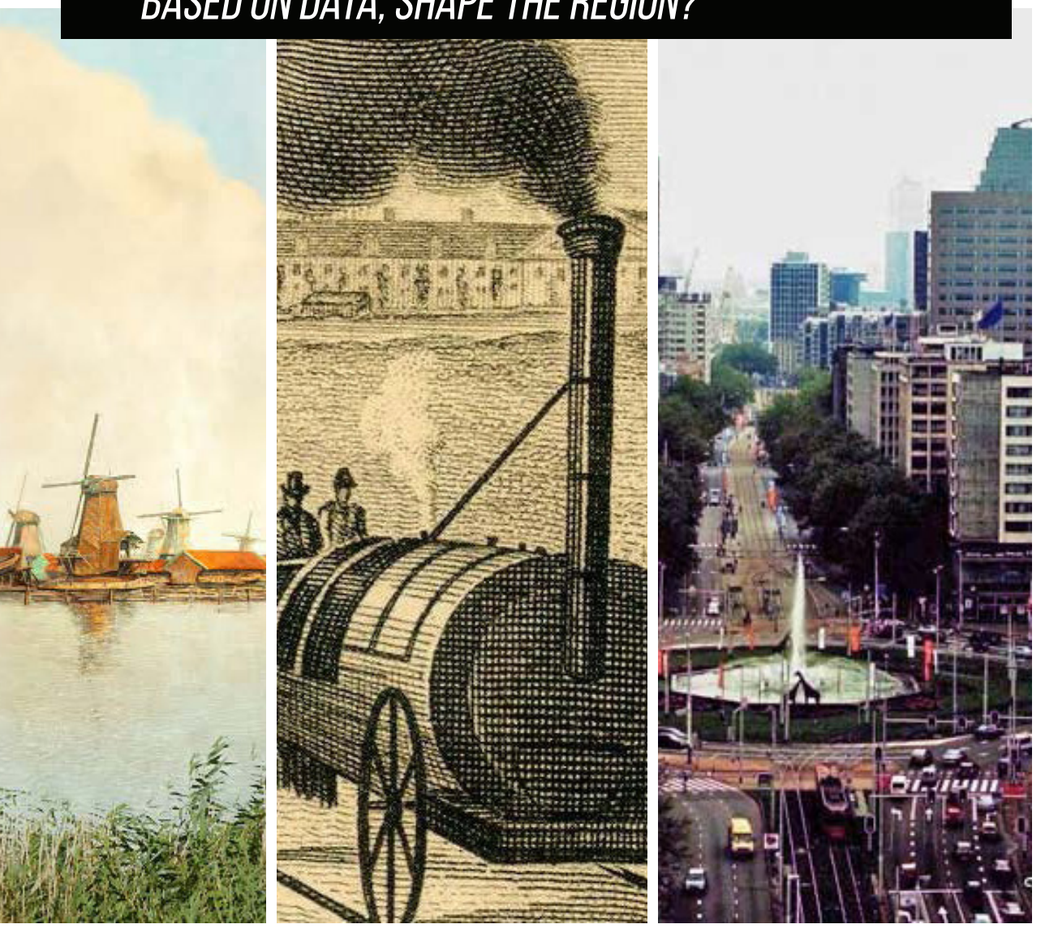
Economic developments and industrial revolutions have always shaped our landscape. They brought new production, distribution and consumption landscapes.

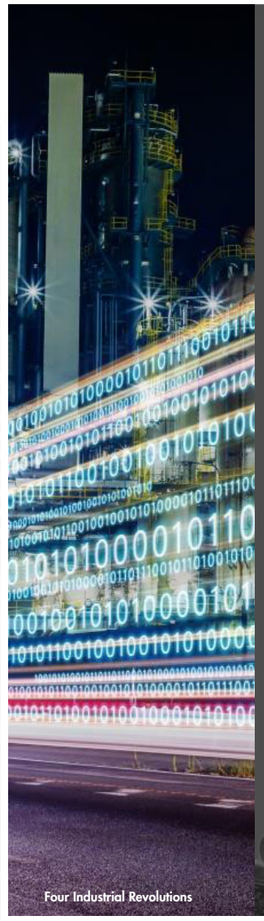
The first revolution emerged from a need for dry feet. The wet ground of the lowlands was not suitable for the construction of buildings and villages.
Windmills are the representation of the innovative techniques that are used to pump out the water. Even after the land reclamation, the windmills are still part of the system to keep the polder dry. Villages develop on the dry and higher grounds and the fertile grounds are used for agricultural purposes. By the end of the 19th century, the traditional windmills are replaced by (steam)pumping stations (Den Exter, 2013).
The next industrial revolution starts at the end of the 18th century in Great-Britain (De Roode, 2015). It represents the transition from individual hand-made production to mass production, situated in factories. These large factory grounds appeared at the edges of cities, and also compromised workers housing, waste dumps and large buildings. The fast distribution of products was facilitated by the construction of a railway network throughout the country. Stations became the connecting nodes between cities and also between people. People moved from the countryside towards the cities, for job opportunities and the desire for a better life.

The third revolution shaped our region to a large extent. Motorized vehicles started to appear in the streets at the beginning of the 20th century (Avnskjold, 2012), but became normalized as individual property after the Second World War. Together with the post-war redevelopment of many cities, the motorized vehicles became a dominant design- and policymaker. Highways cut through the traditional landscapes, establishing fast connections between cities. Gas stations, supplying fuel for cars and people, became the new meeting places along these highways filled with individual vehicles. In the 80s and 90s of last century, business parks emerged at the edges of cities and close to highway nodes. These infrastructures and built environment consumed patches of land, leaving a large footprint on the original landscape.

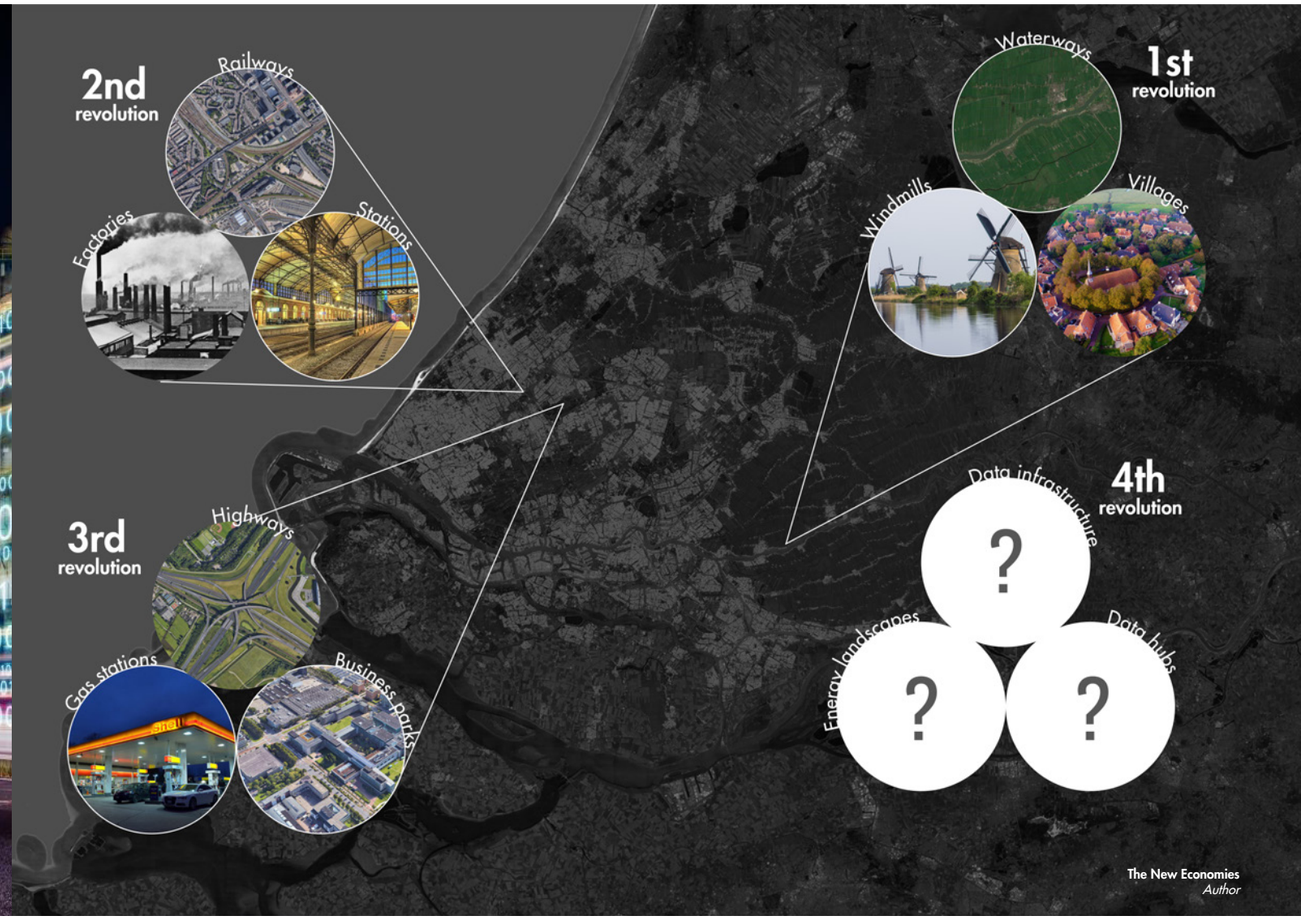
Each economic development and industrial revolution leaves traces in the landscape. Some of them are hard to erase, when a new economy enters and demands a change of land use. By taking this into account in the spatial development strategies, a change in land use can be facilitated more easily, without high costs or damages to the original landscape that this region is so well-known for.

HOW WILL THIS NEW CIRCULAR ECONOMY, BASED ON DATA, SHAPE THE REGION?





Four Industrial Revolutions



The New Economies
Author

The digital economy is developing so fast that its traces are almost hard to track. The development of these trends will influence the way the digital economy will be part of society.

Big-data collection
It compromises the large volume of information that is generated on internet resources (i.e. social media), industrial and sensor data (industrial devices), data owned by businesses and public data, collected by governmental and non-governmental institutions (U.S. Chamber of Commerce Foundation, 2014). The collection and processing of user-driven data brings along challenges concerning privacy, security and ownership.

Growth in automatization processes
As automats and robots already take over most of the heavy jobs in factories and distribution centers, this growth can continue and also influence others sectors. Concepts such as online shopping, online education and online entertainment are already present in society and will change the living environments drastically. These processes are driven by the digital economy.

More innovative trends are also developing within the sector.

Edge computing
Within this principle, the processes happen as close as possible to the 'endpoints' of the system, being the small devices such as smartphones or computers. Small packages of summarized data are sent to 'the cloud', the storage location of the system. This ensures short distance communication between the different elements of the system and thus reducing the demand for processing infrastructure. A decentralized system is safer and more energy-efficient than original centralized systems (Ahvar et al., 2019).

Storing on DNA
Research shows the possibility of data storage on DNA chains (Lee, 2019). DNA is very stable and can store amounts of data that are not even comparable to the storage capacity of devices. With the development of this possibility, the scales on which data is stored is completely different from the scales that are the areas of interest right now.

In decision-making, these trends need to be carefully studied and taken into account, as they have a big influence on the future of society and the built environment.

Like previous economic developments and industrial revolutions, the emerge of the digital economy will also have an impact on the spatial lay-out of the region.

Elements of the data system
The seemingly intangible flows of the data sector do need to land somewhere, in the form of data centers, cables, satellites and individual devices. Data infrastructure will mainly be constructed underground and follow major traffic infrastructure lines, because it is more convenient in case of construction or maintenance.

The data hubs that are part of the system are not only buildings, but can be part of a larger whole, such as a campus or Central Business District cluster.

Design of data centers
Data centers are currently developed as closed boxes, without interaction with their direct environments. The buildings were supposed to be as anonymous as possible, leaving no single clue on what happened on the inside (Miller, 2019).

Over time, more attention has been given to the spatial impact of data center locations. The spatial impact is not just about the façade design, but also about the negative externalitites a data center poses to the direct environment.

Intertwining worlds
Next to that, the physical and digital world are completely intertwined. The physical world is driven and shaped by the technologies and data that is collected in the digital world and the digital world is leaving traces in the physical world.

The upcoming energy transition, an important part of the circular development of this sector, also predicts a land use change towards renewable energy production landscapes.

The mobility transition can be supported by data collected in the data clusters around large infrastructure. This data can be used to propose and design concepts for the mobility transition.

The influence of the data sector will thus be visible in many aspects of the built environment and in daily life. The digital economy can be used to facilitate certain important (regional) transitions.

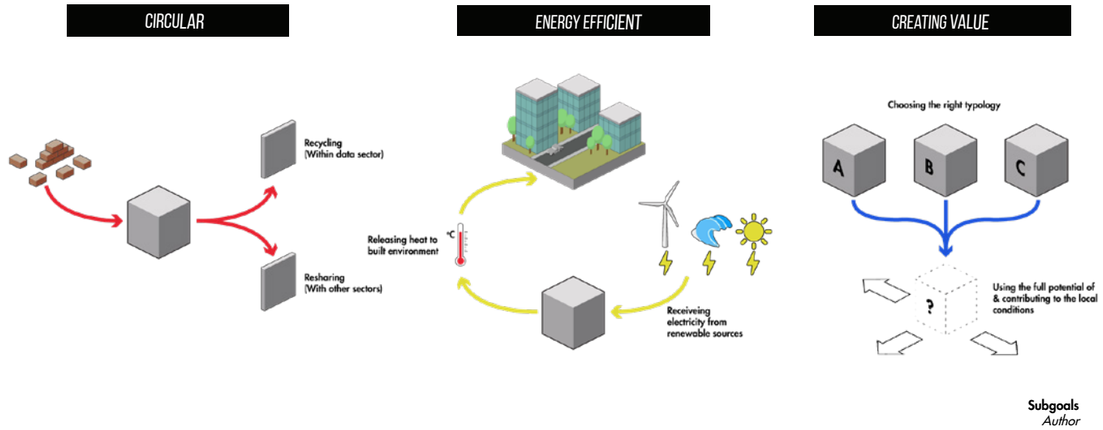
06
VISION

- Main Goal and Subgoals
- Vision Statement
- Principles for Circularity
- Values of the New World
- Vision Map

MAIN GOAL AND SUBGOALS

GOAL: In 2050 South Holland will be circular and contribute to a sustainable world.

SUBGOAL: Implement the digital economy in the (urban) fabric of South Holland in such a way that the developed datascapes are..;



Subgoals
Author

VISION STATEMENT

In 2050 South Holland will be circular and contribute to a sustainable world. A strategic and integrated development of the digital economy into the (urban) fabric of South Holland functions as a catalyst for this goal. The development of these datascapes is circular, (energy-)efficient and creates value throughout the different scales.

On a regional scale, renewable energy production landscapes are developed to establish a powerful grid to support this new economic sector. Locally, energy exchange principles and agglomeration effects are used to their full potential. The construction material use is optimized from a linear flow to a circular cycle, focussing on keeping the production and consumption patterns as local as possible.

[environmental sustainability]

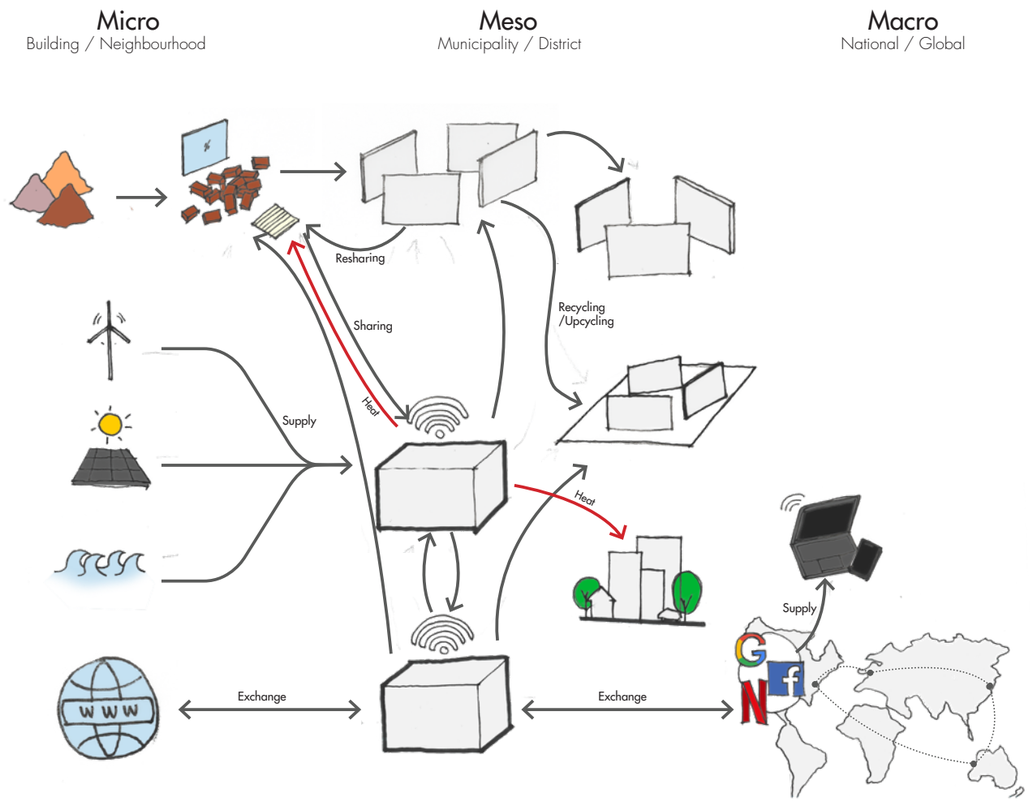
New sustainable business models are created to preserve the important global position of this region, without losing attention for the local and national value.

[economic sustainability]

In this strategy, we bring data hubs as a platform for awareness, participation and knowledge exchange. These platforms will either function as a creator or a transformer of the local environment.

[social sustainability]

PRINCIPLES FOR CIRCULARITY



Three Principles for Circularity
Author

The flows of material, energy and data, that facilitate the data sector, are present on multiple scales. To transform these currently linear flows into circular cycles, three principles are used.

1. Recycling
Recycling is the most described principle in the road towards a circular economy.
With this principle, the process of retrieving materials that can still be used from old products and create new products with them (Terracycle, 2020). The functionality of the original product is destroyed in the conversion, but a more useful product can be created.
For example, construction materials or plastic waste can be transformed into proper construction material for the data centers and interiors.

2. Upcycling
Upcycling represents the process in which a used product is transformed into a product of higher quality than the previous product. This principle can be applied to raw materials, but also to finished products (Sung, 2015). In the data sector, a higher quality for servers or other electronic components would mean: adapted to the latest technology or innovation. Also, building materials or electronic components from other sectors could be upcycled to function in the data sector.
In the large-scale production and consumption streams that supply the data sector at the moment, it is difficult to understand the possibilities of upcycling. Upcycling therefore demands local or regional production and consumption flows and a clear insight in the who, what, where and how (Sung, 2015).

3. Resharing
In the resharing-principle, products and materials are exchanged with other sectors than the data sector. This principle is characterizing a sharing economy, in which materials and products have different lifecycles within many sectors. Collaborative models between sectors and a well-structured logistic system in the region can facilitate this principle. A sharing economy can contribute to a circular economy over time (Sposato, 2017).

The material flow
Materials can be recycled, upcycled and reshared. Preferably, this happens mainly on the micro- and meso-scale, because of transport distances and the scale of the logistic system that the materials are part of. Some materials for data centers will come from other continents, so for this logistic scale a system optimization needs to be implemented as well.

The energy flow
The construction of new energy landscapes will keep the production and consumption of energy within the region. Heat exchange principles will close local loops between data clusters and the built environment. Electricity from the energy landscapes will be distributed over the region.

The data flow
Data can also be upcycled and reshared. The processing takes place between individual devices and communal cloud storage. Re-use will lead to less digital waste.

VALUES OF THE NEW WORLD

SAFETY
of the network and the data via trust, reliability, resilience & flexibility

EQUALITY/JUSTICE
of the sector's products via accessibility & ownership of data and the network

HEALTH
of people and planet via efficient use of resources

DIVERSITY
of stakeholders and spaces via minimizing monopolies

PROSPERITY
of the society via diverse employment opportunities, economic growth, and high living quality

PARTICIPATION
of all stakeholders via activation of users and creating shared responsibility

Six Local Values
Author

SOUTH HOLLAND 2050 VISION

To implement this vision, diverse strategic interventions in this region have to take place. These interventions are aimed at a controlled growth of the South Holland data cluster, making use of local renewable energy production and local material cycles. The star-shapes present the data centers, while the circles show the High-Potential-Areas where the circular flows of material, energy and data are present. The data centers can rely on these areas for the necessary flows.

Urban Value
Transport Value
Agricultural Value
Educational Value
Urban Value
Delta Value
Agricultural Value
Agricultural Value

Legend
- Supporting function
- Core function
- Data flow
- Material flow
- Energy flow - Electricity
- Data centers
- Energy landscape
- Highly urbanized zone
- Hinterland zone
- Waterfront zone

Transformer — Creator

- Ecological Preservation
- New Economy
- Employment Opportunities
- Increased Property Value
- Activity Catalyst
- Flood Protection
- Education
- Agricultural Value
- Transportational Value
- Urban/ Educational Value
- Delta Value

environmental values

economic values

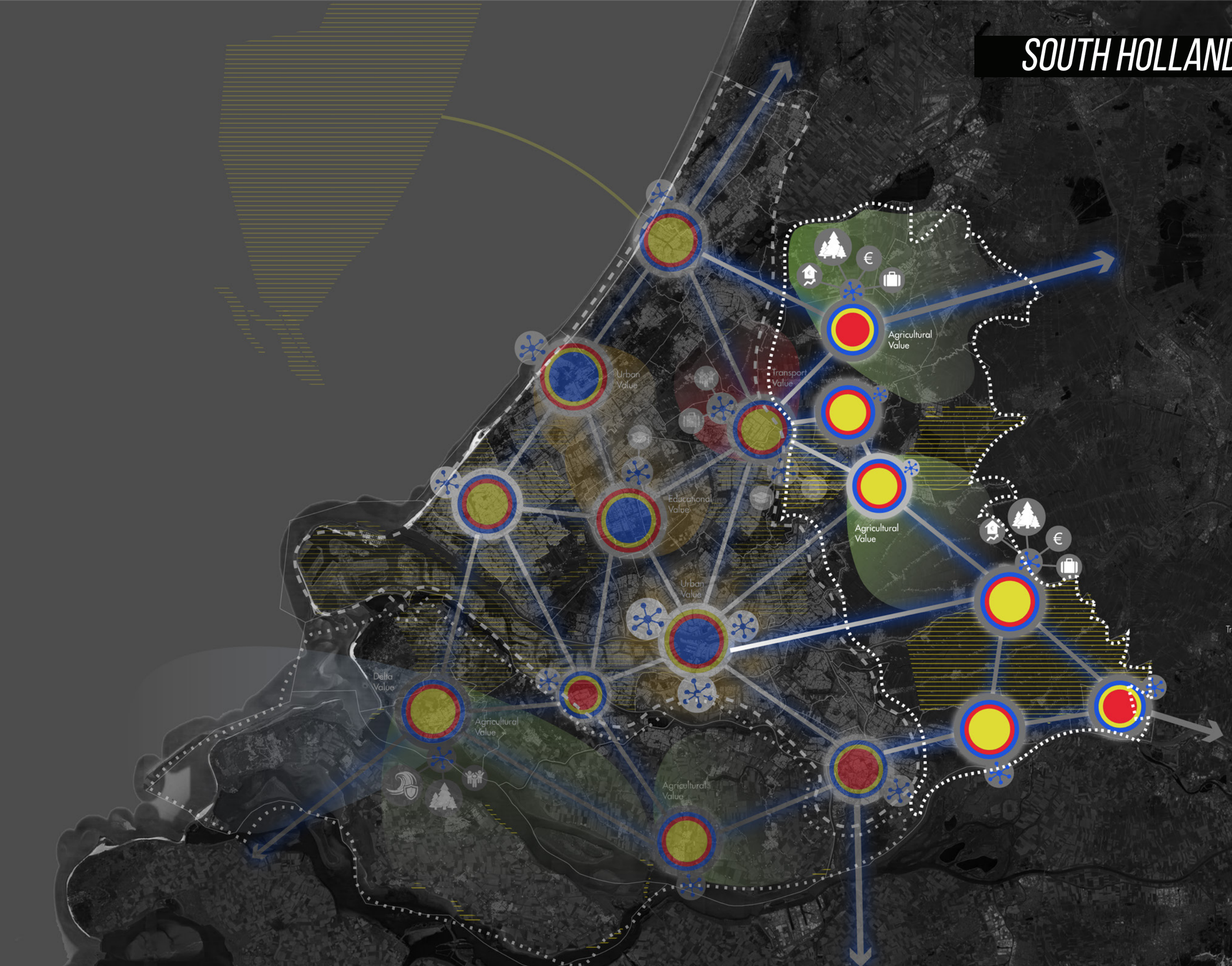
social values

0KM 2.5KM 5KM 10KM

SOUTH HOLLAND 2050 VISION

The Green Heart

In the hinterland zone, data hubs will be developed, aimed at improving/optimizing the agricultural economy in this area. It can also generate new economies/businesses, so the economy of the area is not only dependent on agriculture. Energy production will mainly be done by biomass processing. The extension of the grid from the urbanized area makes sure the difference between the zones does not increase enormously.



Legend

- Supporting function
- Core function
- Data flow
- Material flow
- Energy flow - Electricity
- Data centers
- Energy landscape
- Highly urbanized zone
- Hinterland zone
- Watertront zone

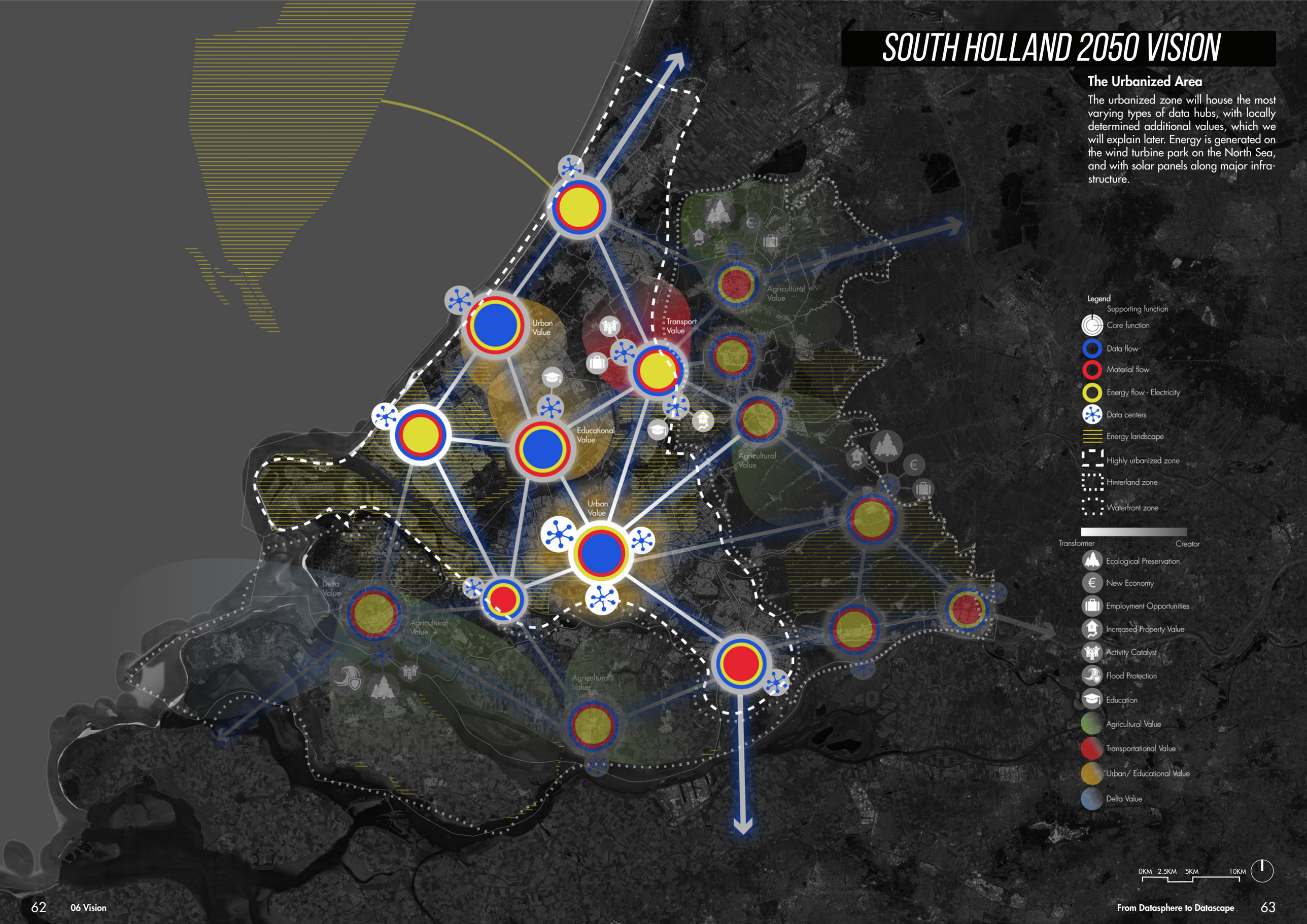
Transformer — Creator

- Ecological Preservation
- New Economy
- Employment Opportunities
- Increased Property Value
- Activity Catalyst
- Flood Protection
- Education
- Agricultural Value
- Transportational Value
- Urban/ Educational Value
- Delta Value

SOUTH HOLLAND 2050 VISION

The Urbanized Area

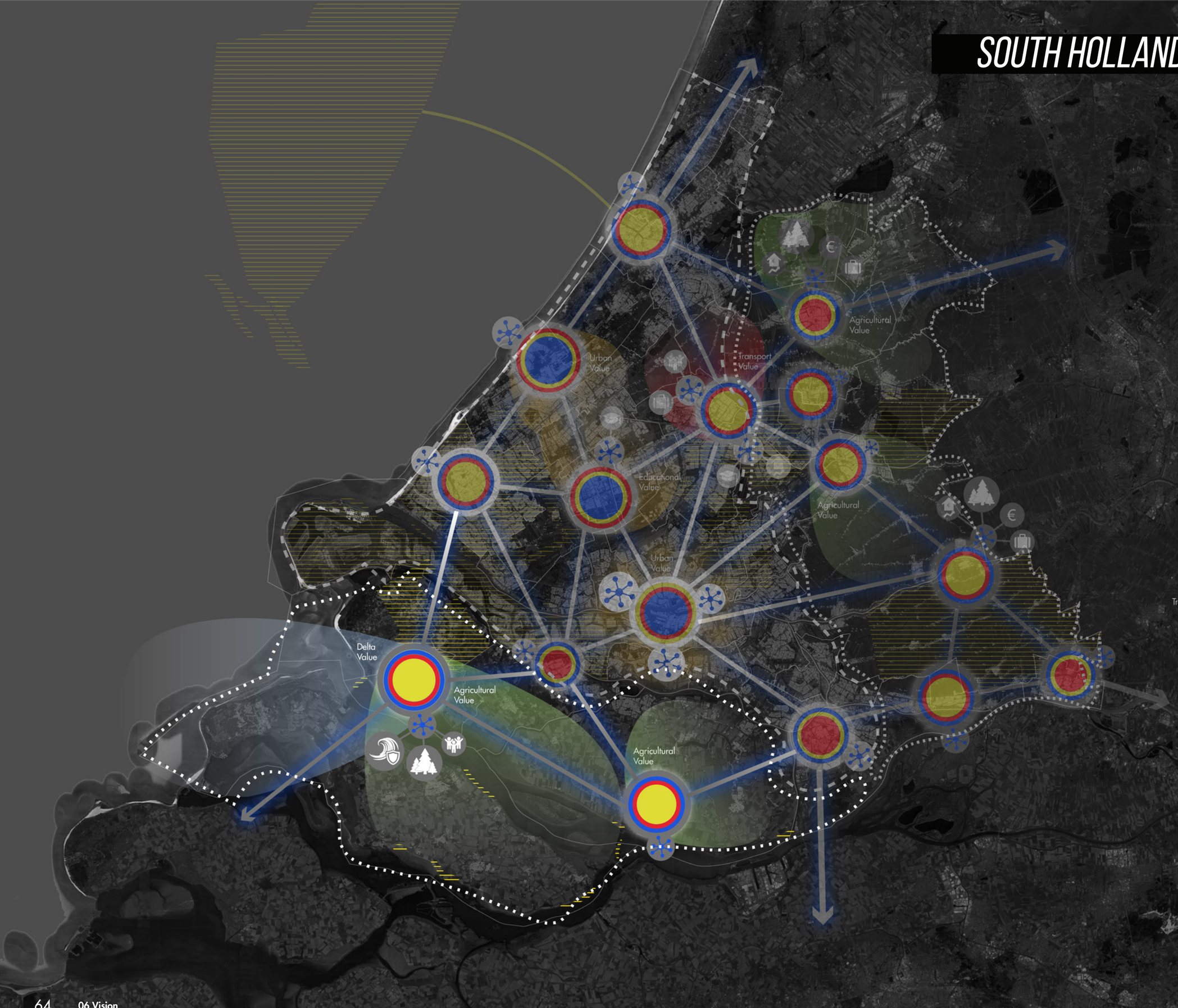
The urbanized zone will house the most varying types of data hubs, with locally determined additional values, which we will explain later. Energy is generated on the wind turbine park on the North Sea, and with solar panels along major infrastructure.



SOUTH HOLLAND 2050 VISION

Beijerland & Goeree-Overflakkee

Data hubs in the southern part of the province will be part of the flood protection system of the country. Collected data will contribute to smart knowledge on these systems and real-time action. Energy will be produced in hydropower plants and in wind turbines. The extension of the grid in this direction and improving infrastructure connections could lead to less depopulation because of urbanization.



Legend

- Supporting function
- Core function
- Data flow
- Material flow
- Energy flow - Electricity
- Data centers
- Energy landscape
- Highly urbanized zone
- Hinterland zone
- Waterfront zone

Transformer — Creator

- Ecological Preservation
- New Economy
- Employment Opportunities
- Increased Property Value
- Activity Catalyst
- Flood Protection
- Education
- Agricultural Value
- Transportational Value
- Urban/ Educational Value
- Delta Value

0KM 2.5KM 5KM 10KM

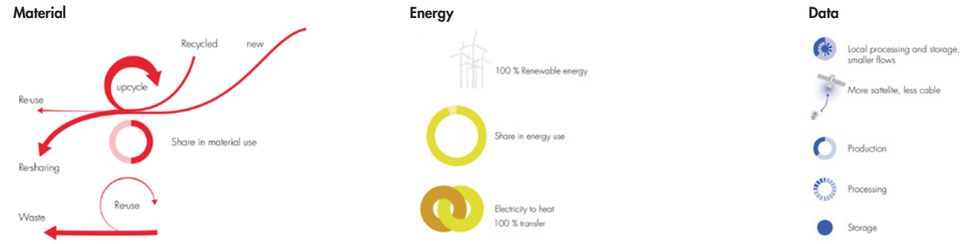
07

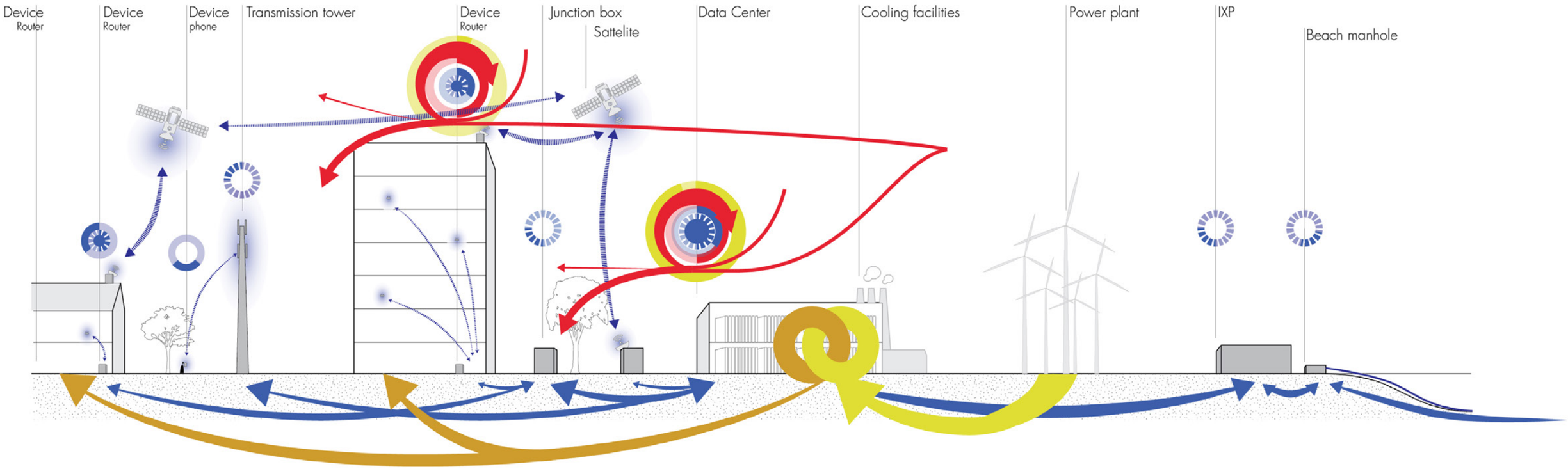
EXPLANATION OF THE NEW SYSTEM

- Circular Flows
- Best Practices
- Creating More Local Value
- Creating Datascapes As a Space

CIRCULAR FLOWS

Proposal for sustainable, circular flows of material, energy and data.





Circular Flows
Author

The material and energy flows of the data infrastructure have a lot of potential to transition from linear into becoming circular. In this way they do not only comply with the goals of the province of South Holland but become an exemplary industry as well as a catalyst for the new economy.

The material flow | Built environment
The largest datacenter of Rotterdam, 3500 square meters, is located in a Unesco former factory building. The former industrial area provides a suitable location for this energy demanding activity [SmartDC, 2020]. It is an example that shows the potential for repurposing drosscape, former industrial sites into highly demanded extention sites of the internet infrastructure. In order achieve a circular material flow, the built environment component [besides the hardware component] requires a mainly 'no new buildings' policy. Repurposed former vacant facilities will provide the much needed space for expansion of the network. However, the construction of new buildings is inevitable. Not all locations that have a demand for extention of the data infrastructure hold these kinds of grounds. In that case, such as shown later on in this report, new structures have to be realized with local resources.

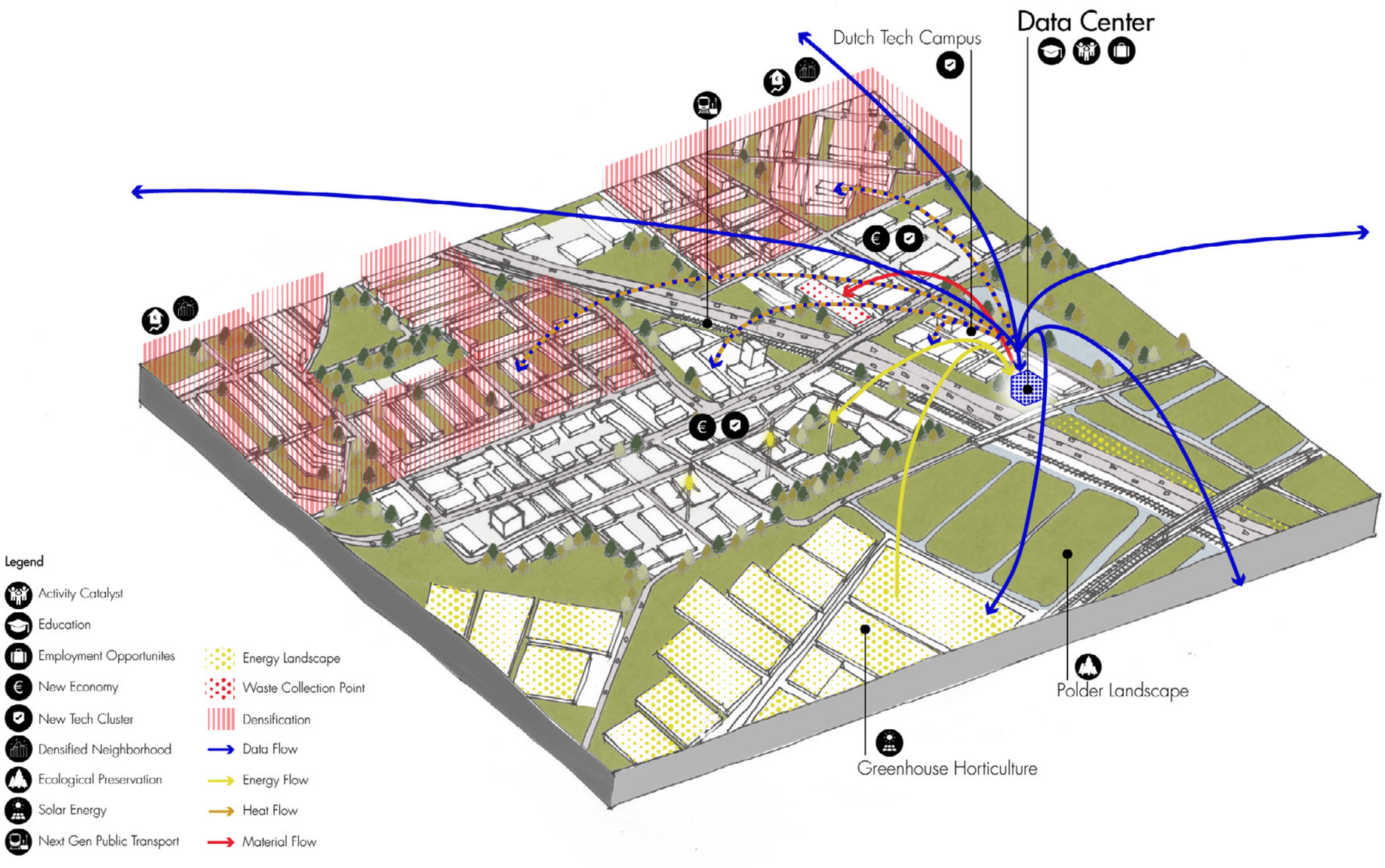
The material flow | Hardware
In a circular [hardware] material flow, outdated hardware is upcycled and reused. When no longer upcyclable, the hardware is recycled or reshared, for example distibuted to activities that do not require state of the art computing power. When no longer suitable for recycling or resharing, the hardware is used for material mining. The precious minerals can be mined and used as input for newly manufactured hardware using only sustainably mined material. In this way, value loss is minimized and finite resources are no longer depleted.

The energy flow
By 2050 the entire data infrastructure is powered by renewable energy sources. Residual heat that is released is used as input for systems such as city heating.

The data flow
According to IDC [2019] by 2025, 80 percent of the data worldwide is stored and unused. Most of this data consist of so called 'unstructured' data. This data is difficult to analyze such as photos, audio, social media data or real-time streaming data from IoT devices. This large amount of 'refrigerated' data is a result of companies do not yet know how to exploit this type of data. It is thus of importance to value our data, for example by sharing and integrating it and develop efficient store methods. For example the storage of data on DNA [Lee, et al. 2019].

lastly, fragmenting the data infrastructure to a certain extent would be ideal because it is very beneficial on many levels [Metselaar, 2020]. This concerns all three flows. An exemplary solution is the modular, prefab datacentermodule, constructed within a repurposed shipping container [Eltek, 2020]. Placed within a Smart Grid, it facilitates renewable energy production, local use of residual heat, re-use of material and local processing and storage of data.

CREATING MORE LOCAL VALUE



Creating More Local Values
Author

Creating and transforming the local value

Local flows, elements, users and sectors will be influenced by the development of a data cluster.

In the current way of developing, existing local qualities are not connected to the development of the data clusters and therefore not use to their full potential.

Transforming the local value is about adding to something that is already present. In the case of Zoetermeer, that will be discussed later, this can be an intensification of the existing educational cluster. By bringing different sectors, people and flows together, this educational cluster can be optimized and thus transformed, by the development of a data center.

In other cases, it is about creating more local value. By bringing employment opportunities to a region that has a shortage of jobs, or by developing a visitors center to create awareness of the importance of the ecological structures in this region.

In current decision-making processes, local values are not represented, as most decision-making is based on (national and global) economic importance. Taking into account the environmental and social consequences and challenges that data clusters pose on their direct environments can lead to a more sustainable development of the centers, in multiple perspectives.

Advantages that a data cluster brings are for example, educational possibilities, employment opportunities, better digital and physical connectivity, increasing value of the built environment and better security. Also, data centers can function as local community centers, bringing people together.

Challenges that are posed by data clusters are the heat release, the high energy demand, and, temporarily, the amount of interventions that need to be done in order to construct a data center.

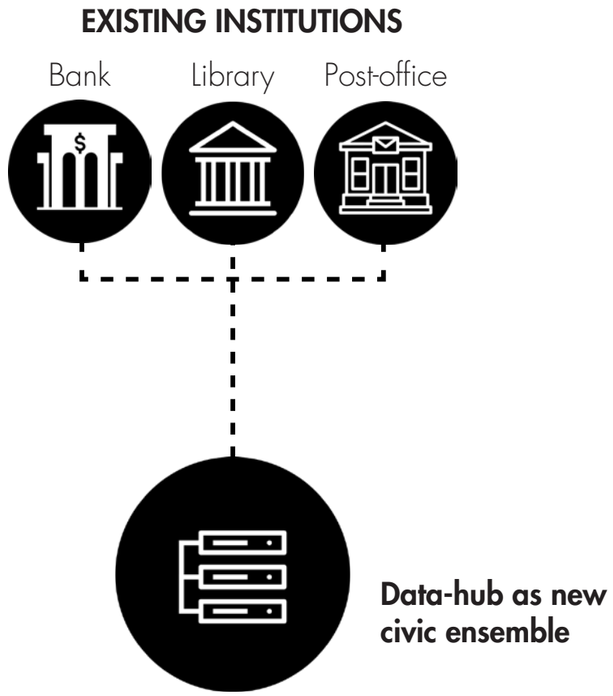
Establishing more local value with each intervention in this strategy means searching for local synergies, to create multi-functional purposes of interventions. It is also about optimizing local flows, by connecting the heat- and electricity streams to establish local energy loops. Thirdly, more local value will be added by bringing benefits to the local community and economy.

CREATING DATASCAPES AS A SPACE

URBAN COMPLEXITY & INSTITUTIONAL CIVIC HUB

COUNTRYSIDE DEVELOPMENT & TRANSFORMATION

Creating Datascape as a Space
Author



FUTURE INSTITUTION

Data-hub as New Civic Ensemble
Author

Data and everyday life

The average person spends six hours per day on the internet (Kemp, 2018). This adds up being one third of the time we are awake. But blending data technology into our lives comes with questionable conditions regarding the binary logics that we impose on ourselves. We are accustomed to see our smart devices, also known as hardware, as an instrument that does what we wish, but the role of smart devices in our lives is changing.

Nowadays, data and algorithms are increasingly taking decisions that were previously made by humans (Kieft, 2018). The implications of our smart devices trigger a paradigmatic shift. This shift is embedded with increased technologic automatization and more computing power. This transition towards a world of digital regulation, does not only include our extensive use of more powerful IT systems (Kurzweil, 2005). It also comes with more intelligent IT systems and networks.

Transitioning

When we as a society start replacing analoge methods of data-storage, such as banks, post offices, or even libraries, with smart devices and IT technology, our physical living environments become more and more digitised. Cloud storage systems are a direct result of this shift. The could space is a digitised zone that stores our increasingly outsourced data. This trend in data outsourcing makes remote workplaces possible and development is no longer limited to specific physical locations. Internet frees us from geographic locations and might take us to topic based communities.

We access the internet and data through our hardware. But hardware needs a soft place to reside and store its necessary algorithms. The digital cloud environment has become that new soft place and therefore the infrastructure in our living envrionment is changing towards a network of cables. In the near future highways are fast fibre glass Wi-Fi connections. Data simultaniously supports and uses the cloud space, while it is harvested by server farms. Law is prescribed by algorithms and borders are defended by firewalls. But how do we prevent our public data insitutes, such as the before mentioned post-offices and libraries, from disappearing? And how do we guarantee inclusive, secure, and fair accessiblity to our common data?

Data centers / hub

In this exceedingly growing system, the data centre is the physical place where everything comes together. Currently it is a publicly inaccessible building that hides a digital world within our cities. But, what if the nature of a data center would change towards that of a library or municipal office. A civic or even public ensemble where people of all walks of life can come together and access, store, or even share knowledge with one another.

08
DEVELOPMENT STRATEGY

- Redefinition of the Region
- Stakeholder Analysis
- Development of 17 Data Clusters
- Data Hub Typology
- Data Hub Guideline

REDEFINITION OF THE REGION

Redefinition of the region - functional zones

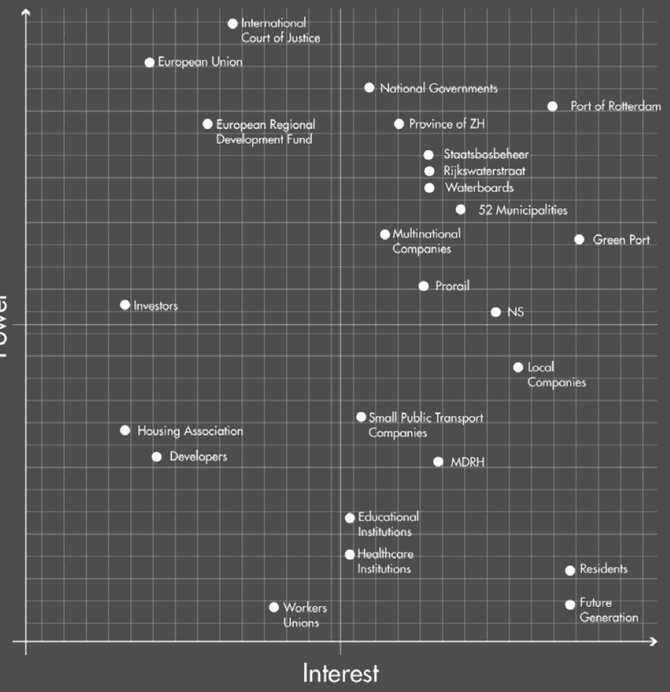
1 - Lisse & Hillegom [agriculture]
2 - Green heart [ecology]
3 - Katwijk [global internet connection]
4 - Leiden [knowledge institute]
5 - Alphen aan den Rijn [PTT-tower & Alpherium]
6 - Coastal zone [ecology]
7 - Greenport Boskoop [agriculture]
8 - Gouda [material hub]
9 - Scheveningen [NATO research center & former radar location]
10 - CBD The Hague [ministries & international justice cluster]
11 - Neighbourhoods The Hague [residential]
12 - Delft [knowledge institute]
13 - Greenport Bleiswijk - Pijnacker [agriculture]
14 - Zoetermeer [ICT-focussed city]
15 - Greenport Westland [agriculture & logistics]
16 - Midden-Delfland [ecology]
17 - Neighbourhoods Rotterdam [residential]
18 - CBD Rotterdam [concentration of businesses]
19 - Schoonhoven & Nieuwpoort [water & ecology]
20 - Drechtsteden [metal industry]
21 - Gorinchem [industry]
22 - Hoek van Holland [connection to GB]
23 - Port of Rotterdam [trade, logistics, production]
24 - Spijkenisse [residential]
25 - Beijerland [agriculture, energy production]
26 - Delta coastal zone [protection]
27 - Goeree-Overflakkee [agriculture, energy production]
28 - North sea [energy production]

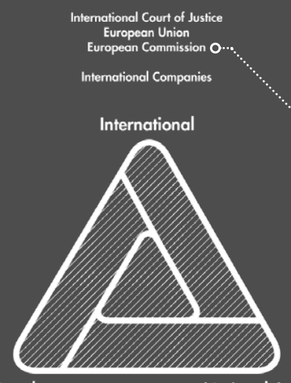
To kickstart the implementation of the strategy, the region is subdivided into 28 functional zones. Planning and implementing a regional strategy goes beyond municipal boundaries. New collaborations are needed, and these functionality zones represent the scales on which the collaborations need to be established. The 28 zones all serve a specific purpose in the development of the West-Holland data cluster, for example as an energy production landscape or a logistic hub.

0KM 2.5KM 5KM 10KM

STAKEHOLDERS ANALYSIS

To comprehend who are the stakeholders involved in the regional scale, they are positioned in the triangular diagram, which is divided into three scales: international, national and regional, and local. Moreover, The power and interest table is used to analyze their amount of power and interest. Besides, they are also mapped to see the overview of where they are located in the province. Altogether, we learned that which stakeholders need to be persuaded and which ones we can use to support the ideas in our development strategy.





International Court of Justice
European Union
European Commission
International Companies

Local

Governments
52 Municipalities

Energy Suppliers
Wind energy companies
Solar energy companies
Tidal wave energy companies

Water Supplier Companies

Material Production & Waste Recycling Companies
Electronic component industrial companies
Material repair companies
Recycling materials sorting centers

Data Centers
Tech Companies
Network Operators

Educational Institutions
TU Delft
Leiden University
The Hague University
Erasmus University Rotterdam

Residents

National & Regional

Cabinet of the Netherlands
Prime Minister
Deputy Prime Ministers

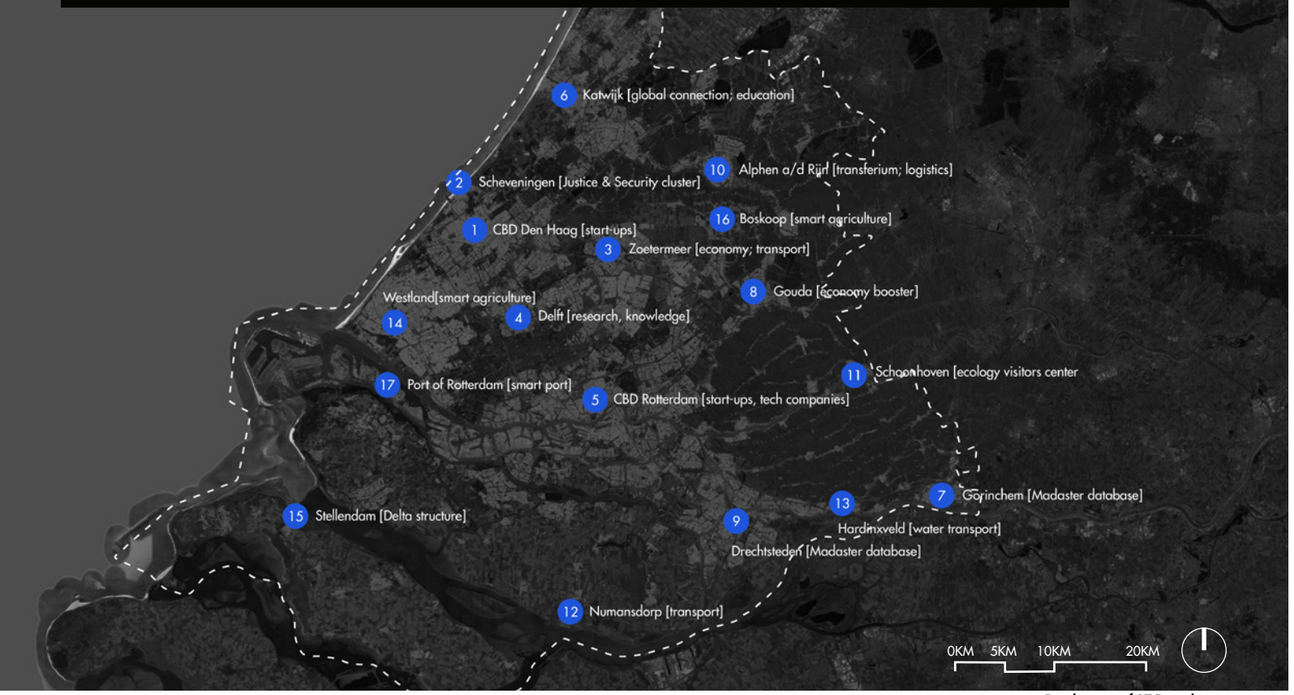
12 Ministries

Staatbosbeheer
Rijkswaterstraat
Waterboards

Province of South Holland
Stated-owned Transport Companies
NS
Prorail

Greenport
Port of Rotterdam

DEVELOPMENT OF 17 DATA CLUSTERS



Development of 17 Data clusters
Author

1 CBD The Hague - storage
Tech companies and start-ups in the city center enjoy proximity advantages.

2 Scheveningen - storage
An extension of the Security & Justice cluster situated in The Hague, with highly-secured data storage.

3 Delft - production
A lot of data and knowledge is generated in the university-hub and related Technopolis business park. The hub will be complemented by a education facility for primary and high schools.

4 Zoetermeer - production
Zoetermeer will be the ICT-cluster of the region. The generated data of the nearby A12 highway will be used to kickstart the mobility transition.

5 CBD Rotterdam - storage
Tech companies and start-ups in the city center enjoy proximity advantages.

6 Katwijk - processing
The main global internet connection cable of North-West Europe arrives in Katwijk. This data cluster therefore plays an irreplaceable role in the global data network.

7 Gorinchem - storage
The establishment of the Gorinchem data cluster will support the emerge of new business types and economies. It will give a boost to the local economy.

8 Gouda - storage
The establishment of the Gouda data cluster will support the emerge of new business types and economies. It will give a boost to the local economy.

9 Drechtsteden - storage
The Drechtsteden are an important material producing cluster in the region. The establishment of the Madaster headquarters will provide the entire region with up-to-date information on urban mining and materials of the built environment in this region.

10 Alphen aan den Rijn - processing
Alpherium is one of the largest logistic transferia of the region. Intensifying the incoming and outgoing flows of this transferium will be facilitated by the Alphen aan de Rijn data cluster. It will process, just like the goods, all the incoming and outgoing information.

11 Schoonhoven - storage
Schoonhoven is situated in the center of the Green Heart ecological structure. The aim to connect the entire region to the data-grid will happen by extending the network towards this part of the region. The local qualities of the cluster can be enhanced by creating a visitors center where ecology and water management in the Green Heart are promoted.

12 Numansdorp - processing
Numansdorp lies close to a major highway from the Randstad to Antwerp. The data cluster will play a role in the mobility transition. Additionally, the data cluster will focus on the surrounding energy production landscapes.

13 Hardinxveld - storage
Hardinxveld has an historic local economy of shipyards and -repair. The local economy will get a boost from the development of a data cluster, while the region profits from the craftsmanship and workforce that is situated in this town.

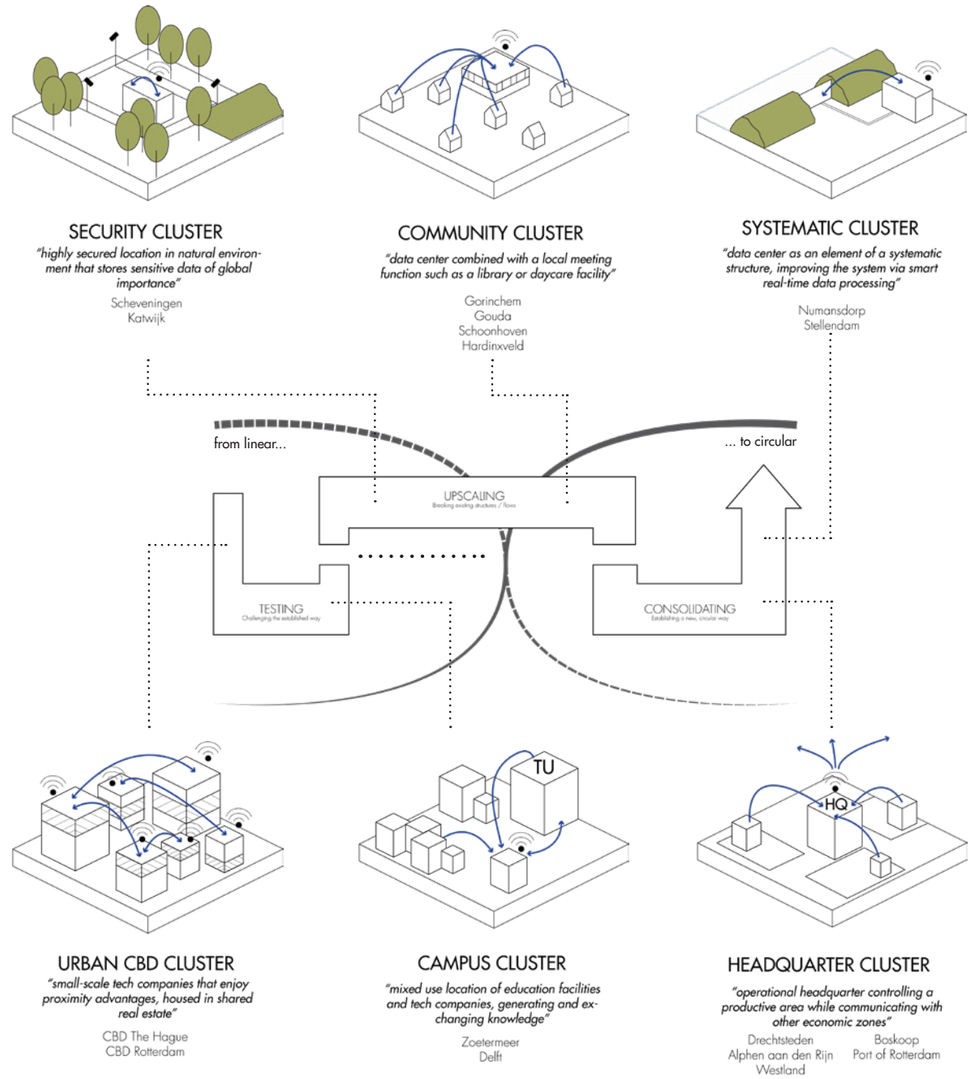
14 Westland - production
The Westland, being one of the most important food production areas in the world, faces a major challenge: to make the food chain circular and preserve the food quality that the area is well-known for. The cluster will become a self-sufficient food production cluster with global importance, facilitated by smart data systems.

15 Stellendam [Delta] - processing
The Netherlands is facing challenges regarding flood protection and water safety. Data clusters can play a large role in the security of the country, by collecting and processing data on the protection structures. This data cluster will be complemented with a visitors center to provide education on how the Delta works.

16 Boskoop - production
Boskoop is another agricultural cluster in the region. It will become a self-sufficient cluster that is focussed on energy production.

17 Port of Rotterdam - processing
The Port of Rotterdam is one of the main economic drivers of the entire country. Most economic activity is fossil-fuel-based. In the upcoming decennia, the focus will shift towards business driven by renewable energy resources. The port will still function as a transfer and logistic hub, driven by smart technology clusters and renewable energy production landscapes.

DATA HUB TYPOLOGY



Data Hub Typologies
Author

Based on their spatial layout, the 17 clusters can be subdivided into six categories of spatial development and functions.

Phase 1
In the first phase of the implementation, the 'testing' phase, mainly the urban CBD [Central Business District] cluster and the campus cluster are developed.

The urban CDB cluster will stimulate cooperation and sharing between companies and institutes. The data hubs will be supported by the facility rich urban landscape in which they are located and can thus be developed in an early stage. The Campus cluster focuses on the merging of data and education in an effort to further develop the dutch data sector and help set up new local data industries on all educational levels. From recycling existing IT equipment to the development of Dutch IT manufacturing plants.

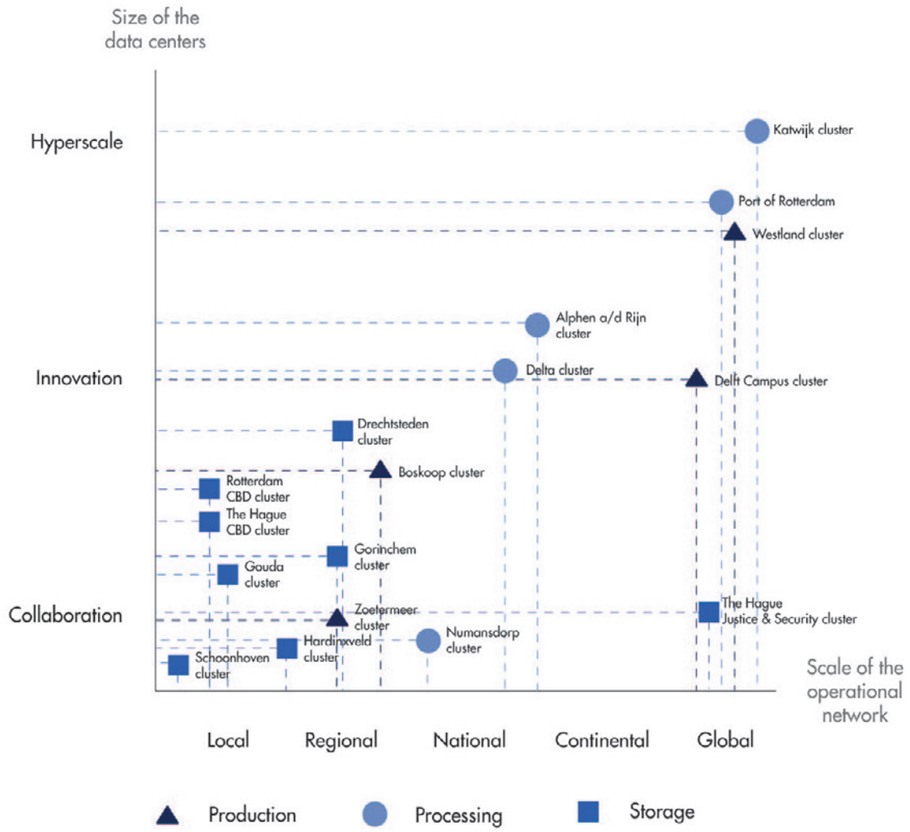
Phase 2
In the second phase, the 'upscaling' phase, new developments such as the security cluster and the community cluster take place.

On the one hand, the Security cluster will improve the overall operability and safety of the overall data network by extending into new territory and develop high security data clusters. While on the other hand, the community cluster will connect new regions to the data network and provide a more diverse local landscape in which data will help stimulate existing local potentials, such as nature reserves or agricultural landscapes.

Phase 3
In the third phase, the 'consolidating' phase, large-scale projects such as the systematic and headquarter clusters are developed. Both types of clusters will dramatically change the local environment by introducing infrastructural elements or create new economies.

To conclude, this diverse mix of data clusters creates a wide range of development strategies. Thus ensuring a smooth transition towards a circular datascape.

DATA HUB GUIDELINES



Data Hub Guideline
Author

Data cluster guidelines

As mentioned before the 17 data clusters can be subdivided into six categories of spatial development and functions. This categorization also has influence on the scale of the actual data centers and the scale of the operational network that is needed (see the figure above). By doing so an additional categorization can be made that will follow regional guidelines and goals. The data clusters can be divided into a place of; production, processing, or storage. These three categories characterize the nature of the actual data centers and can help with the strategic implementation of the larger provincial network.

The Hague data cluster

In this location an URBAN CBD CLUSTER with a storage nature will be proposed. Tech companies and start-ups in the city center will benefit from the proximity to this new and improved data hub. One of the main positive externalities will be new businesses that feel attracted to the area.

Scheveningen data cluster

In this location a SECURITY CLUSTER with a storage nature will be proposed. An extension of the Security & Justice cluster situated in The Hague, with highly-secured data storage.

Delft data cluster

In this location a CAMPUS with a local production nature will be proposed. A lot of data and knowledge is generated in the university-hub and related Technopolis business park. This data needs to be processed and stored. The hub can be complemented by an education facility for primary and high schools.

Zoetermeer data cluster

In this location a CAMPUS with a local production nature will be proposed. Zoetermeer will be the IT-cluster of the region. The city is well-connected by different transport modes and houses departments of The Hague University that are focussed on the IT-sector. Besides that, the AIVD headquarters are situated in this city. This all adds up to a site with great data improvement potential. The nearby A12 highway will serve as a data-producing element about use, amounts and real-time management. The generated data will be used to kickstart the mobility transition, controlled by the Zoetermeer data cluster.

Rotterdam city center data cluster

In this location an URBAN CBD CLUSTER with a storage nature will be proposed. The central business district of Rotterdam houses many tech companies and start-ups. The data cluster in the center is focussed on data production and storage.

Katwijk data cluster

In this location a SECURITY CLUSTER with a processing nature will be proposed. The main global internet connection cable of North-West Europe and the Netherlands comes to land in Katwijk. This data cluster therefore plays an irreplaceable role in the global data network, security and safety will be main development goals.

Gorinchem data cluster

In this location a COMMUNITY CLUSTER with a storage nature will be proposed. The establishment of the Gorinchem data cluster will support the emerge of new business types and economies. It will give a boost to the local economy.

Gouda data cluster

In this location a COMMUNITY CLUSTER with a storage nature will be proposed. The establishment of the Gouda data cluster will support the emerge of new business types and economies. It will give a boost to the local economy.

Drechtsteden data cluster

In this location a HEADQUARTER CLUSTER with a storage nature will be proposed. The Drechtsteden are an important material producing cluster in the region. The establishment of the Madaster headquarters in the area will provide the entire region with up-to-date information on urban mining and materials of the built environment in this region.

Alphen aan den Rijn data cluster

In this location a HEADQUARTER CLUSTER with a processing nature will be proposed. Alpherium is one of the largest logistic transferia of the region. Intensifying the incoming and outgoing flows of this transferium will be facilitated by the Alphen aan de Rijn data cluster. It will process, just like the goods, all the incoming and outgoing information.

Schoonhoven data cluster

In this location a COMMUNITY CLUSTER with a storage nature will be proposed. Schoonhoven is situated in the center of the Green Heart ecological structure. The aim to connect the entire region to the data-grid will happen by extending the network towards this part of the region. The local qualities of the cluster can be enhanced by creating a visitors center where visitors can learn about the ecology and water principles in the Green Heart.

Numansdorp data cluster

In this location a SYSTEMATIC CLUSTER with a processing nature will be proposed. Numansdorp lies close to a major highway from the Randstad to Antwerp. The data cluster will play a role in the mobility transition. Additionally, the data cluster will have another focus, namely the surrounding energy production landscapes.

Hardinxveld data cluster

In this location a COMMUNITY CLUSTER with a storage nature will be proposed. Hardinxveld has an economic history in shipyards, repair and production. As the mobility transition will lead to new or former ways of moving. The local economy can get a boost from the development of a data cluster, while the region profits from the craftsmanship and workforce that is situated in this town.

Westland data cluster

In this location a HEADQUARTER CLUSTER with a production nature will be proposed. The Westland, being one of the most important food production areas in the world, faces a major challenge: to make the food chain circular and preserve the food quality that the area is well-known for. The cluster will become a self-sufficient food production cluster with global importance, facilitated by smart data systems.

Delta data cluster

In this location a SYSTEMATIC CLUSTER with a processing nature will be proposed. The Netherlands is facing challenges regarding flood protection and water safety. Data clusters can play a large role in the security of the country, by collecting and processing data on the protection structures. This data cluster will be complemented with a visitors center to provide education on how the Delta and protection structures actually work.

Boskoop data cluster

In this location a HEADQUARTER CLUSTER with a production nature will be proposed. Boskoop is another agricultural cluster in the region. It will become a self-sufficient cluster that is focussed on energy production.

Rotterdam Port data cluster

In this location a HEADQUARTER CLUSTER with a processing nature will be proposed. The Port of Rotterdam is one of the main economic drivers of the entire country. Most economic activity is fossil-fuel-based. In the upcoming decennia, the focus will shift towards business driven by renewable energy resources. The port will still function as a transfer and logistic hub, driven by smart technology clusters and renewable energy production landscapes.

TESTING PHASE // short term, 0-5 years
Developments in this phase are;
- CBD The Hague
- CBD Rotterdam
- Delft
- Zoetermeer

These developments will use existing data grids which are based on mixed-use real estate, and will mix with other city functions. These areas are clustered with businesses, thus profits from proximity adventages can be anticipated. Vacant real estate (i.e. empty stores in the city centers) can be re-used as a data center. Another idea is "pop-up" which adds flexibility and moveability to the data center. However, it needs combination with education to investigate possibilities

Recommendations for the development of these types:
Urban CBD cluster: Upper floors in mixed use buildings.
Campus clusters: Multiple buildings functioning together as a whole.

UPSCALING PHASE // mid term, 5-15years
Developments in this phase are;
- Scheveningen
- Katwijk
- Gorinchem
- Gouda
- Drechtsteden
- Hardinxveld
- Numansdorp

This phase focuses on finding synergies between the implementation of the data network and local challenges (i.e. boost the local economy by extending the network or creating new employment opportunities). Innovative research on long-term projects will be initiated in this stage.

Recommendations for the development of these types:
Community clusters: More fixed design. Multifunctional buildings. Central location, open atmosphere.
Security clusters: Located in a natural environment. Partly underground

CONSOLIDATING PHASE // long term, 15-30 years
Developments in this phase are;
- Alphen aan den Rijn
- Schoonhoven
- Westland, Stellendam/Delta
- Boskoop
- Port of Rotterdam

The development in this phase will take place at location-specific sites. It includes large infrastructural projects which will change the network of energy and data. The data center implemented in this phase will be controlled from one central site or the headquaters. However, detailed development guidelines are not available yet, due to they being dependent on innovations of upcoming years.

Types:
Headquarter clusters
Systematic clusters

09
SPATIAL INTERVENTIONS

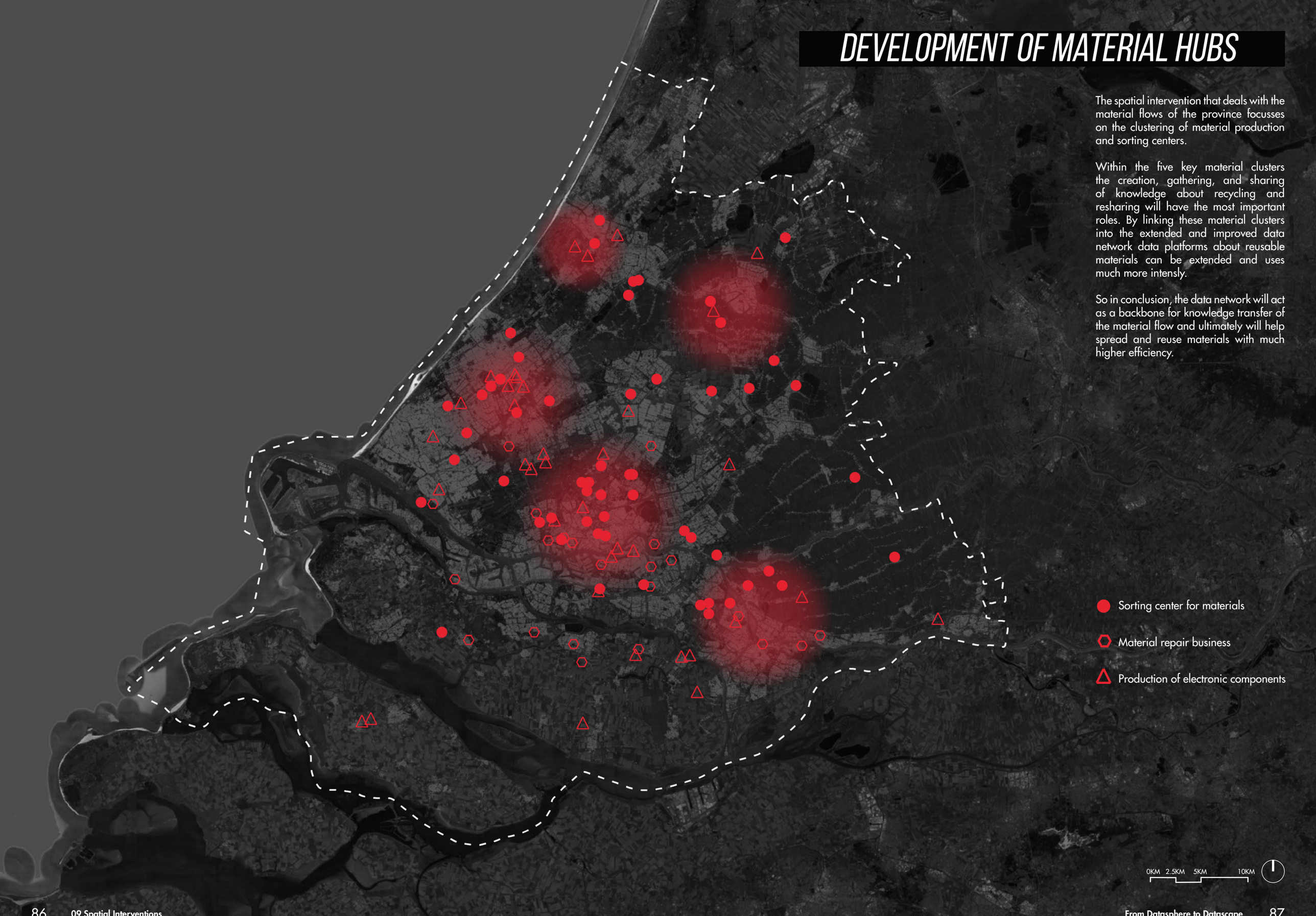
- Development of Material Hubs
- Development of Renewable Energy Landscapes
- Extension of the Existing Data Network
- Densification Developments
- Mobility and Transport Interventions
- Restructuring the Flows
- Influencing Other Flows

DEVELOPMENT OF MATERIAL HUBS

The spatial intervention that deals with the material flows of the province focusses on the clustering of material production and sorting centers.

Within the five key material clusters the creation, gathering, and sharing of knowledge about recycling and resharing will have the most important roles. By linking these material clusters into the extended and improved data network data platforms about reusable materials can be extended and uses much more intensly.

So in conclusion, the data network will act as a backbone for knowledge transfer of the material flow and ultimately will help spread and reuse materials with much higher efficiency.



DEVELOPMENT OF RENEWABLE ENERGY LANDSCAPES

The spatial intervention that deals with the large energy demand of the data sector and province of South Holland focusses on the implementation of more renewable sources of energy. The proposal consists of the extension of current renewable energy landscapes and the initial development of new energy landscapes such as;

- Biomass landscapes
- Windturbine parks
- Geothermal extraction sites
- Solar panel parks

In the long run more rigorous energy interventions will be proposed. Such as the Katwijk Blue Energy powerplant, the Stellendam Ionic Energy powerplant, and the Brouwersdam Tidal Energy powerplant. These interventions involve many stakeholders on a local, regional, national and even an international scale, so they will be implemented in the final consolidating stage.

Solar panels along highways

Solar panels along train tracks

Extension heat network

Geothermal extraction installations

Windturbine landscapes

Windturbine park on the North Sea

Renewal of the Port of Rotterdam

Biomass power plants

1 Katwijk Blue Energy powerplant

2 Stellendam Ionic Energy powerplant

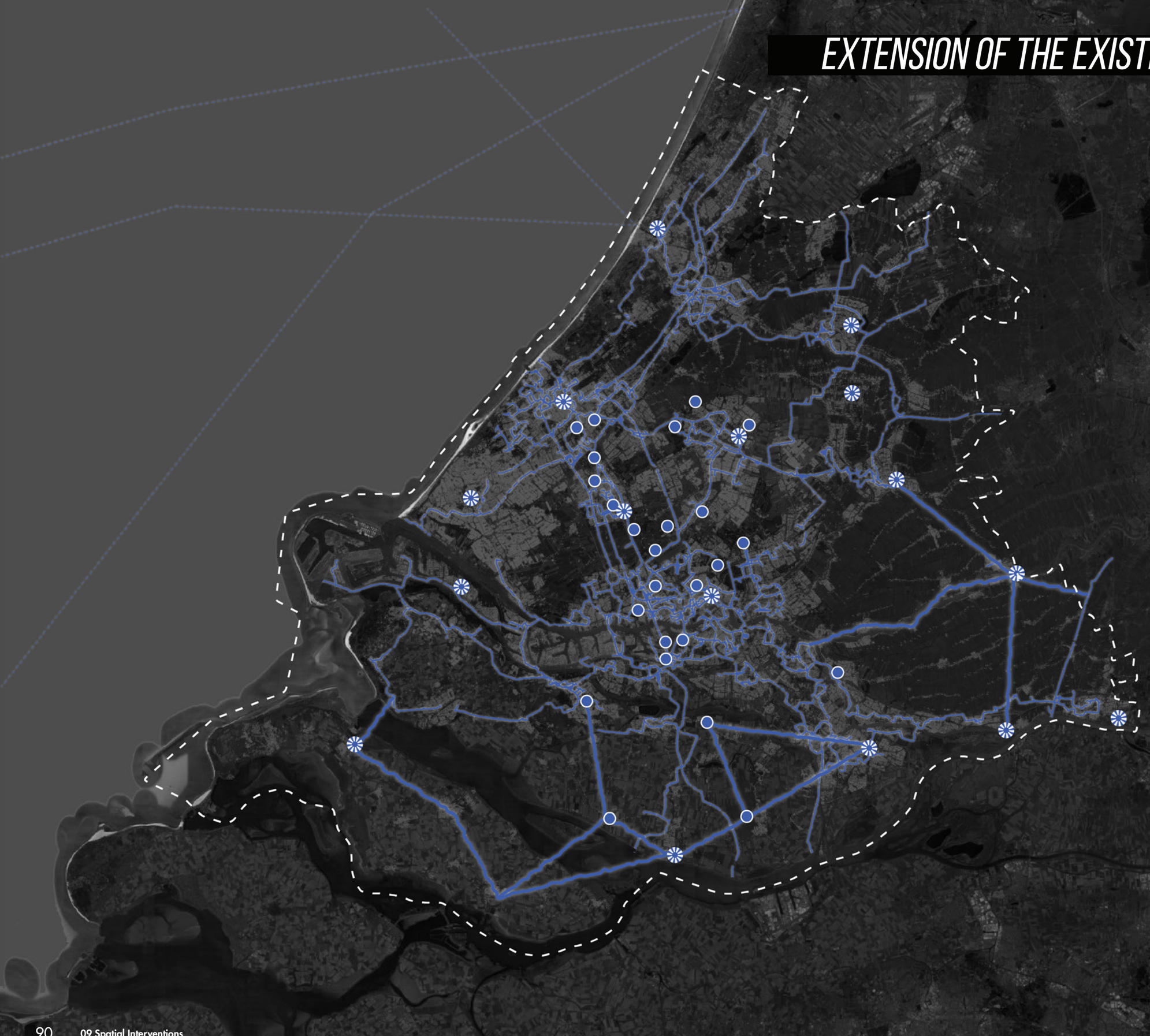
3 Brouwersdam Tidal Energy powerplant

0KM 2.5KM 5KM 10KM

EXTENSION OF THE EXISTING DATA NETWORK

The spatial intervention that deals with the data network is focussed on the extension of the existing data services. As mentioned before there is an unfair distribution of the data network within in the province of South Holland. Most is the network is located in the urbanized areas of the province, whereas the more hinterland areas are left with very little or no high quality data connections.

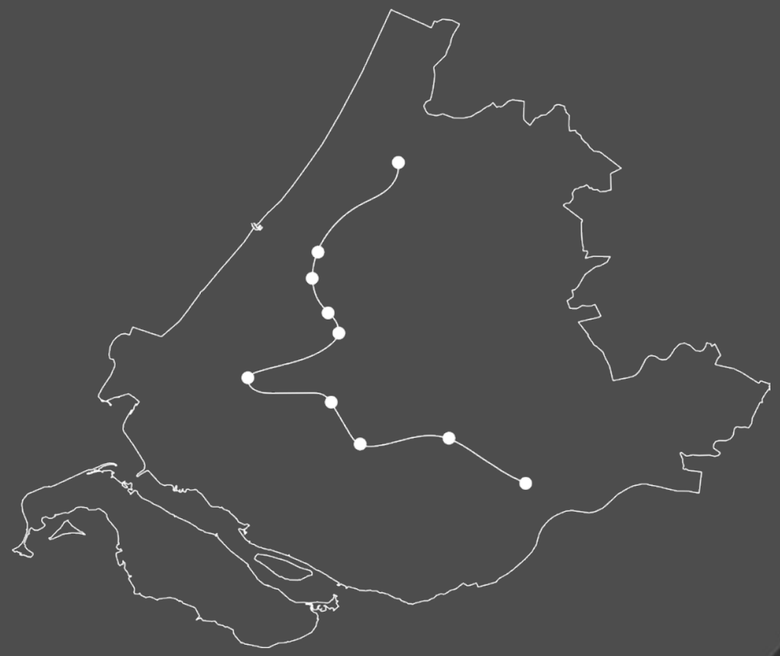
By extending the glass-fiber network into these areas the proposed plan can not only guarantee more access and higher inclusivity, but will also tranform the current network into a more secure and interoperatable system. These last values will not only improve the local and provincial position of the data sector, but will also make sure that the overall system follows EU safety regulations when it comes to clustering of the data services. Thus making the West-Holland data cluster a real international competitor and local spatial and economic catalyst.



DENSIFICATION DEVELOPMENTS

The spatial intervention that deals with the housing demand of the province focusses on the densification of ten strategic areas. These areas from a belt like structure in the province of South Holland. They consist of site that can either be apdatpively reused or exisitng city extension plans that can be altered to fit more residents.

The proposed densification interventions have a supporting role for the extending West-Holland data network. As the network extends, new businesses and even economies can be created thus increasing the demand on the housing market. These densifcation interventions will deal with the additional demand for residential developments, while also partly relieving the current pressure on the housing market.



1 BioScience Park, Leiden

2 Central Innovation District & Binckhorst, The Hague

3 Plaspoelpolder & In Den Boogaard, Rijswijk

4 Schieoevers, Delft

5 Technopolis, Delft

6 Transit-oriented development along Hoeksche lijn, Maassluis

7 Schieveste & A20-zone, Schiedam

8 Stadshavens, Rotterdam

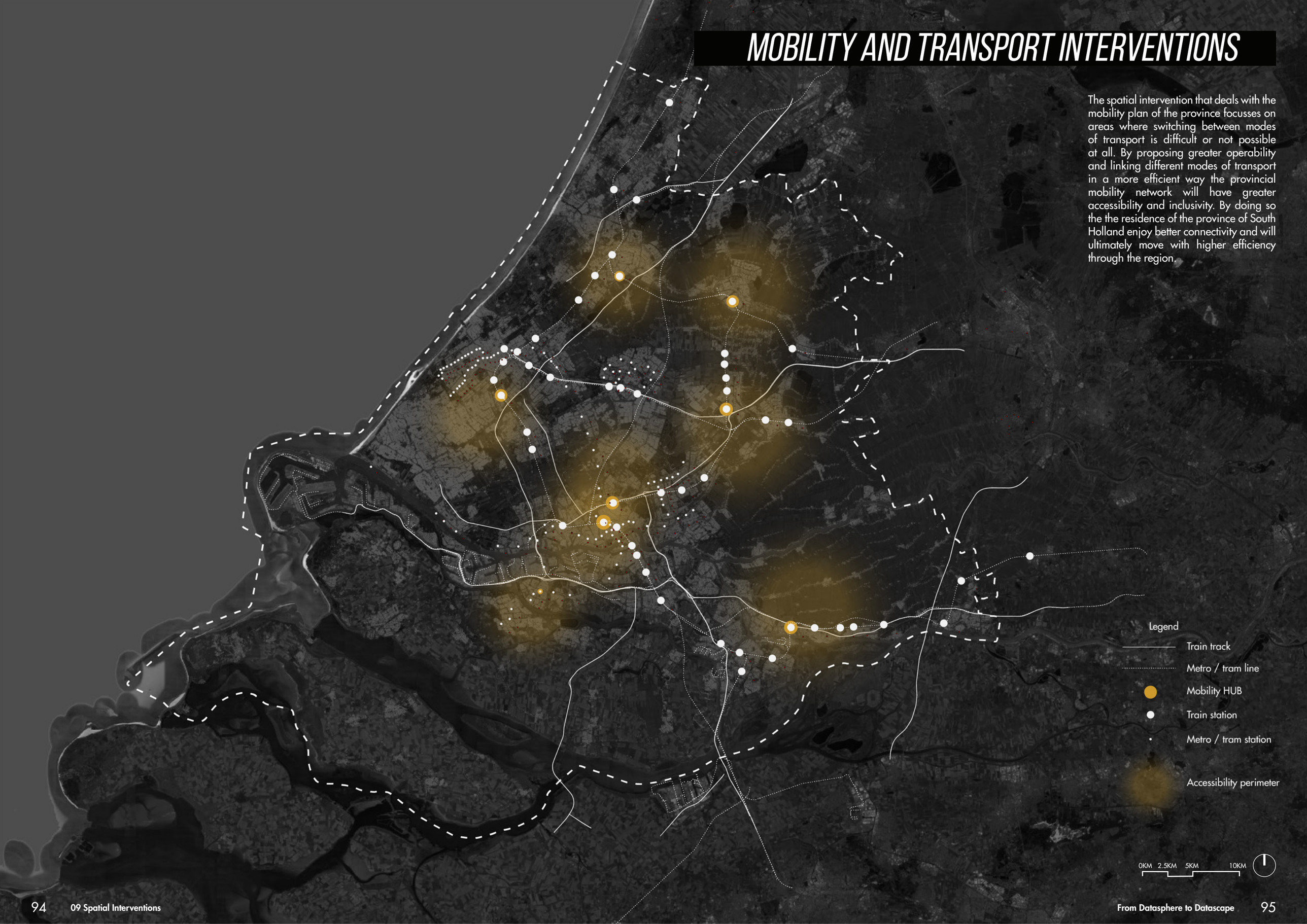
9 Stadionpark, Rotterdam

10 Dordrecht & Zwijndrecht

0KM 2.5KM 5KM 10KM

MOBILITY AND TRANSPORT INTERVENTIONS

The spatial intervention that deals with the mobility plan of the province focusses on areas where switching between modes of transport is difficult or not possible at all. By proposing greater operability and linking different modes of transport in a more efficient way the provincial mobility network will have greater accessibility and inclusivity. By doing so the the residence of the province of South Holland enjoy better connectivity and will ultimately move with higher efficiency through the region.

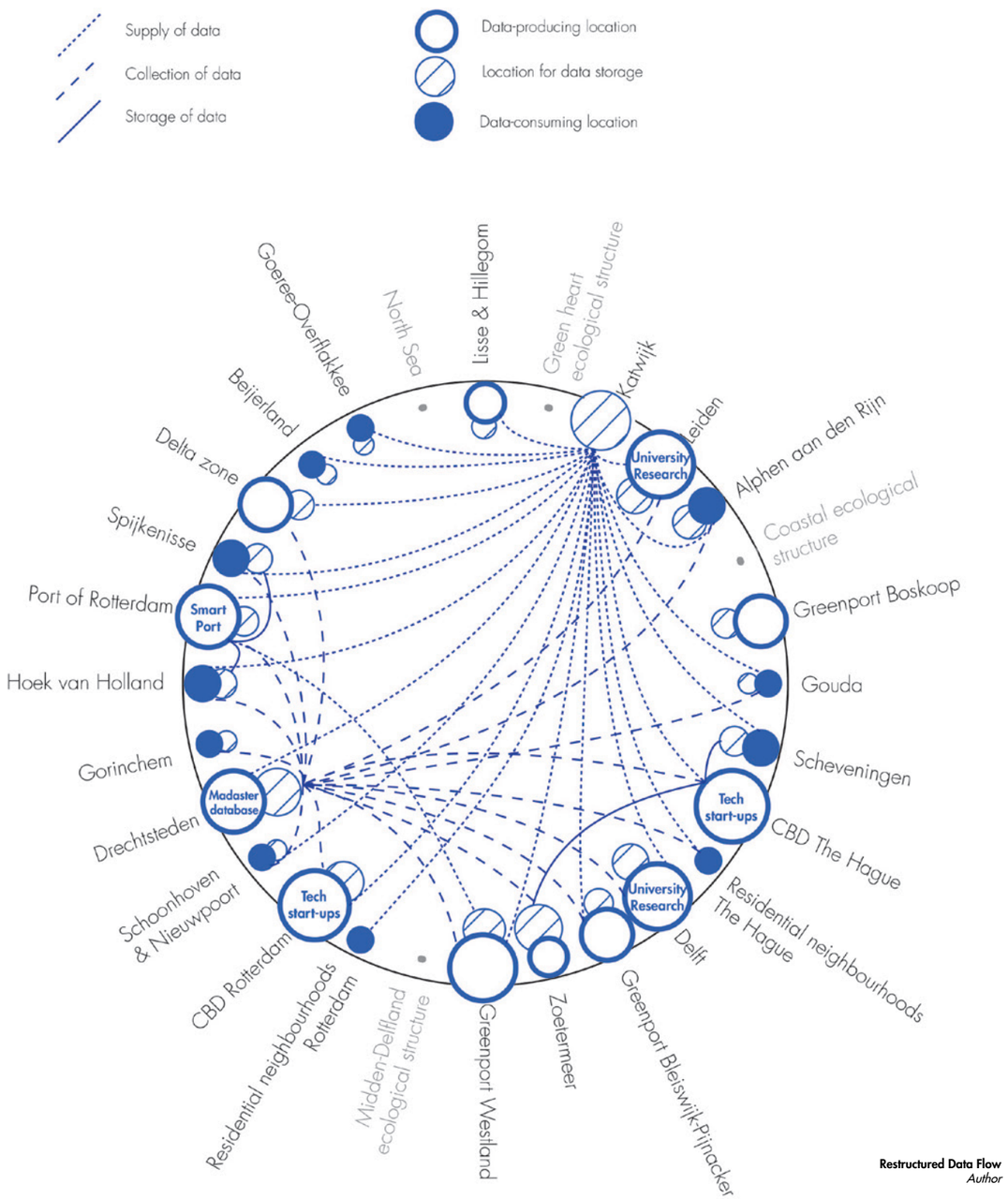


RESTRUCTURING THE FLOWS

All these spatial interventions have one main objective: transforming the current linear flows of data, energy and material into circular loops. Collaborations between the 28 functional zones are established, so the flows can be optimized. There is a difference between production, consumption and transfer places. Each zone gets its own important function within the network of data, energy or material.

Keyplayers in the data system are Katwijk, where the global internet cable enters the mainland, and the Drechtsteden, where the future Madaster Headquarters will be situated. This headquarter will collect and distribute information on urban mining and the status of materials in the built environment throughout the entire region.
Knowledge clusters such as universities and business clusters with tech companies produce a lot of data that is stored in the region.

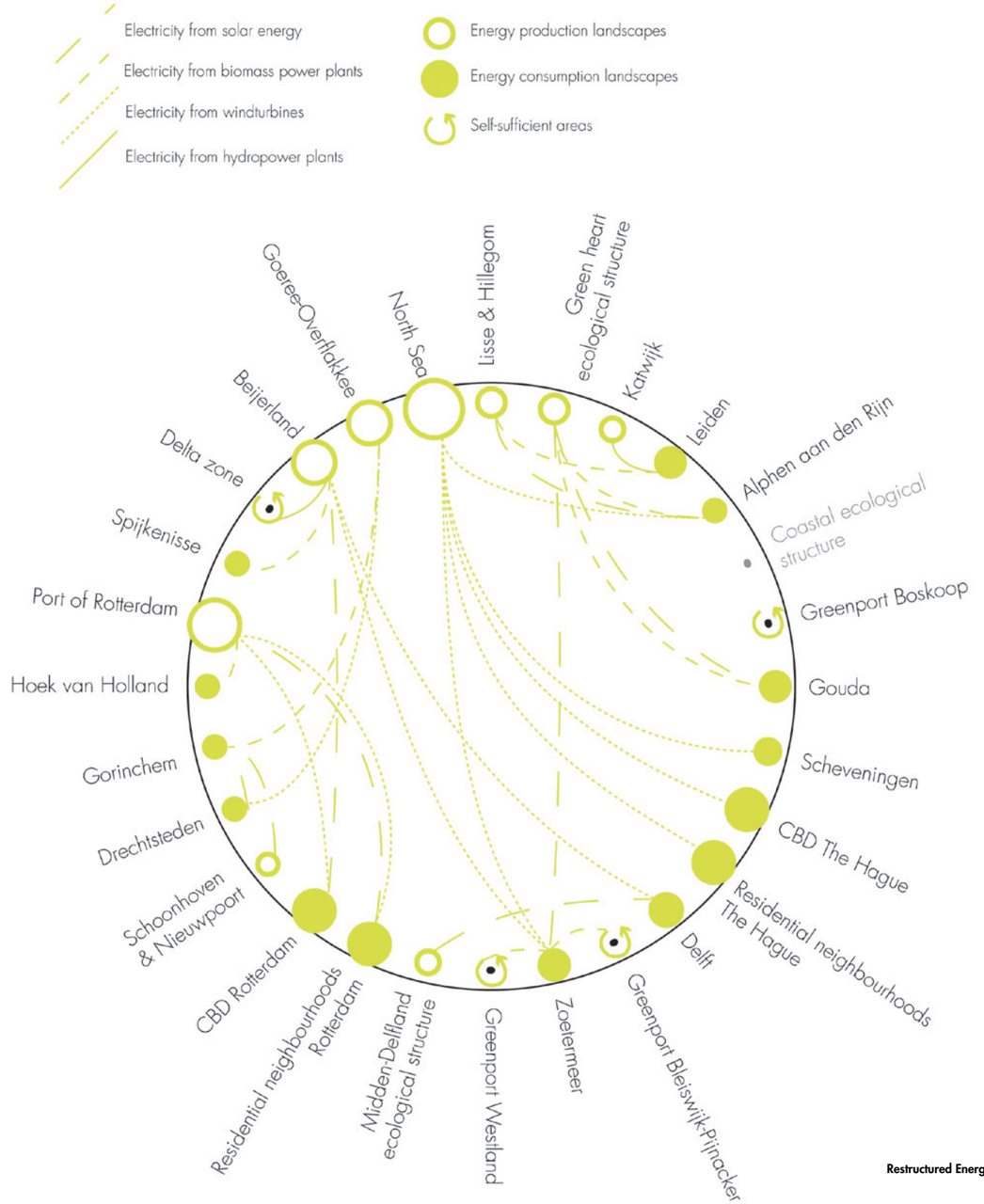
The Greenports and the Port of Rotterdam will produce and store a lot of data in order to become Smart Ports. The real-time data collection will be used to optimize logistic and storage processes in these mainports.



Restructured Data Flow
Author

Large-scale and small-scale energy production landscapes form together the energy system of the region.
Different types of energy are distributed, such as solar energy, biomass power, wind energy and hydropower. Some clusters, like the Greenports, become self-sufficient and can distribute their possible surplus of energy to other zones.

The windturbine park on the North Sea will provide a lot of electricity, to supply The Hague and surrounding cities.
Adding renewable energy production landscapes to the Port of Rotterdam will contribute to the sustainable energy system of the city.



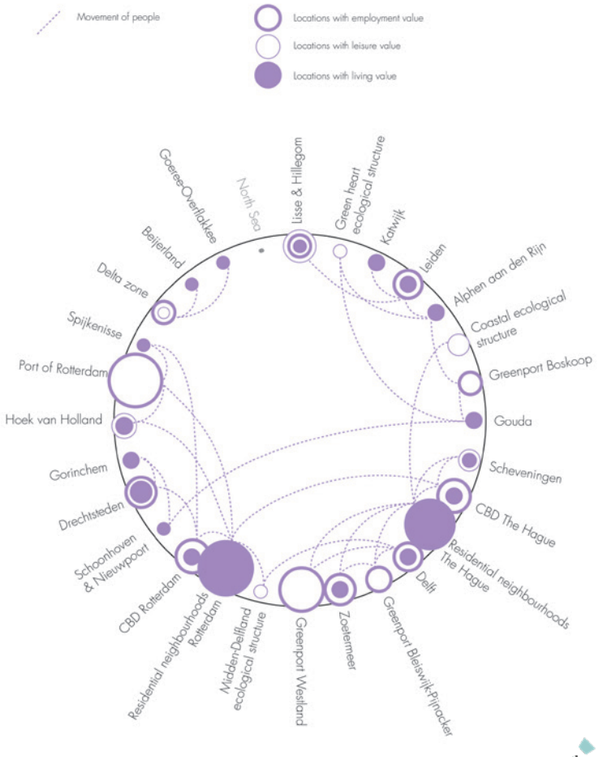
Restructured Energy Flow
Author

RESTRUCTURING THE FLOWS

To create a circular material system, production and consumption need to take place as local as possible, in order to get a grip on the distribution chain and reduce the need for transport.
Production, consumption and distribution places can be distinguished. From the production places, materials are transported towards one of the regional storage hubs, such as Alphen aan den Rijn, Zoetermeer or Gouda. Businesses and individuals can use these hubs to pick up or bring back materials and products. These will then be brought back to the right location for recycling, resharing or upcycling. The Drechtsteden and Port of Rotterdam are the main material production clusters.

Restructured Material Flow
Author

INFLUENCING OTHER FLOWS



Influenced People Flow
Author

Flow of People

By restructuring certain flows in the region, other flows will be influenced.
New workplaces, living places and transportation places will emerge from the developments.
The 28 functional zones in the region can be roughly subdivided into environments with three different qualities: locations with employment value, locations with leisure value and locations with living value. Some (urban) areas comprise all three values to a large extent.

Flow of Goods

Five logistic, cooperating hubs structure the distribution of goods on a regional, national and global scale.
The Port of Rotterdam is the gateway from the world to Europe and the other way around. A part of the incoming cargo is distributed to Alpherium, the logistic center in Alphen aan den Rijn. From this hub, it is further transported into the country.
The Greenports of Westland, Bleiswijk-Pijnacker and Boskoop produce food products for global distribution. A close collaboration with the Port of Rotterdam, that is smart-data-driven and supported by the digital and physical infrastructure, is necessary to preserve the global economic position of this region.

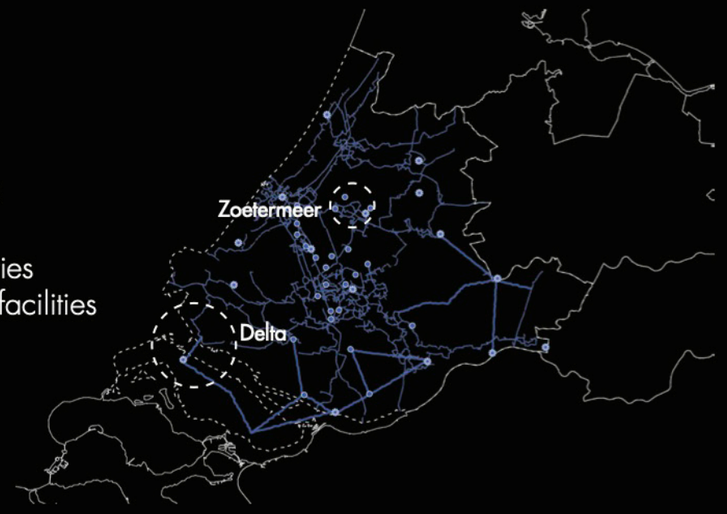
Influenced Goods Flow
Author

10
INTERVENTION EXAMPLES - PASSPORTS

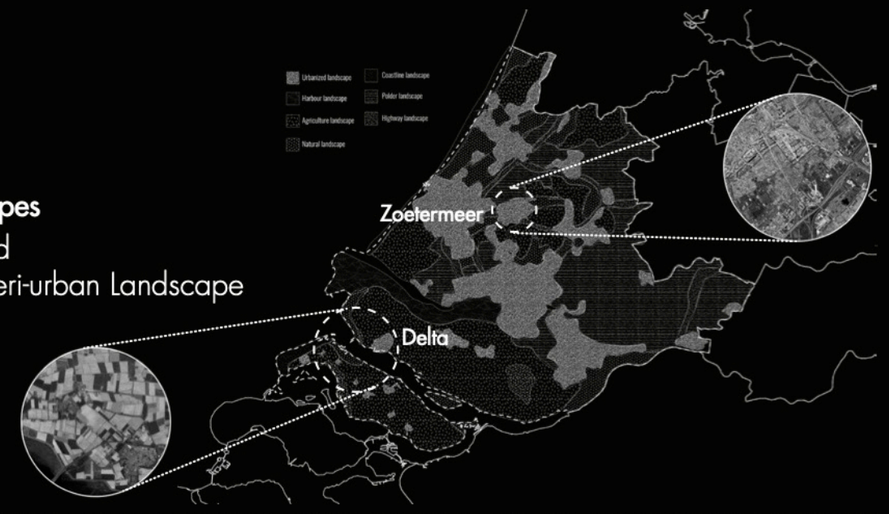
Passport Stellendam (Delta)
- Description of the Location
- Socio-ecnomonic Status
- Status in Regional, National, and EU Context
- Problem Statement
- Stakeholder Analysis
- Vision for the Location
- Circle Diagram of Local Circular Flows
- Strategic Local Interventions
- Identity & Atmosphere

Passport Zoetermeer
- Description of the Location
- Socio-ecnomonic Status
- Status in Regional Context
- Problem Statement
- Stakeholder Analyis
- Vision for the Location
- Circle Diagram of Local Circular Flows
- Strategic Local Interventions
- Identity & Atmosphere

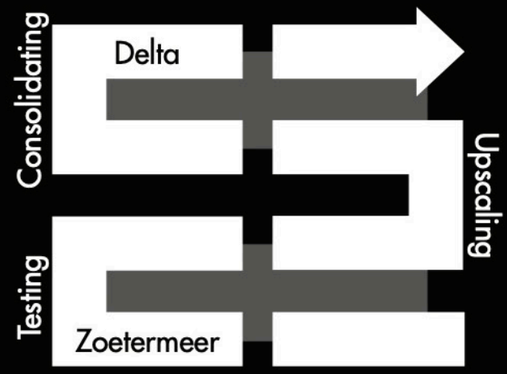
Presence of Networks and Facilities
Delta Expand the networks and create new facilities
Zoetermeer Existing networks and facilities



Different Landscape Types
Delta Hinterland
Zoetermeer Urban/Peri-urban Landscape

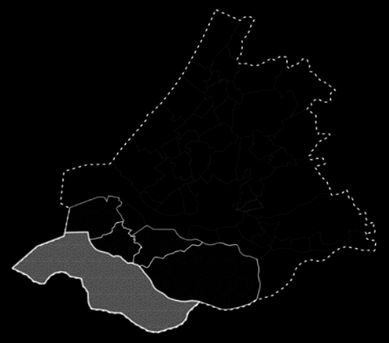


Different Phasing Stages
Delta 3rd phase Consolidating Phase
Zoetermeer 1st phase Testing Phase



PASSPORT STELLENDAM (DELTA)

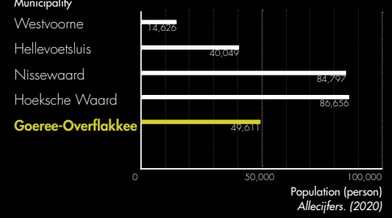
Haringvleitsluizen
Rijkswaterstaat (n.d.)



Goeree-Overflakkee in South Holland
Based on Qgis

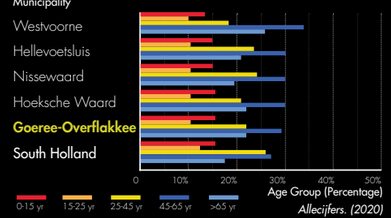
Socio-economic Status

Population



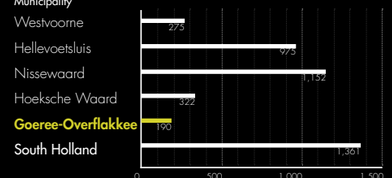
Population (person)
Allecijfers. (2020)

Age Group



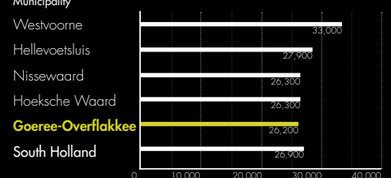
Age Group (Percentage)
Allecijfers. (2020)

Density



Density (person/m²)
Allecijfers. (2020)

Average Income



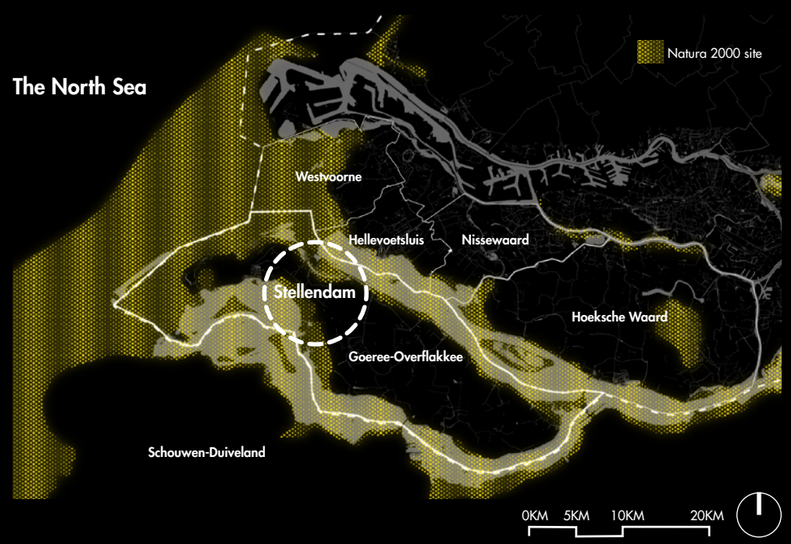
Average income (€/year)
Allecijfers. (2020)

Description of the Location

The intervention is located in the south-western area of the province, where the rivers flow through and enter the North Sea, making it the vital delta of the region and country. The chosen site is situated in the municipality of Goeree-Overflakkee, surrounded by other municipalities, namely Westvoorne, Hellevoetsluis, Nissewaard, Hoeksche Waard, and Schouwen-Duiveland which belongs to the province of Zeeland. Stellendam is the town surrounded by two river mouths: Haringvliet on the Northern side, where Haringvlietdam connects this town and Voorne-Putten Island, and Grevelingenmeer in the South.

Natura 2000

Stretching across all 27 EU countries, Natura 2000 is the world's largest coordinated network of protected areas. It accommodates resting sites and natural habitats for rare, threatened species (European Commission, 2020). This delta comprises many Natura 2000 sites, as can be seen on the map (figure xx).



Natura 2000 sites within delta area
Based on European Environment Agency. (n.d.).

Status in the EU context
Author

Status In Regional, National, and EU Context

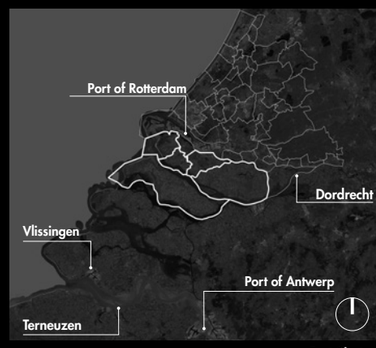
The Rhine-Meuse Delta is the river delta in The Netherlands, which is combined with two rivers, namely The Rhine and The Muese.

The Rhine is one of the major rivers in Europe, flowing through six countries from its source in Switzerland (Most , van der H., 2009). It starts to divide into two major branches at the Netherlands-German border and continues to flow through the Dutch landscapes and many important Dutch cities, for example, Nijmegen, Dordrecht, and Rotterdam, before reaching the North Sea at the intervention Area.

The Meuse has its source in France, flowing through Belgium and entering the Netherlands near Maastricht. Stretching to the North, it starts to combine with The Rhine's branches and creates the estuary.

What poses more significance to this estuarine delta is the location within the port cluster, the Port of Rotterdam, and the Port of Antwerp. The high mobility of ship transport can be witnessed here.

In conclusion, it can be seen that this delta is not only crucial towards the province of South Holland and the Netherlands but also to the international level.



Port Clusters
Author

PROBLEM STATEMENT

Regional & International Microplastics Contamination

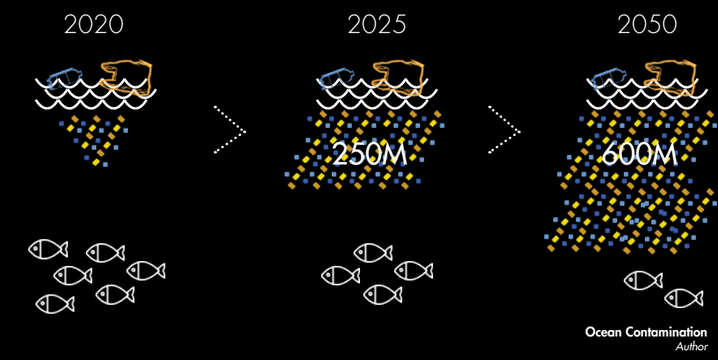
The estuary is the area where rivers reach the sea, which means that it is the gathering place of all the sediments flowing along the way from the river source. This includes the sediments that can cause water pollution, particularly plastic waste, which could flow out to the sea if they are not trapped.

Plastics can be categorized by their particle size. The large plastic objects are classified as macroplastics, which have their size more substantial than 5mm, for example, plastic bags and bottles. While Microplastics are the unidentified plastic pieces, with a diameter of less than 5mm (Winton, Anderson, Rocliffe, & Loiselle, 2020, pp. 1–3), Macroplastics could be trapped at the watergate to prevent they reaching the sea. Nevertheless, the invisible plastic particles can sneak through the dam and eventually leading to ocean contamination. According to Ellen MacArthur Foundation (2017), in the ocean, there will be more plastics than fish by 2050.

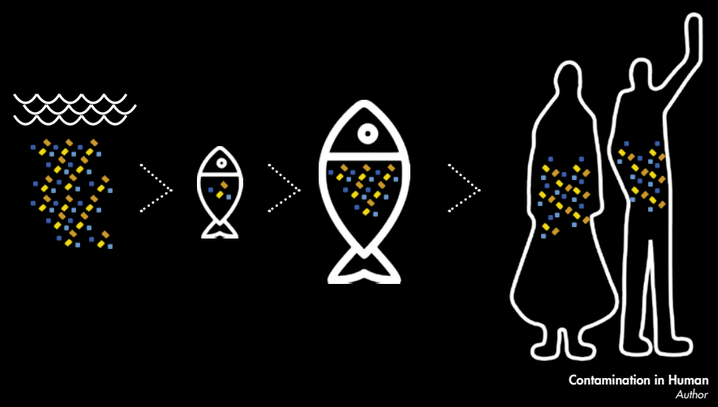
Besides the impact on the seawater and marine ecosystem, it also causes a severe effect on us as a human being, which we might not realize. Each main meal we ingest contains more than tiny 100 plastic particles (Catarino, Macchia, Sanderson, Thompson, & Henry, 2018, p. 681). This shows that our health can be threatened by microplastics by the consumption of contaminated seafood, and eventually cause the vicious cycle.

Regarding the condition as mentioned earlier of this delta and the drastic impacts, the problems of microplastics contamination can be seen and need to be tackled. By implementing this, the aquatic ecosystem and people's health will be enhanced.

Catagories of Plastics
Author



Ocean Contamination
Author



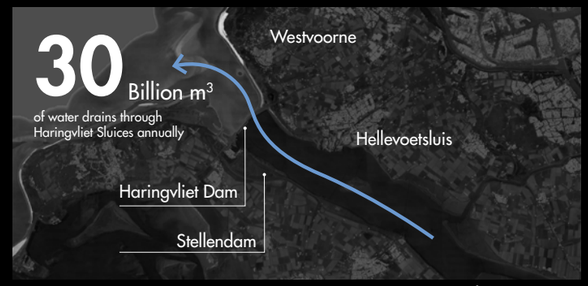
Contamination in Human
Author

Local & Regional Flood Risk & Protection

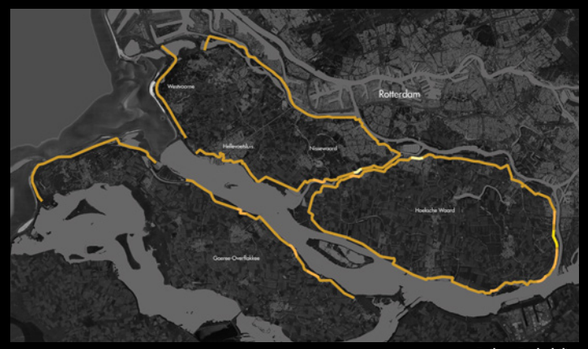
Haringvliet Dam

Haringvliet Dam is one of the primary flood defense structures which also functions as storm surge barriers. It contains the Haringvliet locks, preventing the low lying land from high sea water level. The locks are opened or closed depending on the amount of water entering the country at Lobinth (Rhine) and Borgharen (Meuse). It has been opened since 1970. Therefore, it needs renewal to ensure the efficiency of flood protection in the future.

However, others flood defence structures are also indispensable. Voorne-Putten and Goeree-Overflakkee islands are protected by the dikes (See the below figure). These structures need to be monitored to make sure if there was any breach and defect in the system. Thus, the maintenance and evacuation procedure can be implemented in time.



Haringvliet Dam Overview
Author
Information based on Rijkswaterstaat. (2020)

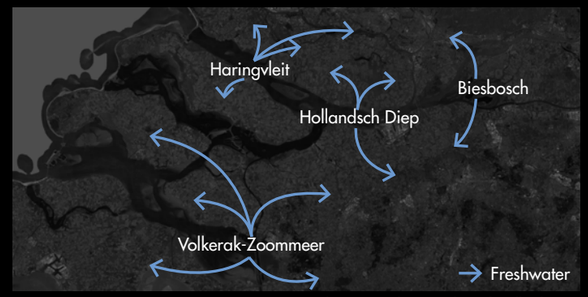


Failure Probability
Author
Information based on Vergouwe, (2016)

Individual Risk
Author
Information based on Vergouwe, (2016)

Fresh Water

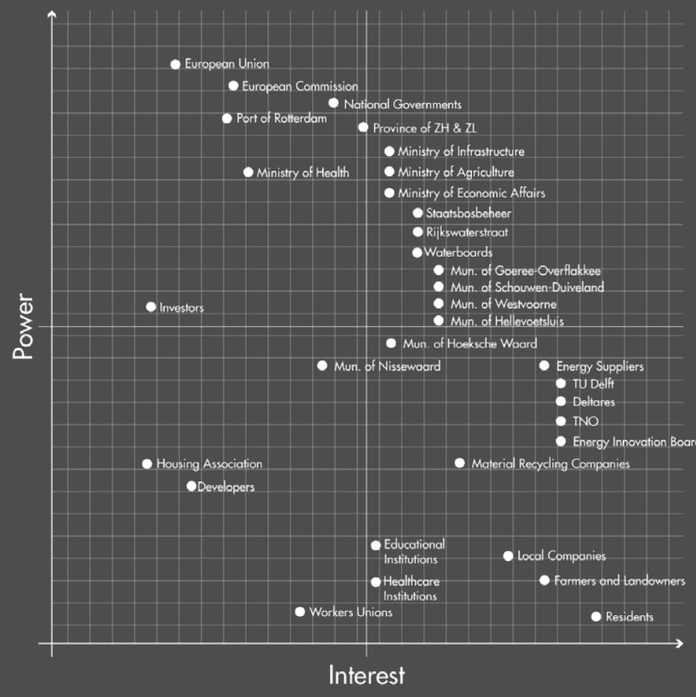
Southwest Delta is the vital freshwater source of the region. The islands in this are, West-Breabant, Tholen, Sint Philipsland, and Reigersbergsepolder receive fresh water from the tributaries, such as Biesbosch, Hollandsch Diep, Hairingvleit, and Volkrak-Zoommeer lake. Major consumers are the agricultural sector, industry, and drinking water companies (Ministerie van Infrastructuur en Waterstaat, 2019). According to Rijkswaterstraat (2018), the Haringvleit dam has been opened to allow fish migration and restore the western brackish water region. As the dam controls the entry of salt water from the sea into the rivers, opening the dam for aforementioned reason means that the potential of fresh water can decrease due to the salination. Altogether with the microplastics contamination issue, the fresh water bodies need to be ensured of its great potential to serve the region.



Freshwater Distribution with South Holland
Author
Information based on Ministerie van Infrastructuur en Waterstaat, (2019)

STAKEHOLDERS ANALYSIS

To comprehend who are the stakeholders involved within this intervention exmaples, they are positioned in the triangular diagram, which is divided into three scales: international, regional, and local. Moreover, The power and interest table is used to analyze their amount of power and interest. Besides, they are also mapped to see the overview of where they are located in the province. Altogether, we learned which stakeholders need to be persuaded and which ones we can use to support the ideas in our development strategy.



European Union
European Commission
Natura 2000

Governments
Municipality of Goeree-Overflakkee
Municipality of Westvoorne
Municipality of Hellevoetsluis
Municipality of Nissewaard
Municipality of Hoeksche Waard
Municipality of Schouwen-Duiveland

Energy Suppliers
Wind energy companies
Solar energy companies
Tidal Wave (Research Project)
- Deltares
- TU Delft
- TNO
- Enery Innovation Board
Heat
- Aardwarmte Wierpolders

Waste (Recycling)
Electronic component industrial companies
Material repair companies
Recycling materials sorting centers

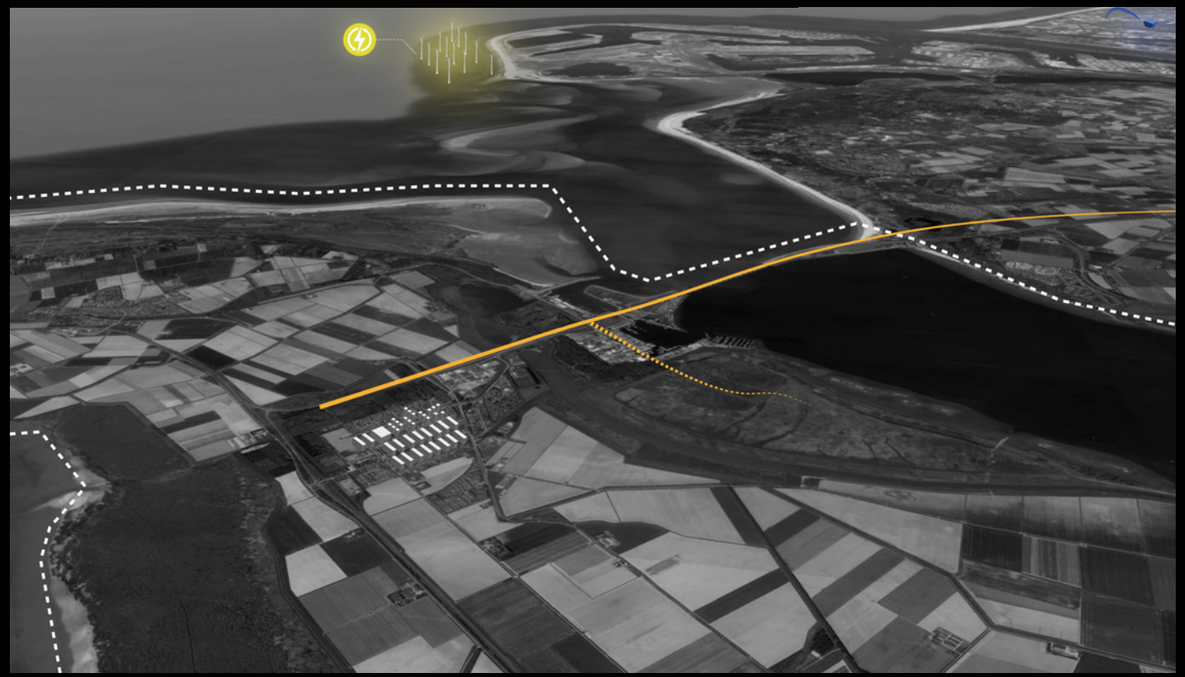
Agricultural Industries
Farmers and Landowners

Residents

Governments
- Ministry of Infrastructure and Water Management
- Ministry of Economic Affairs and Climate Policy
- Ministry of Agriculture, Nature and Food Quality
- Ministry of Health, Welfare and Sport
- Province of South Holland
- Province of Zeeland
- Directorate-General for Public Works and Water Management (Rijkswatertraat)
Waterboard (Waterschap Hollandse Delta)

VISION FOR THE LOCATION

2020



Delta - Existing Situaiton
Author

2020; Existing situation

As mentioned before, the Stellendam Delta proposal focusses on the most Southern island of the Province of South Holland, also called Goeree-Overflakkee.

Currently this island has no high-quality data network in place and consists of a few municipalities that are mostly linked to agriculture. The island is mostly characterized by its special ecological and delta environments.

Goeree-Overflakkee plays in important role in the overall delta protection of the South Holland province. Major delta protection structures such as the Haringvliet and the Brouwersdam protect the island and the hinterland from flooding by the North Sea.

Futhermore the island has a rich biodiversity as it houses both fresh and salt water that attract all kinds of species. Thus most of the Islands delta is protected by natura 2000 regulations. So the site has not only local, provincial, or national laws and regulations to obide by, but also international accords and laws such as the European Natura 2000 legislation.The area is accessible by one main infrastructural connection, namely the N57 provincial road. There are no major public transport connections in the area other than the local bus services. Current vision documents for the area propose the expansion of public transport services in this ares.Also the engery landscapes that exist on the island are to be expanded and futher developed. This includes the norhtern wind park in the Norht Sea and on land wind parks.

All in all, the island of Goeree-Overflakkee has great potential for the implemtation of a high quality data network that will help activate local qualities such as the diverse ecology and renewable energy potentials.

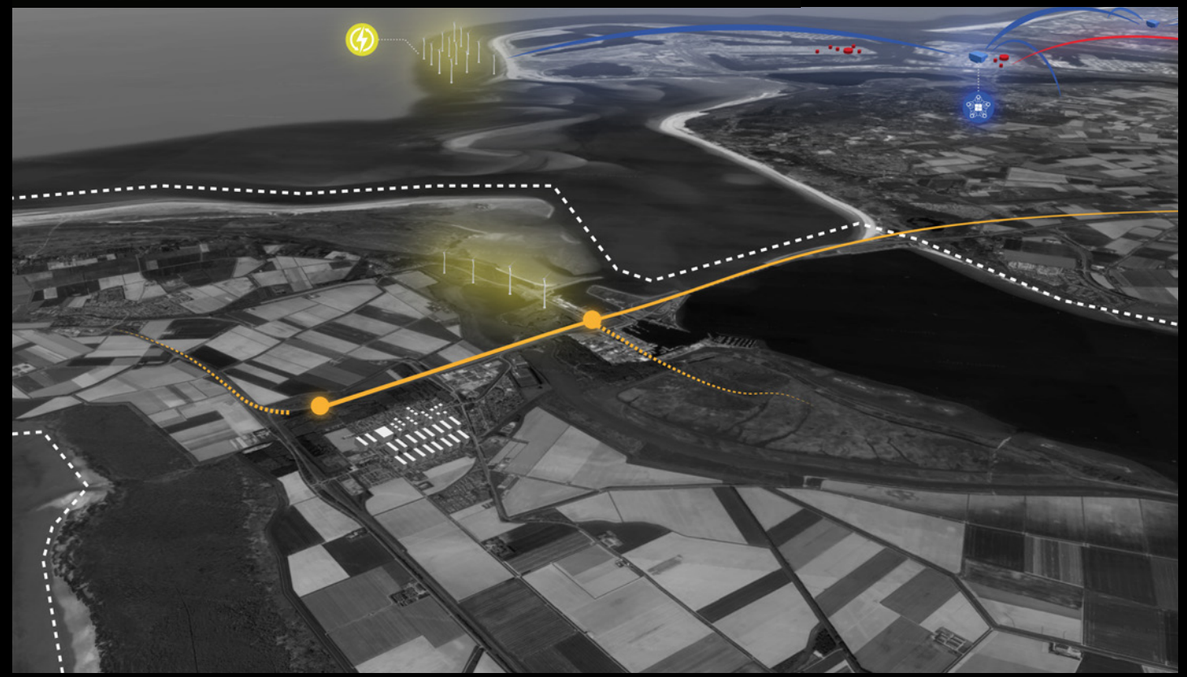
Existing Data Infrastructure

Existing Transportational Infrastructure

Existing Renewable Energy Source

Existing Greenport Data Center

2025



Delta - Laying Grounds
Author

2025; laying grounds

Within the first five years of development the Stellendam Delta proposal introduces new renewable energy sources on the Island, such as the havenhoofd Wind park that will be situated next to the N57 provincial road. This intervention will help the local energy transition and will prepare the area for the coming delta data cluster.

The Port of Rotterdam who is a very important regional stakeholder will aslo further develop in the first 5 years of development. A new data cluster will be introduced into the port of Rotterdam and will extend the data network towards the southern part ot the province.

By creating this data network, new businesses will get a chance to develop in the port of Rotterdam. These businesses will have the opportunity to utilize the high speed data network to optimize the enourmous flow of goods and materials in the harbor. As the port of Rotterdam is entry way for most of goods and materials in Europe this local data transition will not only stimulate the local environment but it willl also help internationl connections and flows. Thus enhancing the international competiveness of the Port of Rotterdam and all its industries.

All in all,will this stage of the proposal focus on the so-called ground works for the data hub that will arrive in the next phase. Supporting facilities such as diversified port economies and extended engergy landscape will prepare the island for the arrival of the data network.

Existing Data Infrastructure

Existing Transportational Infrastructure

Existing Renewable Energy Source

Existing Greenport Data Center

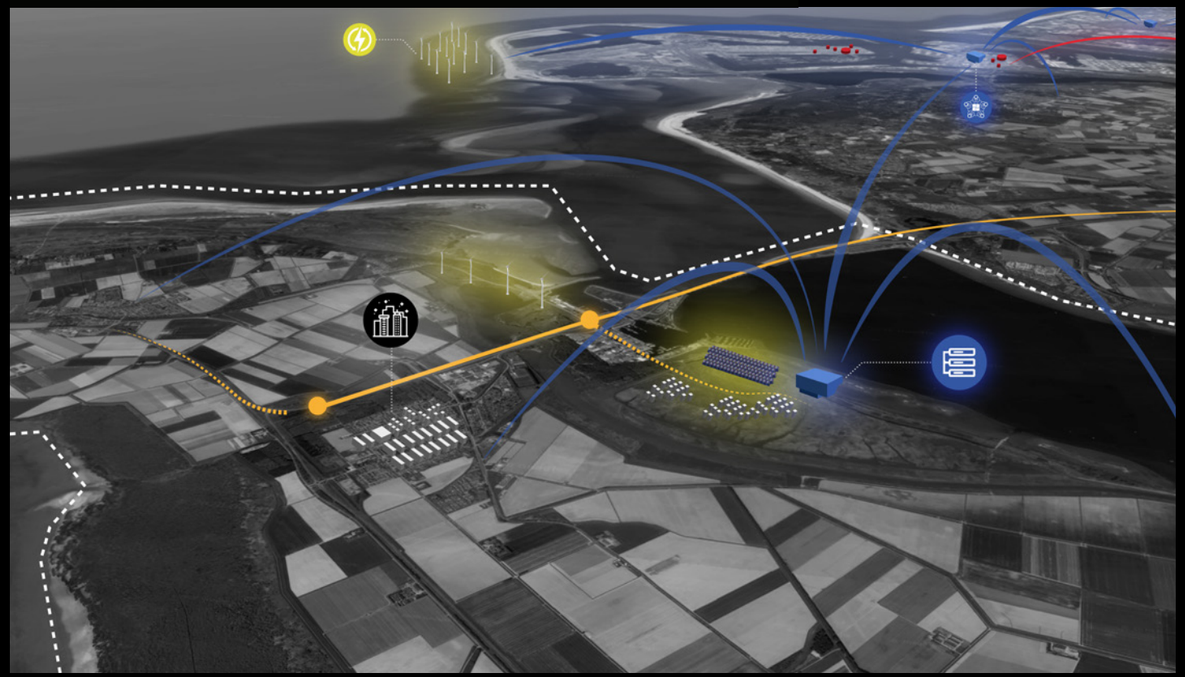
Proposed N57 Wind park

Proposed Port Data Hub (DH1)

New share / reshare material flow

VISION FOR THE LOCATION

2030



2030; Delta Data Hub

In this second stage of the proposal the island of Goeree-Overflakkee will get its physical data infrastructure constisting of a high quality glass-fiber connection to the West-Holland Data cluster and a brand new delta Data Hub.

The data network is extented towards the island by following the N57 provincial road and will connect to the new delta Data Hub. This Data Hub will activate local qualities by actively cleaning, monitaoring, and enhacing of the local ecology fo the haringvliet. Thus giving flora and fauna the chance to further diversify the area. This will be achieved throught the filering of the local water through the cooling system of the Data Hub. Other than this physical effect of the introdcution of high quality data connections to the area, the increased monitoring will provide the area with a lot of usefull data that might attract new businesses to the region.

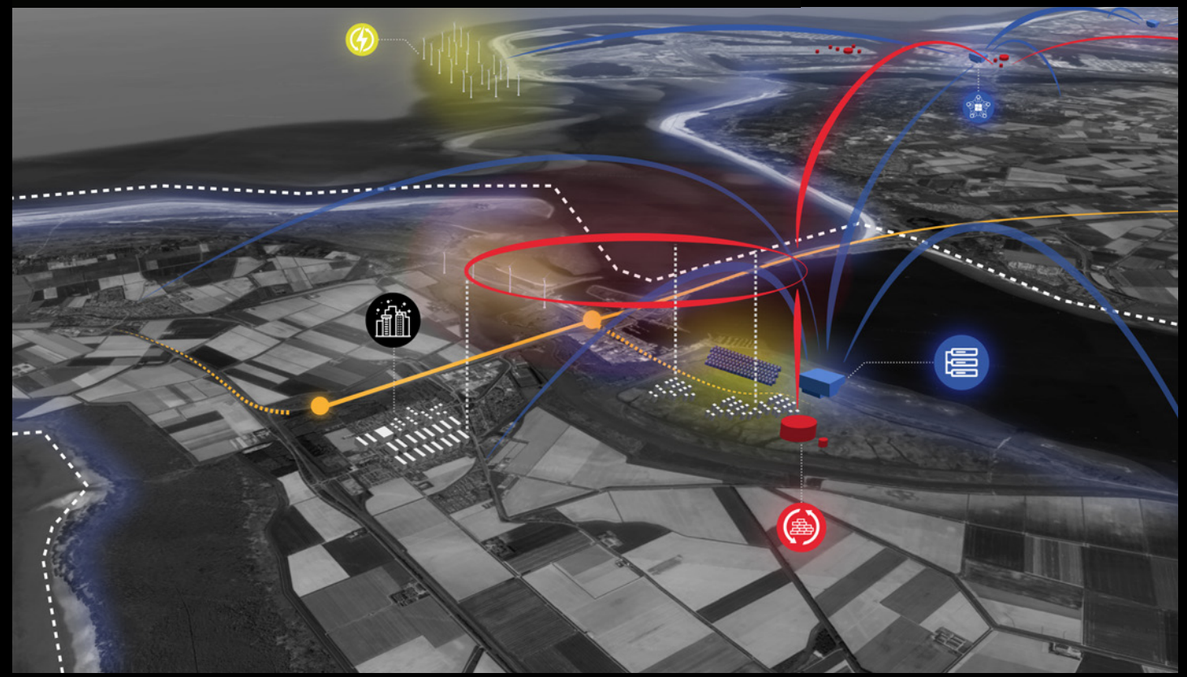
So to cope with this expanded business activity the proposal also looks towards the existing built environment of the island and plans to intervene, revitalize, update the existing redisdential areas. Whilst also proposing new development close to the Data Hub to create a lively lcoal urabn fabric.

All of this is partnered by the extension of the renewable engery sources by developing a new solar park neighboring the Data Hub.

To conclude, this stage is all about setting up the Delta Data Hub and establishing a connection to the West-Holland Data Cluster.

- Existing Data Infrastructure
- Existing Transportational Infrastructure
- Existing Renewable Energy Source
- Existing Greenport Data Center
- Proposed N57 Wind park
- Proposed Port Data Hub (DH1)
- New share / reshare material flow
- Proposed N57 Solar park
- Proposed Delta Data Hub (DH)
- Densification Intervention

2040



2040; local enhancement

The next stage will focus on the enhancement of the local urban fabric and systems. These interventions involve more stakeholders and thus take more time to develop. This proposed local enhancement stage will take approximately 10 years, leading towards 2040.

In this stage of the phasing the proposed Delta Data Hub will reallly consolidate itselft in the West-Holland Data cluster and in the local urban fabric. New implementations of the data network in the island are proposed in this stage. One of these implementations is the Data Delta protection programme that enhances the existing delta protection stystems.

As mentioned before, the Goeree-Overflakkee island is connected to very special delta. Most of the European rivers end up in this specific delta. Not only the North Sea poses a threat, also the inland rivers bring a centrain kind of risk with them. By linking up the extended data network to the sensory systems of the Delta protection programme the overall response time and monitoring of the delta will be much improved. Thus creating more safe living conditions on the hinterland areas.

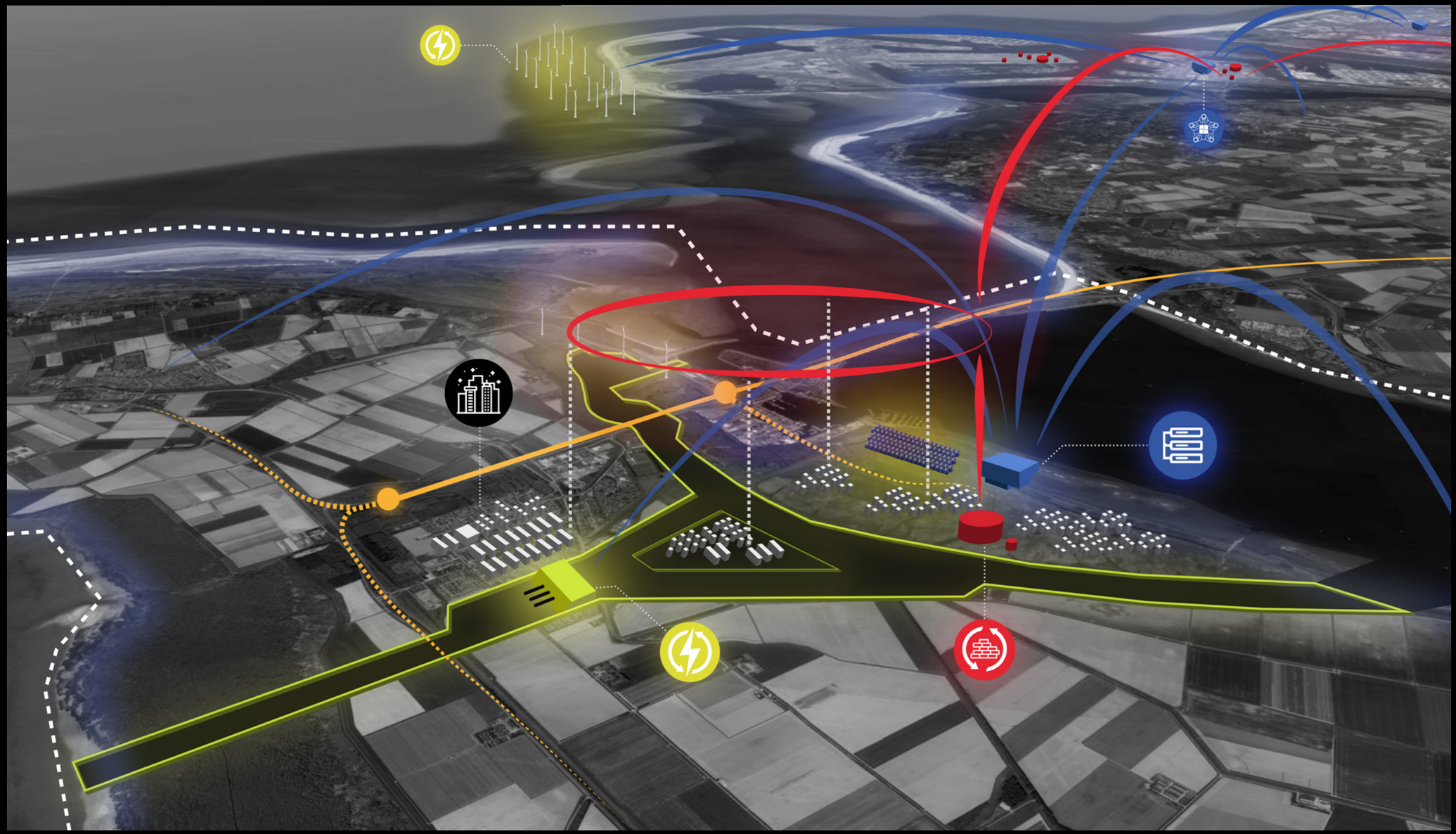
Also new material based industries will be able to pop up in the Delta data hub knowlegde cluster. These businesses can be actively linked to the data hub water filtering systems and will be able to use the extracted microplastics as a resource for new building materials. By doing so the overall Data Network will not only help with the online sharing of material knowledge, it will also provide actual resources for the new material industries.

All in all, will this stage help create a more diverse local economic landscape and will use the engergy landscape to its fullest potential.

- Existing Data Infrastructure
- Existing Transportational Infrastructure
- Existing Renewable Energy Source
- Existing Greenport Data Center
- Proposed N57 Wind park
- Proposed Port Data Hub (DH1)
- New share / reshare material flow
- Proposed N57 Solar park
- Proposed Delta Data Hub(DH2)
- Densification Intervention
- Proposed Material cluster based on mcroplastics
- Proposed Data Delta protection

VISION FOR THE LOCATION

2050



Delta - Circular Finish
Author

Existing Data Infrastructure

Existing Transportational Infrastructure

Existing Renewable Energy Source

Existing Greenport Data Center

Proposed N57 Wind park

Proposed Port Data Hub (DH1)

New share / reshare material flow

Proposed N57 Solar park

Proposed Delta Data Hub(DH2)

Densification Intervention

Proposed Material cluster based on mcroplastics

Proposed Data Delta protection

Proposed Stellendam Ionic Powerplant

2050; circular finish

In this last phase of the intervention the final energy landscape based developments will take place. Starting with the further expansion of the North Sea windpark. But also the development of the bigger and more influential Stellendam Ionic powerplant that will finilize the delta masterplan for the region.

The Stellendam Ionic powerplant combines the southern saltwater supply with the northern freshwater supply in an effort to create renewable energy. This development requires a large delta infrastructural intervention. Both bodies of water need to be connected in a controlled way. The Datascape proposal will follow the existing Deltares & Stellendam Omgevingsvisie for this development.

By introducing this new renewable energy source also other types of development can be introduced in the area, and thus further diversifying the region. Densification projects will take place in the area, and will help shorten commuting distances, stimulate to local business environment. The visitor center function of the Delta Data Hub will further help attract activity to this area and will stimulate the awereness about local ecology and delta structures.

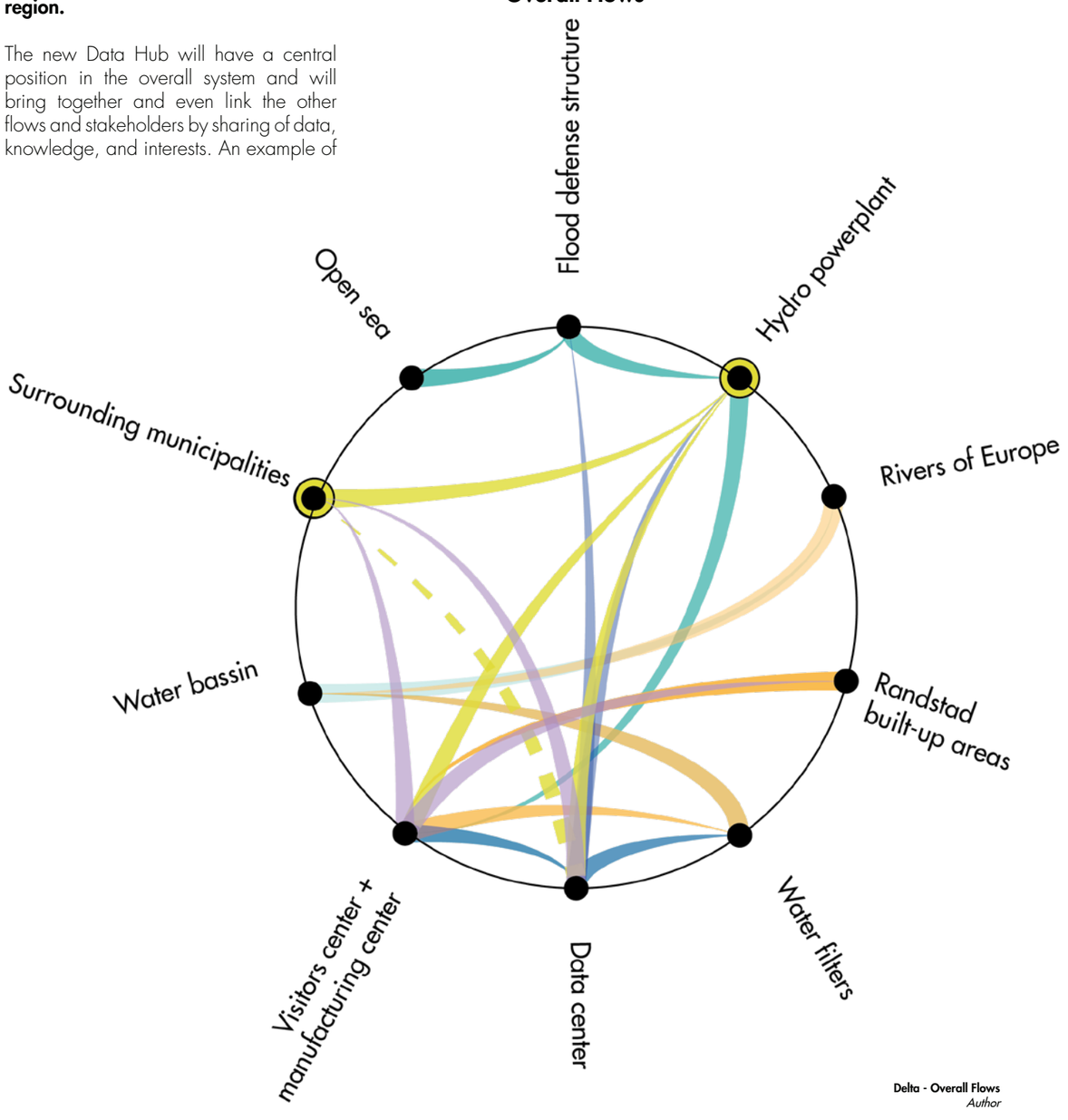
To conclude, the proposed Delta Data Hub intervention is based on a wide set of development related to the five main flows [Data, Energy, Materials, People, and Goods]. These flows will gather in the Data Hub, with the data acting as a backbone for the creation, reusing, and sharing of knowledge between governments, economies, and people.

CIRCLE DIAGRAMS OF LOCAL CIRCULAR FLOWS

In this chapter the five main flows [Data, Engery, Plastic, Water, People] of the Delta Data Hub intervention are shown in relation to each other. The main circle diagram below shows the importance of the supporting structures for the proposed data network extension, such as the extended and newly developed engerly landscapes that will provdive renewable energy resources to the region.

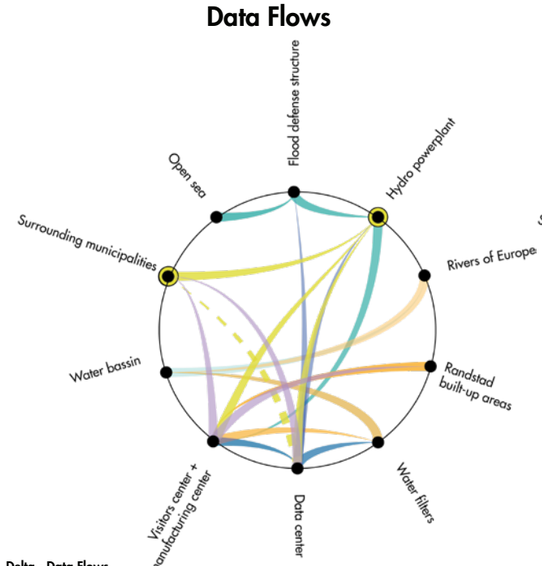
The new Data Hub will have a central position in the overall system and will bring together and even link the other flows and stakeholders by sharing of data, knowledge, and interests. An example of this sharing of data is the improvement of the local environment by creating a Data Hub system that actively filters the delta water and by doing so new micro plastic industries can be realized at a local scale. So on the much larger international scale the delta pollution problem will be adressed by filtering. And on a local scale the biodiversity of the environment will get a change to further develop by these filtering systems, while also creating a more diverse economic landscape by introducing more business opportunities.

Overall Flows



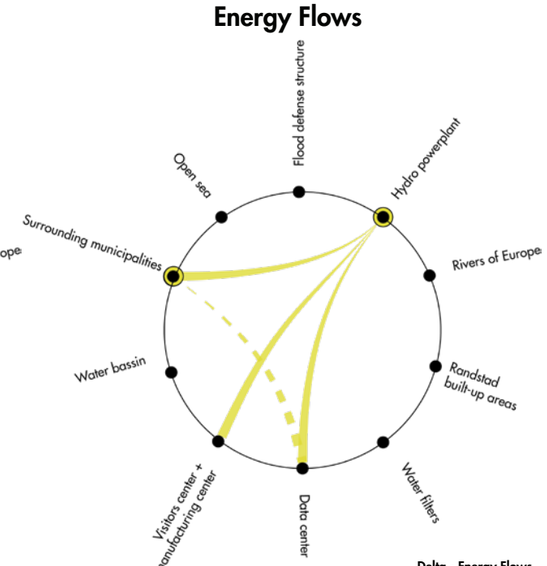
Delta - Overall Flows
Author

Data Flows



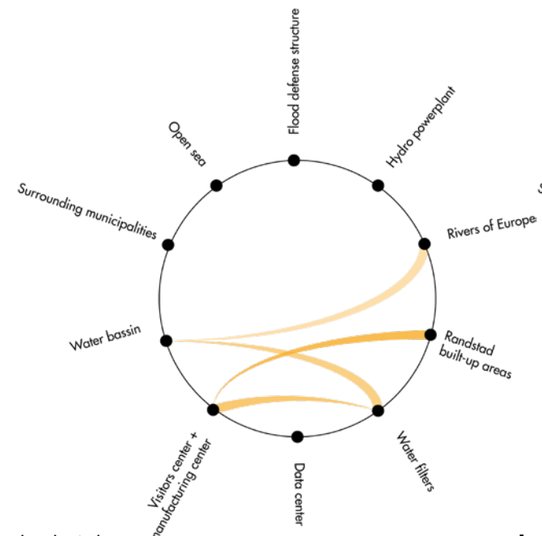
Delta - Data Flows
Author

Energy Flows



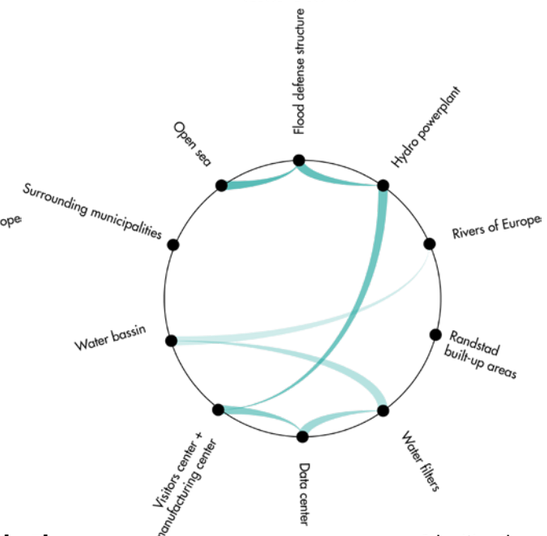
Delta - Energy Flows
Author

Plastic Flows



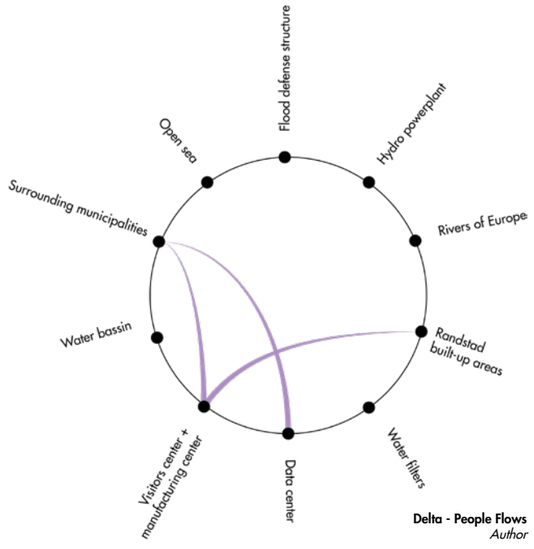
Delta - Plasctic Flows
Author

Water Flows



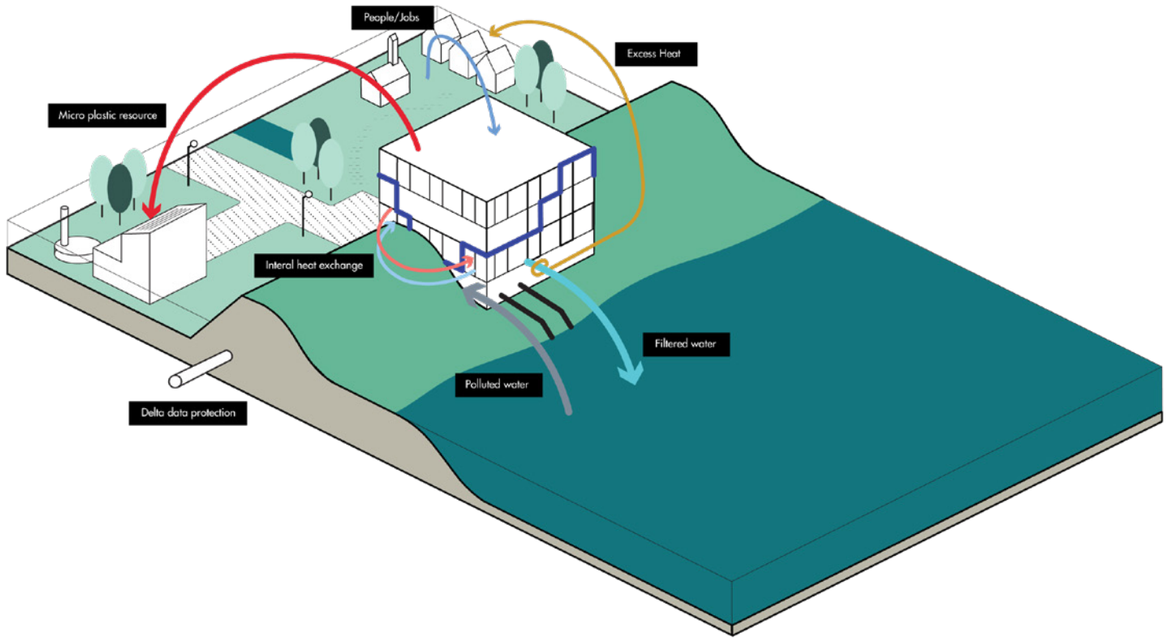
Delta - Water Flows
Author

People Flows

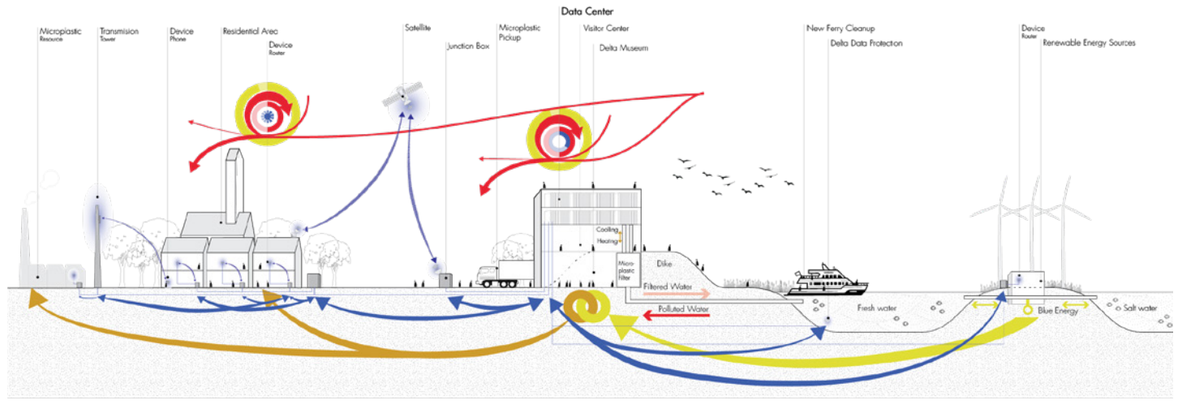


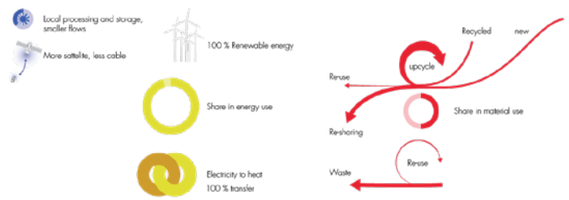
Delta - People Flows
Author

STRATEGIC LOCAL INTERVENTION



Delta - Strategic Local Intervention
Author





Delta - Systematic Section
Author

The local Data Hub on the Goeree-Overflakkee island will supply this part of the province of South Holland with a steady and high quality data connection. This proposed intervention will furthermore deal with one of the local qualities, the diverse haringvliet delta.

The haringvliet delta is an accumulation of many international waters, such as the many rivers of Europe. The local biodiversity is threatened by the polluted waters that enter The Netherlands thorugh these rivers. As mentioned before, these waters carry high concentrations of microplastics and the haringvliet delta forms the last stop until this pollution reaches the North Sea. Once micro plastics reach the sea, they become very hard to extract, so the Datasphere to Datascpae proposal suggests an integrated Data Hub filtering system that will extract the microplastics from the body of water.

The filtering system can be integrated in the active cooling system that is needed for the Data Hub. The cooling system will pump in water that will than cool the internal liquid heat transfers system. The heated water will then go through a series of heat transmitters to, agian, exchang as much energy [heat] to a third system that is linked to look district heating. The last step of the overall system is too dispose of the cooling water, that up until this point is still polluted. Before the water returns to the haringvliet the Delta Data Hub intervention will push the water trough carbonized filters in an effort to extract microplastics. By doing so the water loses it polluting microplastics and will give the local ecology a better chance to thrive. Vegetation and animals will have better living environements and less pollution will reach the Sea. This intervention does not deal with the source of the micro plastic pollution, but will prevent unnecessary harm to the local environment. The haringvliet is not only a special nature reserve, but it is also used for as a drinking water supply for big parts of South Holland province.

So to conclude, the proposed data intervention will also help with the physical improvent of the local living environment and that of the province.

As shown on the previous pages the Delta Data Hub intervention focusses on five main flow; Data, Energy, Materials, People, and Goods.

The systemic setcion that is featured above shows the five main flows and how they interact with each other after the proposed interventions have taken place.

First of all the section features some of the important data infrastructural elements that have to be constructed in the first stages of the development. This includes glass-fiber cable, transmittion towers, junction boxes, sattelites, servers, routers, and even consumer products such as laptops, smartphones, tablet, etc. This wide variety of devices and infrastructural elements creates many connection possiblities to the overall West-Holland Data cluster.

Governments, regional systems, businesses, and people will be able to connect to our data network much faster, thus ensuring more knowledge transfer in our ever digitizing world.

The data network acts as a backbone for the envisioned circulair data and material economy. The data network will contribute with both physical data infrastructures and non-physical infrastructures to the linking of economies. The spatial inteventions are mostly focussed on the gathering and transporting of knowledge. Some of the spatial outcomes of these interventions are the Delta Data Hub that acts as a data center, connector, delta clean-up, and a vistors center about data and the haringvliet Delta and how our data society is contributing to the protection of our hinterland.

The non-physical infrastructures are focussed on the creation of knowledge platforms where ideas, data, and concepts can be shared. An example of one of those platforms is the 'harvestmap.nl' sharing community, where reusable building materials are shown, traded, and even sold. By proposing an extensive data network a link between the harvestmap platform and the governmental Madaster can be ensured, thus creating a much more complete circulair approach towards material and data flows.

To conclude this data intervention is all about connecting a wide range of stakeholders and creating a platform for knowledge transfer between economies, so South Holland can truly become a province that is all about reusing, recycling, and sharing.

IDENTITY AND ATMOSPHERE

Visualization of Delta Data Hub
Author

The image shown above visualizes the nano scale implementation of the Delta Data Hub Proposal.

The image shows the participatory elements of the data hub such as the vistors center that stimulates the spread of data and delta related knowledge, as well as the recycling truck that indicates existance of the new micro plastic processing industries. Overall the image shows the interaction between the different stakeholders and economies within the region whilst promoting the six datascape values [see icons].

IDENTITY AND ATMOSPHERE

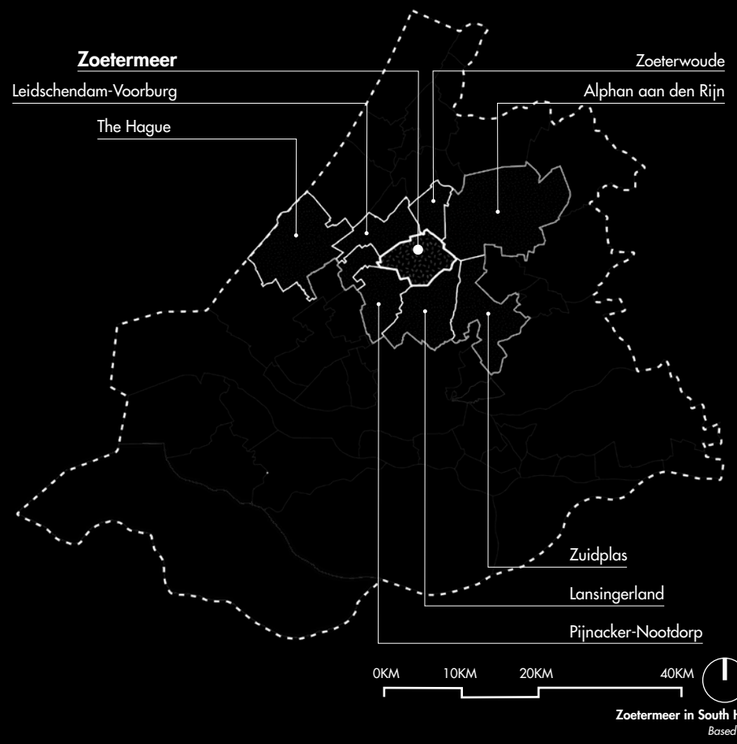
Visualization of Densification and Housing Projects Alongside the Delta Data Hub
Author

The image shown above visualizes the nano scale implementation of the densification and housing projects that are developed alongside the Delta Data Hub.

The image shows the integration of data infrastructure, innovative energy landscape, and housing strategies on the Goeree-Overflakkee island in the Southern parts of the overall province.

PASSPORT ZOETERMEER

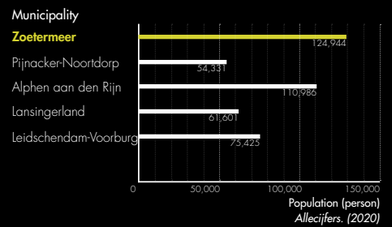
Aerial View of Zoetermeer
Buro Sant en Co. (2018)



Zoetermeer in South Holland
Based on Qgis

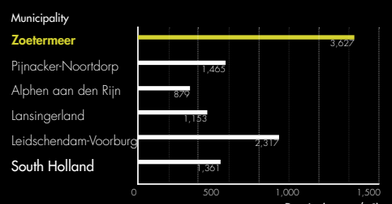
Socio-economic Status

Population



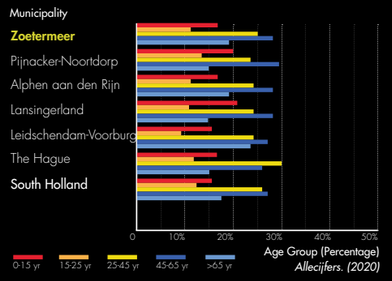
Population (person)
Allecijfers. (2020)

Density



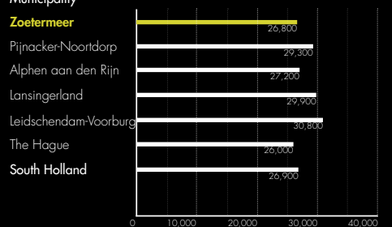
Density (person/m²)
Allecijfers. (2020)

Age Group



Age Group (Percentage)
Allecijfers. (2020)

Average Income



Average Income (€/year)
Allecijfers. (2020)

Description of the Location

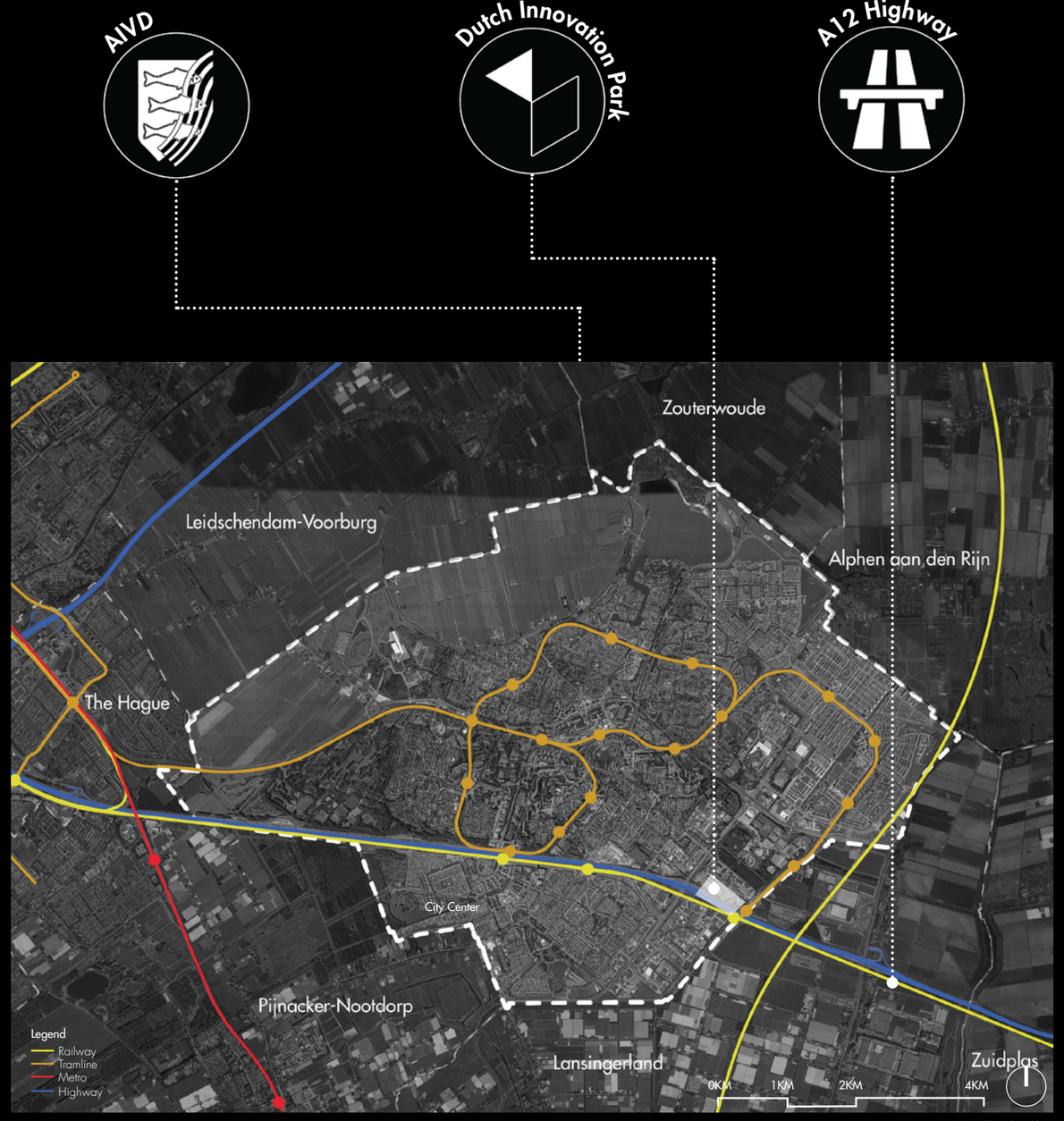
Situated in between the principal city of the province, The Hague, and the Green Heart, Zoetermeer is characterized by the urbanized environment and the Dutch polder landscape. On its Northern and Eastern borders, the edges dividing urban landscape and natural landscape can be seen. While on the southern side, the adjacent municipalities of Lansingerland and Pijnecker-Nootdorp are the Greenport clusters, where the large patches of green horticulture are located.

Demographically, Zoetermeer is the third-largest population center in the province, after Rotterdam and The Hague. Therefore, when comparing the density with the municipalities around, Zoetermeer is the most densely populated. However, the average income of its citizens could be an issue, since it is slightly lower than those of surrounded municipalities.

Regarding the potential of security, Zoetermeer was chosen to be the location of the governmental organization. The General Intelligence and Security Service or AIVD have its fully fenced headquarters in the city center. It is in charge of gathering intelligence and assisting in combating domestic and foreign threats to national security (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2019).

The economy of Zoetermeer primarily depends on Information Technology businesses. The city is equipped with modern infrastructure. Het Forum, the digitized center in the city center houses city hall, central library, and other companies. Dutch Innovation Park is located on the southwestern side of the municipality, where numerous IT-related firms, particularly software development companies, are based here, including Siemens and Atos. Academically, within the compound, The Hague University of Applied Sciences established its campus. It provides research-based education focusing on IT and design in collaboration with the IT business community (The Hague University, 2020). This illustrates the connection between IT-wise education, research, and business within the Dutch Innovation Park.

The municipality connects to The Hague and Gouda by A12 highway, as well as by train. Moreover, the tramline goes pass its city center connecting with The Hague Central Station. For this reason, Zoetermeer will be the anticipated mobility hub of the region.



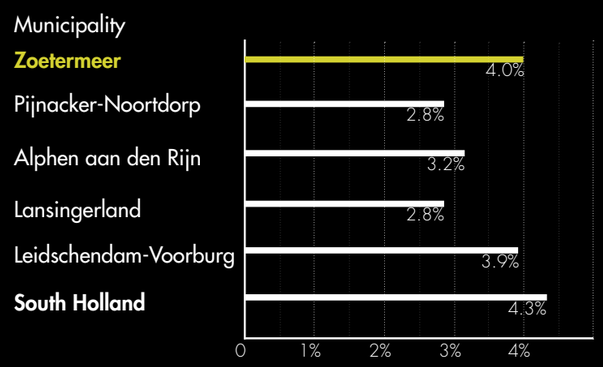
Zoetermeer Existing Situation Map
Based on Qgis

PROBLEM STATEMENT

High Unemployment Rate

Comparing to the surrounding municipalities, Zoetermeer experienced higher unemployment rate at 4% of the population of the municipality. Also, half of the unemployed people do not have any basic qualification for the education. This soio-economic issue needs to be solved to provide more job opportunities especially the semi-skilled professions to the jobseekers. However, the other half of them is also important, as they have higher skills. With all the existing assets in the municipality, particularly the Dutch innovation park, there is a high prospect of more special-skilled employment opportunities occurring in the future.

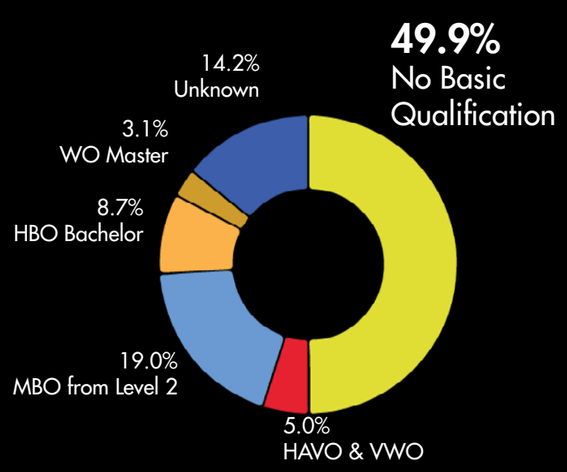
Unemployment Rate



Unemployment rate of 15-75 yrs (%)

Gdindex, (2018)

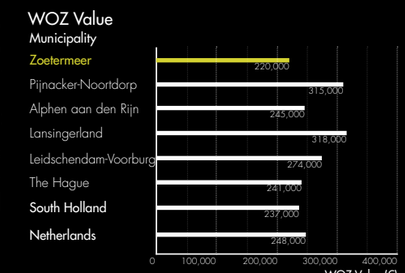
Jobseekers by Level of Education



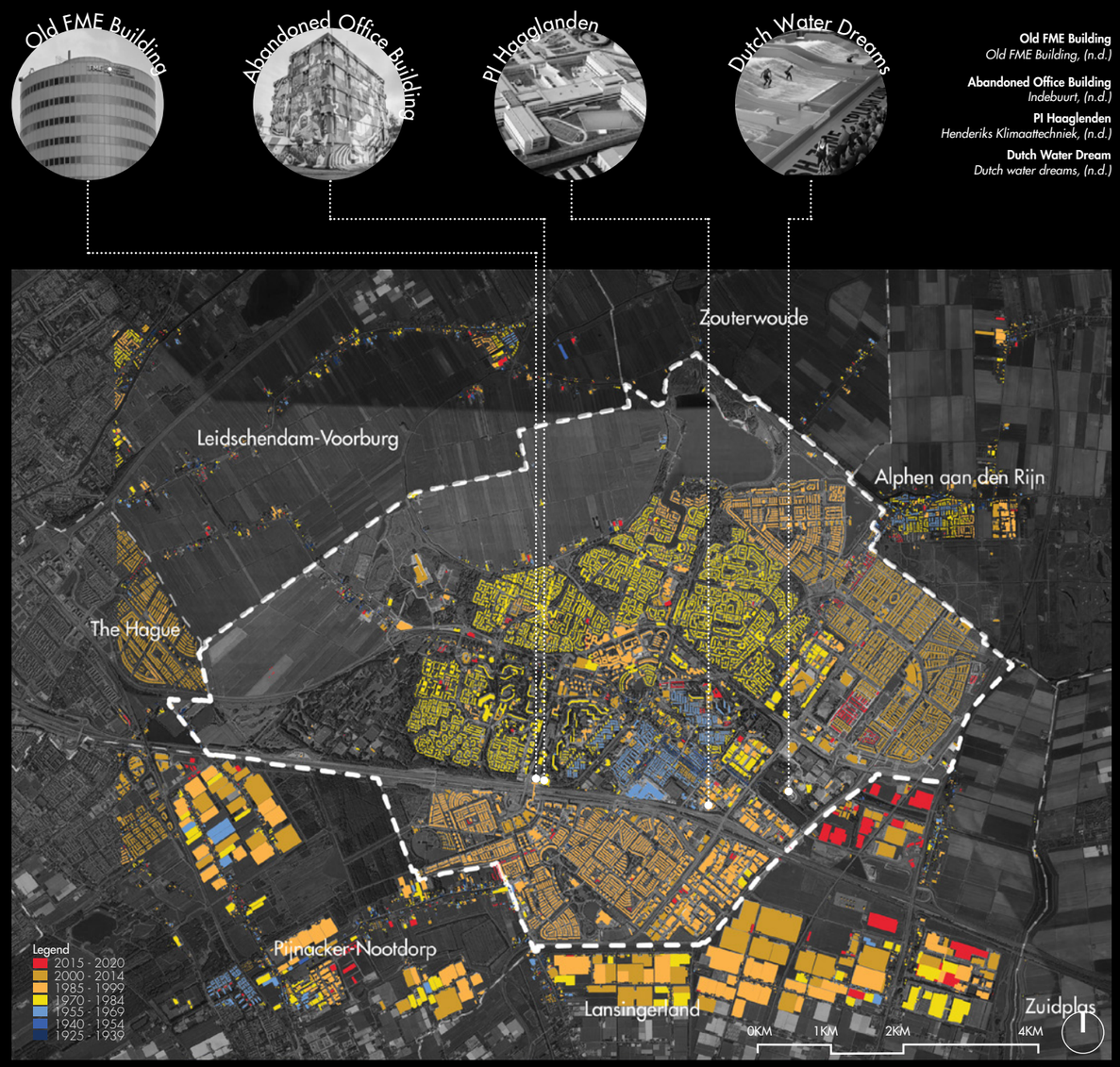
Gemeente Zoetermeer, (2020)

Vacant Buildings

As developments have happened in Zoetermeer, for example, brand new office buildings, companies are attracted to rent and occupy those new spaces. This leaves many obsoleted structures all around the city which also contributes to more possibilities of crimes within and around these buildings. Moreover, the majority of built environments in this municipality was constructed before 1980s or more than 40 years ago leading to the lower woz value compared to other municipalities around and the province. Therefore, there are high feasibilities of demolishing these structures in the future and all the residual construction materials need to be organized and utilized instead of dumping them.



Allecijfers. (2020)



Old FME Building
Old FME Building, (n.d.)

Abandoned Office Building
Indebuurt, (n.d.)

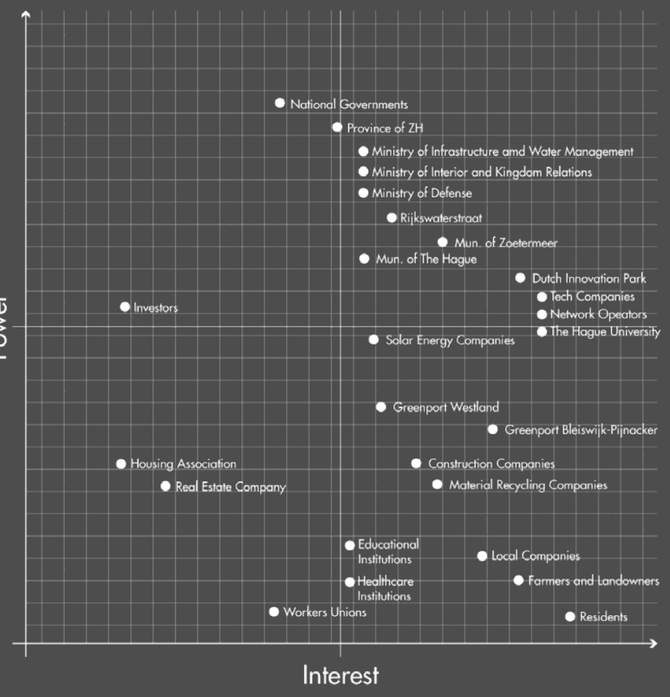
Pl Haaglenden
Henderiks Klimaattechniek, (n.d.)

Dutch Water Dream
Dutch water dreams, (n.d.)

Building Year Map
Based on Qgis

STAKEHOLDERS ANALYSIS

To comprehend who are the stakeholders involved within this intervention exmaples, they are positioned in the triangular diagram, which is divided into three scales: governments, busineses, and residents. Moreover, The power and interest table is used to analyze their amount of power and interest. Besides, they are also mapped to see the overview of where they are located in the province. Altogether, we learned which stakeholders need to be persuaded and which ones we can use to support the ideas in our development strategy.



A12 Highway
Ministry of Infrastructure and Water Management
Rijkswaterstraat

AIVD Headquarters
Ministry of Interior and Kingdom Relations
Ministry of Defense

City Center and Neighbourhoods of Zoetermeer
Municipality of Zoetermeer

CBD
Municipality of The Hague

Governments

Businesses (Local and Large) — **Residents**

Dutch Innovation Park
Siemens, Atos, Teleplan and Sivantos
The Hague University

Material Hub Zoetermeer
TLN (Transport and Logistic Netherlands)
Logistic Companies

Data Centers
Tech Companies
Network Operators

City Center and Neighbourhoods of Zoetermeer
Unibail-Rodamco-Westfield (Real Estate Company)

Greenport Westland
Construction Companies
- Dutchgreenhouses
- Genthon
- Dalsem
Farmer

Greenport Bleiswijk-Pijnacker
Construction Companies
Farmer

Energy Suppliers
Solar Energy Companies

Delft
Construction Companies

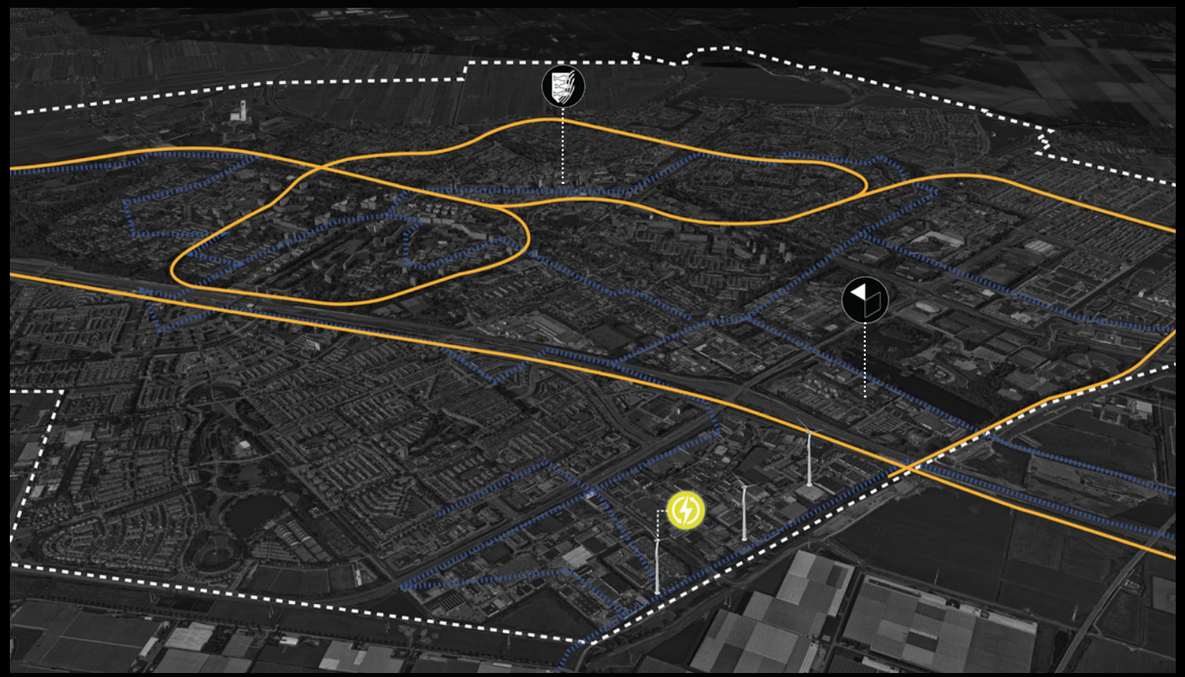
CBD The Hague
Tech Companies

Education Facilities
Primary Schools High Schools

Drechtsteden
Material Supplier

VISION FOR THE LOCATION

2020



Zoetermeer - Existing Situation
Author

2020; Existing situation

As mentioned before, Zoetermeer is situated in the prime location where it is surrounded by The Hague, Rotterdam, and the Green Heart.

Currently, the transportational infrastructure has already been developed and the accessibility from other cities has been provided. The main infrastructural connection is the A12 highway which runs in the east-west direction, stretching from The Hague to the German border.

Public transportation has also already existed. The railway runs parallelly to the highway connecting The Hague and Gouda. These two main infrastructural lines separate the municipality into Northern and Southern parts. Moreover, light rail transit called RandstadRail has been operating, linking The Hague and the city center of Zoetermeer as well as other neighbourhoods in the municipality.

When looking at the current data connection, Zoetermeer is equipped with the network of the underground data cable. It can be seen that the cable lines were installed along the transportational infratructure such as highway and roads.

Renewable energy source can be found in the form of wind turbines. They are situated on the Southern side of the municipality.

In conclusion, Zoetermeer has many existing assets including the aformentioned IT-related community and institution, and AIVD, which added the potential to the city. Therefore, it is suitable to implement the campus-wise data hub that will be the catalyst to enhance the circular flows and local values. Besides, altogether with the existing data grids and other infrastrustures, it will be developed in the testing phase.

- Existing Data Infrastructure
- Existing Transportational Infrastructure
- Existing Renewable Energy Source

2025

Zoetermeer - Local Enhancement
Author

2025; Local enhancement

Within the first five years of development Zoetermeer proposal introduces new two data hubs. The first chosen location is within the Dutch Innovation Park where IT-related companies and The Hague University campus is situated. This data hub will help increase the value of participation. Integrated with the existing IT community, this data hub will be the platform where the knowledge innovation happen. Moreover, the value of equality will as well be enhanced, specifically, job opportunities for all levels of education. For example, highly skilled labors are needed for software writer positions, while converting hardware will be the job for medium skilled labor.

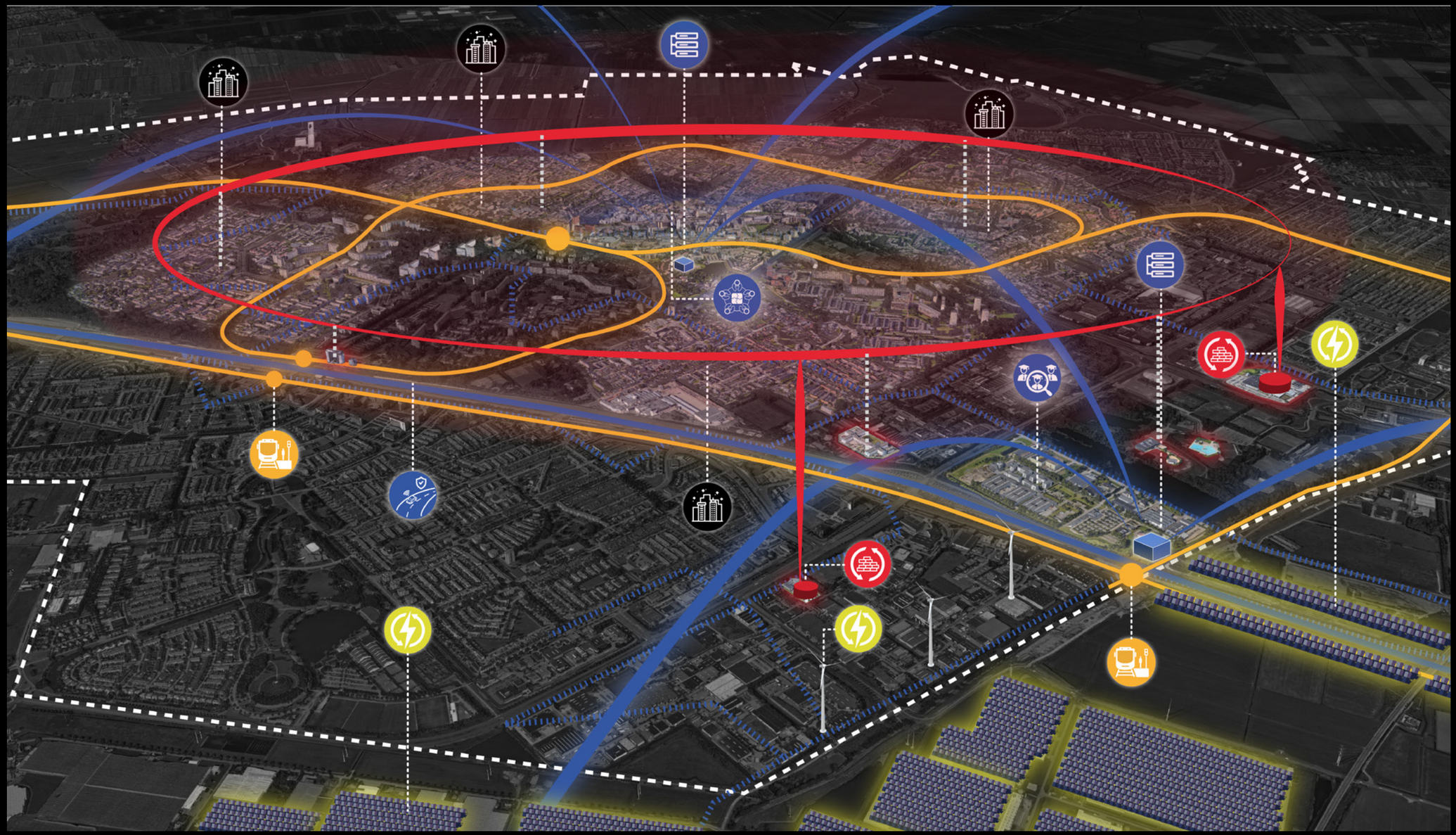
The second location is within the city center where AIVD is located. This development will enhance participatory value. To illustrate, it can be a city activator where people from all educational levels can come together and share the knowledge in a more practical way. In the mean time the surrounding neighbourhoods will be densified due to more job opportunities generated from the data hub.

Regarding energy transition, the new energy landscape will be developed along A12 highway, as it has potential for solar energy.

- Existing Data Infrastructure
- Existing Transportational Infrastructure
- Existing Renewable Energy Source
- New Data Connection
- Proposed Data Center at Dutch Innovation Park
- Proposed Data Center at Dutch Innovation Park
- Proposed A12 Solar Park
- Densification Intervention

VISION FOR THE LOCATION

2030



Zoetermeer - Circular Finish
Author

2030; circular finish

In the last stage, the data hub within the IT community which is close to the A12 highway will serve as a data-processing element, optimizing the traffic flow and security. The generated data will also be used to kickstart the mobility transition, integrated with the exising public transportation.

The material hubs where building materials from the obsoleted buildings can be shared and reshared will be developed, leading to the circular built environment.

Moreover, more renewable energy landscapes will be developed. The greenhouse horticulture has a great potential for solar panels installment on the its roof. Therefore, the solar energy will be generated and provided to the data hubs and built environment.

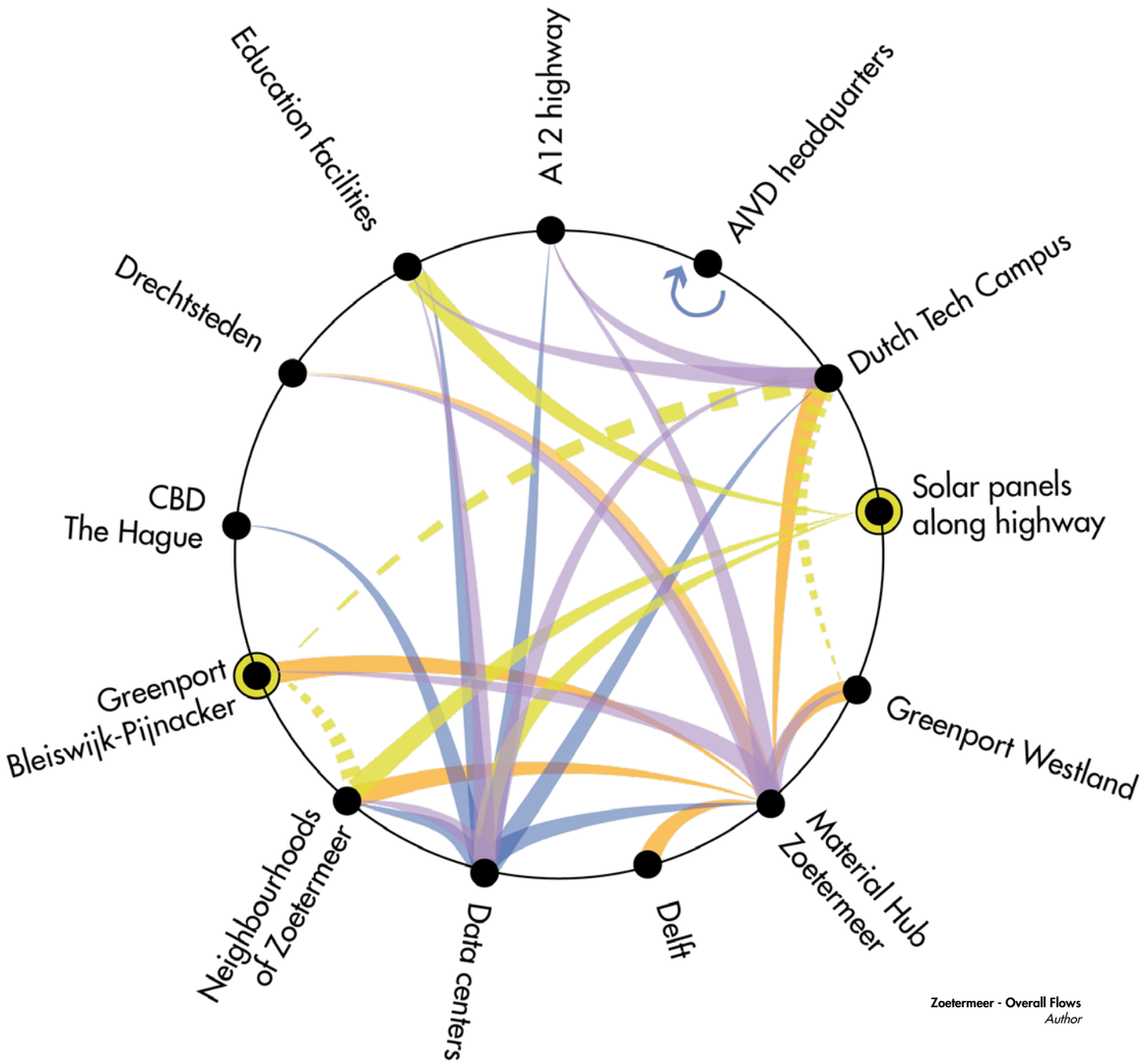
CIRCLE DIAGRAMS OF LOCAL CIRCULAR FLOWS

In this chapter the four main flows [Data, Engery, Materials, and People] of the Zoetermeer Data Hub intervention are shown in relation to each other. The main circle diagram below shows the importance of the supporting structures for the proposed data network extension, such as the extended and newly developed engerly landscapes that will provdive renewable energy resources to the region.

The new Data Hub will have a central position in the overall system and will bring together and even link the other flows and stakeholders by sharing of data, knowledge, and interests. An example of this sharing of data is the devleopment of a new type of educational institute that gahters people from all educational levels and makes knowledge transfers specifically about data and recycling accessible to all.

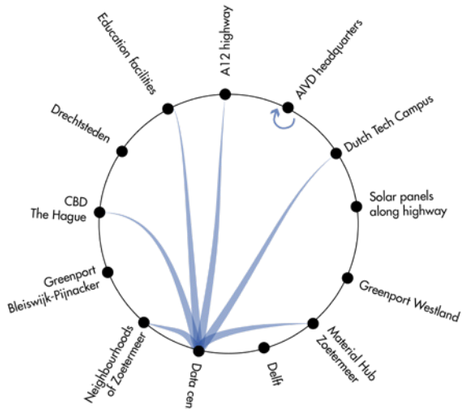
By doing so the proposal will not only create a societal impact by extending and branching out the existing data network, but will also create a wider knowledge base about data industries which could lead to new dutch industries that design, manufacture elements for the further development of the circular data system.

Overall Flows



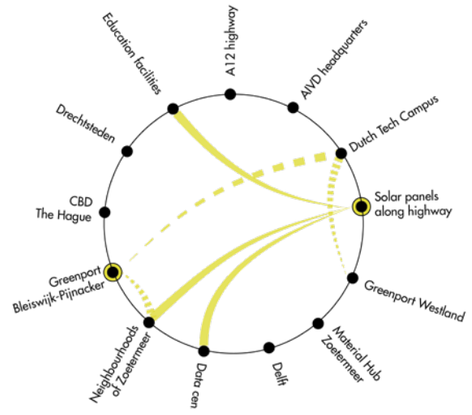
Zoetermeer - Overall Flows
Author

Data Flows



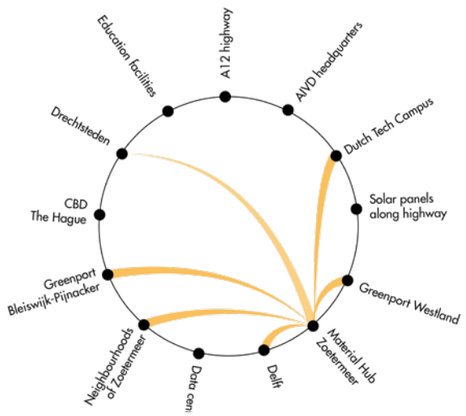
Zoetermeer - Data Flows
Author

Energy Flows



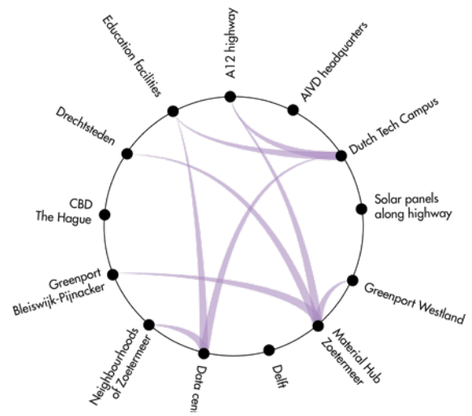
Zoetermeer - Energy Flows
Author

Material Flows



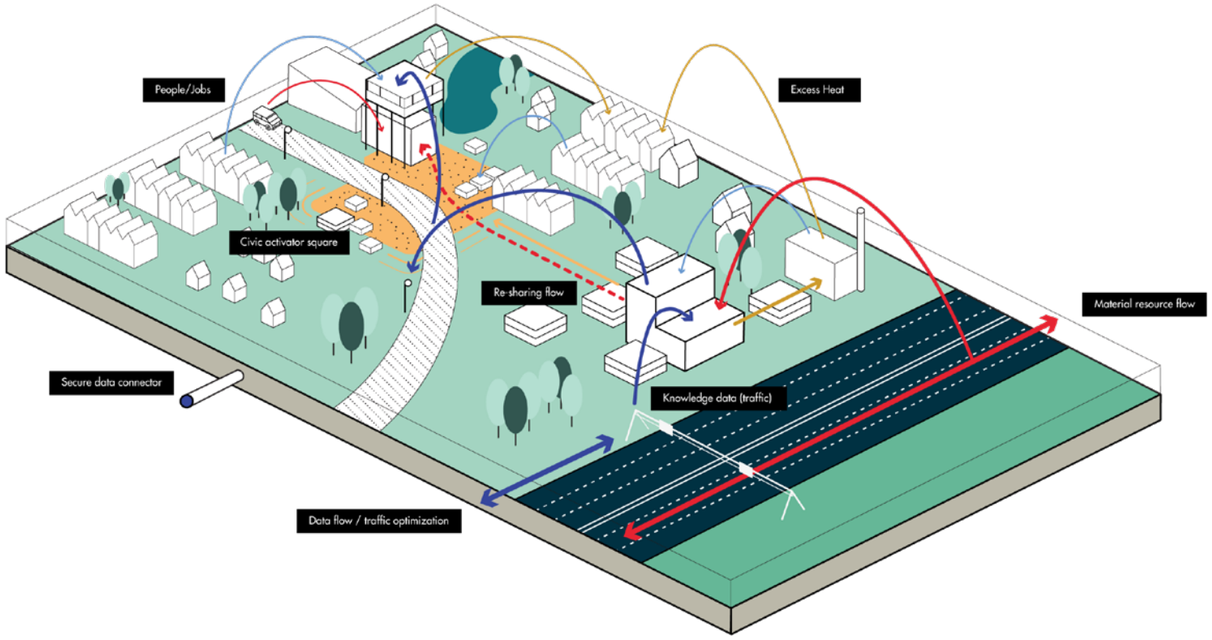
Zoetermeer - Material Flows
Author

People Flows

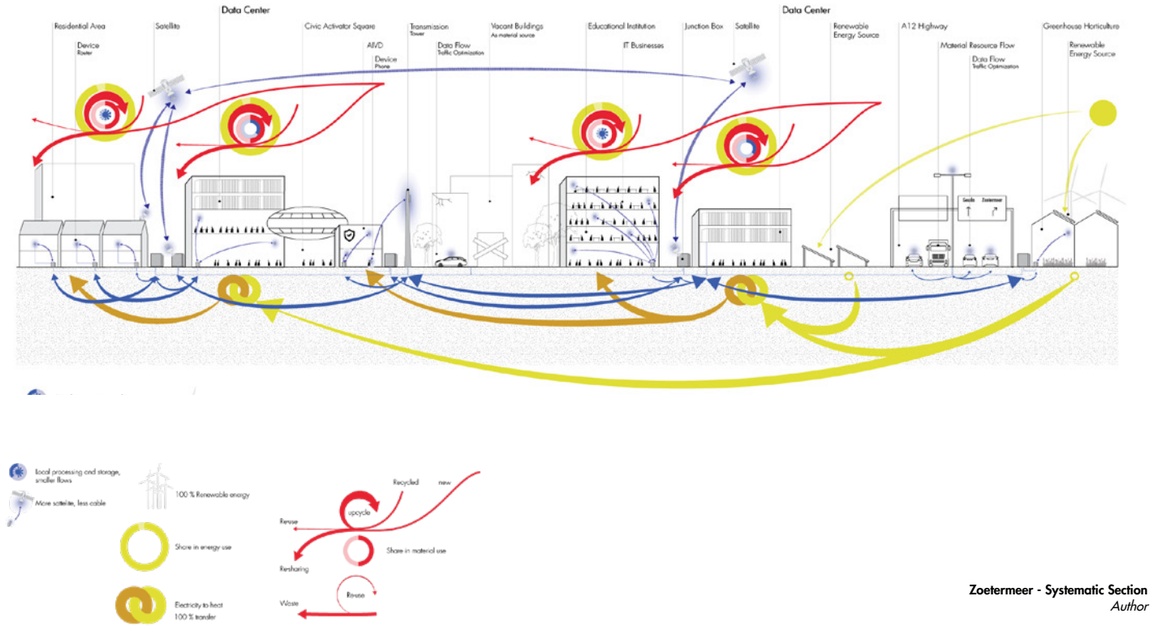


Zoetermeer - People Flows
Author

STRATEGIC LOCAL INTERVENTION



Zoetermeer - Strategic Local Intervention
Author



Zoetermeer - Systematic Section
Author

The local Data Hubs within the Zoetermeer municipal boundries will extend the exisinting data network to work at a much higher efficiency.

As mentioned before, Zoetermeer is situated in a prime location between The Hague, Rotterdam, and the Green Heart. Currently, the transport orientated infrastructure is a part of an advanced provincial and even national network. Accessibility from and to other cities has been is relatively high, with the main infrastructural connection being the A12 highway which runs in the east-west direction, stretching from The Hague to the German border.

Public transportation in the area consists of three parts. The railway runs parallelly to the highway connecting The Hague and Gouda. The train tracks and A12 highway separate the municipality into a Northern and a Southern part. Moreover, a light rail transit option called the RandstadRail has been operating for a couple of years and thus linking The Hague and the city center of Zoetermeer as well as other neighbourhoods in the municipality. The proposed data network development will make sure that the intermodal transport will run much more smooth. Thus ensuring an overall highter transportation efficieny and a more optimized energy use.

The current data cluster in Zoetermeer is equipped with a network of the underground data cables. Renewable energy source can be found in the form of wind turbines and they are mostly situated on the Southern side of the municipality.

The Zoetermeer Data cluster proposal actually plans for the development of two data hubs. Zoetermeer has many existing local qualiteis such as the aformentioned IT-related community and institutions, an the AIVD. Therefore, Zoetermeer is suitable location for the implemention of two campus-like data hubs. One that will act as a catalyst to enhance the circular material flows and one that will further develop dutch data and reclycing knowledge.

As shown on the previous pages the Zoetermeer Data Hub intervention focusses on five main flow; Data, Energy, Materials, People, and Goods.

The first chosen location for development is wihin the Dutch Innovation Park where IT-related companies and The Hague University campus are situated. This data center will help increase the value of participation. Integrated with the existing IT community, this data center will also become a platform where knowledge and innovations related to the data sector can be exchagned or developed. Moreover, the value of equality will as well be enhanced, specifically, job opportunities for all levels of education. For example, highly skilled labors are needed for writing software, while converting hardware will be the job for medium skilled labor. This Innovation Data Hub will help set up a much stronger Dutch data service sector and might even lead to local manufacturing platns of the needed infrastructural elements and thus creating less need for the costly and polluting import of products.

The second proposed data location is within the city center of Zoetermeer, where AIVD is located. This development is fccussed on the creation of a new public campus which will enhance participatory values and will pose as anew face for the local governemental stakeholders. In this location a CAMPUS with a local produaciton nature will be proposed. Zoetermeer will become the IT-cluster of the province, the city is well-connected by different transport modes and houses departments of the Haagse Hogeschool that are focussed on the IT-sector. Besides that, the AIVD headquarters are situated in this city. This all adds up to a site with great data networking potential.

To conclude these data interventions in Zoetermeer are all about connecting a wide range of stakeholders to new economies and vice versa. The creation of a provincial platform for data education is essential for the future maintance and development of the overall system. This will all garuantee that South Holland can truly become a province that is all about reusing, recycling, and sharing.

Visualization of Zoetermeer City Center Data Hub
Author

The image shown above visualizes the nano scale implementation of the Zoetermeer Central City Data Hub Proposal.

The image shows the participatory elements of the data hub such as the education center that stimulates the spread of data and recycling related knowledge. Overall the image is showing the interaction between the different stakeholders and economies within the region whilst promoting the main six datascape values [see icons].

IDENTITY AND ATMOSPHERE

Visualization of Densification and Housing Projects Alongside the Zoetermeer Data Hub
Author

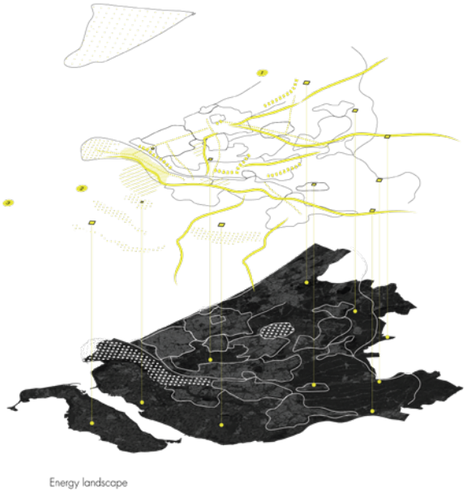
The image shown above visualizes the nano scale implementation of the densification and housing projects that are developed alongside the Zoetermeer Data Hubs.

The image shows the integration of data infrastructure, innovative energy landscape, and housing strategies in the Zoetermeer municipality. The proposal focusses on the development of affordable and diverse living opportunities within the city center.

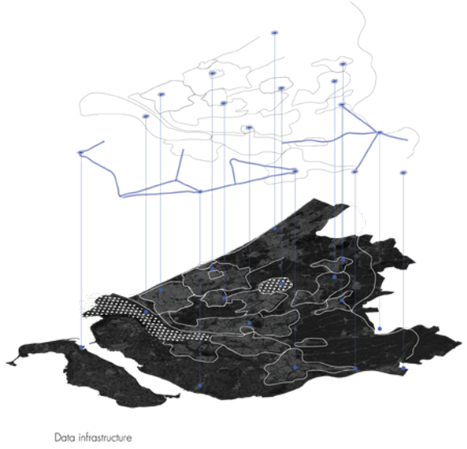
11

PHASING AND STAKEHOLDERS

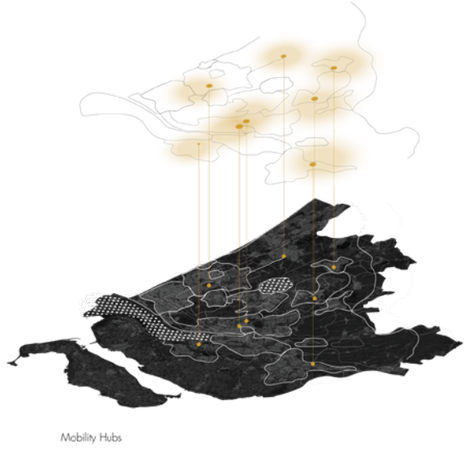
- Regional interventions
- Phasing Stages
- Planning of interventions
- Types of stakeholders
- How to establish stakeholder involvement
- Four regional keyplayers highlighted



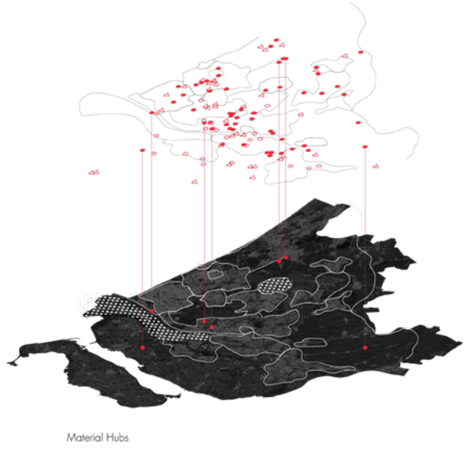
Energy landscapes



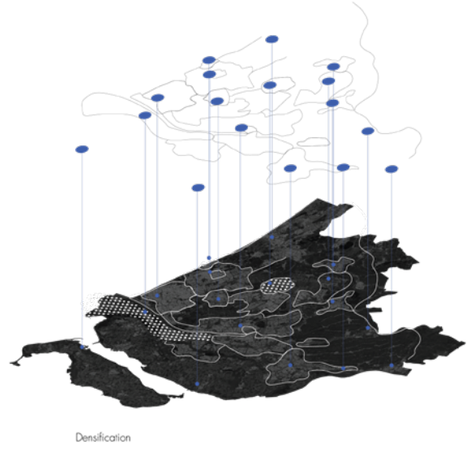
Data infrastructure



Mobility hubs



Material hubs



Data clusters

Regional Interventions
Author

PHASING STAGES

2 **What?** Developing policies to shape the new decision-making environment

Where? On the national, continental and global scale

Who? Global organizations, EU, National Government, knowledge institutions

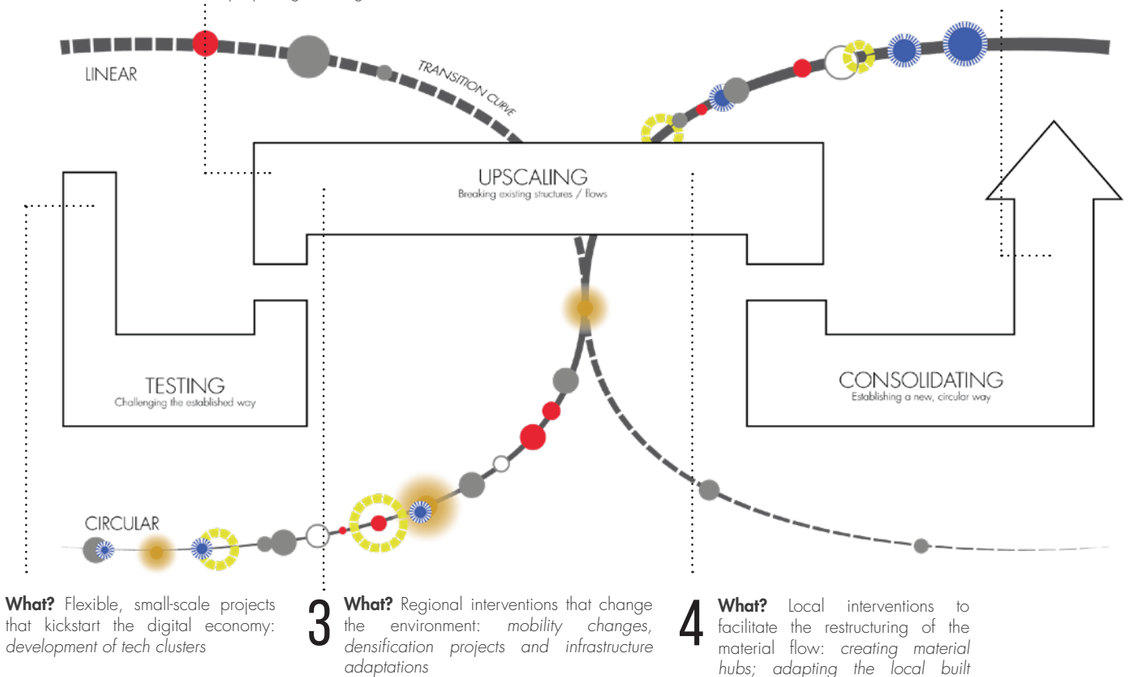
How? Adapting existing policies and proposing new legislation

5 **What?** Large-scale interventions that change the national-global physical and digital environment: *construction of large systematic structures and data centres*

Where? On the local and regional scale; along major infrastructures and in newly developed data clusters

Who? Global organizations, EU, National Government, Province of South Holland, involved municipalities, entrepreneurs, construction companies

How? Based on new legislation



1 **What?** Flexible, small-scale projects that kickstart the digital economy: *development of tech clusters*

Where? On the local scale; on campuses and in city centres

Who? Pioneers, local businesses, municipalities, real estate developers, knowledge institutes, residents

How? Based on current legislation

3 **What?** Regional interventions that change the environment: *mobility changes, densification projects and infrastructure adaptations*

Where? On the regional scale: along major infrastructure and larger patches of land outside the cities

Who? EU, National Government, province of South Holland, involved municipalities, construction and development companies

How? Based on new legislation

4 **What?** Local interventions to facilitate the restructuring of the material flow: *creating material hubs; adapting the local built environment*

Where? On the local scale; on business parks and former industry locations

Who? Construction companies, entrepreneurs, municipalities, real estate developers, residents

How? Based on new legislation

Phasing Stages
Author

How to read the phasing strategy

Many strategic interventions form the translation from the future vision to the actual spatial outcome of the region.
These interventions can be categorized in:

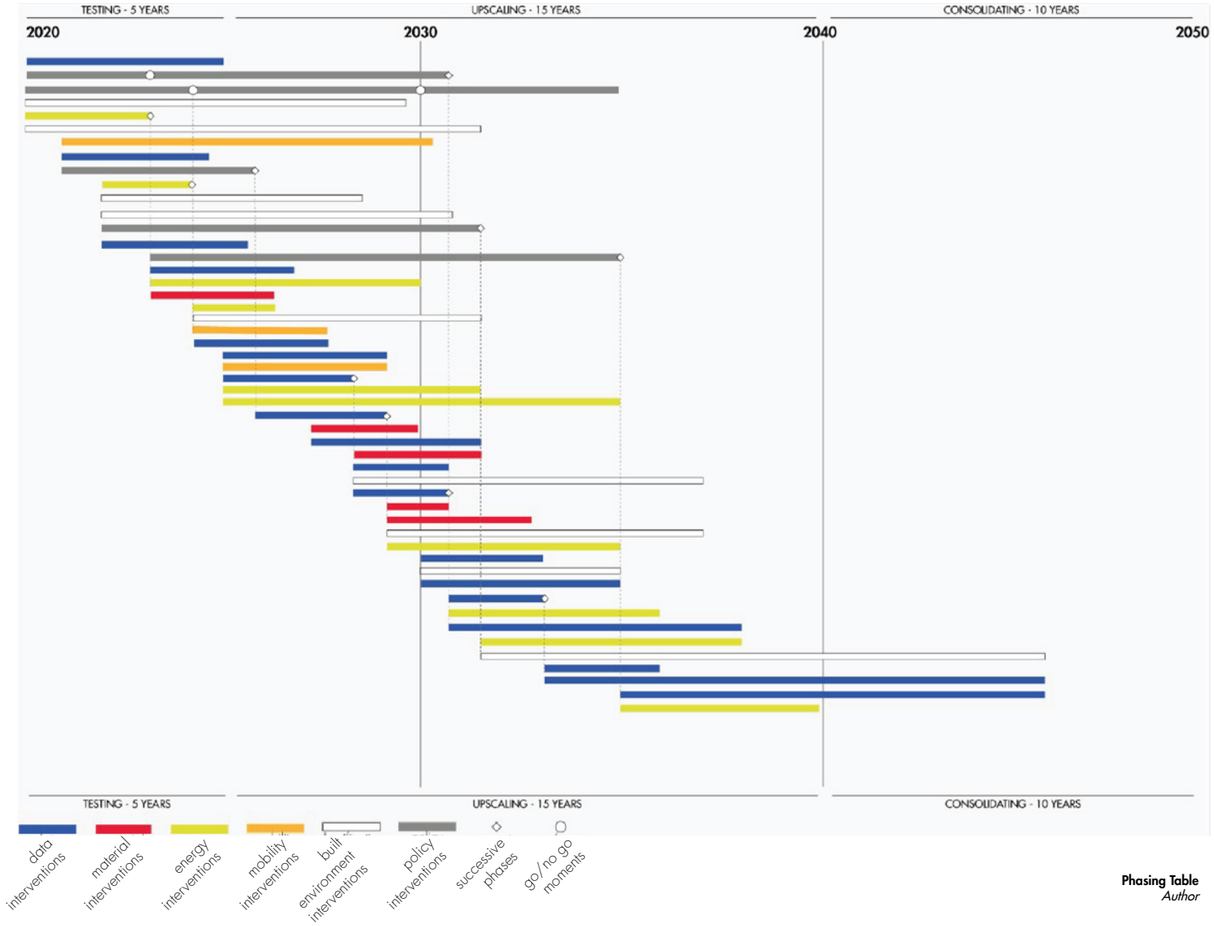
- construction of energy landscapes,
- development of data infrastructure and centres
- construction of mobility hubs
- development of material hubs,
- adaptations in the built environment
- policymaking

The categories each have their own colormark. The X-curve on this page, shows the transition from a linear to a circular economy. The interventions are placed on the curve, according to their timing in the phasing, the scale of the intervention and the category in which they belong.

The X-curve is connected to the intervention planning on the next page. This development planning table shows which intervention happens in which timespan. It also shows the relation between certain interventions.

The elaborate version of this overview is given in Appendix 1. In this table, all strategic projects are explained, including the involved stakeholders (policy-making and operational) and the location where the intervention will happen.

PHASING TABLE



Phasing Table
Author

Planning the interventions that are part of a regional strategy is complex and dependent on many factors and (future) uncertainties. Sometimes, factors that are not taken into account while proposing a phasing strategy, pop up during the development.

Successive phases

In this strategy, certain interventions follow up other interventions, that facilitate their development. For example, the construction of a data cluster in a less-connected area can only take place after the extension of the data infrastructure towards this area. These successive phases are dependent on the preceding phase. Therefore, a buffer of time is considered in the planning. In case of delays for specific interventions, the phasing for the entire strategy is not subject to a lot of change.

Checkpoints

Another checkpoint that is built within the phasing strategy, are the go/no go moments. These moments represent the need for a certain alliance to be made, a certain policy to be implemented or they mark the beginning of a new term. 2030 is for example an important moment in the strategy, as the mobility transition kicks off in this year, the windturbine park on the North Sea will be finished and the Greenports will start their journey towards self-sustaining clusters.

Feasibility of the projects

The feasibility of the strategic intervention or project reaches way beyond just economic feasibility. According to Adams & Tiesdell (2013) strategic projects must be tested on five aspects: ownership (property rights), regulation (zoning and licences), physical suitability (site investigation and treatment time), market appeal (competition, supply and demand) and financial viability (revenue forecast, risk strategy and funding). By identifying and solving the problems that might impede feasibility, developers can stay in control of the planning and phasing strategy. In order to do so, a development team should consist of experts of different fields, ranging from financial, legal, management and technical expertise (Adams & Tiesdell, 2013).

Governments and developers should therefore involve the relevant stakeholders as early in the process as possible. They must understand that stakeholders are not always clearly organized groups of people. There are many types of stakeholders in large strategic developments like a regional vision.

In the next part, this stakeholder participation and collaboration models will be discussed.

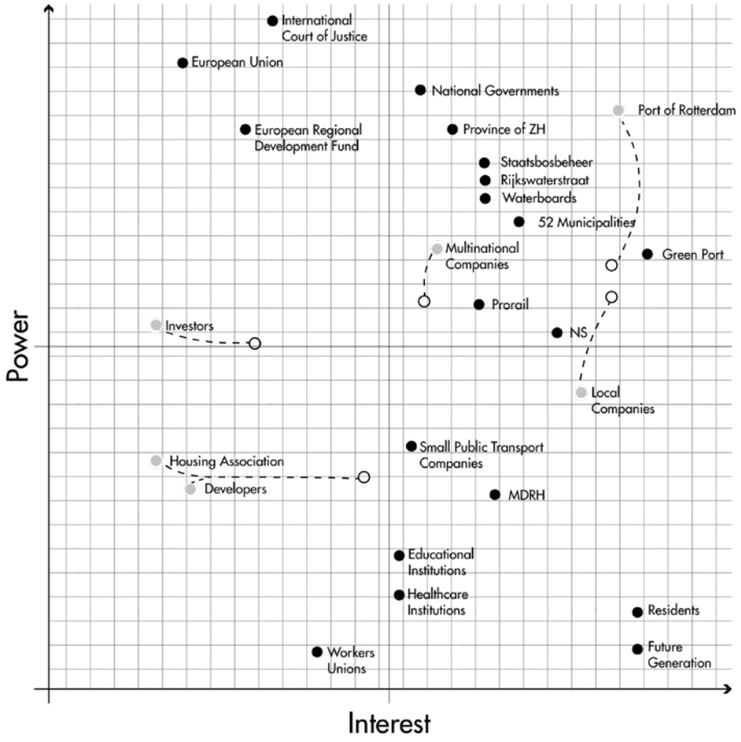
STAKEHOLDERS

The power-interest chart
This chart shows how much power and interest stakeholders have in the (development of the) region, and thus it also includes how stakeholder relate to eachother.
High power, high interest represents the direct partners, that need to be involved and with whom the initiator needs to collaborate. .
High power, low interest represents powerful players that need to be updated and satisfied.
Low power, high interest represent the (silent) stakeholders that need to be informed and sometimes consulted.
Low power, low interest represent the less involved stakeholders, that just need to be monitored.
(Rocco, 2020).

Power of stakeholders
Stakeholders can use different types of power to influence decision-making and development concepts: voting power (*residents*), economic power (*companies, investors*), political power (*government*) and legal power (*land owners*) (Wilson, 2017).

To strive for a just and equal decision-making process, some shifts in the power-interest chart are necessary. The grey dot represents the former location of the stakeholder, and the white dot represents the proposed new location.
The Port of Rotterdam should get less monopoly and power, to faciltate the transition towards a sustainable port. The local companies should get more power, and the multinationals a bit less, in order to develop the local and regional material hubs and to stimulate local economies.
Developers, investors and housing associations should be more participatory and thus increase their interest in the region, not only in a economic manner, but also become willing to participate in the energy transition. In order to change the existing and developing built environment, operational stakeholders such as these parties should have a high interest in the area as well.

Some stakeholders are involved in the decision-making processes of this strategy, and some other are involved in the operational processes that will develop the interventions. This difference is highlighted in Appendix 1.



Stakeholders Power and Interest Chart
Author

Taskforces and alliances
Establishing collaborations in an early stage of the process, far before the actual construction of interventions, can prevent delays and setbacks.

In this strategy, local stakeholders are involved from the beginning on. Next to that, larger (private) organisations and governments form taskforces to exchange knowledge and collaborate towards a better outcome, for example in the case of the Data Driven Delta. Public-private partnerships have proven to be very successful in large-scale and complex projects (Heurkens, 2013). By bringing together stakeholders with different power-interest positions and from different sectors, a network governance can be established (Rocco, 2020).

Stimulating participation
Besides stimulating organized stakeholders to participate, residents and non-organized stakeholders should also be part of the decision-making and developments. Transparency and just information distribution are very important to involve stakeholders that have a non-influential position in the power-interest chart. The digital economy could contribute to this distribution of information and let people participate on many platforms.

INTERESTING KEYPLAYERS

Challenges and pitfalls for having these important conversation partners on board, towards a circular Province 2050

European Commission

Some regulations concerning the circular economy affect the entire continent of Europe, such as the ban on single-use plastic (European Commission, 2019). The knowledge that the Commission has on the circular economy can also be seen as an opportunity. This platform can serve as an information exchange forum in which countries can stimulate eachother to do better. The European Commission also has a say in the environmental law and proposes documents like the Natura 2000 (European Commission, 2020).

Havenbedrijf Rotterdam

Currently, the Havenbedrijf Rotterdam, that represents all the businesses, activities and companies in the port, has almost a monopoly over this area. They have to obey Dutch and international law, but function as a self-sufficient whole. There are only two shareholders in the company: the municipality of Rotterdam and the Dutch state. In order to create a more sustainable port, new policies are necessary to facilitate this transition. An intensive collaboration between global multinationals, European companies, the national government and local governments is essential. This makes the Havenbedrijf Rotterdam a very important conversation partner, from the beginning to the end of the strategy.

Port of Rotterdam

Westland municipality & residents

The Westland is one of the high-productive areas of the Netherlands. In this greenport, food is produced for global distribution. The region is well-known for the quality of the production, processing, storage and distribution of goods. It will be difficult to implement certain interventions in the area, because the production can not be put on a hold. Next to that, a lot of land is in private ownership, so the negotiation phase will take a long time. The Westland has a different data infrastructure company than the rest of the Province, so development in this field should be checked with multiple operational stakeholders. Farmers and land owners should be involved from the beginning, to prevent obstructions in a later stadium and to also define the benefits that they can gain from these developments.

GEMEENTE WESTLAND

Future generations

An important stakeholder, maybe even the most important one, is one that is overlooked many times: the future generation. The generation that planners, policymakers and designers are creating a better world for. Since the future generation is not here yet, they can not have a voice in the decision-making. And therefore, their voice needs to be represented by other stakeholders around the table. Currently, the governmental institutions are looked upon as representatives for (future) residents. But a change in the way of thinking of all the stakeholders needs to happen. Everyone around the table should think of the future generations, in order to create a region that will sustain. Now, and in the future.

12

ETHIC PARAGRAPH

- Risk analysis
- Forecast externalities of this proposal
- Give recommendations for further elaboration

A REFLECTION ON ETHICS

Nowadays the internet is all around us, but how connected are we really? The evolution of the Internet has led to a new economy based on digital information and communication.

Is it possible to make this resource depleting industry circular and can it even make our world circular using the possibilities of the internet? How can a connected and resilient datascape in South Holland be created while preserving the global value and increasing the local value?
These questions lie at the basis of the proposal presented in this report. It explores the opportunities and the boundaries of both the system and the region. This short chapter will reflect on the ethical meaning and the values that are brought forward with this proposal.

Six values that represent the new world
The world that is created after the implementation of this strategy is characterized by six main values.
Safety of the network and data is established on one hand via trust and reliability between producer, consumer and processor, and on the other hand via resilience and flexibility of the system itself.
Justice in the distribution of the product(s) that the sector brings forward, is created via overall accessibility and clear ownership of data and the network.
A ***diversity*** of stakeholders and involved locations minimizes monopolies within the sector. Diversity in the material, data and energy flows reduces the relience on one specific stakeholder.
By making efficient use of (energy and material) resources, ***health*** of people and planet is pursued and the balance between economic, environmental and social values is restored in decision-making.
Prosperity of the society will increase via the diverse employment opportunities that are created in this new economy, growth of current and new economic drivers and the high living quality that is strived for.
Participation of all stakeholders, organized and non-organized, is realized via activation of every user in the chain and the creation of awareness and shared responsibility.

SAFETY
of the network and the data via trust, reliability, resilience & flexibility

EQUALITY/JUSTICE
of the sector's product via accessibility & ownership of data and the network.

DIVERSITY
of stakeholders and spaces via minimizing monopolies

HEALTH
of people and planet via efficient use of resources

PROSPERITY
of the society via diverse employment opportunities, economic growth, and high living quality

PARTICIPATION
of all stakeholders via activation of users and creating shared responsibility

Six Local Values
Author

On reducing equalities
Everyone is part of the (global) data network. We all produce and consumse data. The strategic interventions that are part of this development are aimed at improving and extending the existing data network, to support the digitization of the world. We all benefit from this development, although some stakeholders might have to give up a bit of convenience temporarily, during the construction or development of (infra)structures.
In this strategy, minimizing the differences between the urbanized area and the hinterland is a central theme. Digital and physical accessibility and the spread of economic activity are key goals to be pursued in this strategy.

On preventing (spatial) injustice
However, the spatial injustice caused by this strategic proposal is concerned. Proposing data hubs in the urbanized areas would lead to more competitiveness in these locations. For example, more companies will be attracted by these emerging data hubs, and the land price will increase. Therefore, space will be occupied by the affluent firms while the smaller practices will be left outside. Possible ways that could tackle this anticipated issue are policy-making focussed on a fair land use program and processing designs focused on adaptive approaches. Reflective moments will be organized during the process to check the distribution of burdens and benefits among the local stakeholders. The parties gaining the benefits, should also be the ones bearing the burdens of the investments.

On establishing a fair distribution
A new energy system is proposed in this strategy. The renewable energy gained from solar, wind and hydropower installations will be justly distributed over the region, not just the nearby stakeholders. The new energy landscapes will not just supply the data sector, but also be beneficial for other sectors in society. To illustrate this, housing units and offices will derive the electricity from the solar panels installed on the greenhouses and the heat from the data centers closeby. Moreover, new data hubs will create public goods, for example, public spaces around them, which will be used by the citizens. This shows the provision of fairness among people given by the implementation of new typologies of data centers.

On involving the silent stakeholders
The main silent stakeholder that is taken into account in the strategy is the environment, on a global, regional and local scale. By making the region energy sustainable and circular the impact on the planet will be minimized and the interests of the environment are represented on all scales. Strategic interventions on the regional and local scale contribute to a betterglobal environment.
In the micro-scale interventions the silent stakeholders are taken into account, such as current residents, but also future generations that will live in this region. They are directly concerned with the interventions that are proposed in the strategy. The need for access to, for example, jobs, housing, and amenities need to be represented. Within this group, subgroups such as lower educated groups, lower-income groups or the handicapped need to be considered. Some specific subgroups are not organized and represented very well and therefore not able to take part in the stakeholder-action strategy. These groups such as the lower educated or the environment are therefore represented in the values that are set in the vision and strategy.

On being part of something bigger
This strategic report explores how a connected and resilient datascape in South Holland can be developed while preserving the global position of the Dutch data sector and increasing the local value. This strategic framework will deal with the complex accumulation of scales that are present in the province of South Holland. On the global scale, the Sustainable Development Goals (United Nations, 2015) are taken into account, of which six are directly addressed by the strategy.
On a contentinental scale, the European Urban Agenda (European Commission, 2020) will have to be taken into account when it comes to the interoperability of the key stakeholders of the data network. And on the national scale, the more local spatial transitions such as the Dutch Energy transition Strategies (National Programma RES, 2020) that will have to be accelerated to sustain the more widespread and advanced data network

The strategies and the different scales need to be considered in order to create the overall transition towards a datascape that is contributing towards a circular South Holland. **A South Holland that promotes safety, equality, diversity, health, prosperity and participation.**

13
FINAL VISUAL

- The Old and New Landscape
- Conclusion

All in all, we aim at the Province of South Holland to transform from a ‘datasphere’ and the existing landscape type of South Holland into a ‘datascape’ in 2050, as shown in this final visual. It will be the province where all six values, namely safety, health, equality and justice, prosperity, diversity, and participation, are enhanced.

FROM DATASPHERE

TO DATASCAPE

SAFETY

HEALTH

EQUALITY/JUSTICE

PROSPERITY

DIVERSITY

PARTICIPATION

CONCLUSION

In this report, the possibilities for the implementation of the digital economy in the region of South Holland are explored. The main objective is to show how the implementation of this digital economy can support and shape the transition towards a circular Province in 2050.

The following research question is the guideline for the research:

How can a regional design strategy promote local values using the global position of the West-Holland Data cluster as a catalyst?
How can concepts of the circular economy and energy transition contribute to this strategy?

Research structure
In order to answer this question, a thorough analysis of the system of the digital economy is conducted. Together with a (spatial) analysis of the region, the challenges and problems that are posed by this development are brought forward. These challenges are adressed in a strategic, regional vision for the Province of South Holland, taking into account the goals, values and development trends in the sector. The development strategy functions as the spatial translation of the vision and explains which interventions need to happen where, when, how and by whom, in order to reach the future vision. Part of this development strategy are regional and local interventions. In the passports, the specific local interventions in two case studies are presented: the Zoetermeer case and the Delta case.
The research is concluded by a phasing strategy, stakeholder strategy and an evaluation of the ethics.

Results
To develop the digital economy in a sustainable and future-proof way, the linear flows of material, energy and data that facilitate the current data sector need to be turned into circular loops that stimulate local production and consumption patterns.

Principles of circularity, such as recycling, resharing and upcycling will keep materials and products in the loop. Local businesses, focussed on these principles, will be employed to perfom this transition.
The development of regional energy production landscapes will facilitate the transition towards a region that runs on renewable energy from solar-, wind-, biomass- and hydropower.

The data flow will still supply and be supplied by the global scale, but the knowledge on security and justice present in this region will contribute to more safety and a better distribution of the data and network globally.

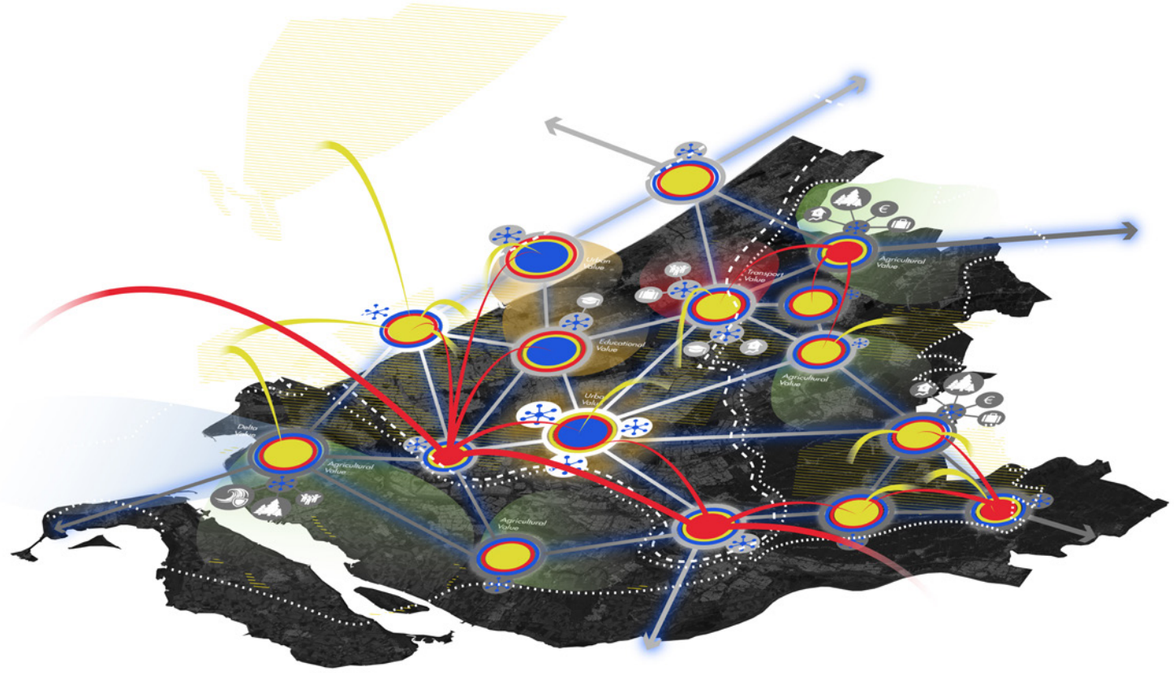
The regional interventions of the design strategy, that change the spatial structure(s) of the area, will promote local values by facilitating the implementation of local data clusters. Economic and social advantages that a data cluster can pose to its direct surroundings are exploited. Establishing more local value with each intervention in this strategy means searching for local synergies, to create multifunctional purposes of interventions. It is also about optimizing local flows, by connecting the heat- and electricity streams to establish local energy loops. Thirdly, more local value will be added by bringing benefits to the local community and economy.

The strategy can use the global position of the West-Holland datacluster as a catalyst by making use of the present knowledge, economic, power, material and infrastructure resources that are already present in the region. By strengthening the existing powerhouses of the region, such as the Port of Rotterdam and the Greenport Westland, and making them sustainable and future-proof, the economic position on the global scale is secured.

This strategy promotes the shift from linear flows to circular cycles, creating a safe, equal, diverse, healthy, prosperous and participatory world.

What's next?
The next step is getting in touch with the stakeholders, organized and non-organized. Collaborations, taskforces and alliances will lead to a network governance. The exact sites where the interventions will take place need more specification. To prevent unexpected delays and setbacks to happen, feasibility tests, such as site investigations and land ownership can already be studied for these locations.

When policy-makers work hand-in-hand with global and European institutions, planners, designers, developers, investors, educational institutions, companies, transportation companies, constructors, residents and consider the future generation, a circular Province is achievable in 2050.



Vision
Author

14
REFLECTION

- Group Reflection
- Personal Reflection

GROUP REFLECTION

We would like to start our group reflection with an analogy of our studio experiences;

"Q3 was like rafting down a turbulent river. We encountered a waterfall of inspiration and ideas that led to the choosing of our specific topic: the implementation of datascapes in the province of South Holland. But later on we had to deal with turbulent circumstances, and in figurative speach this pushed and pulled our boat from left to right. A clear division of tasks, based on our characters and personal interests, good communication and productive teamwork, kept us going forward in the right direction. We, the team members, complement each other. Everyone's strengths are used to the fullest potential and trust is based on collective positive results from the past weeks. We are focussed on our own boat, and we have set our own coarse. The environment that was created by our teachers allowed us to transcend the planned route of this studio, and lead us to new and interesting places. In the end, a small and calm lake lies ahead, namely our finished proposal. This is a place where we as teammebers can look over our shoulders to a turbulent, but super interesting boat trip!"

At the start of our project we stated the following; Our economy and technological innovations have always shaped the Dutch landscape and its society. The evolution of the Internet has led to a new economy, based on digital information and communication. So the question we asked ourselves is; how do we get from a Datasphere to a Datascape?.
Nowadays our lives and the internet are completly intertwined, but how connected are we really? Can we make this resource depleting industry circular? Or is it even possible to make our world circular through the internet? This strategic report explores how a connected and resilient datascape in South Holland can be created and or developed while preserving the provinces global poistion and increasing its local value.

Cerating a circular province posed to be a bigger challenge than we had anticipated. By seeking help form our studio and methodology teachers we were able to create a research framework that is focussed on the development of a circular South Holland through the implementation of the so-called West Holland Data cluster. We used a variety of research methods to gain more knowledge about this unusual data topic. For example, we did site visits where took pictures of data centers in an effort to capture their identities. We also looked at the acitvity surrounding these spatial elements throughout different times of the day. These site visits made our responsibilities as designers and urbanists very clear. Even the smallest spatial invention can have a big imapct on the local envrironment and it is up to us to uphold fair and just ethical standards.

Our 'Datsphere to Datascape' proposal is characterized by six values. Safety of the data network is established via trust, reliability, resilience & flexibility. Justice of the sector's product is created via accessibility and ownership of data and the network itself. A greater diversity of stakeholders and [economic] environements minimizes monopolies. By making efficient use of (energy and material) resources, greater health of people and planet is established. Prosperity within our society will increase through the diverse employment opportunities that the expanding data sector will provide. Participation of all stakeholders is realized through the activation of users and the creation of shared responsibilities.

For the strategic and integrated development of the digital economy into the (urban) fabric of South Holland we propose data hubs as a platform for awareness, participation and knowledge exchange. These platforms will either function as a creator or a transformer of the local environment, while preserving the global position of the region. The development of these datascapes is circular, (energy-) efficient and creates value throughout different scales. These interventions will form the base of a sustainable and resilient circular economy in the Province. In this strategy, the flows of construction materials, energy, and data are optimized from linear flows to circular cycles.

Our integrated design will create a platform that strengthens local qualities while promoting the regions global position. In conclusion, we want to create an effective and resonating solution for the future.

PERSONAL REFLECTION

4295153 || Jurriënne Heijnen

1) What is the relationship between research and design in your group project?

Research and Design process
The development of our strategy was not a linear process of a research leading to design, it was a constant back and forth between the two. You could almost say it was circular in a sense. Shaped by our personal interests, theory and the assignment of the course we gravitated towards the topic of data. Focusing our research on this topic immediately led to some relevant design challenges such as the high, inefficient energy demand, lack of circularity and lack of local value. Following our personal interest and the discourse on the topic we struggled for a little while to stay within the boundaries of the assignment that guided us to focus on one particular flow. I think it is fair to say that in this way, it was a constant back and forth between research, design and the assignments of the course. Conclusions of the research, sometimes together with the assignment, would lead to design challenges. Design proposals would lead to new questions or subjects to do research on and so on.

Research by Design
Besides research of literature, site visits or GIS analysis, we also researched by design. An example of research by design from our report is the vision. Through this design tool, a desirable future is proposed. By discussing this design amongst ourselves or with our teachers and classmates, missing links and new research topics came forward. The passports are also a good example of this, they explore possible synergies in and externalities that are created when applying the strategy we propose.

Role of the Designer
Even though all of our group members appeared to be strategic planners as described by Sehested [2010], we all have a different way of researching and designing. Nevertheless, in general we had the same objectives, a strategy that will benefit all. We also shared ideas about what our role should be as designers, appealing to other city makers to formulate and set sustainable goals. We all tended to lean a bit more to either sides of the spectrum of research versus design, this created a very good environment to have visionary thoughts based upon theory.

Implications of Design on Research
Research and design are closely connected in our group project. In researching the topic of the data sector, it became clear that it is an industry that is developing and expanding at a fast pace and relates to many different relevant topics such as sustainability, safety and accessibility. With our design we aimed to shed a light on the industry in an integrated way and with this urge policy makers and individual to set the same goals. Adding to the existing body of knowledge by proving the urgency of intervening in the development of this sector in the province of South Holland.

Source:

Sehested, K. [2010]. Urban Planners as Network Managers and Metagovernors, Planning Theory & Practice 10(2), 245-263. http://dx.doi.org/10.1080/14649350902884516org/10.1080/14649350902884516

4348125 || Karlou Westerbeek

2) What is the role of a vision in the planning and design proposal of your group project and how has it influenced your development strategy?

Development strategies
A development strategy consists of goals, a vision, design proposals and strategic actions. It focuses on outcomes (Balz, 2020). In order to focus on outcomes, the desired final outcome of the strategy should be clear. This can be portrayed through a future vision, an essential part of a development strategy. A vision presents the desired future outcome and gives clear action-oriented directions. The action-oriented directions are aimed at the socio-technical transitions needed to establish the future outcome.

Our future vision
The future outcome that is presented in our group project, from Datasphere to Datascape, relates to a circular, sustainable and participatory world. The vision elaborates on the main goal of the Province, by describing sub-goals related to the specific topic and sector. In our project, the final outcome is a circular Province of South Holland, driven by the development of the digital economy and data clusters. The important global economic position of the region is strengthened, meanwhile on the local scale economic, social and environmental value are improved. Concepts of the circular economy, energy transition and a sustainable society are represented in the final outcome, but also during the process.

The vision has a descriptive and spatial component. The description of the vision consists of the statement about the world that will be created with this strategy. It also connects to the principles and the values that will characterize this world. The spatial component adds to the descriptive part by explaining what the possibilities for strategic interventions are. This spatial translation of the vision includes regional interventions that will shape the environment in which local implementation can take place. Together, the regional and local interventions will guide the socio-technical transitions that are needed to reach the future vision.

Other influences of the vision on the strategy
Emphasizing values
Our project vision emphasizes the importance of the balance between economic, environmental and social sustainability. In our perspective, this will not just be an important characteristic of the desired outcome, so we made it an important part of the development strategy. Next to the importance of this balance, our project vision involves certain values that will shape and characterize the new world. It is thus important that these will not only be represented in the project, but also in the process and decision-making.

Enthusing stakeholders
Strategies can be used to convince stakeholders to move in a certain direction. To enthuse stakeholders to participate in the development, a clear future vision supported by appealing images and clear actions can be used.

A reflection tool
The vision is also used in our report to reflect upon the strategic interventions that are proposed as part of the development strategy.

In conclusion, the vision thus frames the desired future outcome of our strategy. It emphasizes the importance of the values during the process and for the end result. Lastly, it is used to enthuse stakeholders and move them in a certain direction.

A planner's perspective
Considering myself as a strategic planner (Sehested, 2010), convincing policy-makers of development strategies is an action that I find very important. Scenariobuilding and visionmaking can guide decision-making and actions. By collaborating with other involved parties, such as investors, residents and governments on different scales, an integrative and feasible strategy can be constructed.

Source:

Balz, V. (2020). From vision to strategy [lecture slides]. Retrieved from https://brightspace.tudelft.nl/d2l/le/content/192733/viewContent/1633026/View

Sehested, K. (2010). Urban Planners as Network Managers and Metagovernors, Planning Theory & Practice 10(2), 245-263. http://dx.doi.org/10.1080/14649350902884516org/10.1080/14649350902884516

PERSONAL REFLECTION

4490983 || Kelvin Saunders

1) What is the relationship between research and design in your group project?

The Circular Economy is receiving a lot attention and interest, even on a global level. It is seen as a way to overcome problems related to societies outdated production and consumption habits. Metropolitan areas often are seen as critical success factors when transitioning towards a Circular Economy (Leer, Timmeren, & Wandl, 2018). So, it is necessary for designers and urbanists to find more integrative methods of development that lead to cohesive urban spatial outcomes of this Circular Economy model.

From the start of this project my group decided to focus on the dutch Data sector. Our initial research into the Circular Economy provided us with articles that talked about the extension of the dutch data sector from the Metropolitan Region of Amsterdam towards the province of South Holland. We learned that our economy and technological innovations have always shaped the Dutch landscape and society. The evolution of the Internet and data sector has led to a new economy, based on digital information and communication.

As we started with our research into the data sector and all the elements that it entails, it became quite clear that we had to deal with a very complex system. On top of that, we struggled to create a clear relationship between this data development and the three suggested circular cycles; [Plastics, Food, and Building Material]. With help from our studio and methodology teachers we created a research framework that is focussed on the development of a circular South Holland through the implementation of the so-called West Holland Data cluster. We used a variety of research methods to gain more knowledge about this unusual data topic. We took pictures of data center identities, we determined activity levels during different times of the day, and we looked at landscape transitions. Furthermore, we also contacted specialists from the data sector and conducted interviews that focussed on the circularity of our current data use and the sustainability of our overall data network.

By doing research through design our strategic development plan started to narrow down on the vast material flows that are used to the develop and maintain data centers and their network. On average, devices for data storage are only used for five years because new and more efficient ways of storing our data are developed at a rapid pace. This fast development is facilitated by the massive exploitation of construction materials, energy, and data flows. Our 'Datasphere to Datascape' proposal focuses on the phased development of the West Holland Data Cluster in terms of a Circular Economy. The spatial implications of our proposal are vast and thus we had to create a complex set of guidelines, as well as a detailed phasing that connects stakeholders and create environments for active participation.

In the final methodology "planning game" exercise I could really identity myself with the character of a strategic planner. Someone with the objective to develop strategies that will benefit all, but is also aware that elected politicians are the legitimate representatives of the people and do the actual decision making. This is why creating a clear story with engaging visuals and appealing scenarios is key to inspire these government officials.

To make a long story short, in this final week our third quarter education I can can truly say that designers and urbanist have a really big impact on our daily life and its their ethical responsibility to create clear and engaging designs that envision a world that is good for all.

Source:

Leer, J. V. D., Timmeren, A. V., & Wandl, A. (2018). Social-Ecological-Technical systems in
urban planning for a circular economy: an opportunity for horizontal integration. Architectural Science Review, 61(5), 298–304. doi: 10.1080/00038628.2018.150559810.1080/00038628.2018.1505598

5001595 || Sorawit Pattarasumunt

2) What is the role of a vision in the planning and design proposal of your group project and how has it influenced your development strategy?

Nowadays, the internet has become a part of our lives. The data center is one of the physical elements in the network that my group chose as a catalyst to create a circular economy and spatial justice in the Province of South Holland. Although integrating this topic with the thematic focuses was challenging, but I am appreciated that having it as the backbone could create a strong and clear narrative through the process. Moreover, the knowledge and methodology derived from studios and lectures helped me and my group to conduct the project and comprehend the significance of each step.

Before the strategies are conducted, the spatial vision has to be proposed. Therefore, vision plays a vital role as a structure to guide spatial planning. It poses the direction of which way South Holland will be developed. In the planning process, we always have to refer back to the vision to ensure that we are going towards the goals. The specific subgoals of developing the datascapes that are circular, energy-efficient, and creating values are the core, helping us steering the planning process. Besides, it is a contributor to the group debate, which does not mean only the discussion created by the vision itself, but also the debate during the process of making it. The exemplary situation also occurs in real practice, where stakeholders are encouraged to articulate their interests freely (Healey, 1992). Despite the current difficult circumstance, surprisingly, we could still remotely collaborate and manage to complete the products.

Regarding the influence of the vision on our development strategy, it has an impact on the planning and categorization of data clusters. After the existing regional contexts were analyzed, a reinterpretation of the territories and redefinition of three zones were conducted to conclude the problem statement and formulate the vision. Then the areas were continuously reinterpret based on different functions, which eventually led to the proposal of 17 data clusters and six data center typologies. Moreover, the vision can persuade other actors to the understanding of how data clusters will be catalysts of transforming linearity into circularity. The 3-steps phasing was proposed where data center typologies are positioned in different stages. The X-curve model (Lodder et al., 2017) was incorporated to enable a better comprehension of enhancing the transition from a linear towards a circular economy. Lastly, the vision determines the intervention scales and how each intervention connects to enhance the circular system. The 'dancing' through scales is needed in regional planning and developing strategies to optimize the flows. This involves a wide range of stakeholders from the international scale to the local level, particularly the European Union and citizens, respectively. The stakeholder analysis method learned from the SDS lecture helped us to position them on which scale they will take part in and allow them to use their full potential in the development strategy.

In conclusion, it can be seen that vision plays many roles in spatial planning and has great influences on development strategies. What we, as the planners, can contribute to the desired future is proposing the feasible vision and engaging other actors in steering the path of implementation to achieve the goals.

Source:

Healey, P. (1992). Planning through debate: the communicative turn in planning theory. Town Planning Review, 63(2), 143. https://doi.org/10.3828/tpr.63.2.422x602303814821

Lodder, M., Roorda, C., Loorbach, D. en C. Spork (2017) Staat van transitie: patronen van opbouw en afbraak in vijf domeinen. Erasmus Universiteit: DRIFT

15
REFERENCES AND APPENDIX

REFERENCES

Adams, D., & Tiesdell, S. (2013). *Shaping places*. Abingdon, United Kingdom: Routledge.

Ahvar, E., Orgerie, A.-C., & Lebre, A. (2019). Estimating energy consumption of cloud, Fog and edge computing Infrastructures. *IEEE Transactions on Sustainable Computing,* 1–1. https://doi.org/10.1109/tsusc.2019.2905900

Alkemade, F. (2016). Het aantal banen dat binnen 45 minuten kan worden bereikt [Image]. Retrieved from https://www.dearchitect.nl/architectuur/blog/2016/11/van-randstad-naar-middenstad-101107179

Allecijfers. (2020, April 6). Duidelijke informatie in cijfers en grafieken (update 2020!). Retrieved from https://allecijfers.nl/

Alles over Duitsland. (2020, March 23). Tanken langs de snelweg [Photograph]. Retrieved from https://www.allesoverduitsland.nl/info/benzineprijs-duitsland/t

Andrae, A., & Edler, T. (2015). On Global Electricity Usage of Communication Technology: Trends to 2030. Challenges, 6(1), 117–157. https://doi.org/10.3390/challe6010117

ANP. (2019). Het prins clausplein bij Den Haag [Photograph]. Retrieved from https://www.omroepwest.nl/nieuws/3945170/Rijkswaterstaat-stelt-werkzaamheden-Prins-Clausplein-uit-vawege-slechte-weersverwachting

Avnskjold, R. (2012, May 14). Geschiedenis van de auto. Retrieved from https://historianet.nl/techniek/machines/geschiedenis-van-de-auto

Bakker, H. (2019, May 14). Datacenters verbruiken drie keer zoveel stroom als de NS. Retrieved from https://www.nrc.nl/nieuws/2019/05/14/datacenters-verbruiken-drie-keer-zoveel-stroom-als-de-ns-a3960091

Bergevoet, T. van Tuijl, M. (2016) *The flexible city: Sustainable solutions for a Europe in transition*. Rotterdam: nai010 Publishers

Buro Sant en Co. (2018). Zoetermeer [Photograph]. Retrieved from https://www.santenco.nl/nl/nieuws/buro-sant-en-co-geselecteerd-voor-upgrade-stadshart-zoetermeer/

Cass, N., Shove, E. & Urry, J. (2005). Social Exclusion, Mobility and Access. *The Sociological Review,* 53(3). https://doi.org/10.1111/j.1467-954X.2005.00565.x

Catarino, A. I., Macchia, V., Sanderson, W. G., Thompson, R. C., & Henry, T. B. (2018). Low levels of microplastics (MP) in wild mussels indicate that MP ingestion by humans is minimal compared to exposure via household fibres fallout during a meal. *Environmental Pollution*, 237, 675–684. https://doi.org/10.1016/j.envpol.2018.02.069

CBS (2019) Energieverbruik 2018. Climate care organization (2019) Carbon footprint of the internet

Concept Management. (2016). COMPUTER RECYCLING GUIDE – WHY CONCEPT MANAGEMENT?. Retrieved from https://www.conceptmanagement.co.uk/services/disposal/computer/guide

Constanza, R. & Patten, B. (1995). Defining and predicting sustainability. *Ecological Economics*, 15(3), 193-196. https://doi.org/10.1016/0921-8009(95)00048-8

DELL. (2002, November). *28 Facts you should know about Dell* [Report]. Retrieved from https://www.dell.com/downloads/global/solutions/28facts.pdf

De Roode, M. (2015, June 7). De industriële revolutie: Werd het leven beter?. Retrieved from https://www.scientias.nl/de-industriele-revolutie-werd-het-leven-beter/

Den Exter, M. (2013). Hoe werd in Nederland van water land gemaakt? Retrieved from https://npofocus.nl/artikel/7612/hoe-werd-in-nederland-van-water-land-gemaakt

Dresner, S. (2008). *The Principles of Sustainability.* London, United Kingdom: Earthscan.

Dutch Innovation Park. (n.d.). The Logo the Dutch Innovation Park [Illustration]. Retrieved from https://dutchinnovationpark.com/smaakmakers-dutch-innovation-park/

Dutch water dreams. (n.d.). [Photograph]. Retrieved from https://www.tripgems.com/netherlands/zoetermeer/dutch-water-dreams/reviews

Ellen MacArthur Foundation. (2020). Concept: what is a circular economy?. Retrieved from https://www.ellenmacarthurfoundation.org/circular-economy/concept

European Commission. (2019, May 21). Circular Economy: Commission welcomes Council final adoption of new rules on single-use plastics to reduce marine plastic litter. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/IP_19_2631

REFERENCES

European Commission. (2020, March 5). Natura 2000 - Environment - European commission.
Retrieved April 6, 2020, from https://ec.europa.eu/environment/nature/natura2000/index_en.htm

European Commission. (2020). The Urban Agenda for the EU.
Retrieved from https://ec.europa.eu/regional_policy/en/policy/themes/urban-development/agenda/

Ferronato, P., Ruecker, S., & Ruecker. (2018). Smart Citizenship: designing the interaction between citizens and smart cities.
DRS2018: Catalyst. https://doi.org/10.21606/drs.2018.480

Fietsroutenetwerk. (2020). Een fietsroute langs Unesco Werelderfgoed Kinderdijk [Photograph].
Retrieved from https://fietsroutenetwerk.nl/fietsroutes/39885766/een-fietsroute-langs-unesco-werelderfgoed-kinderdijk

Gdindex. (2018). Duurzaamheid.
Retrieved April 4, 2020, from https://gdi.databank.nl/dashboard/duurzaamheid

Gemeente Zoetermeer. (2020, February 18). Zoetermeer in Cijfers.
Retrieved from https://zoetermeer.incijfers.nl/

Google. (n.d.). [Google Maps location of Molenaarsgraaf, The Netherlands].
Retrieved March 1, 2020, from https://www.google.nl/maps/place/Molenaarsgraaf/@51.8665513,4.8101204,5929m/data=!3m2!1e3!4b1!4m5!3m4!1s0x47c681a4f17910cf:0x5e024fc8bdb0b8b!8m2!3d51.8776567!4d4.8288345

Google. (n.d.). [Google Maps location of Zuidzijde, The Netherlands].
Retrieved March 1, 2020, from https://www.google.nl/maps/place/3284+LB+Zuidzijde/@51.7801335,4.3568616,2970m/data=!3m2!1e3!4b1!4m5!3m4!1s0x47c437f06e54d70b:0x2a92613ec0464d3b!8m2!3d51.7801346!4d4.3656063

Google. (n.d.). [Google Maps location of Binckhorst, The Netherlands].
Retrieved March 1, 2020, from https://www.google.nl/maps/place/Binckhorst,+2516+BA+Den+Haag/@52.0687567,4.3320468,2951m/data=!3m1!1e3!4m5!3m4!1s0x47c5b701ef70705b:0x2b4038f0f640440e!8m2!3d52.0695139!4d4.3368047

Hague University. (2020). Zoetermeer campus - The Hague University.
Retrieved from https://www.thehagueuniversity.com/about-thuas/our-campuses/zoetermeer-campus

Hartog, J. (2015). 'Geen sluitingen raffinaderijen in Rotterdam' [Photograph].
Retrieved from https://www.europoortkringen.nl/geen-sluitingen-raffinaderijen-in-rotterdam/

Havenbedrijf Rotterdam. (2020). Missie, visie en strategie: Europese haven van wereldklasse.
Retrieved from https://www.portofrotterdam.com/nl/havenbedrijf/over-het-havenbedrijf/organisatie/missie-visie-en-strategie

Henderiks Klimaattechniek. (n.d.). PI Haaglanden [Photograph].
Retrieved from http://henderiksklimaattechniek.nl/referenties/

Het Kontakt. (2016). Polders Groene Hart onder grote druk [Photograph].
Retrieved from https://www.hetkontakt.nl/regio/krimpenerwaard/54781/polders-groene-hart-onder-grote-druk#

Heurkens, E. (2012). *Private Sector-led Urban Development* [Thesis].
Retrieved from https://books.bk.tudelft.nl/index.php/press/catalog/view/22/27/35-1

Hollandse Hoogte. (2018). Den Haag bouwt smart city ambitie verder uit [Photograph].
Retrieved from https://www.cbs.nl/nl-nl/corporate/2018/44/den-haag-bouwt-smart-city-ambitie-verder-uit

Huis van de Nederlandse Provincies. (2020). Regio Randstad.
Retrieved from https://www.nl-prov.eu/regios/regio-randstad/

IDC. (2020). Maximize your competitive advantage with IDC's leading research.
Retrieved from https://www.idc.com/

Indebuurt. (n.d.). Abandoned Office Building [Photograph].
Retrieved from https://indebuurt.nl/zoetermeer/wp-content/uploads/2019/10/kantoor-3-e1572623378995.jpg

Lee, H., Kalzor, R., Goela, N., Bolot, J. & Church, G. (2019). Terminator-free template-independent enzymatic DNA synthesis for digital information storage. *Nature Communications*,10(2383). https://doi.org/10.1038/s41467-019-10258-1

Lee, S. (2019). DNA data storage is closer than you think.
Retrieved from https://www.scientificamerican.com/article/dna-data-storage-is-closer-than-you-think/

Lobster, M. (2010, February 21). Den Haag HS, the oldest train station in The Hague, The Netherlands. [Photograph].
Retrieved from https://www.flickr.com/photos/magneticlobster/4379378608/in/photostream/

REFERENCES

Kemp, S. (2018). 2018 digital yearbook. Hootsuite.

Kurzweil, R. 2005. *The singularity is near: When humans transcend biology.* New York: Viking Press.

Kwan, N. (2019, February 9). The hidden dangers in algorithmic decision making.
Retrieved from https://towardsdatascience.com/the-hidden-dangers-in-algorithmic-decision-making-27722d716a49

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. (2019). The AIVD's role in national security.
Retrieved from https://english.aivd.nl/about-aivd/

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. (2015). Logo of the Dutch General Intelligence and Security Service AIVD [Illustration]. Retrieved from https://www.aivd.nl/actueel/nieuws/2015/11/13/kabinet-wil-aivd-en-mivd-samen-op-frederikkazerne

Roemers, G., Exter, van P., Kotvis, X. & Hoeks, J. (2019). CIRCULAIRE INDICATOREN: Een verkenning voor de provincie Zuid-Holland.
Retrieved from https://www.metabolic.nl/publications/circulaire-indicatoren-een-verkenning-voor-de-provincie-zuid-holland/

Miller, R. (2019). In Loudoun, Neighbors want better looking data centers.
Retrieved from https://datacenterfrontier.com/in-loudoun-neighbors-want-better-looking-data-centers/

Most , van der H. (2009). Towards sustainable development of deltas, estuaries and coastal zones: Description of eight selected deltas; trends and responses. Retrieved from https://edepot.wur.nl/322988

Nationaal Programma RES. (2020). Nationaal Programma Regionale Energiestrategie.
Retrieved from https://www.regionale-energiestrategie.nl/default.aspx

Niiler, E. (2019, January 25). How the second industrial revolution changed Americans' lives: The rapid advancement of mass production and transportation made life a lot faster [Photograph]. Retrieved from https://www.history.com/news/second-industrial-revolution-advances

Old FME Building. (n.d.). [Photograph].
Retrieved from https://i.pinimg.com/originals/71/4a/a1/714aa1b379b81c864b23676990b02ebc.jpg

Persbureau Tammeling B.V. (2019). Het mooiste dorp van Nederland ligt in Groningen! [Photograph].
Retrieved from https://www.gic.nl/nieuws/het-mooiste-dorp-van-nederland-ligt-in-groningen

Planbureau voor de Leefomgeving. (2020). Waarom een circulaire economie?.
Retrieved from https://themasites.pbl.nl/circulaire-economie/

Professional Academy. (2020). Marketing theories – Swot analysis.
Retrieved from https://www.professionalacademy.com/blogs-and-advice/marketing-theories–swot-analysis

Programmabureau Groene Hart. (2018). Hoodlijnen opbrengst gebiedsdialoog novi-groen hart [report].
Retrieved from https://omgevingswet.provincie-utrecht.nl/publish/pages/331250/novi-perspectiefgebied_groene_hart.pdf

Provincie South Holland. (2017). Anders verwarmen: Naar een duurzame warmtevoorziening [report].
Retrieved from https://www.South Holland.nl/onderwerpen/energie/.

Provincie South Holland. (2020). Bio-energie.
Retrieved from https://www.South Holland.nl/onderwerpen/energie/productie-duurzame/bio-energie/

Provincie South Holland. (2020). Circulair South Holland.
Retrieved from https://www.South Holland.nl/onderwerpen/economie/circulaire-economie/

Provincie South Holland. (2020). Delta-energie.
Retrieved from https://www.South Holland.nl/onderwerpen/energie/productie-duurzame/delta-energie/

Provincie South Holland. (2020). Energie uit bodem en ondergrond.
Retrieved from https://www.South Holland.nl/onderwerpen/energie/productie-duurzame/energie-bodem/

Provincie South Holland. (2020). Innovatie en energy.
Retrieved from https://www.South Holland.nl/onderwerpen/energie/innovatie-energie/.

Provincie South Holland. (2020, February 28). LISA_Data [Dataset].
Retrieved from https://brightspace.tudelft.nl/d2l/le/content/192733/Home

Provincie South Holland. (2020). Warmte - warmterotonde.
Retrieved from https://www.South Holland.nl/onderwerpen/energie/productie-duurzame/warmte-warmterotonde/

REFERENCES

Provincie South Holland. (2016). Watt Anders: Energieagenda 2016-2020-2050 [report].
Retrieved from https://www.South Holland.nl/onderwerpen/energie/energieagenda/

Provincie South Holland. (2020). Windenergie.
Retrieved from https://www.South Holland.nl/onderwerpen/energie/windenergie/

Rijksdienst voor ondernemend Nederland (2016) MJA-Sectorrapport 2015 Rubber- en kunststofindustrie

Rijksoverheid (2018) 5 Agendas for the circular Dutch economy by 2050, regarding biomass & food, construction, consumption, plastics and the makersindustry

Rijksoverheid. (2020). Windparken in ontwikkeling.
Retrieved from https://www.noordzeeloket.nl/functies-gebruik/windenergie-zee/in-ontwikkeling-op/

Rijkswaterstaat. (n.d.). Haringvlietsluizen [Photograph].
Retrieved from https://www.rijkswaterstaat.nl/water/waterbeheer/bescherming-tegen-het-water/waterkeringen/deltawerken/haringvlietsluizen.aspx

Rijkswaterstaat. (2020, March 24). Deltawerk Haringvlietsluizen.
Retrieved from https://www.rijkswaterstaat.nl/water/waterbeheer/bescherming-tegen-het-water/waterkeringen/deltawerken/haringvlietsluizen.aspx

Rocco, R. (2020, March 5). THE GOVERNANCE OF SUSTAINABILITY TRANSITIONS [lecture slides].
Retrieved from https://brightspace.tudelft.nl/d2l/le/content/192735/Home

Ruz, C. (2011, October 31). The six natural resources most drained by our 7 billion people.
Retrieved from https://www.theguardian.com/environment/blog/2011/oct/31/six-natural-resources-population

Sample, I. (2018, October 22). What is the internet? 13 key questions answered.
Retrieved from https://www.theguardian.com/technology/2018/oct/22/what-is-the-internet-13-key-questions-answered

Schilthuizen, C. (2018, February 23). De Drechtsteden moeten meer geld en macht krijgen [Photograph].
Retrieved from https://www.ad.nl/dordrecht/even-slikken-na-rapport-hoe-nu-verder-in-de-drechtsteden~acb4ef8d/

Sijmons, D., Hugtenburg, J., van Hoorn, A. & Feddes, F. (2014). *Landscape and energy.* Rotterdam, Netherlands: nai010.

SMART DC. (2020). Smart DC Rotterdam.
Retrieved from https://www.smartdc.net/nl/rotterdam/

Smit, E., Hoeven, van der J. & Giaretta, D. (2011). Avoiding a Digital Dark Age for data: why publishers should care about digital preservation. *Learned Publishing*, 24(1), 35-49. https://doi.org/10.1087/20110107

Sposato, P., Preka, R., Cappellaro, F. & Cutaia, L. (2017). Sharing economy and circular economy. How technology and collaborative consumption innovations boost closing the loop strategies. *Environmental engineering and management journal*, 16(8):1797-1806. https://doi.10.30638/eemj.2017.196

Stedelijke transformatie. (2020). Verdichten van Leiden tot Dordt.
Retrieved from https://www.stedelijketransformatie.nl/actueel/stedelijke-transformatie-nieuws/verdichten-van-leiden-tot-dordt

Studio Hartzema. (2019, November 26). Ontwikkelkader voor Plaspoelpolder West (noord) Rijswijk [Image].
Retrieved from https://www.studiohartzema.com/ontwikkelkader-voor-plaspoelder-west-noord/

Sung, K. (2015). A Review on Upcycling: Current Body of Literature, Knowledge Gaps and a Way Forward [conference paper].
Venice Italy Apr 13-14, 2015, 17 (4) Part I. Retrieved from https://www.researchgate.net/publication/299559229_A_Review_on_Upcycling_Current_Body_of_Literature_Knowledge_Gaps_and_a_Way_Forward

Telegeography (2020). Internet exchange points [Illustration]. Retreived from https://www.internetexchangemap.com/

Terracycle. (2020). END-OF-LIFE SCENARIOS FOR PRODUCTS & MATERIALS.
Retrieved from https://www.terracycle.com/en-US/pages/definitions

United Nations (2015) Sustainable Development Goals for 2030

U.S. Chamber of Commerce Foundation. (2014). *The Future of Data-Driven Innovation* [report].
Retrieved from https://www.uschamberfoundation.org/sites/default/files/Data%20Report%20Final%2010.23.pdf

Vergouwe, R. (2016). *The national flood risk analysis for the Netherlands.*
Retrieved from https://www.helpdeskwater.nl/publish/pages/131663/vnk-rapport-eng-lr.pdf

Vidal, J. (2017, December 11). 'Tsunami of data' could consume one fifth of global electricity by 2025.
Retrieved from https://www.theguardian.com/environment/2017/dec/11/tsunami-of-data-could-consume-fifth-global-electricity-by-2025

Wijnakker, R., Frijters, E., Bui, D. & Tona, G. (2018). Smart. Multi. Commodity.Grid_.
Retrieved from https://www.South Holland.nl/onderwerpen/energie/.

Wilson, J. (2017, September 26). Four Types of Stakeholder Power.
Retrieved from https://bizfluent.com/info-12105818-four-types-stakeholder-power.html

Weerwind, F. & Steenbakkers, S. (2019, March). Ruimtelijke Strategie Datacenters Routekaart 2030 voor de groei van datacenters in Nederland [report]. Retrieved from https://www.rijksoverheid.nl/documenten/rapporten/2019/03/15/ruimtelijke-strategie-datacenters

APPENDIX 1

Phasing Table 1/3

Timeline	Project	Stakeholders - policymakers	Stakeholders - operational	Category
2020-2025	Development Zoetermeer data cluster [campus cluster along highway]	Municipality of Zoetermeer Ministry of Infrastructure & Water Management	Rijkswaterstaat AIVD Haagse Hogeschool Tech companies Uniball-Rodamco-Westfield Stedin	Data clusters
2020-...	Establishment Taskforce "Data Driven Delta"	Ministry of Economy & Climate Ministry of Infrastructure & Water Management European Union European Commission Province of South-Holland Province of Zeeland Six municipalities in the region Waterboard Hollandse Delta	Rijkswaterstaat TNO TU Delft Deltares Stedin	Policy
2020-2035	Taskforce "Mobility Transition 2030"	Ministry of Infrastructure & Water Management	Rijkswaterstaat Kennisinstituut voor mobiliteitsbeleid ANWB	Policy
2020-2029	Densification projects Rotterdam city center	Municipality of Rotterdam	TNO Doepel Strijkers (Architect) Sander Lap (Landscape & Urbanists) Drift (Researcher) Real estate developers Architects Landscape architects Construction companies Residents	Built Environment
2020-2023	Start first construction phase of North Sea windturbine park	Ministry of Economy & Climate Ministry of Internal Affairs Ministry of Agriculture, Nature & Food Quality European Union European Commission	Fishermen unions Renewable energy production companies Construction companies Maintenance companies	Renewable energy
2020-2032	Densification in the Binckhorst, The Hague	Municipality of the Hague	PosadMaxwan (Designer) Real estate developers Architects Landscape architects Construction companies Businesses Residents	Built Environment
2021-2030	Start construction mobility hub The Hague [CID/Binckhorst]	Ministry of Infrastructure & Water Management Municipality of the Hague	HTM Prorail NS PosadMaxwan (Designer) Architects Construction companies Businesses Residents	Mobility
2021-2025	Development of the Delft data cluster [campus cluster, Technopolis]	Municipality of Delft	TU Delft Tech companies on Technopolis Stedin	Data clusters
2021-2027	Establishment Taskforce "Madaster"	Ministry of Economy & Climate Municipality of Dordrecht, Papendrecht and Zwijndrecht	Construction companies Tech companies Stedin	Policy
2022-2024	Construction solar panels along A4, A12, A20	Ministry of Economy & Climate Ministry of Infrastructure & Water Management Province of South-Holland	Rijkswaterstaat Renewable energy production companies Construction companies Maintenance companies	Renewable energy
2022-2028	Start densification in BioScience Park, Leiden	Municipality of Leiden University of Leiden	Companies on BioScience Park Real estate developers Architects Landscape architects Construction companies Residents	Built Environment
2022-2031	Start densification in Schieoevers-Noord, Delft	Municipality of Delft	Marco Broekman (Urbanist, Architects) Businesses in the former Kabeldistrict building Real estate developers Architects Landscape architects Construction companies Startups Companies Residents	Built Environment
2022-2030	Start negotiations on the future of the Port of Rotterdam	Municipality of Rotterdam Ministry of Economy & Climate Ministry of Internal Affairs Havenbedrijf Rotterdam	MRDH	Policy
2022-2026	Development Rotterdam city center data cluster [urban CBD cluster, tech start-ups]	Municipality of Rotterdam	MRDH Tech companies Real estate developers Stedin	Data clusters
2023-...	Establishment Taskforce "Westland"	Ministry of Agriculture, Nature and Food quality Municipality of the Westland	Westland Infra Farmers + land owners Data companies	Policy
2023-2027	Development of The Hague data cluster [urban CBD cluster, tech start-ups]	Municipality of The Hague	Tech companies Real estate developers Stedin	Data clusters
2023	Completion first phase windturbine parks North Sea	Ministry of Economy & Climate Ministry of Internal Affairs Ministry of Agriculture, Nature & Food Quality European Union European Commission	Fishermen unions Renewable energy production companies Construction companies Maintenance companies	Renewable energy
2023-2026	Start second phase windturbine parks North Sea	Ministry of Economy & Climate Ministry of Internal Affairs Ministry of Agriculture, Nature & Food Quality European Union European Commission	Fishermen unions Renewable energy production companies Construction companies Maintenance companies	Renewable energy
2023-2026	Development material hub Rotterdam - connecting production and recycling initiatives	Municipality of Rotterdam	Circular Rotterdam Circularity initiatives Material and construction companies	Material
2023	Alliances for the "Data Driven Delta" project with the Rührgebied	Ministry of Economy & Climate Ministry of Infrastructure & Water Management Province of South-Holland Province of Zeeland Six municipalities in the region German local and national politics Waterboard Hollandse Delta European Union European Commission	Rijkswaterstaat Companies of the Rührgebied TNO TU Delft Deltares Stedin	Policy

APPENDIX 1

Phasing Table 2/3

Timeline	Project	Stakeholders - policymakers	Stakeholders - operational	Category	
2024-2026	Construction solar panels along train tracks	Ministry of Economy & Climate Ministry of Infrastructure & Water Management Province of South-Holland	Rijkswaterstaat Prorail NS Renewable energy production companies Construction companies Maintenance companies	Renewable energy	
2024-2032	Densification projects Rijswijk [In den Boogaard]	Municipality of Rijswijk	Real estate developers Architects Landscape architects Construction companies Residents	Built Environment	
2024-2028	Adjustments highways in the region for the mobility transition	Ministry of Infrastructure & Water Management	Rijkswaterstaat Kennisinstituut voor mobiliteitsbeleid ANWB Construction companies	Mobility	
2024-2027	Development Katwijk data cluster [security cluster], development visitors center	Ministry of Foreign Affairs Ministry of Internal Affairs Municipality of Katwijk	Owners of the global cable* Stedin Construction companies Security companies	Data clusters	*BT, Verizon, Deutsche Telekom, Orange, Sprint, Telia Carrier, KPN, Telenor, Etisalat, OTEGLOBE, Singtel, Softbank Corp, Zayo Group, Portugal Telecom, Slovak Telekom, TDC Group, Telus, Tata Communications, Telefonica, AT&T, BICS, Elisa Corporation, Cyta, Rostelecom, CenturyLink
2025-2029	Extension data infrastructure towards Gorinchem, Hardinxveld & Schoonhoven	Municipality Krimpenerwaard Municipality of Hardinxveld-Giessendam Municipality of Gorinchem	Stedin Land owners Businesses Stichting Groene Hart Data companies	Data infrastructure	
2025-2029	Development mobility hub Leiden	Municipality of Leiden	NS Prorail Arriva Stedin	Mobility	
2025-2028	Development of Alphen aan den Rijn data cluster	Municipality Alphen aan den Rijn	Data companies Logistic center Alpherium	Data clusters	
2025-2032	Construction wind turbines throughout the Province	Ministry of Economy & Climate Ministry of Internal Affairs Ministry of Agriculture, Nature & Food Quality European Union European Commission Involved municipalities	Interest groups Renewable energy production companies Network operators Residents	Renewable energy	
2025-2035	Extension heat-round-about structures	Ministry of Economy & Climate Ministry of Internal Affairs Ministry of Agriculture, Nature & Food Quality Province of South-Holland Municipality of the Westland	Farmers & land owners DAGO (Dutch Association Geothermal Operators) EBN B.V. Eneco HVC Hydreco GeoMEC B.V.	Renewable energy	
2026-2029	Development Drechtsteden data cluster, connected to Madaster initiative [headquarter cluster]	Ministry of Economy & Climate Municipality of Dordrecht, Papendrecht and Zwijndrecht	Stedin Data companies	Data clusters	
2026-2029	Change of industry Drechtsteden, material hub connected to Madaster initiative	Ministry of Economy & Climate Municipality of Dordrecht, Papendrecht and Zwijndrecht	Metal processing companies Construction companies	Material	
2027-2030	Development material hub The Hague	Municipality Of The Hague	Construction companies Metal-processing companies Recycling and circular initiatives	Material	
2027-2032	Extension data infrastructure towards Numansdorp	Ministry of Infrastructure & Water Management Municipality Cromstrijen	Stedin Land owners Data companies	Data infrastructure	
2028-2032	Extension of Alpherium logistic center	Municipality Alphen aan den Rijn Havenbedrijf Rotterdam	Stedin Data companies Logistic center Alpherium Transport companies	Material	
2028-2031	Development Scheveningen data cluster [security cluster]	International court Municipality of The Hague	Tech companies Real estate developers Stedin Security companies	Data clusters	
2028-2037	Densification projects Dordrecht & Zwijndrecht	Municipality of Dordrecht & Zwijndrecht	Real estate developers Architects Landscape architects Construction companies Residents	Built Environment	
2028-2031	Development Gorinchem data cluster [community cluster]	Municipality of Gorinchem	Stedin Land owners Businesses Stichting Groene Hart Data companies	Data clusters	
2029-2031	Development material hub Leiden	Municipality of Leiden	Construction companies Metal-processing companies Recycling and circular initiatives	Material	
2029-2037	Renewal of glasshouses Westland > sustainable agriculture	Ministry of Agriculture, Nature and Food quality Municipality of the Westland	Westland Infra Farmers + land owners Construction companies Renewable energy production companies	Built Environment	
2029-2035	Construction geothermal installations Westland	Ministry of Economy & Climate Ministry of Internal Affairs Ministry of Agriculture, Nature & Food Quality Province of South-Holland Municipality of the Westland	Farmers & land owners DAGO (Dutch Association Geothermal Operators) EBN B.V. Eneco HVC Hydreco GeoMEC B.V.	Renewable energy	
2030	Start of the mobility transition, driven by information of a.o. the Zoetermeer data cluster	Ministry of Infrastructure & Water Management	Rijkswaterstaat Kennisinstituut voor mobiliteitsbeleid ANWB	Mobility	
2030	Completion second phase windturbine parks North Sea	Ministry of Economy & Climate Ministry of Internal Affairs Ministry of Agriculture, Nature & Food Quality European Union European Commission	Fishermen unions Renewable energy production companies Construction companies Maintenance companies	Renewable energy	
2030-2033	Development Numansdorp data cluster [systematic cluster]	Ministry of Infrastructure & Water Management Municipality Cromstrijen	Stedin Land owners Data companies Local businesses Residents	Data clusters	
2030-2035	Renewal Boskoop agricultural cluster towards self-sustaining region	Municipality Alphen aan den Rijn	Stedin Farmers + Land owners Data companies	Built Environment	
2030-2035	Development Boskoop data cluster [headquarter cluster]	Municipality Alphen aan den Rijn	Stedin Farmers + Land owners Data companies	Data clusters	
2031-2033	Development Hardinxveld data cluster [community cluster]	Municipality of Hardinxveld-Giessendam	Stedin Land owners Businesses Stichting Groene Hart Data companies	Data clusters	

APPENDIX 1

Phasina Table 3/3

Timeline	Project	Stakeholders - policymakers	Stakeholders - operational	Category
2031-2036	Development hydropowerplant in Katwijk	Ministry of Economy & Climate Hoogheemraadschap van Rijnland Province of South-Holland Municipality of Katwijk Municipality of Noordwijk	Deltares TU Delft TNO Energy Innovation Board	Renewable energy
2031-2038	Development Delta data cluster [systematic cluster]	Ministry of Economy & Climate Ministry of Infrastructure & Water Management Province of South-Holland Province of Zeeland Six municipalities in the region Waterboard Hollandse Delta European Union European Commission	Rijkswaterstaat TNO TU Delft Deltares Stedin Tourism sector	Data clusters
2032-2038	Development of the hydropowerplant in Stellendam	Ministry of Economy & Climate Waterboard Hollandse Delta Province of South-Holland Province of Zeeland Municipality of Stellendam	Deltares TU Delft TNO Energy Innovation Board	Renewable energy
2032-2045	Change of business for fossil-fuel-based industries in the Port of Rotterdam	Ministry of Economy & Climate Ministry of Internal Affairs Municipality of Rotterdam Havenbedrijf Rotterdam	MRDH Stedin Data companies Shell Renewable energy production companies Plastic recycling companies New sustainable business types	Built Environment
2033-2036	Development Schoonhoven data cluster	Municipality Krimpenerwaard	Stedin Land owners Businesses Stichting Groene Hart Data companies	Data clusters
2033-2045	Development Port of Rotterdam data cluster	Ministry of Economy & Climate Ministry of Internal Affairs Municipality of Rotterdam Havenbedrijf Rotterdam	MRDH Stedin Data companies Shell Renewable energy production companies Plastic recycling companies New sustainable business types	Data clusters
2035-2045	Development Westland data cluster [headquarter cluster]	Ministry of Agriculture, Nature and Food quality Municipality of the Westland	Westland Infra Farmers + land owners Data companies	Data clusters
2035-2040	Development of the hydropowerplant in the Brouwersdam	Ministry of Economy & Climate Rijkswaterstaat Province of Zeeland Province of South-Holland Municipality of Goeree-Overflakkee Municipality of Schouwen-Duiveland	Deltares TU Delft TNO Energy Innovation Board	Renewable energy

APPENDIX 2

Interview Michel Metselaar

On March 28, Jurriënne conducted a telephonic interview with Michel Metselaar, a data scientist, about Data Centers and specific about a project with Atos, in which he developed a Data Center in Zoetermeer. This is a summary of the conversation, based on the audio recording. Two notes:
The audio recording was of insufficient quality
The original language of the conversation was Dutch. The transcript is translated by Karlou.

What are the Atos Data center projects you have been involved in?
Client hardware: 300 servers converted to 33 new servers in a DC in Zoetermeer. Maintenance is more expensive than new servers

What was your role and what is your work area / expertise?
Project management.

How is material recycled within the sector?
Data that is stored on the servers is erased and the servers are upcycled.

How do these projects create [local] social value?
The data center in Zoetermeer is connected to the University of applied sciences, located in Zoetermeer. This education institution used the DC as a private cloud. The municipality of Zoetermeer paid the energy bill of the data center.

What new workflows are created by these projects?
On one hand, high-skilled labor that requires writing useful software, which is not very labor intensive, High-educated employees are needed for the software side, and low-educated employees for converting the hardware.

Ideas about the role of DC in the circular economy. What is an incentive for companies to "pull their data out of the fridge"? Companies such as general electric are already working on this: from production to products as a service. However, a lack of "computing power" (trained people and development of the technology) and experience / established projects: there is still much to develop. In addition, legislation on user privacy plays a major role. The current incentive for companies is creating economic value. Data does not lose value if you use/not use it, so it can remain for a long time.

Data centers have no distinction between storage, processing and colocation, now everything is in one. It is an interesting thought to separate them.

"IN AN IDEAL WORLD, EVERYONE HAS A DATA CENTER IN THEIR ATTIC"

In this case, for example, the energy is used most efficiently. Such a decentralized setup is ideal, but monitoring is of course difficult (terrorism, etc.).

American companies (Google, Microsoft, Amazon) almost have a monopoly and that is quite exciting, they are watching everywhere. There is no European counterpart.

Do you think I should speak to someone else who knows a lot about this?
P.... and R. .. have a lot of knowledge about data governance, they can tell you more about business operations. Take a look at Microsoft Middenmeer Data Center

APPENDIX 3

Interview Zuzanna Rosinska

On March 5, we have a meeting with Zuzanna graduation student. Her project is about creating sustainable data centers.
This is a summary of the conversation, based on our personal notes.

Local heat exchange
Data centers produce a lot of heat. 90% of the energy that enters the data center is changed into heat. The residual heat now disappears into the air most of the time. Data centers can function as an energy exchanger.

Locating data centers
Bringing the data centers to the countryside is not that efficient. Data centers bring a lot of money, because of taxes.
Showing/selling is an important aspect of the placement. Three elements are important: the presence of a grid, knowledge, an energy plant (preferably green energy). Having a datacenter run on green energy is also an important selling point.
Most large data centers are placed at "kolos", cold places, where wind can help cool the data center. Of course, this still releases heat into the air.

Type of jobs a data center brings
Operational programmers for security is the most increasing job type in the data sector. Also, constructors of the technical part of the building.

The client vs. the users
"Data clients want a fortress as a visual confirmation of the safety of their data". Clients want to create physical barriers, that show the safety. For example: raising everything one floor, which creates a dead façade. Certificates become more and more important, to show that the safety is guaranteed. It will lead to a higher market value.

Dispursed vs. centralized
The dispurse of data centers is going to be more and more important.

Two types of data centers
1. High security center, privately owned;
2. Co-location (this one is increasing). The data center provides the building envelope and maintenance service. In London, there are a lot of examples of data centers sharing the location with a start-up. "Bring your own equipment".

Storage space
90% of the data is just being stored on servers, not used. Servers become smaller and smaller, demanding less space. But at the same time, the amount of data is increasing enormously, and this will not stop in the upcoming decades. Therefore, the same amount of storage space is needed.
Harddrives need to be improved, so they have less heat release and an extended capacity.

Multi-functionality
Datacenters can be combined with other (urban) functions, such as a library or daycare facility. The funding and finances will come from the data center.

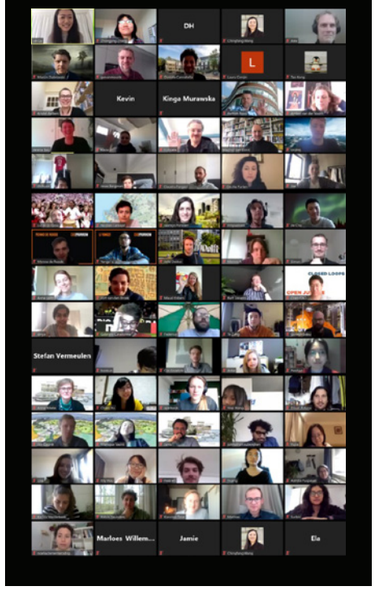
During the project, we kept in touch with Zuzanna and exchanged interesting sources and information. We will also send her our report.

APPENDIX 4

How much data did we use during this project? In this appendix we will discuss and show our data usage. As the New York Times wrote on their front page;

"The Coronavirus Crisis Is Showing Us How to Live Online. We've always hoped that our digital tools would create connections, not conflict. We have a chance to make it happen."

We would like to thank all the teachers and coordinators that made our online education possible. We truly had an amazing Quarter 3.



During this project we used roughly 14,6 GB of online cloud storage on our shared Google Drive.

This consisted of movies, photos, pdf's, Qgis shapefiles etc. Because of the extensive online nature of our studio, we had to clear our free Google Drive account multiple times…

During this project we used roughly 2.3 GB of online cloud storage on our Whatsapp chat.

This consisted of; 280 shared photos, 7 videos,100 links, and 29 pdf documents. Furthermore we have sent thousands and thousands of text messages.

During this project we mainly used the free Google Hangout services to video call each other.

Google Hangout creates accessible and easy to use video calls up to 150 users, and it allows for screensharing and has its own chat function.

We met each other almost daily on the Google Hangout platform so we would stay update about our progress and our common challenges.

During tutoring teachers mostly used ZOOM to conduct online studio sessions.

Zoom is an amazing online platform that allows up to 500 video call participants in one meeting. It allows for screensharing and even recording.

This video call platform was provided by the TU Delft tutors and could only be accessed by invitation.

Group 5

'from Datasphere to Datascape'