Reviving the Ruhr

Preparing the Peri-urban Ruhr for an uncertain energy & climate future.

Jan Eggink

P5 presentation

First mentor: Alexander Wandl
Second mentor: Claudiu Forgaci

Urgency

Science

Climate change: IPCC report is 'code red for humanity'

By Matt McGrath
Environment correspondent

9 August | Comments

COP26

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Brown Coal, Fool's Gold

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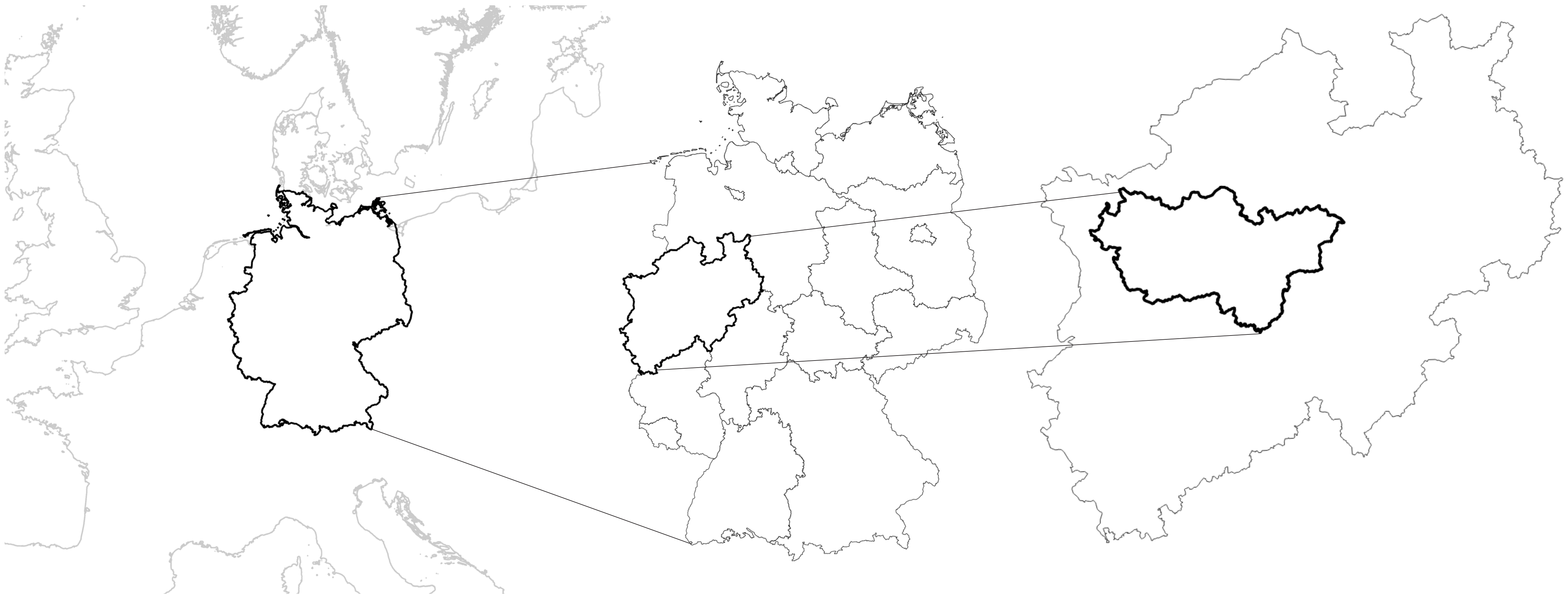
Von Benedikt Becker, Frank Dohmen, Gerald Traufetter und Steffen Winter
22.11.2017, 17.48 Uhr

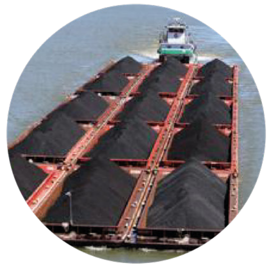
The urgency of climate change and the link to energy (Becker et al., 2017 ; McGrath, 2021).

Location of the Ruhr



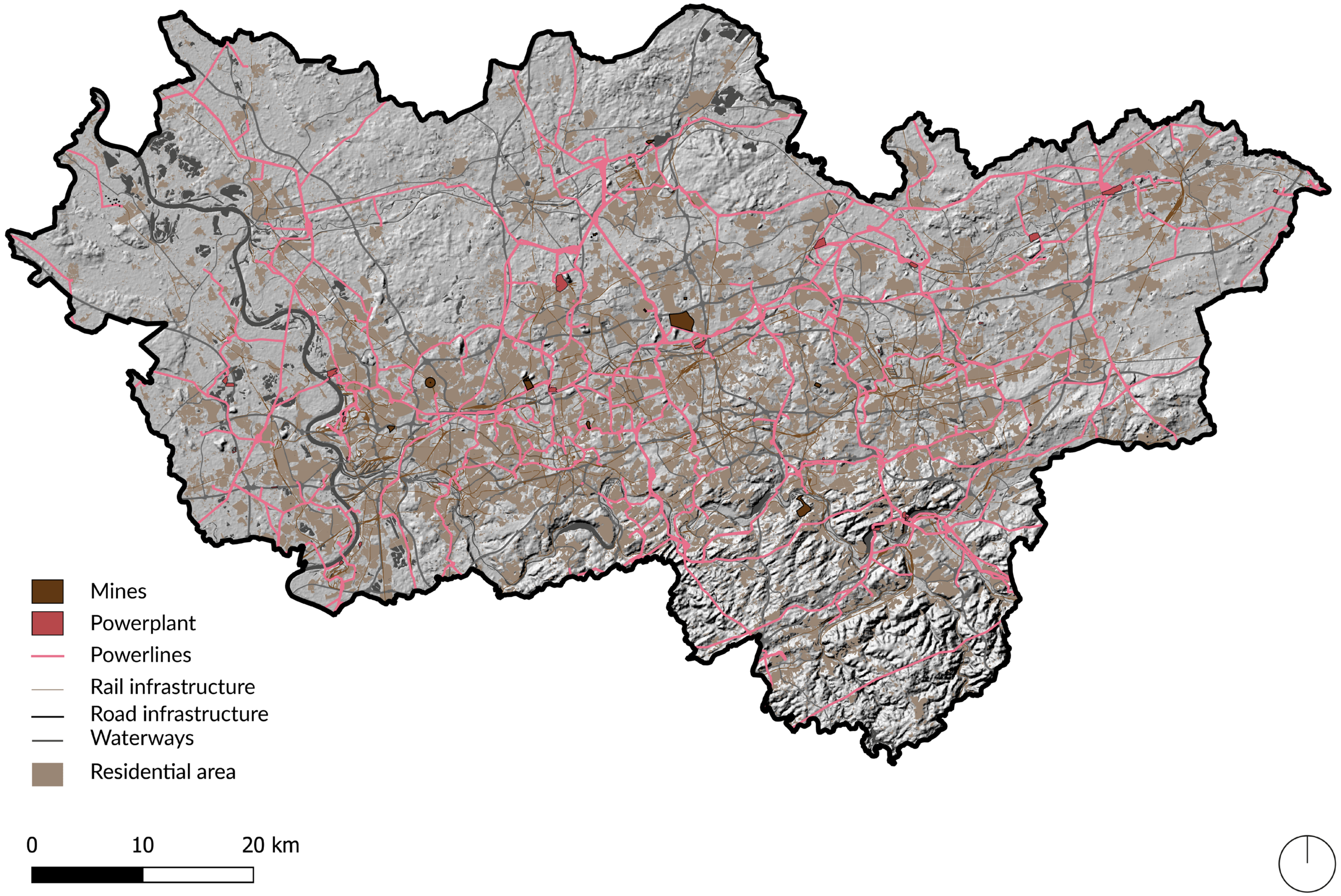
Panarchy

Resource lifelines

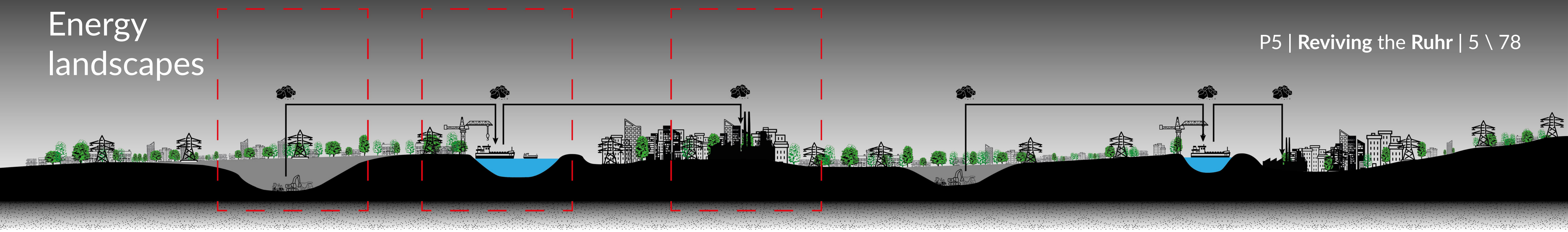


Operational lifelines

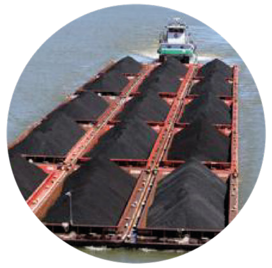
Process lifelines



Energy landscapes



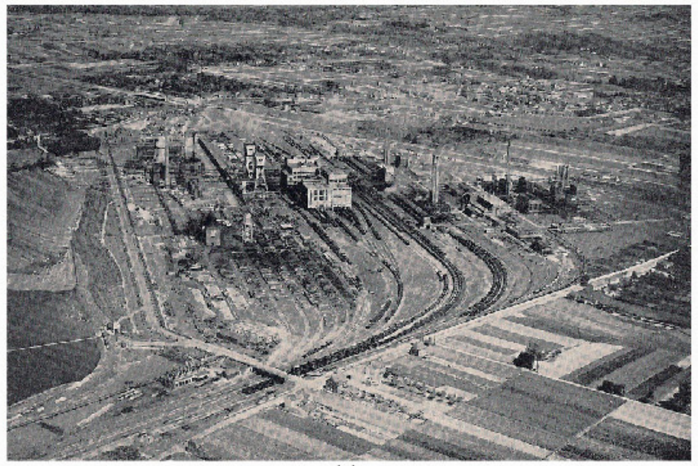

Resource lifelines


Operational lifelines


Process lifelines

Energy landscapes can be described as: “observable landscapes that originate directly from the human development of energy resources” (De Jong & Stremke, 2020).


(b)

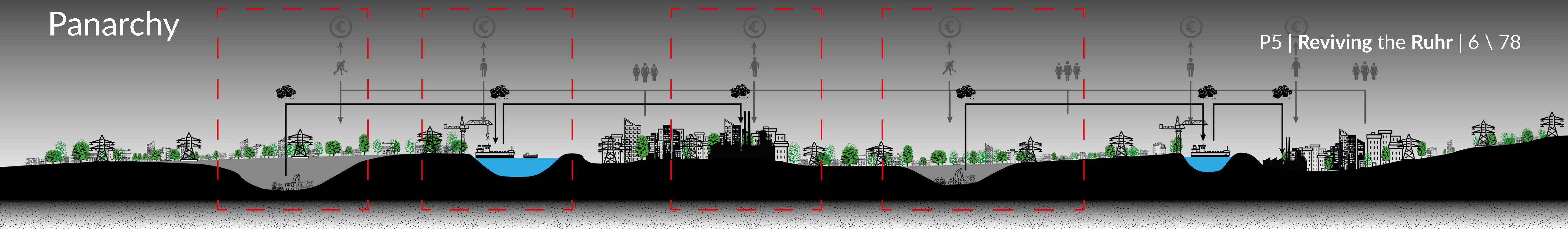

(d)


(a)

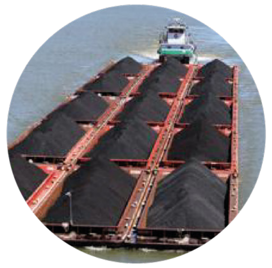

(c)

Figure 1: Examples of Dutch energy landscapes: (a) wind energy landscape; (b) fossil fuel energy landscape; (c) historical wind energy landscape; (d) coal energy landscape (De Jong & Stremke, 2020).

Panarchy



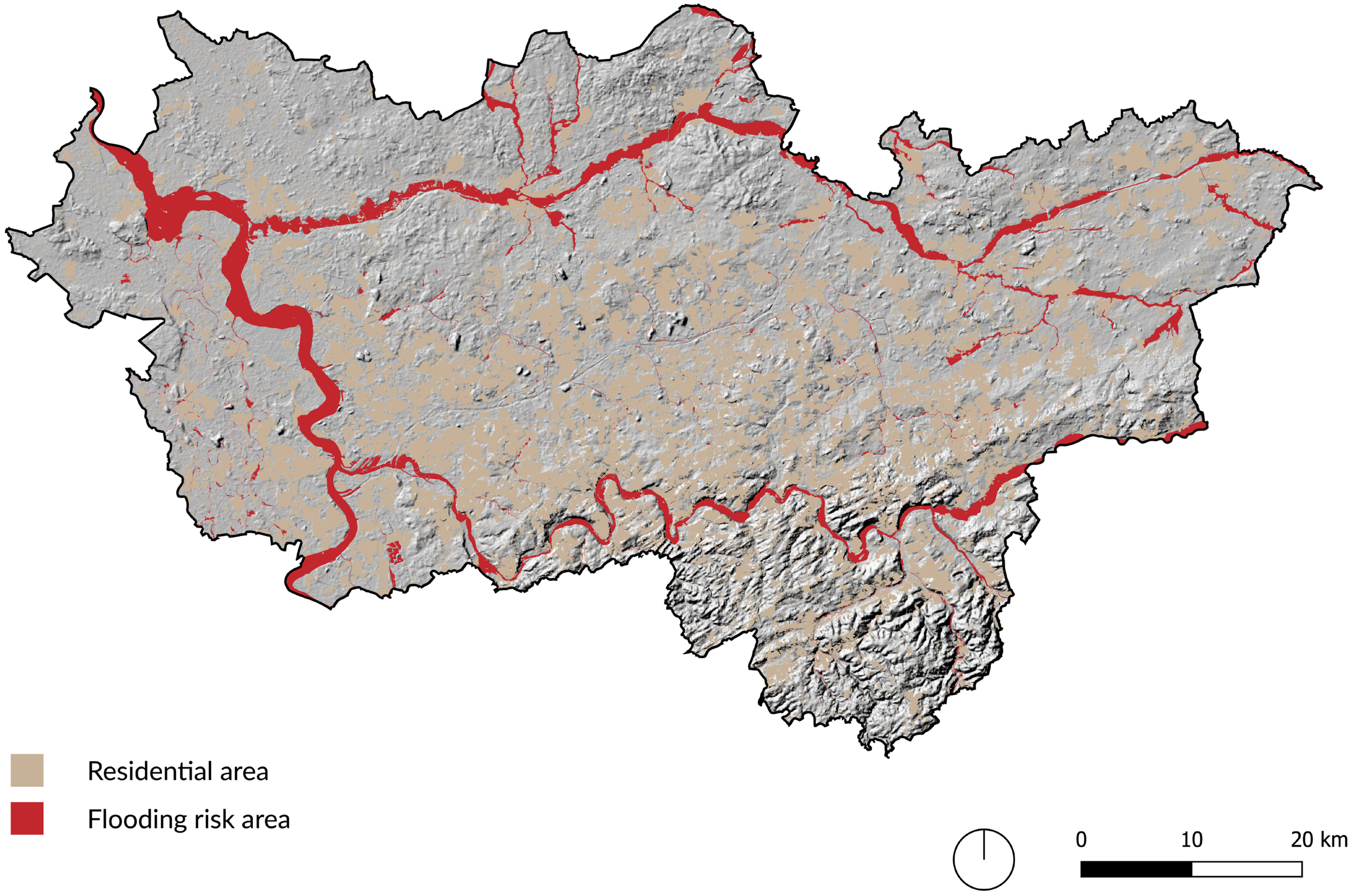
Resource lifelines



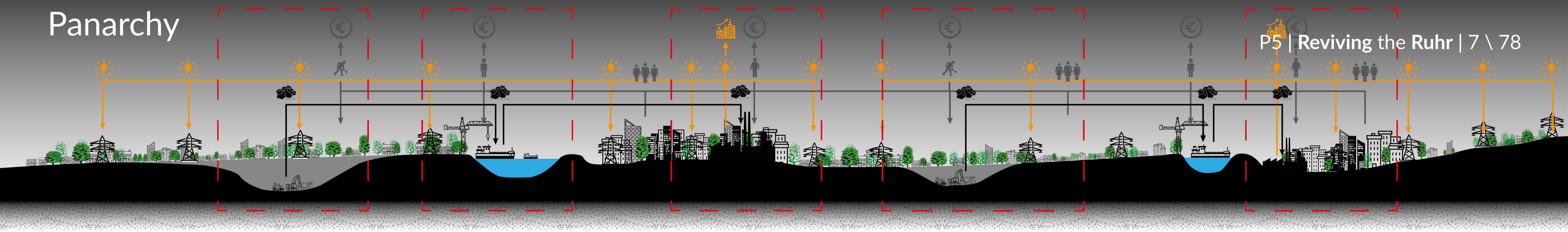
Operational lifelines

Process lifelines

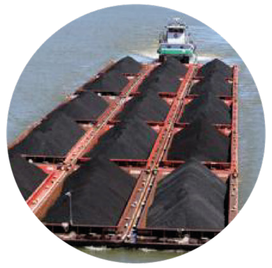
Socio-economic lifelines



Panarchy



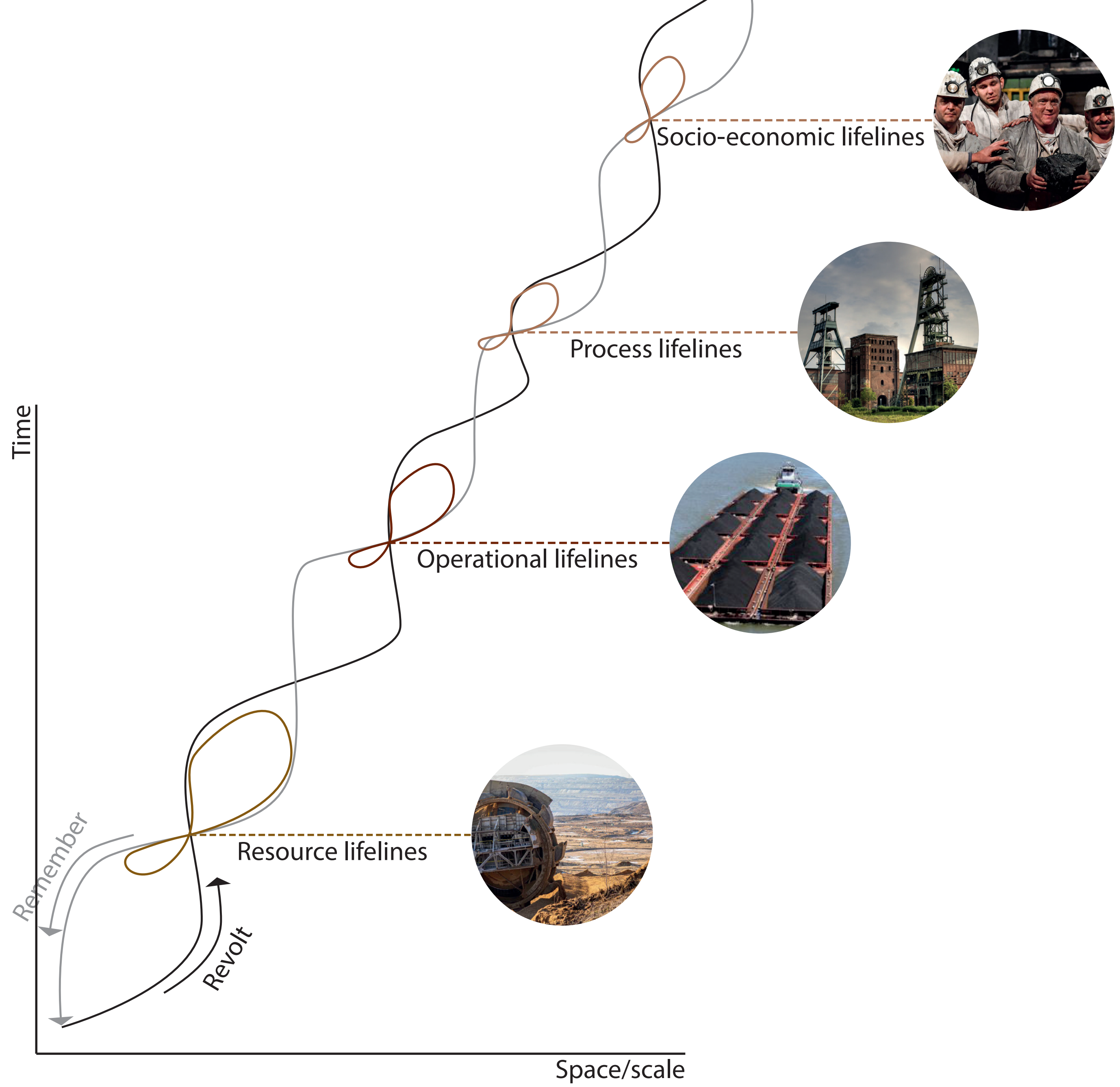

Resource lifelines


Operational lifelines


Process lifelines


Socio-economic lifelines


Cultural lifelines



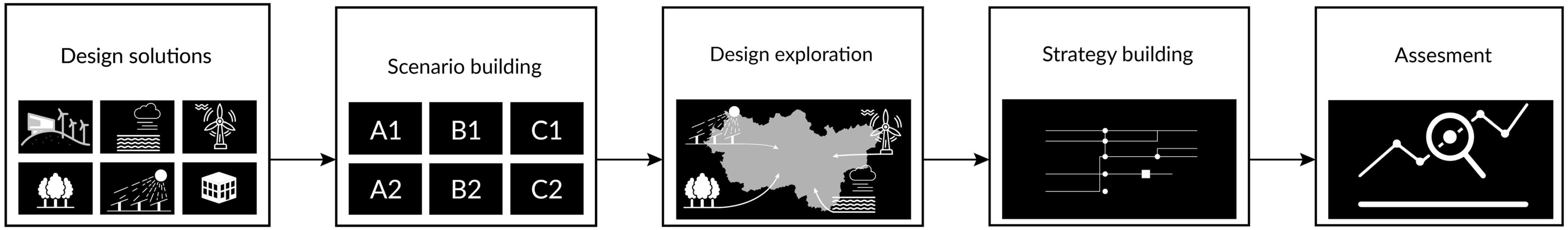
Problem statement

The Ruhr area, experiencing a socio-economic shift as a consequence of de-industrialisation, is undergoing an **energy transition** - which **goals** will probably **not be met** according to modelling - next to the **spatial pressure from the energy transition** the Ruhr area is facing s**patial pressure from climate change**. These problems are **not tackled in an integrated way**, and do not use the specific peri-urban structure potentials of the Ruhr.

Main research question

How can a s**patial development strategy** for a **climate resilient Ruhr** area based on the **specific peri-urban condition** of the Ruhr lead to **fulfillment** for the now **too limited energy transition?**

Approach


Design solutions
Scenario building
A1
B1
C1
A2
B2
C2
Design exploration
Strategy building
Assesment

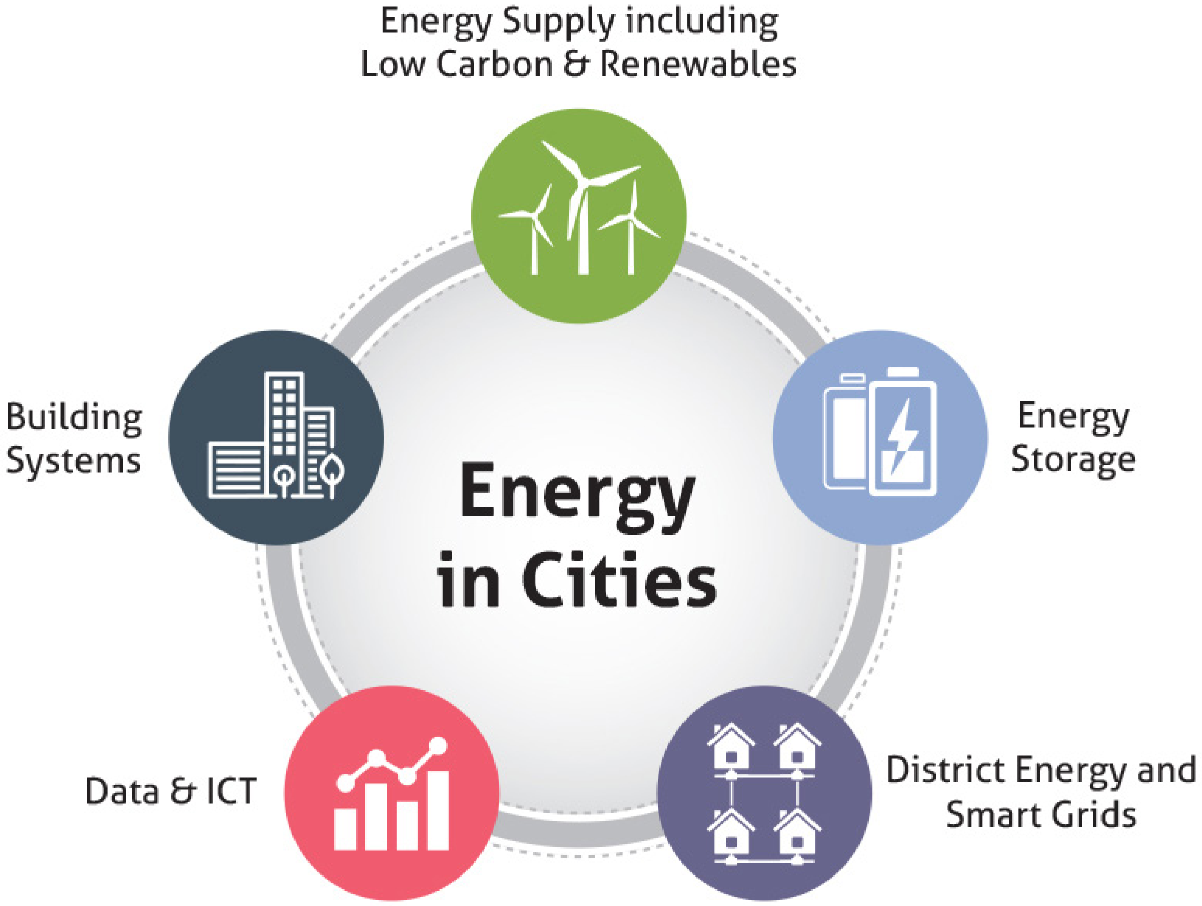
Design solutions | Spatial contexual relation

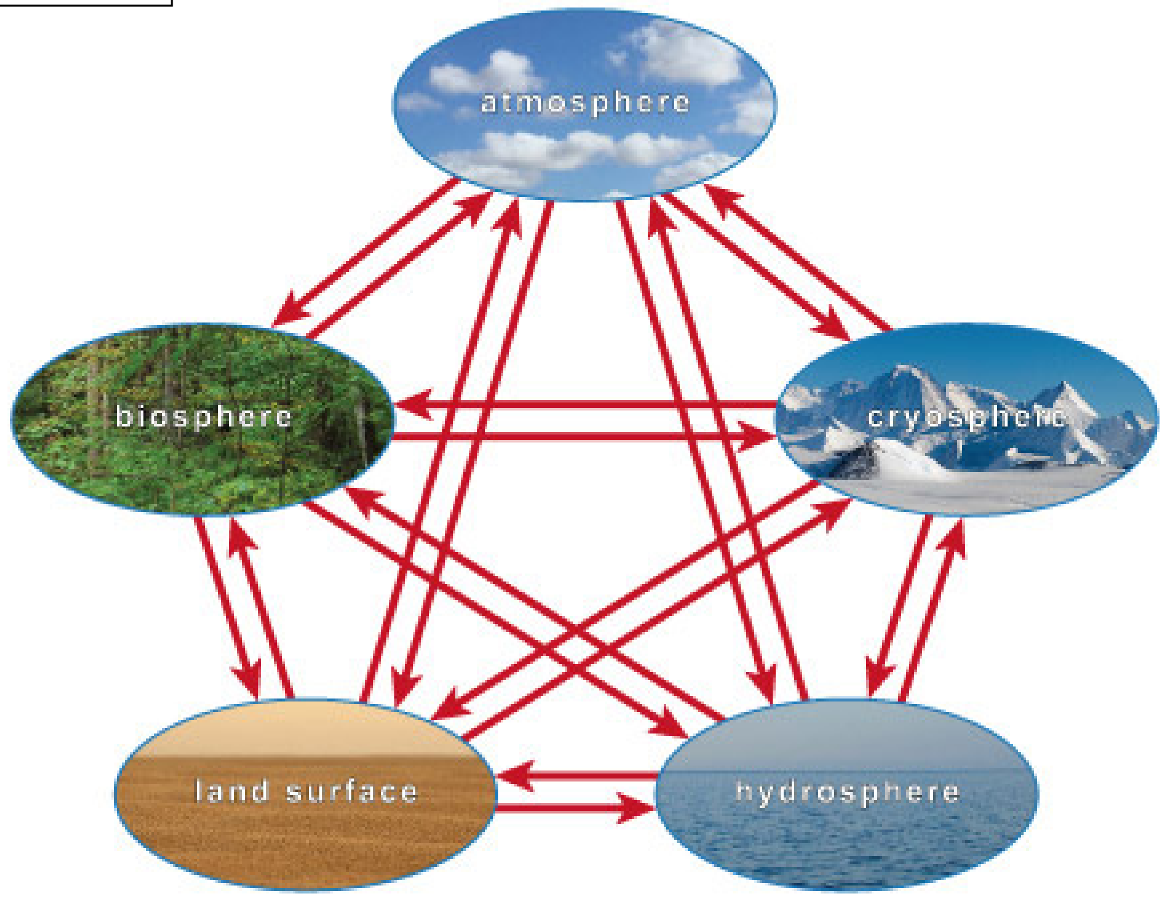
Spatial contextual characteristics

Physical context

Functional context

Network of the context





The energy system and climate system (Arup, 2017 ; Open university, 2021).

Design solutions | mono-layered

Spatial contextual characteristics

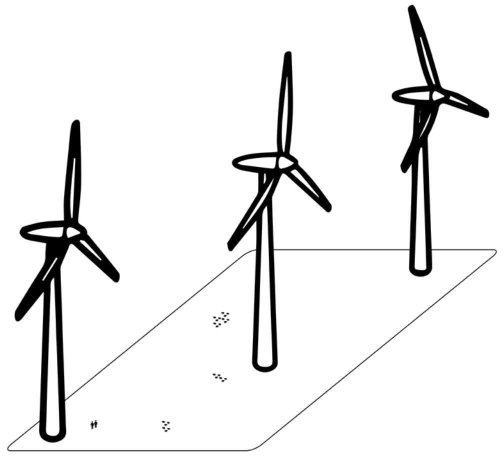
Physical context

Functional context

Network of the context

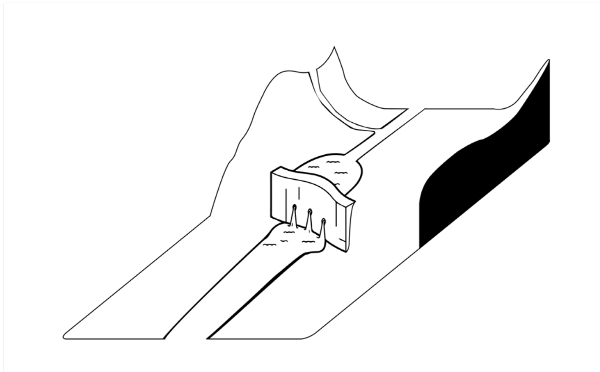
Wind-mill park

S.E.L. 1



Dam & reservoir

C.A. 4



Design solutions | multi-layered

Science

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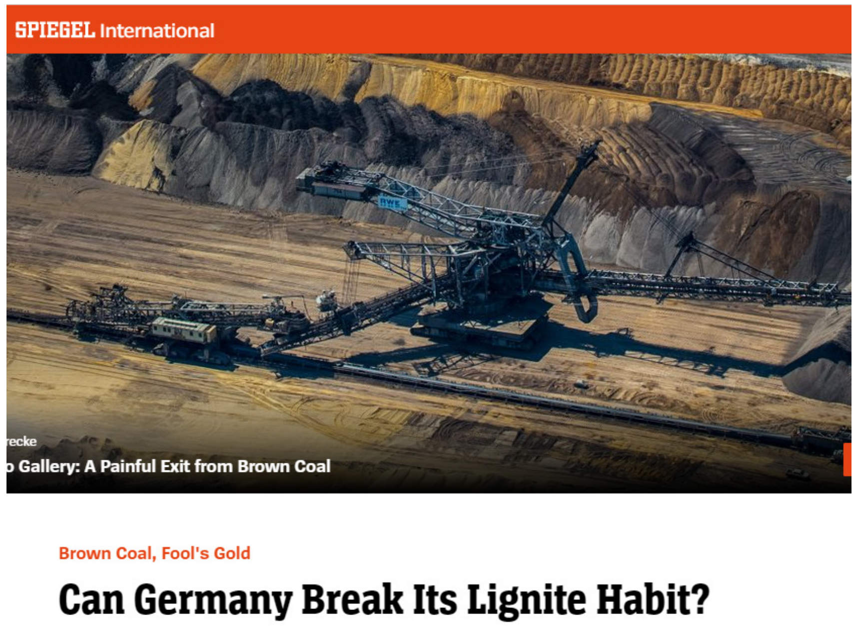
The urgency of climate change and the link to energy (Becker et al., 2017 ; McGrath, 2021).

Design solution | relation between climate and energy



CO_2 emmissions as a consequence of **energy production**, using fossil fuels.

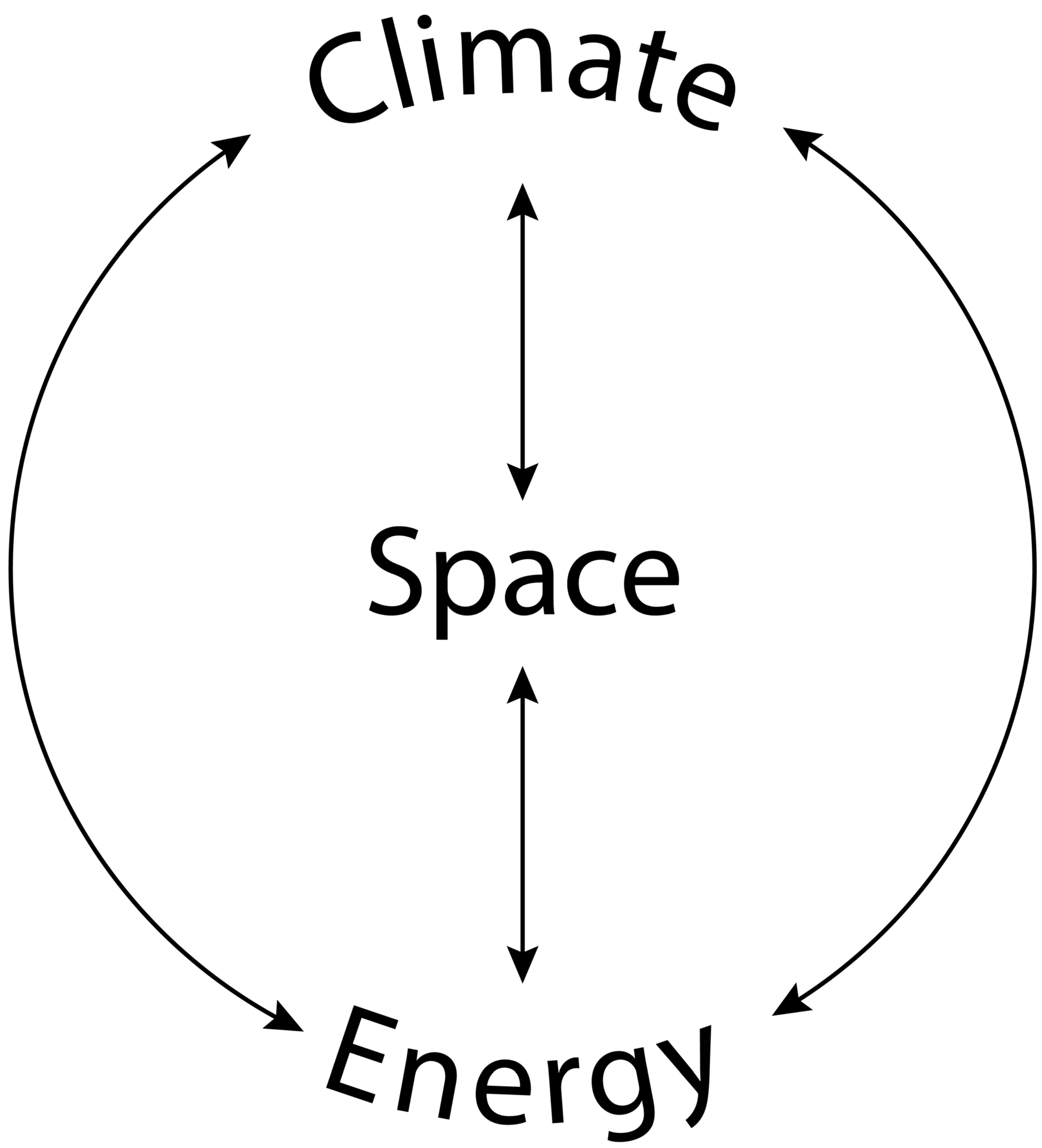
The world

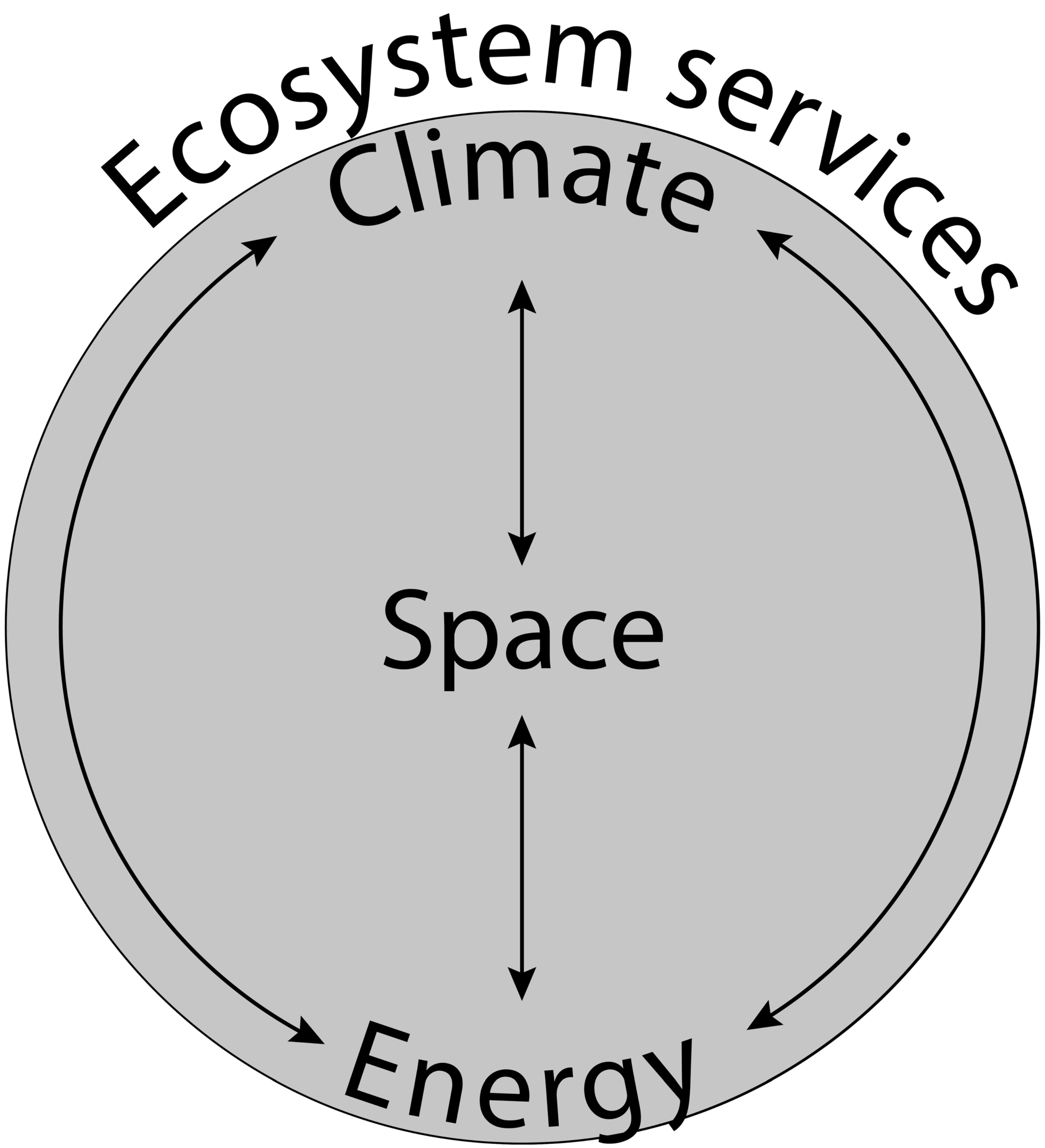
Global warming as a consequence of **climate change**, due to the emmission of CO_2

Mitigation:
Energy transition as a means to produce energy using renewable energy sources, leading to **less CO_2 emmissions.**

Adaptation:
Transforming landscapes to be able to **face stress and shocks** as a consequence of global warming; extreme precipitation, drought and heat.

Design solution | relation in design

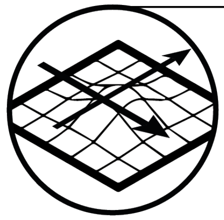



Ecosystem services
Climate
Space
Energy


Regulation functions
Habitat functions
Production functions
Information functions
Carrier functions

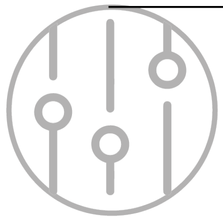
Design solution | ecosystem services

Energy landscapes implemented in green-blue areas



Carrier functions

Climate adaptation, by green-blue areas. (spatial manifestation of ecosystem)

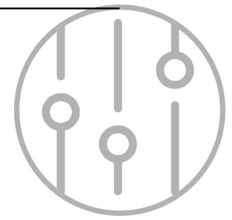


Regulation functions

Production functions

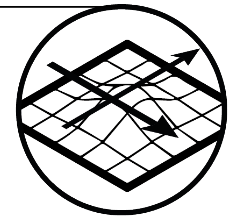
Green-blue areas aid in climate adaptation

Production functions



Regulation functions

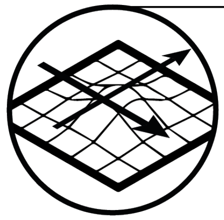
Energy landscapes can be implemented in these areas.



Carrier functions

Design solution | functions of ecosystem services

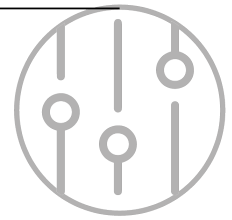
Energy landscapes implemented in green-blue areas



Carrier functions

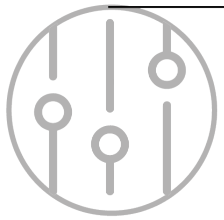
Green-blue areas aid in climate adaptation

Production functions



Regulation functions

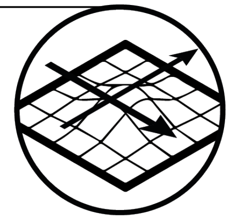
Climate adaptation, by green-blue areas. (spatial manifestation of ecosystem)



Regulation functions

Production functions

Energy landscapes can be implemented in these areas.



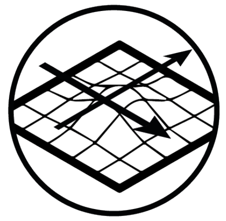
Carrier functions

Regulation functions

Climate regulation,
Water regulation,
Waste treatment

Production functions

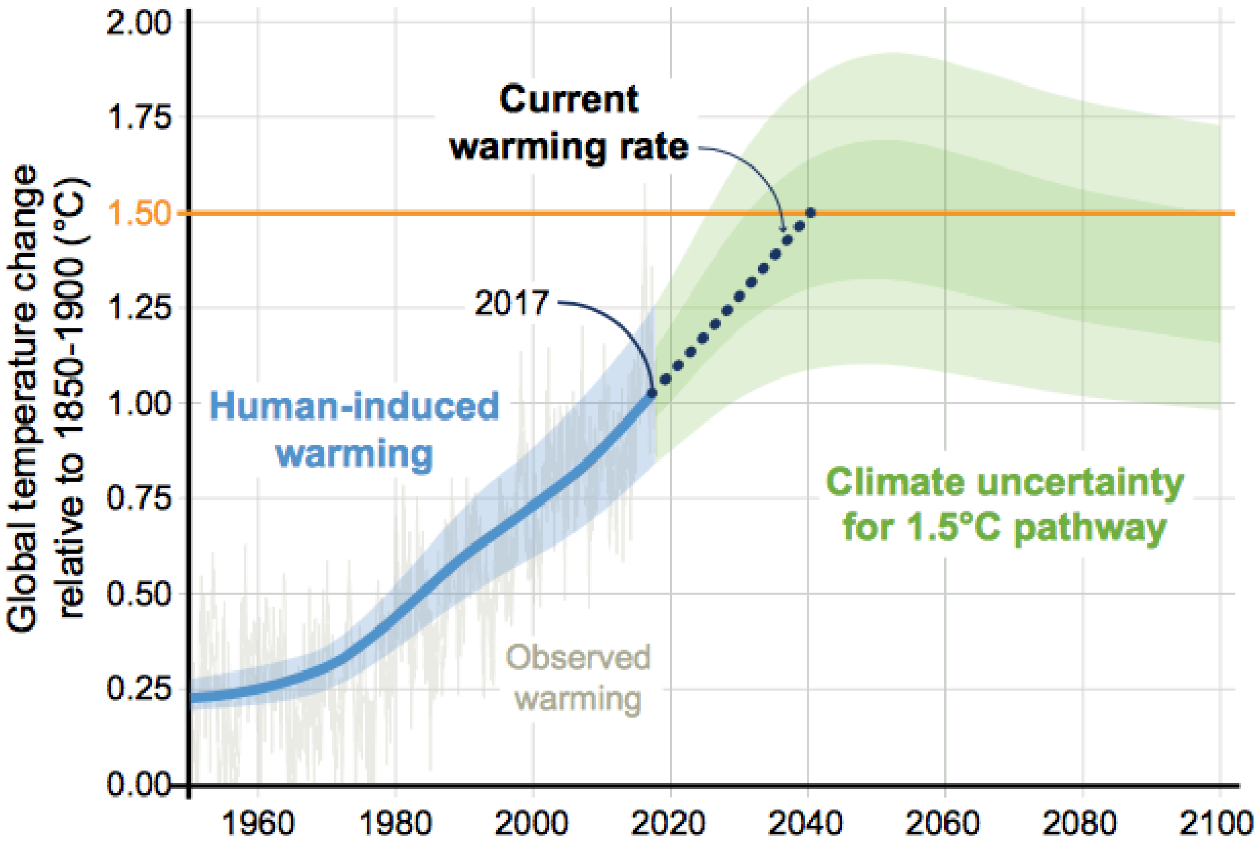
Food,
Raw materials,
Medicinal resources

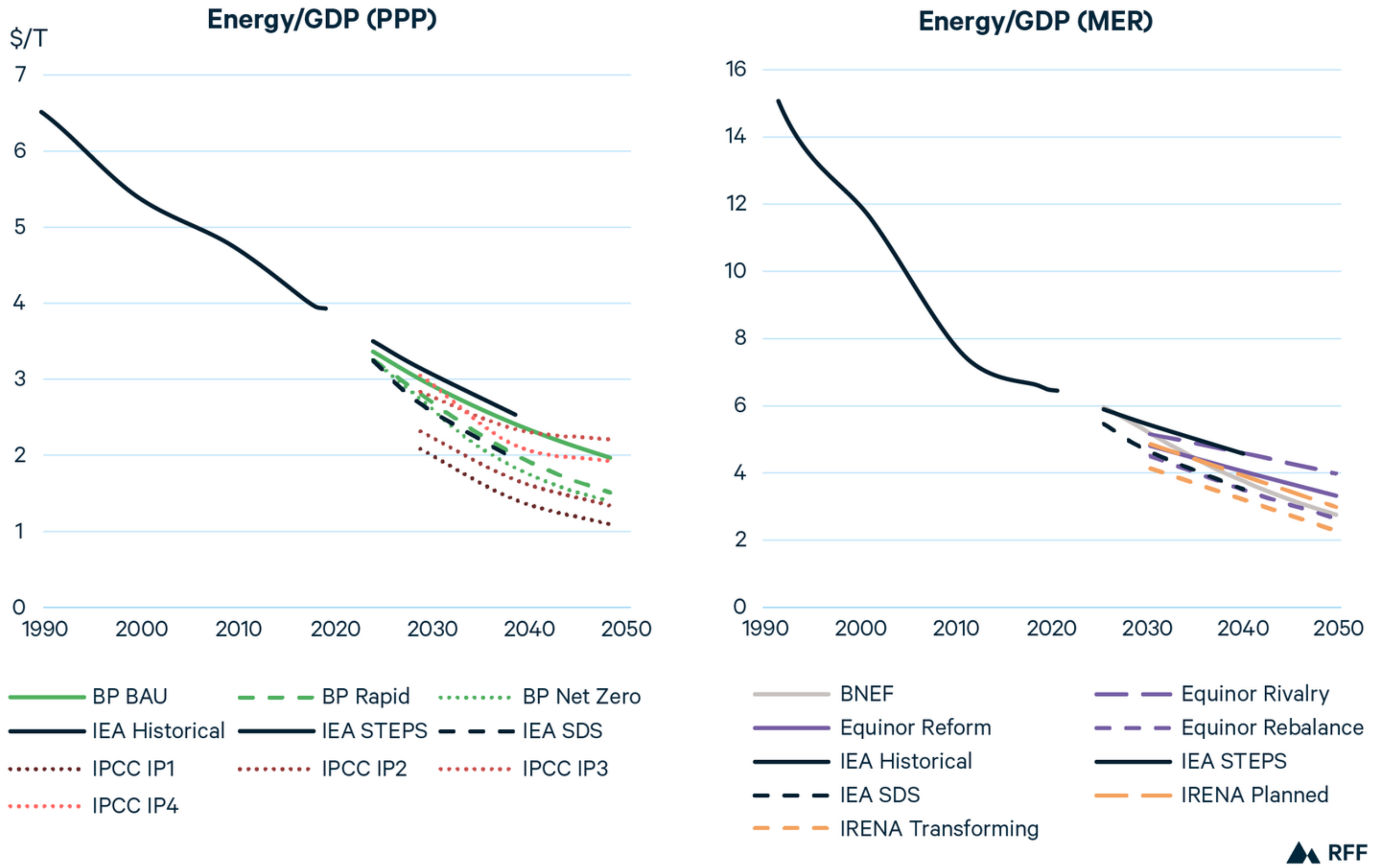


Carrier functions

Mining,
Energy-conversion facilities,
Transportation

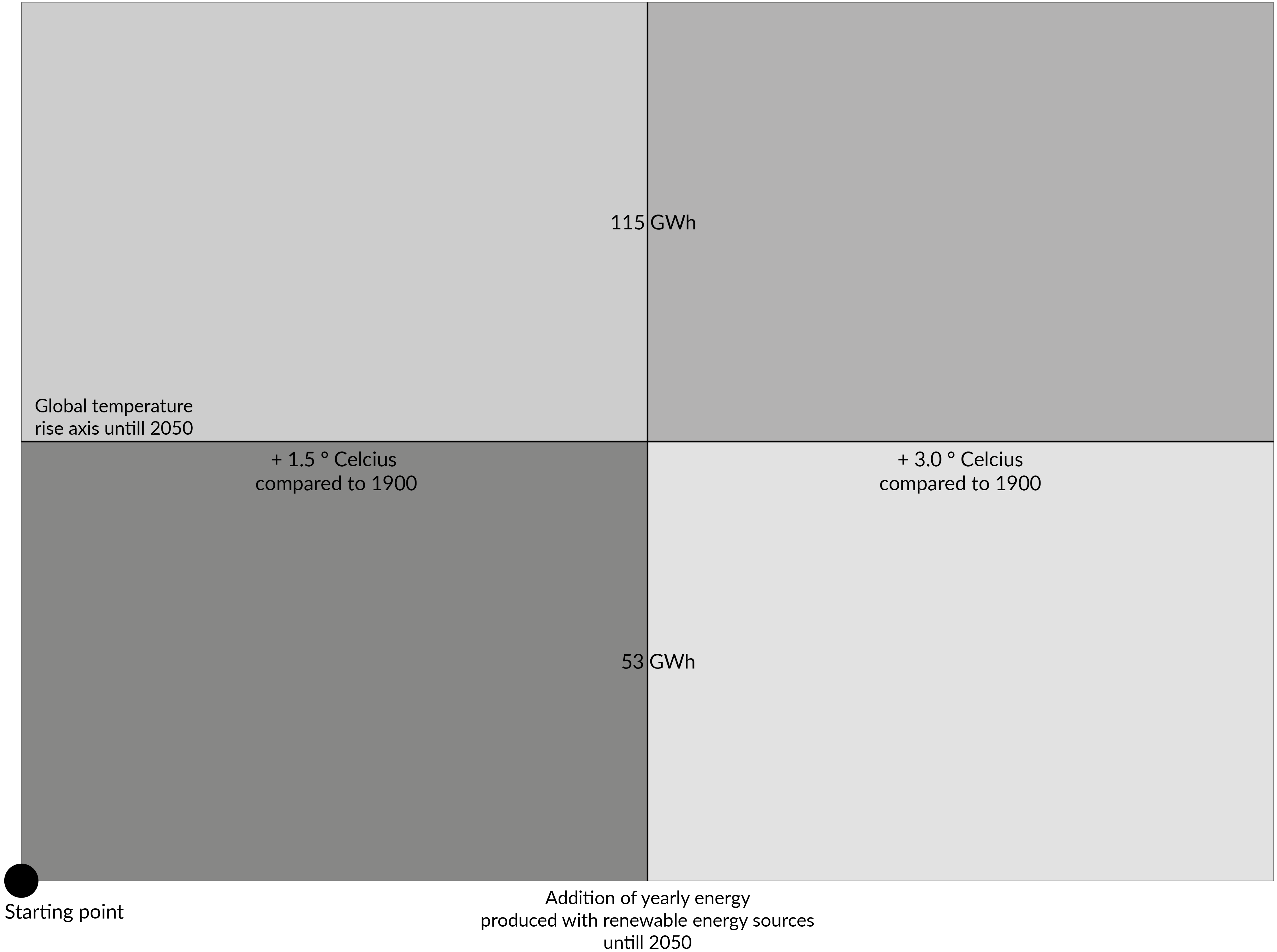
Scenario building | Uncertainty in primary energy consumption and global temperature



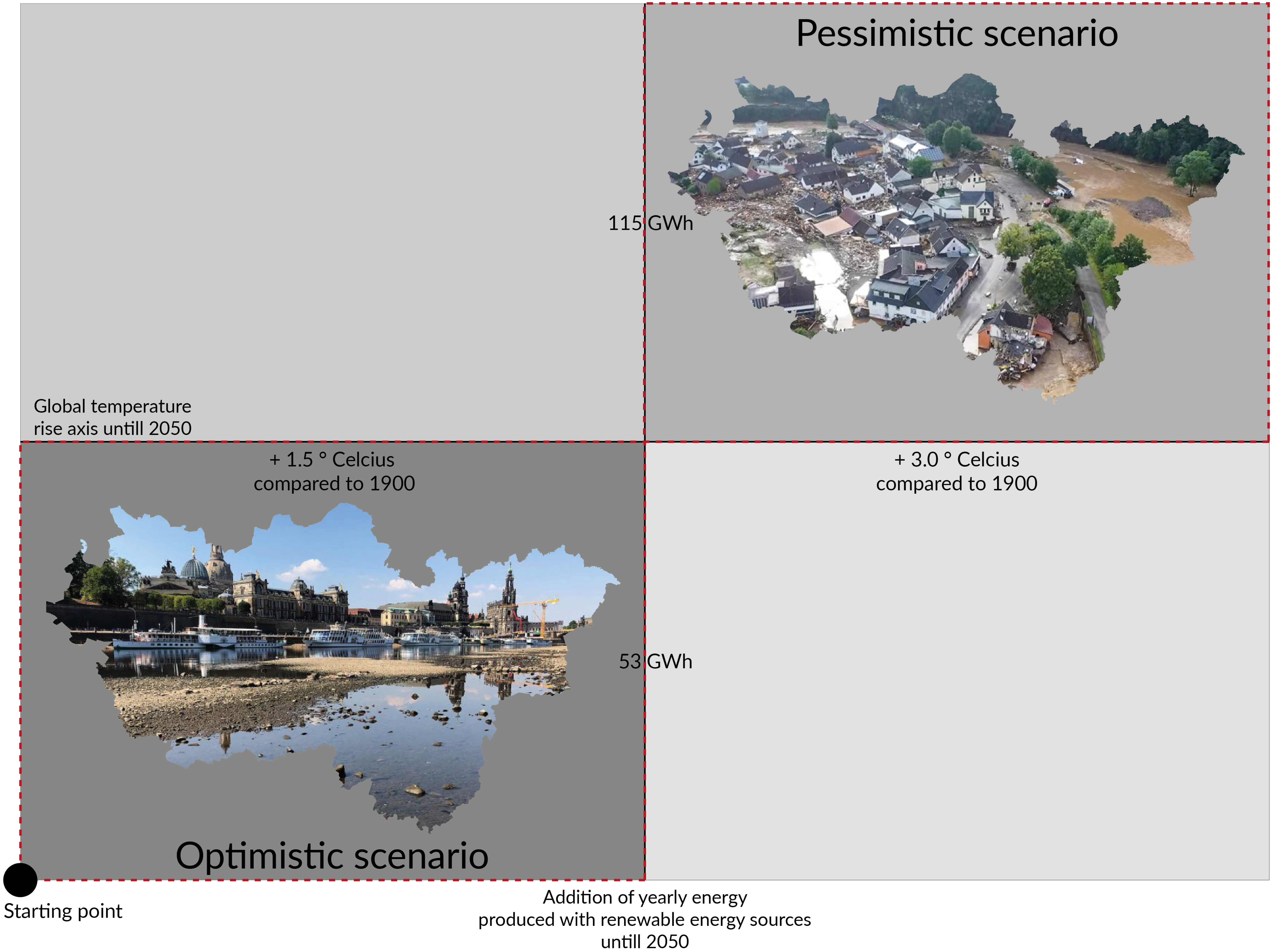


Uncertainty in global temperature rise and primary energy consumption (Nasa, 2019 ; IPCC, 2021).

Scenario building | Defined scenarios

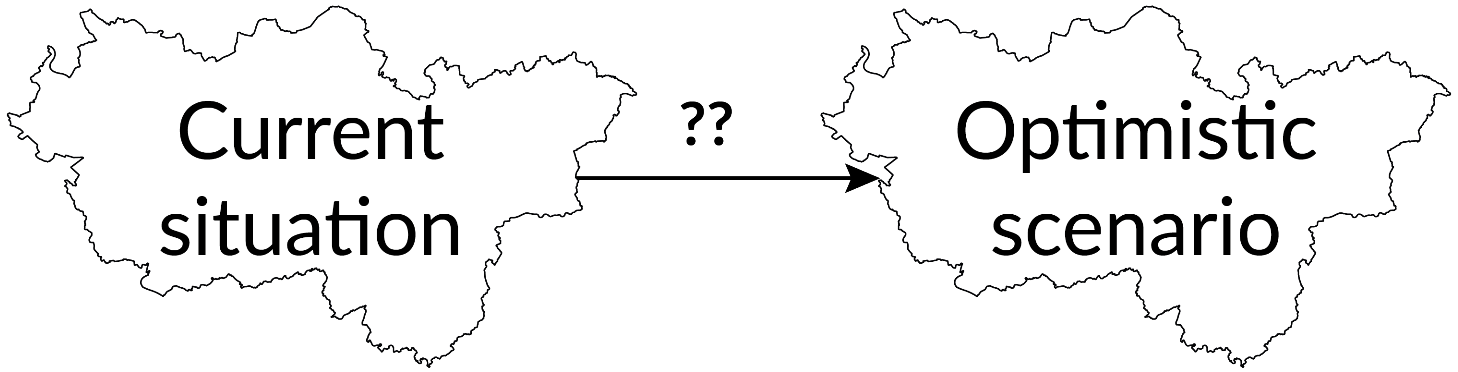


Scenario building | chosen scenario’s



Scenario building | Timeline with scenarios

How many years will it take before the Ruhr area is facing the optimistic scenario?



Scenario building | Timeline with scenarios

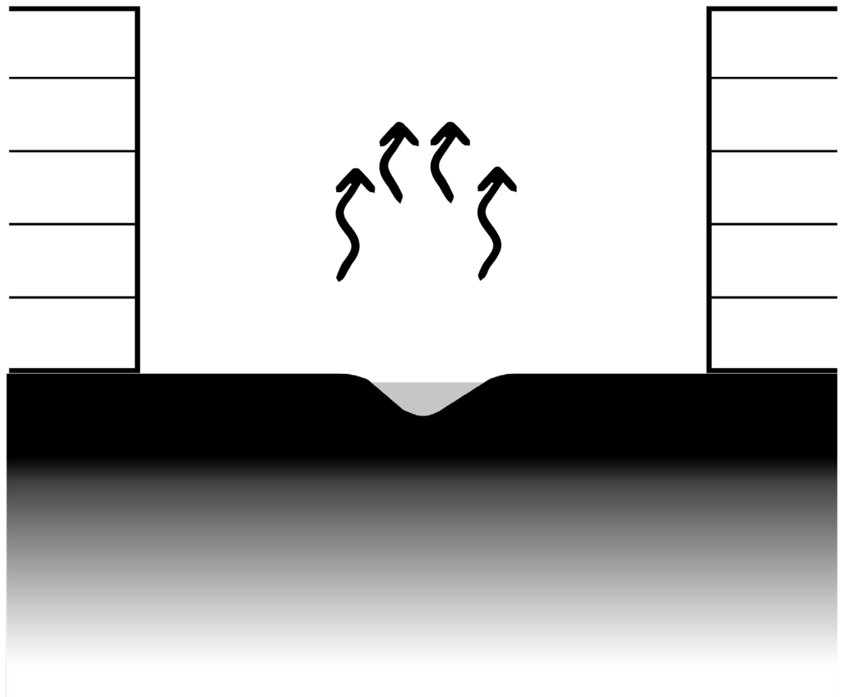
How many years will it take before the Ruhr area is facing the optimistic scenario?

How many years will it take before the Ruhr area is facing the pessimistic scneario?

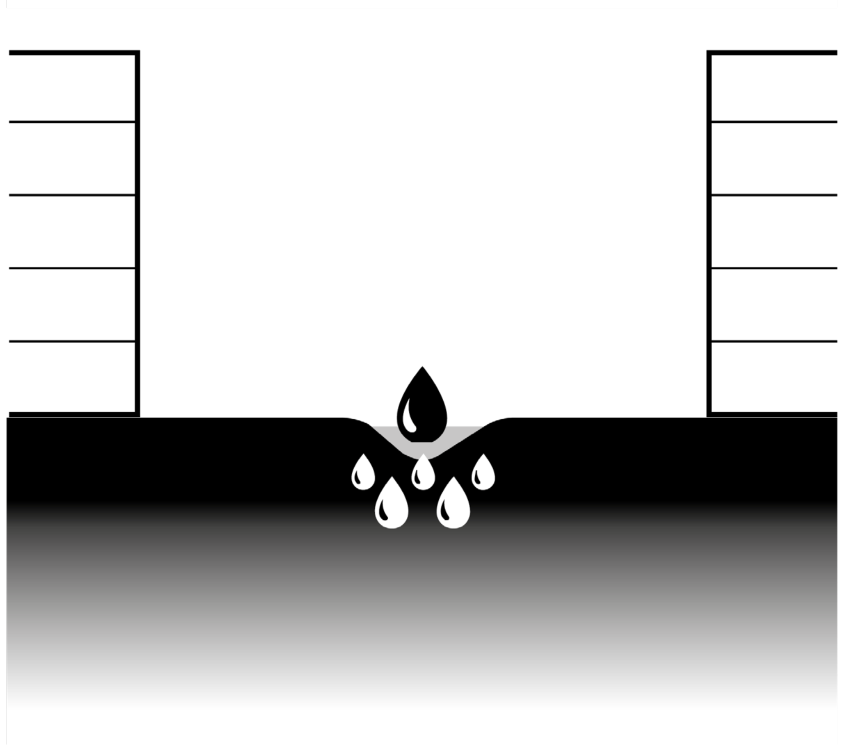
Design exploration | WSUD principles

Water sensitive urban design principles:

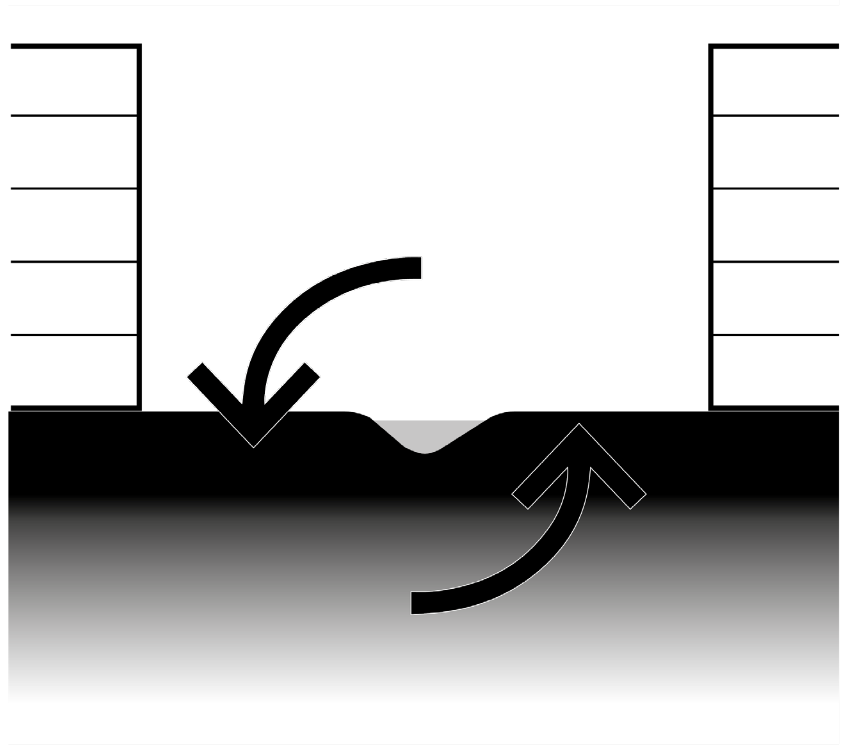
Evotransporation



Infiltration

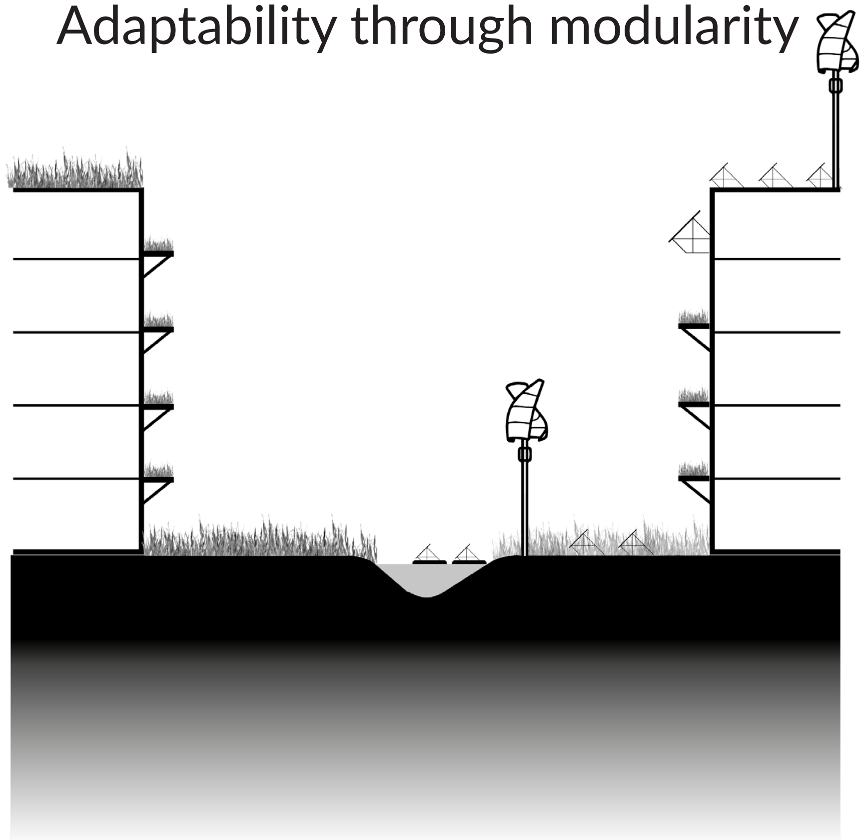


Capturing and reusing

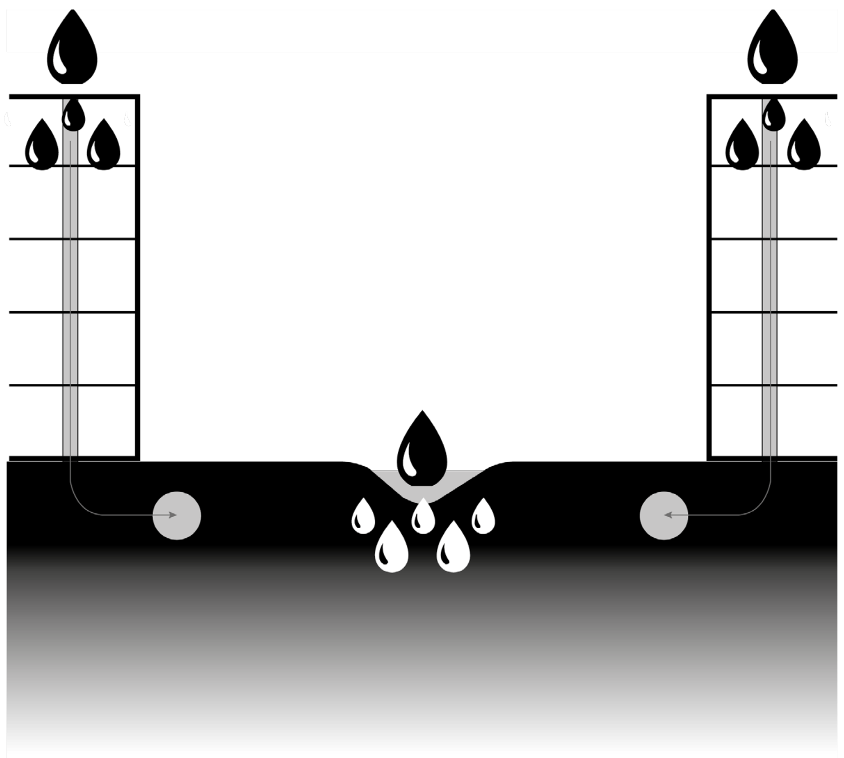


Systemic resilience principles

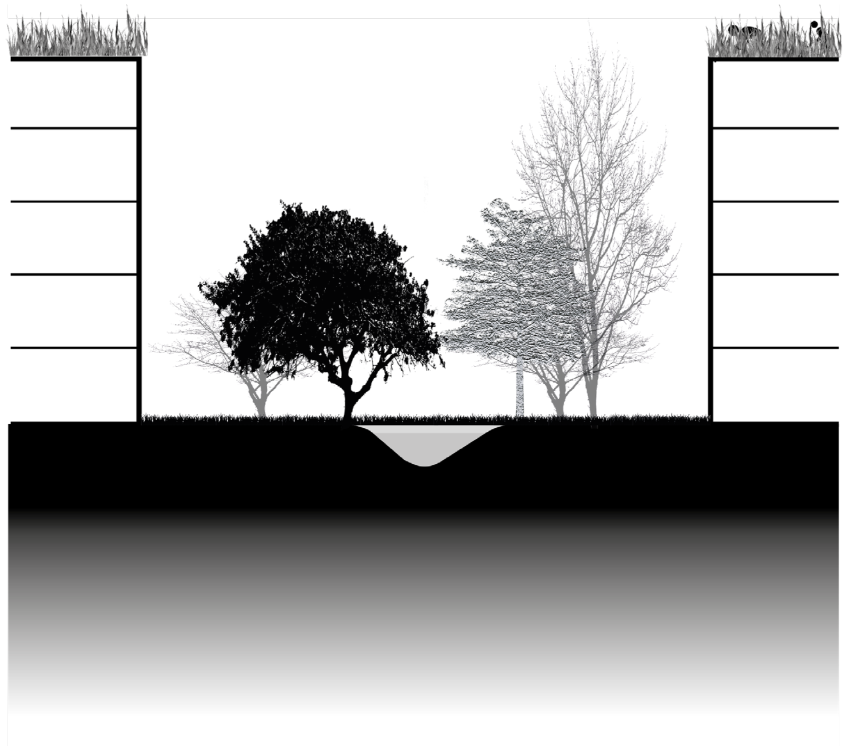
Adaptability through modularity



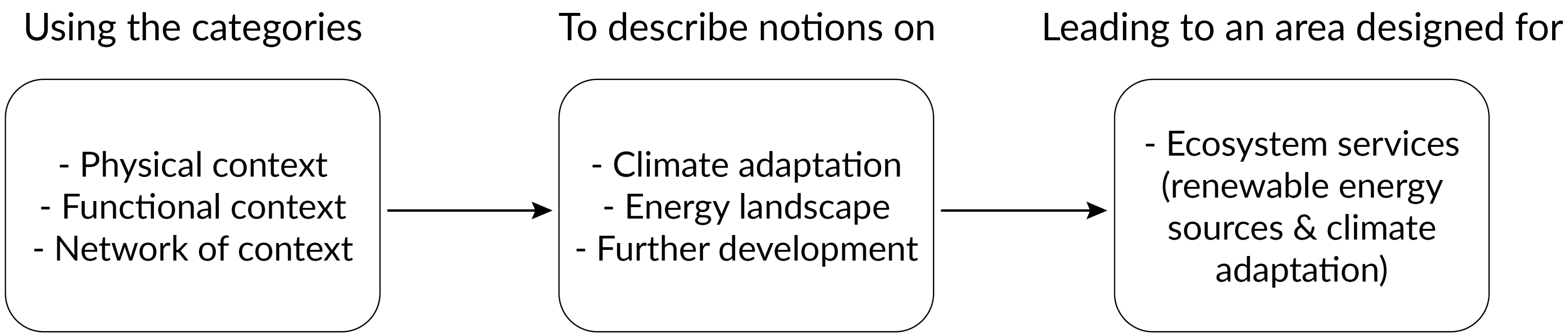
Redundancy through flexibility



Ecosystem services

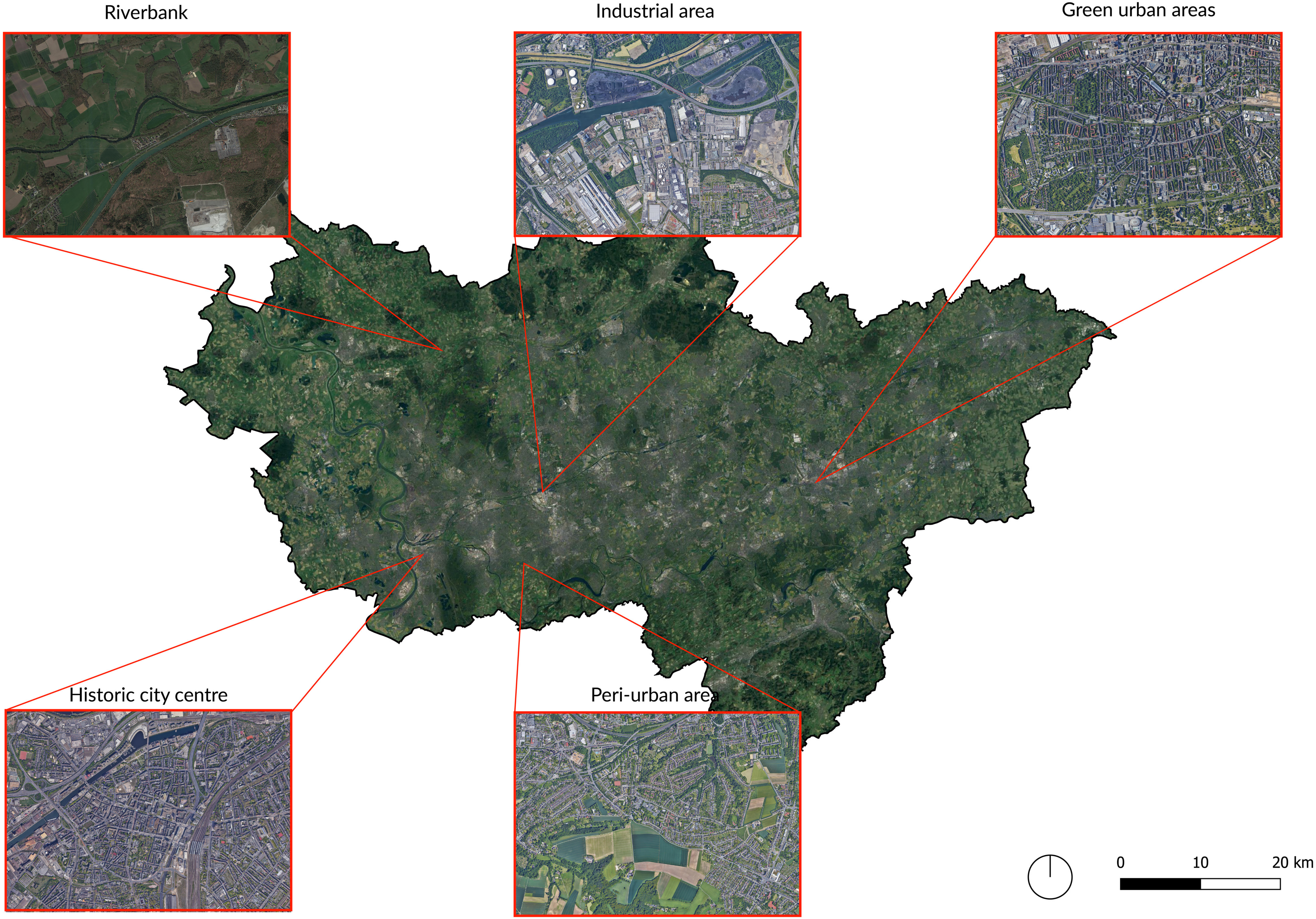


Design exploration | approach



‘’elementary units, designed as discrete entities within the territory, characterized by an inherent tendency to the transformation based on the relations between them’’
(Pisano, 2018)

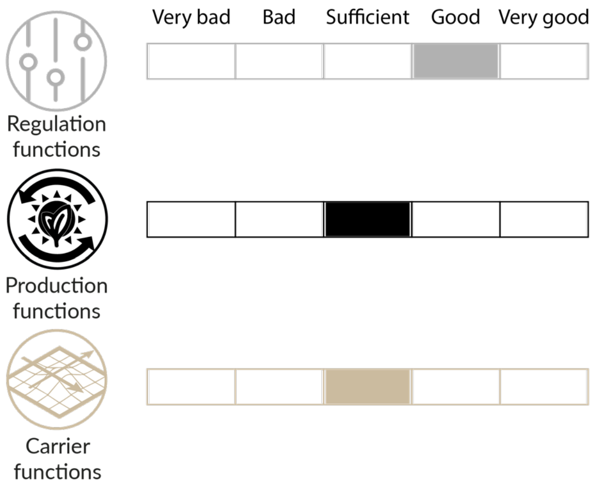
Design exploration | chosen patches



Riverbank

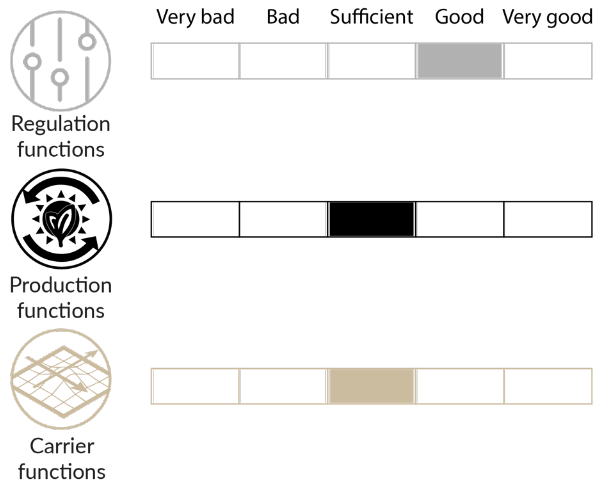
Design exploration | riverbank

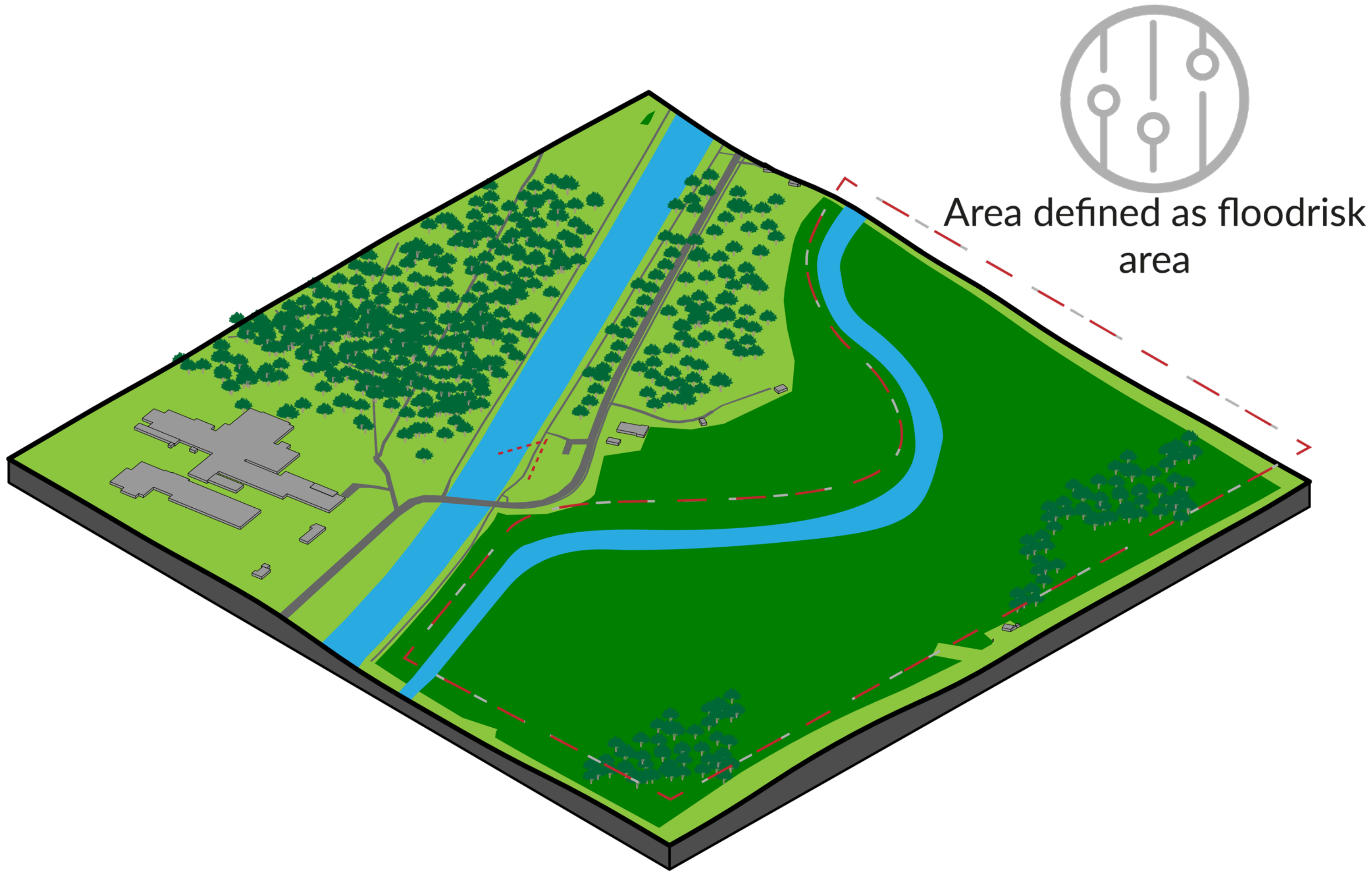
Current situation



Design exploration | riverbank

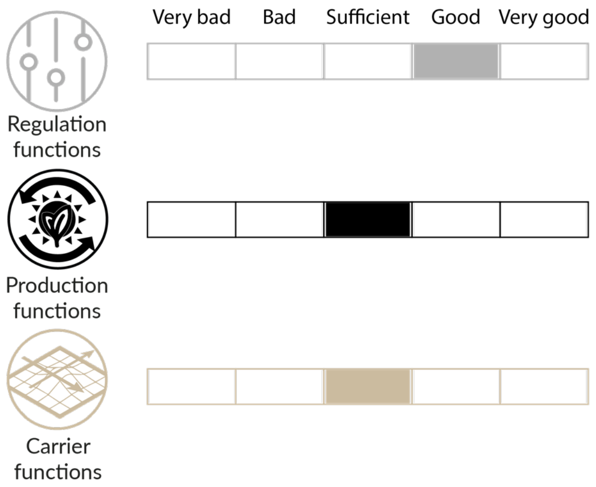
Current situation



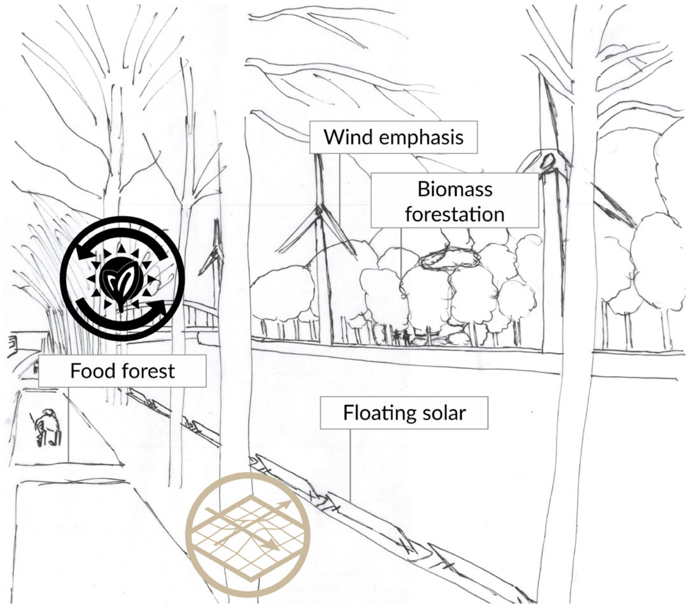


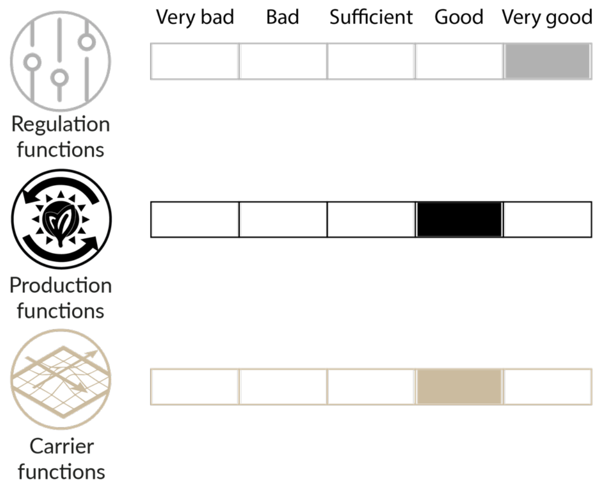
Design exploration | riverbank

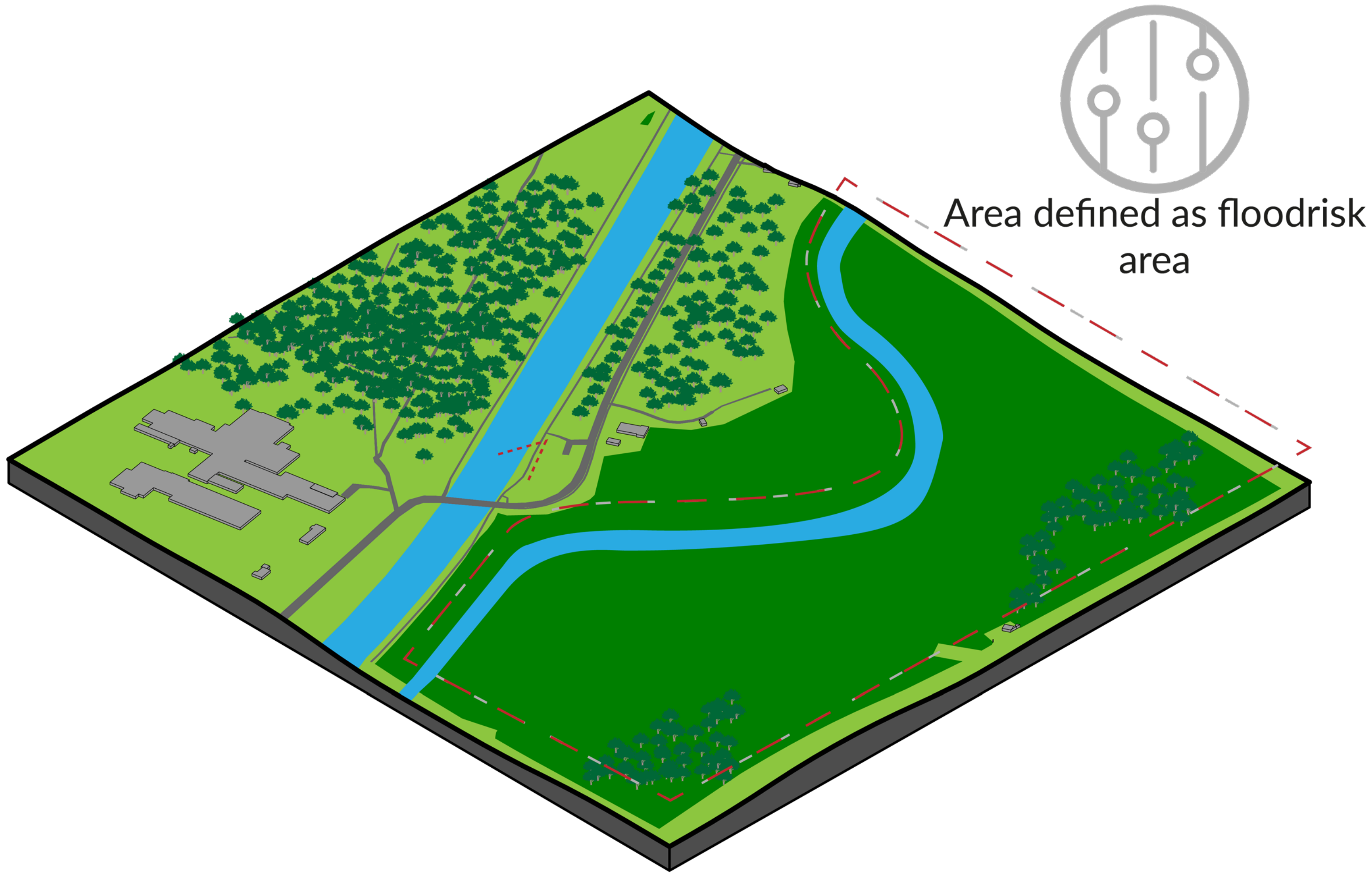
Current situation



Optimistic scenario

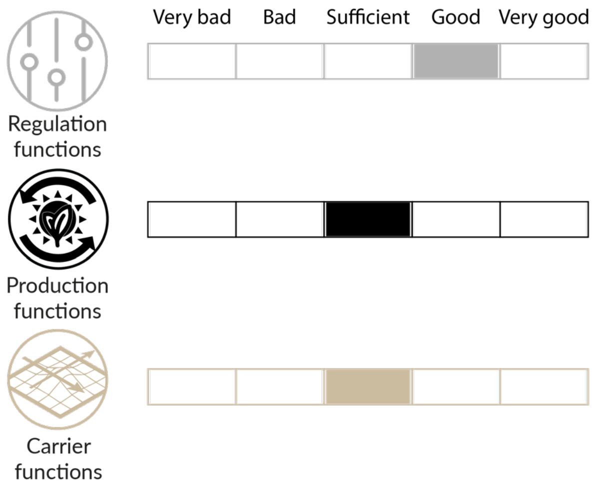


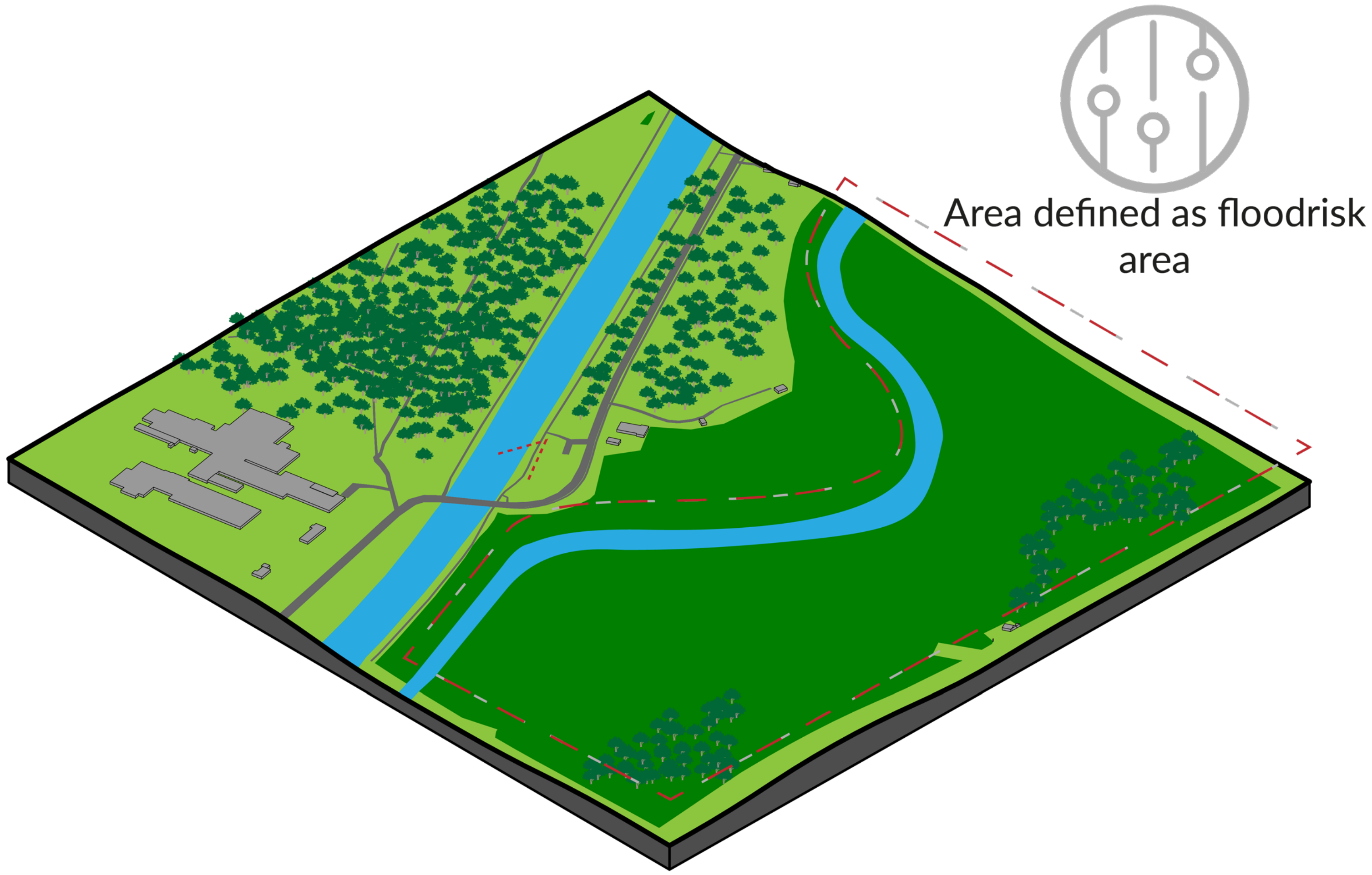




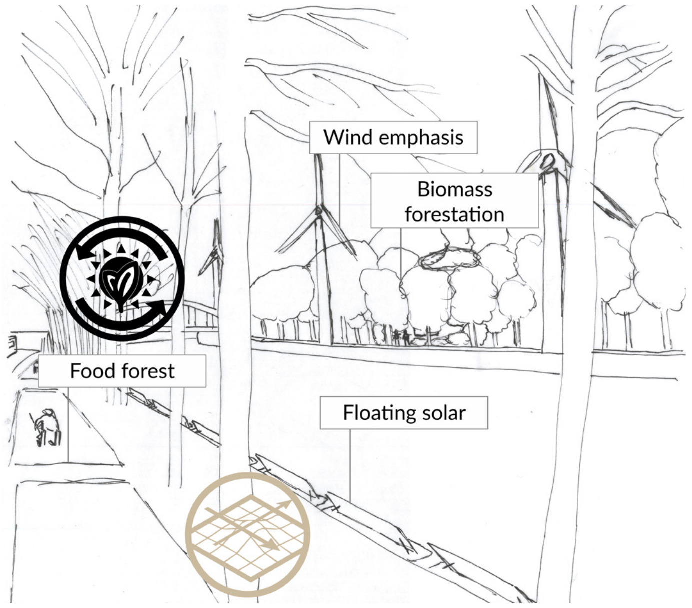
Design exploration | riverbank

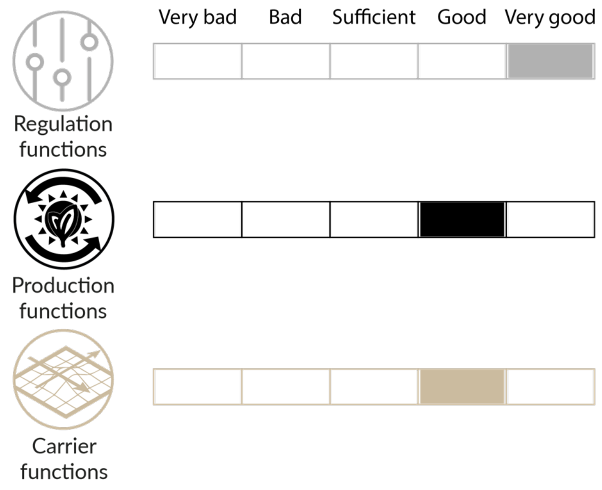
Current situation

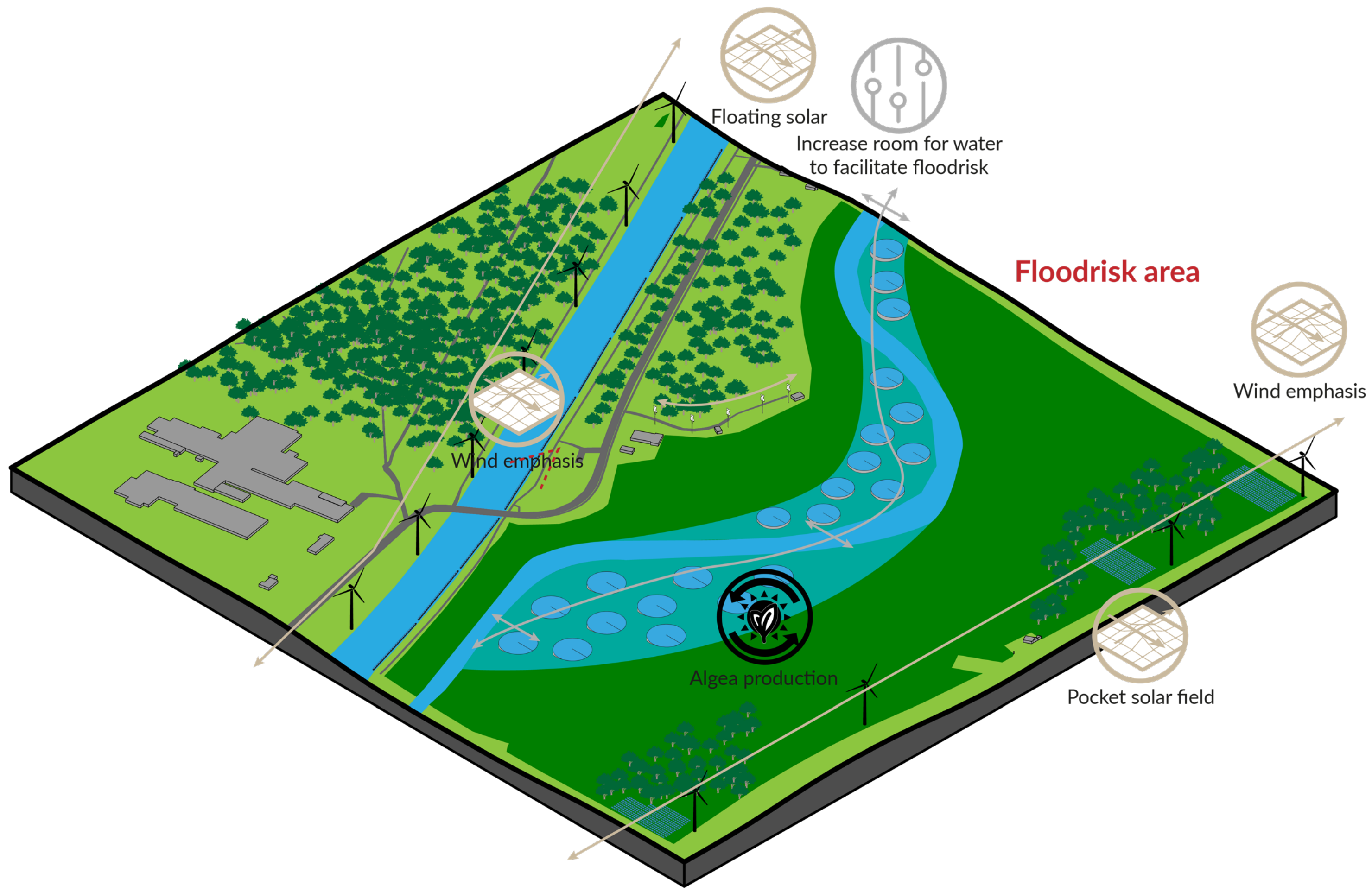




Optimistic scenario

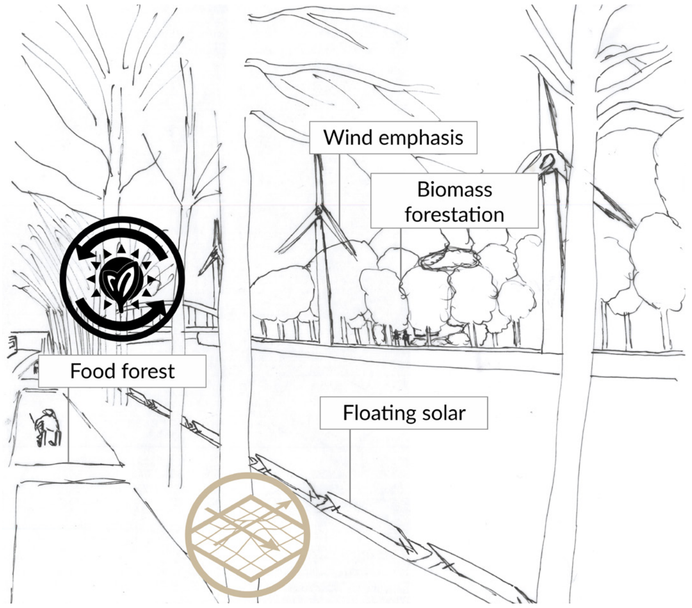


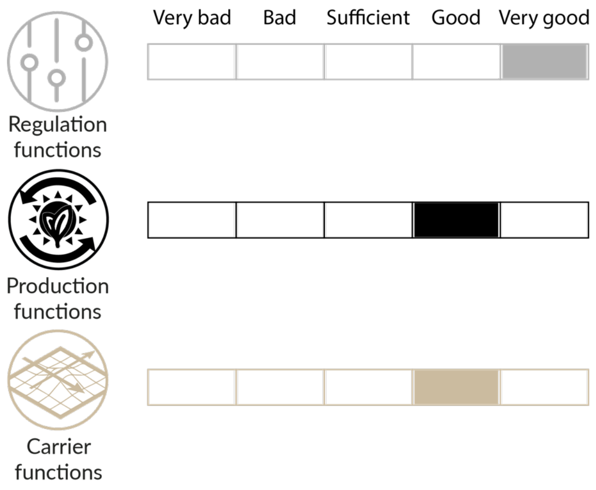




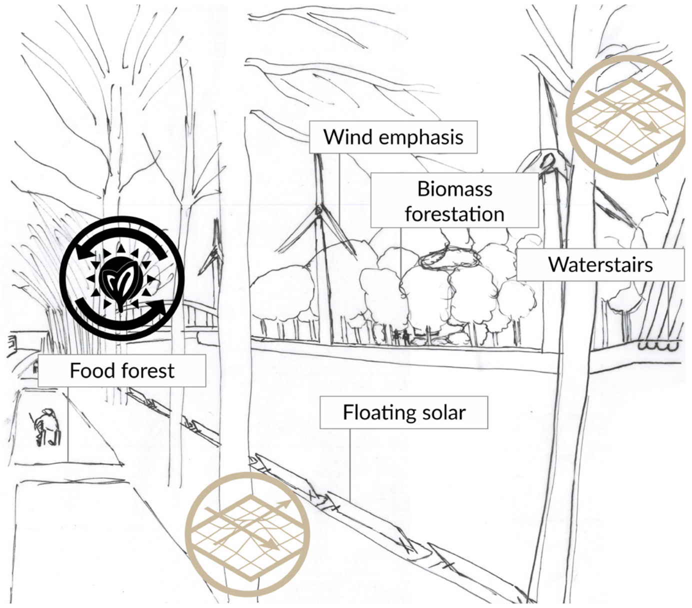
Design exploration | riverbank

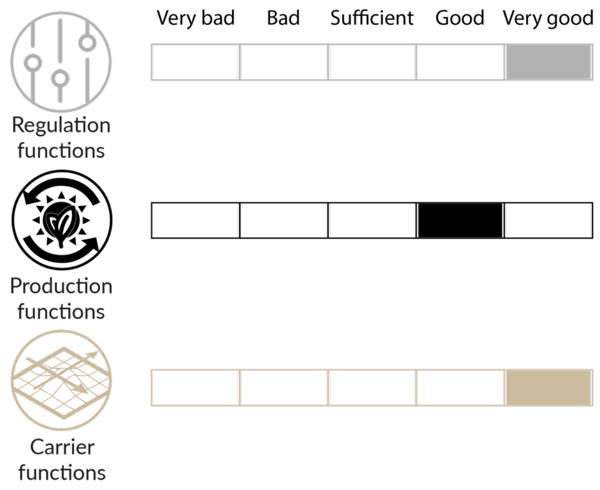
Optimistic scenario

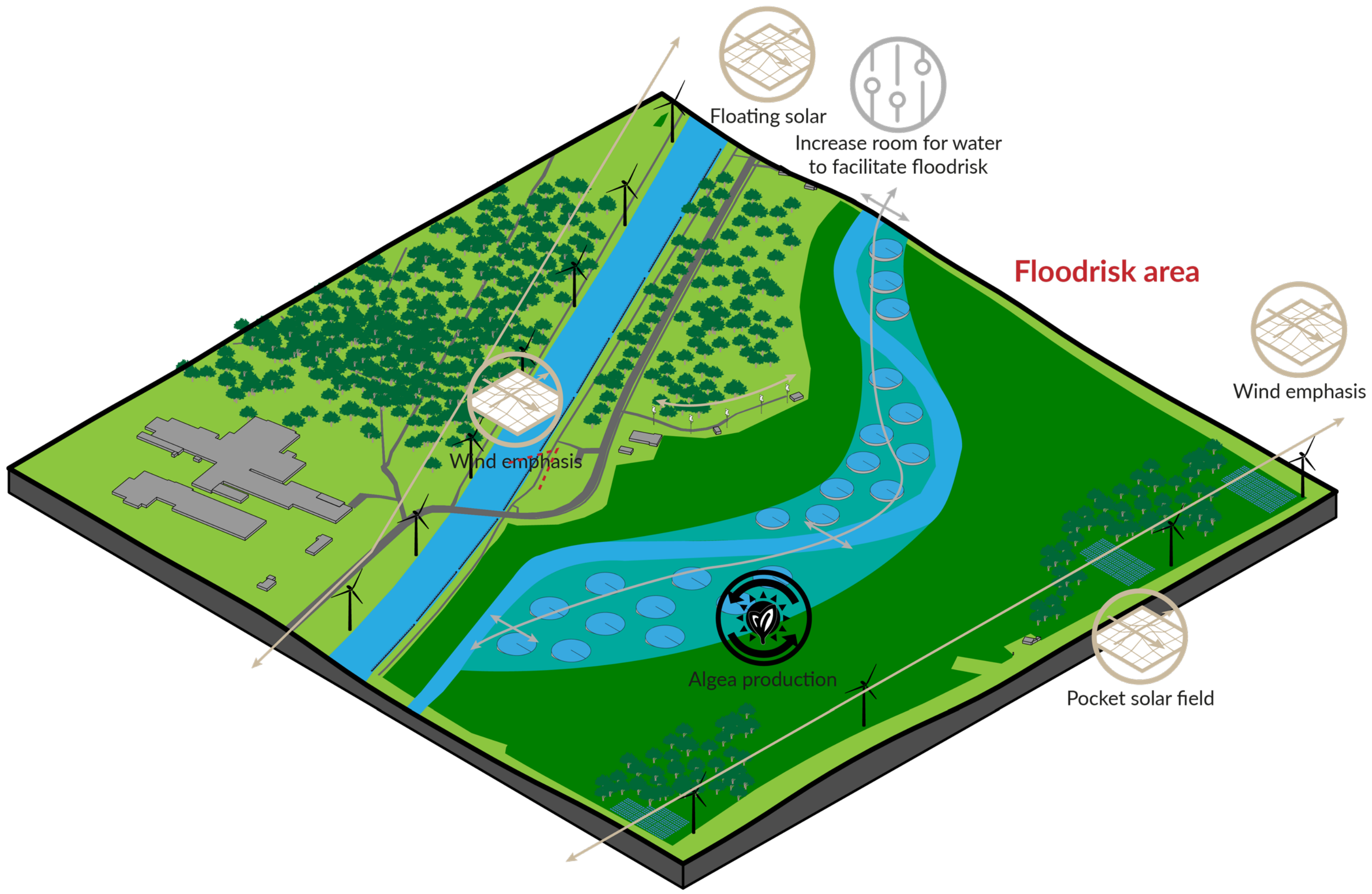




Pessimistic scenario

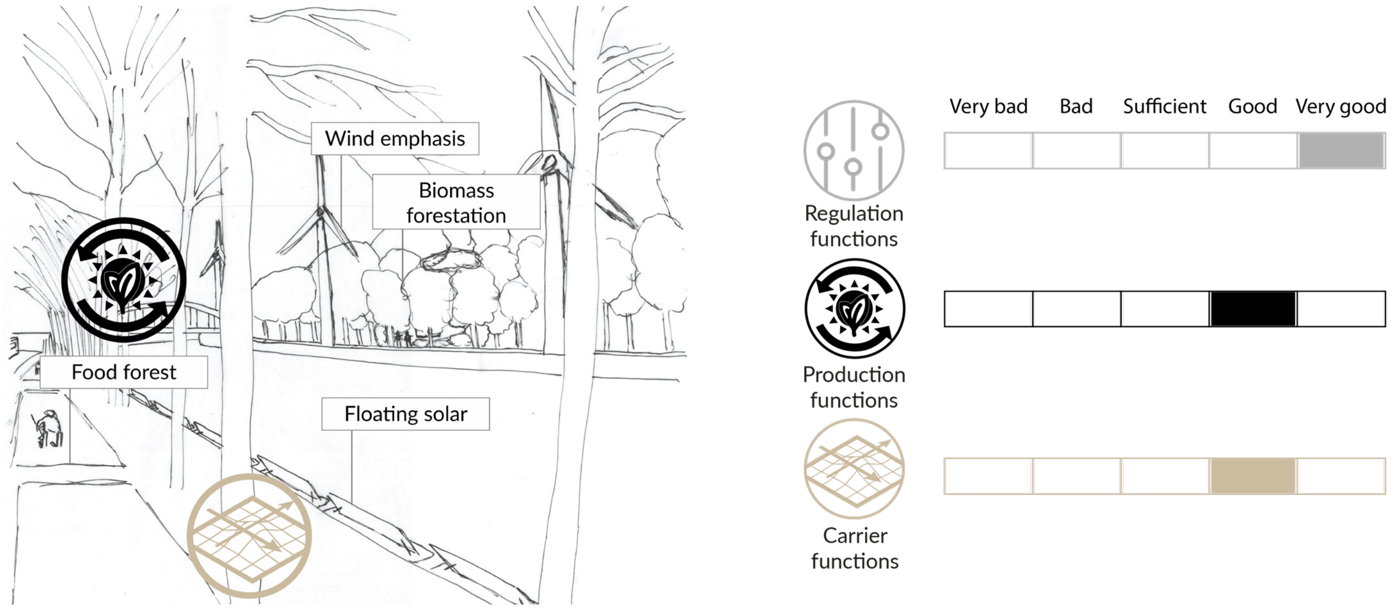


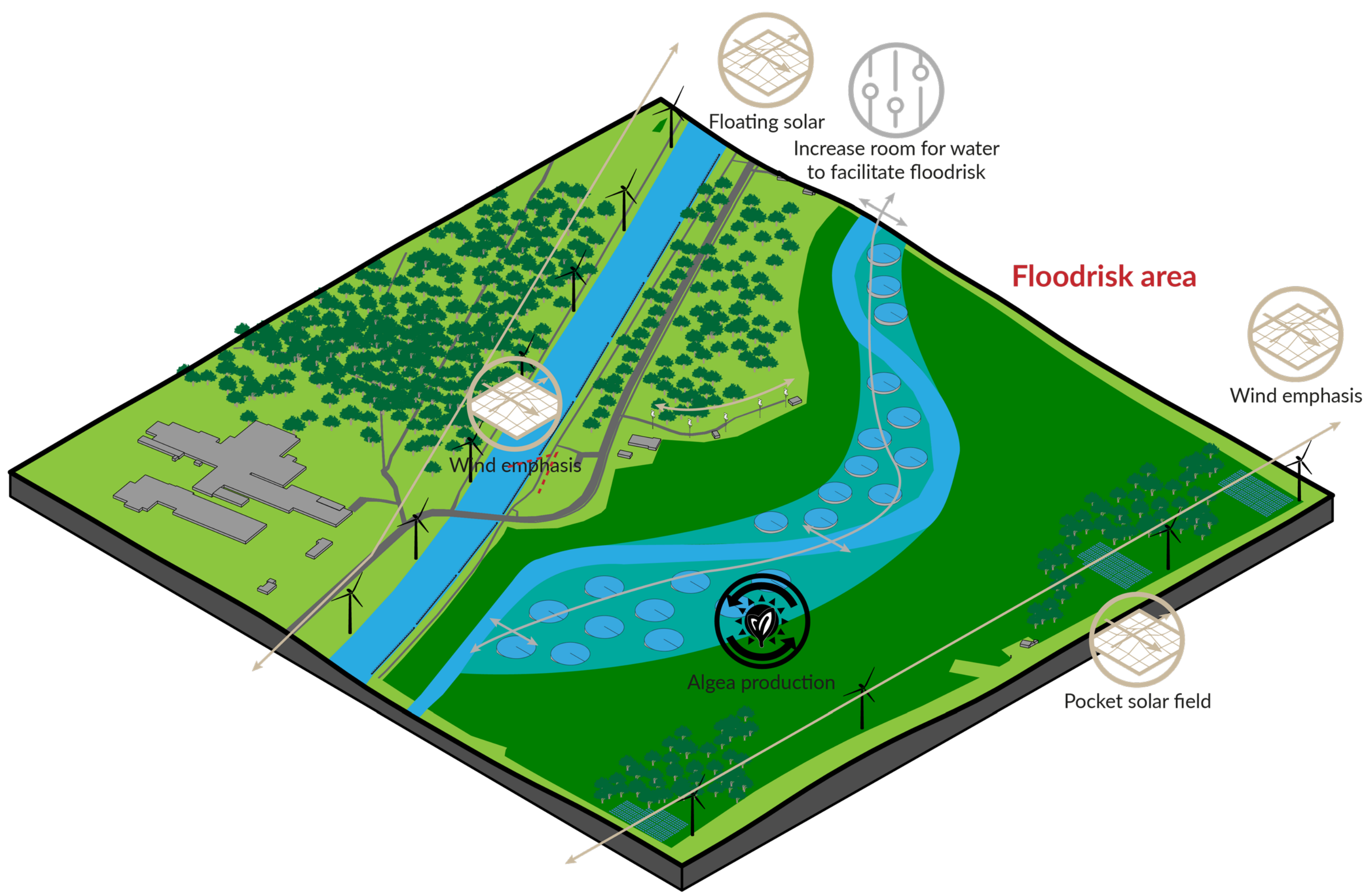




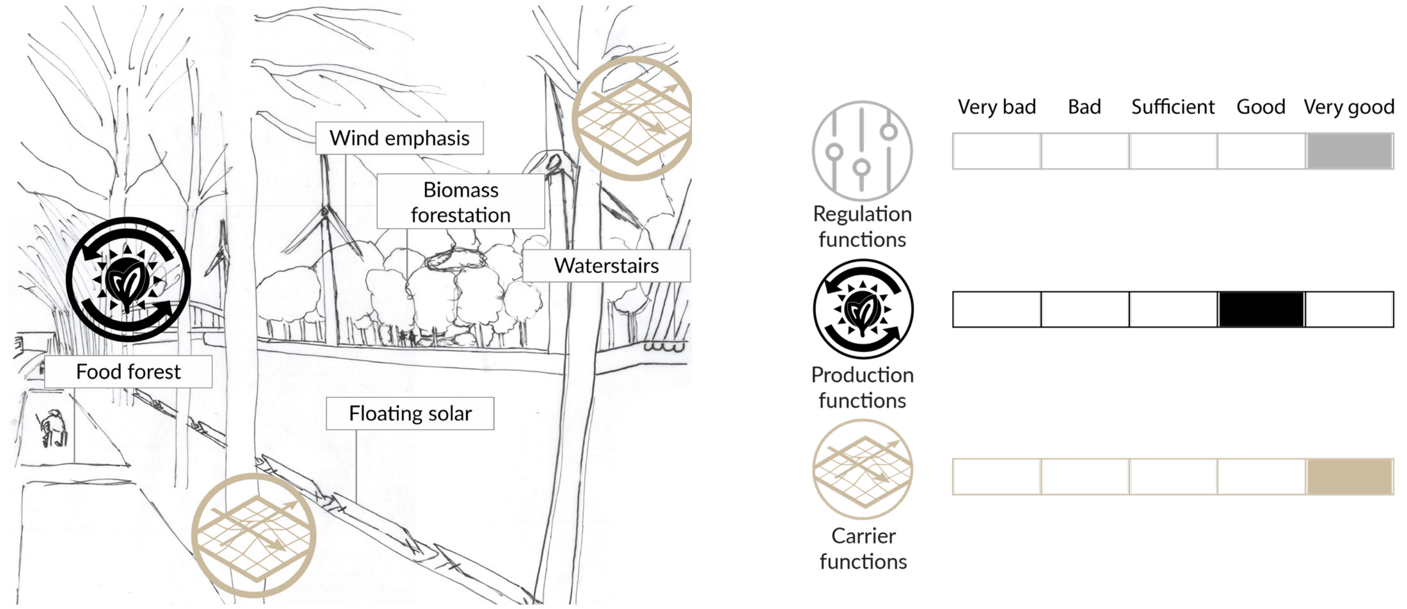
Design exploration | riverbank

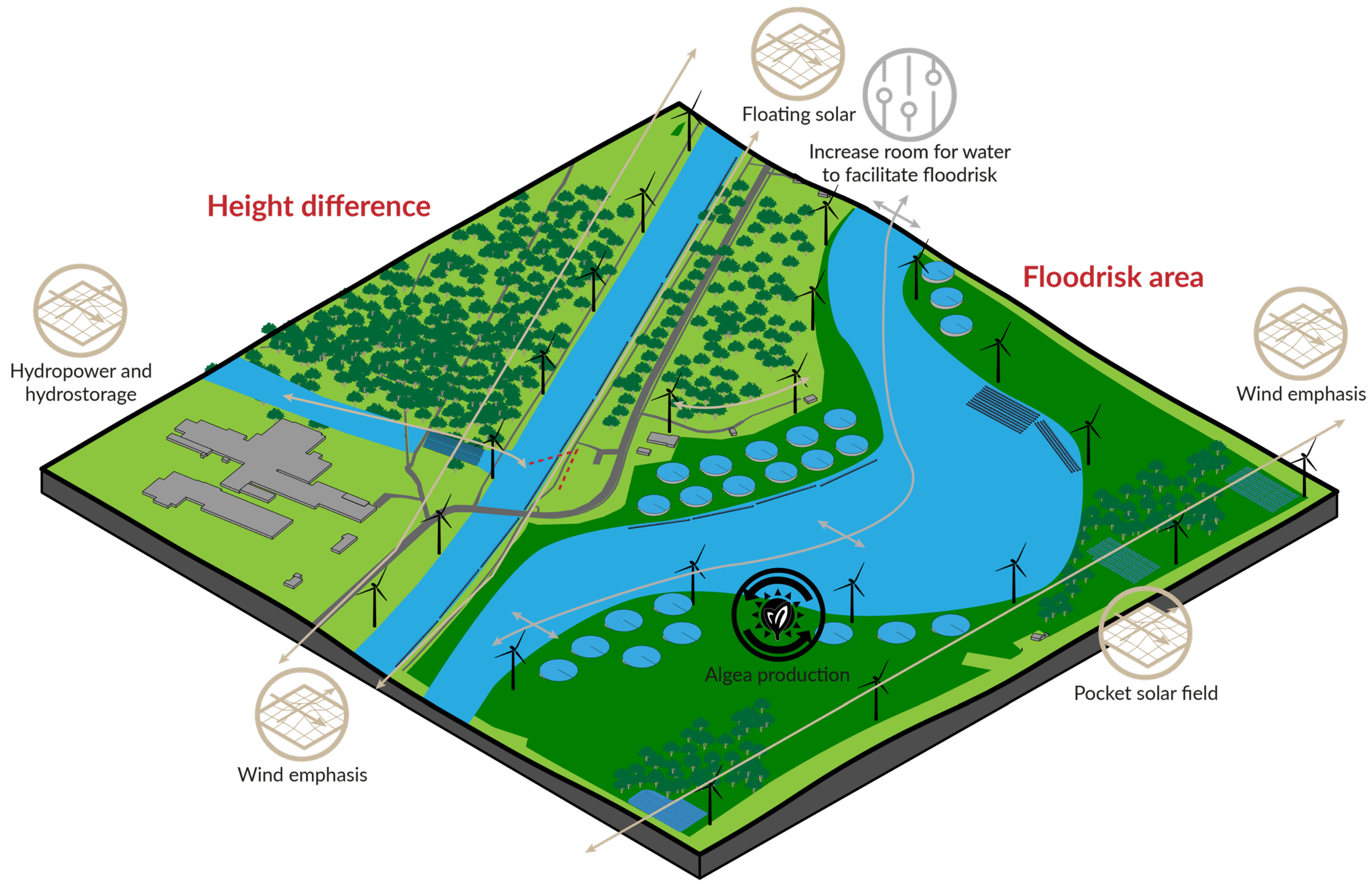
Optimistic scenario





Pessimistic scenario

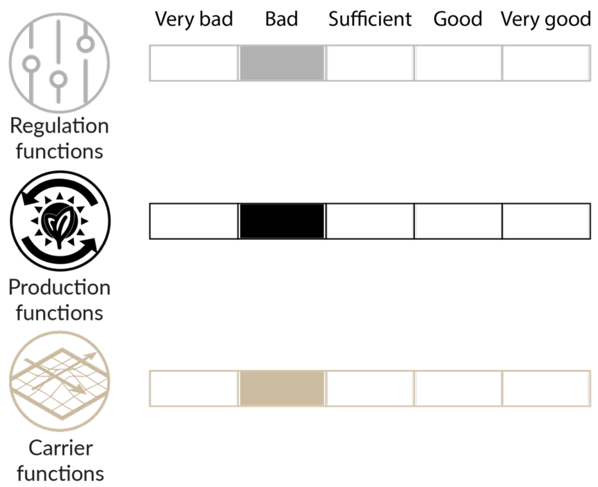




Green urban area

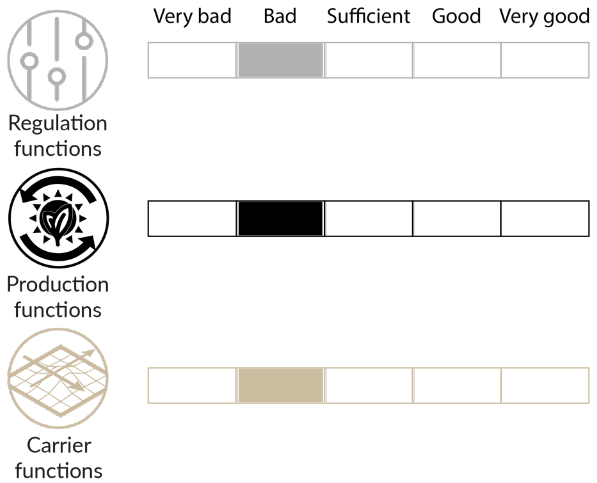
Design exploration | green urban area

Current situation



Design exploration | green urban area

Current situation



Design exploration | green urban area

Current situation

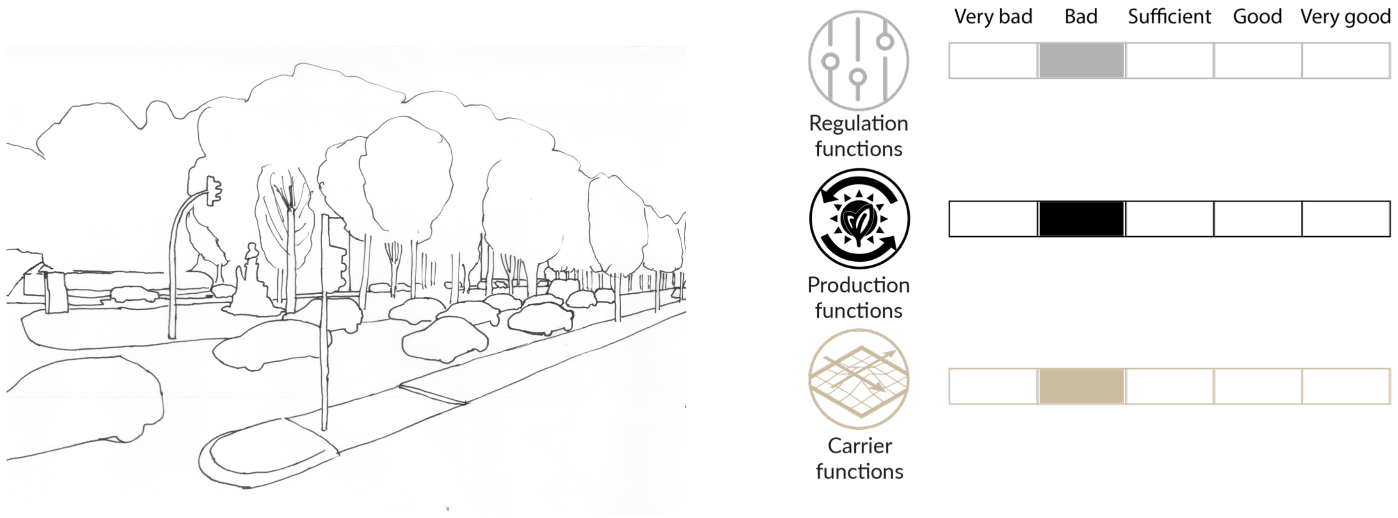
	Very bad	Bad	Sufficient	Good	Very good
Regulation functions		■			
Production functions		■			
Carrier functions		■			

Optimistic scenario

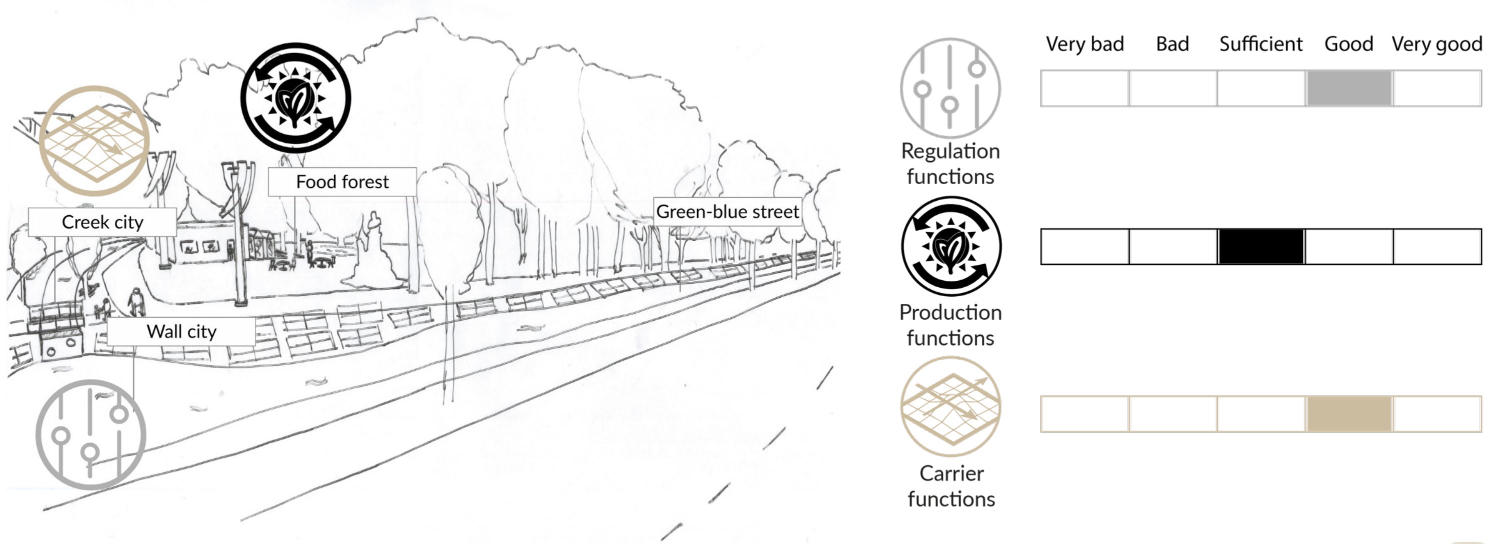
	Very bad	Bad	Sufficient	Good	Very good
Regulation functions				■	
Production functions			■		
Carrier functions				■	

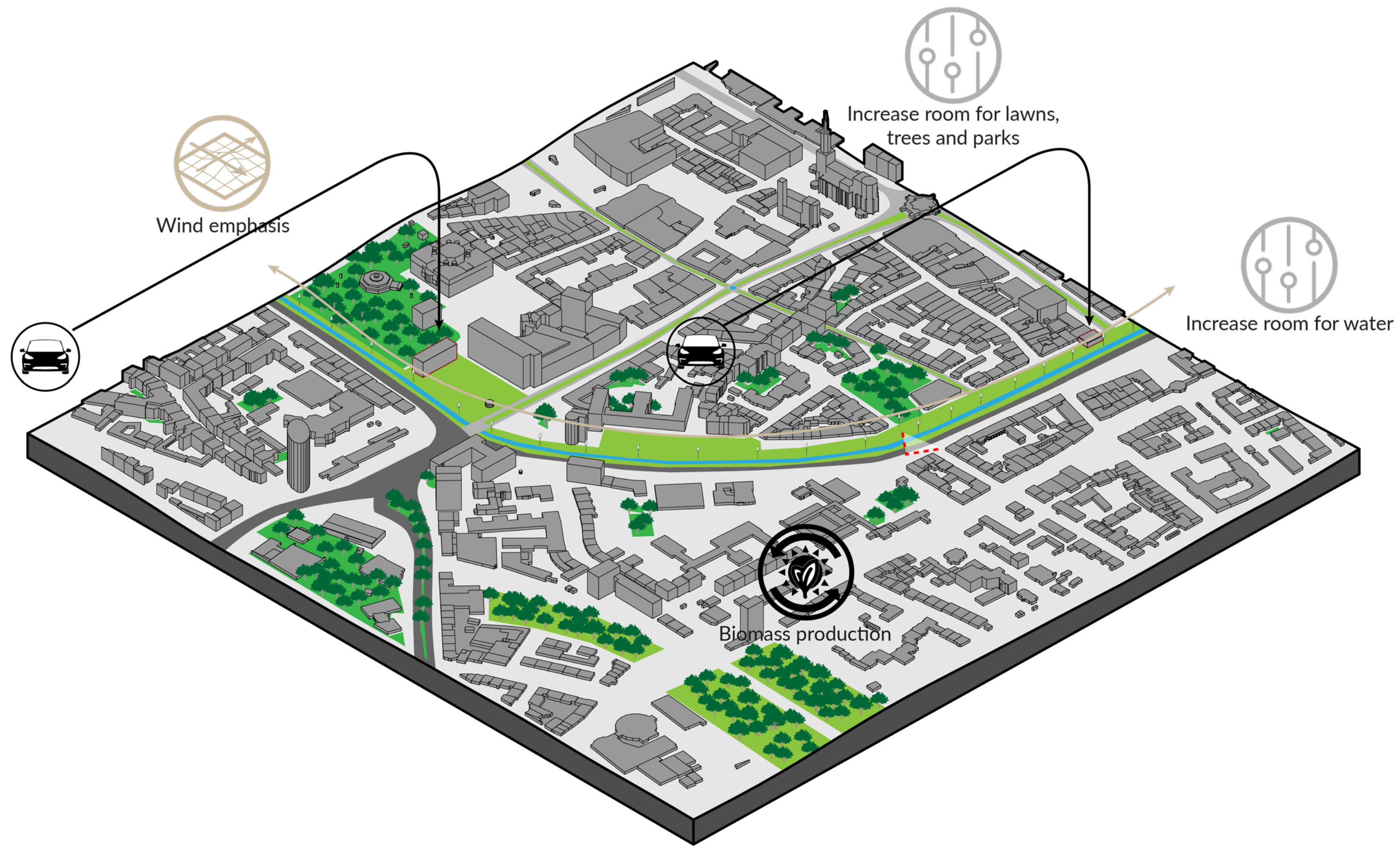
Design exploration | green urban area

Current situation



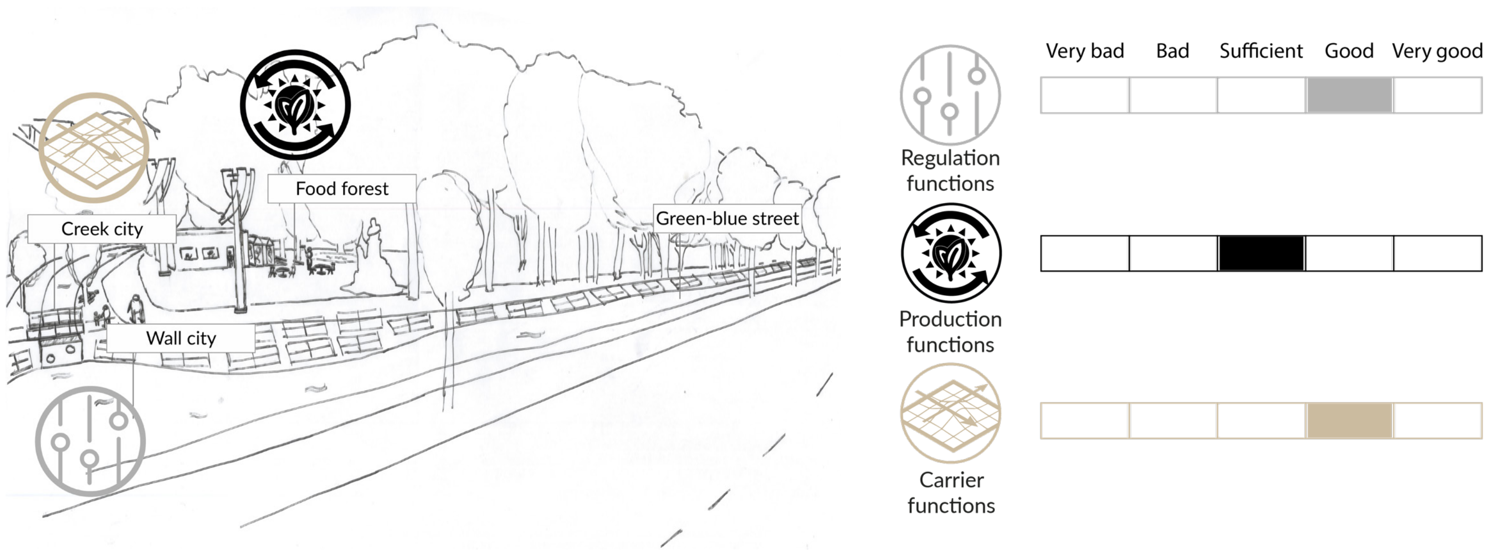
Optimistic scenario



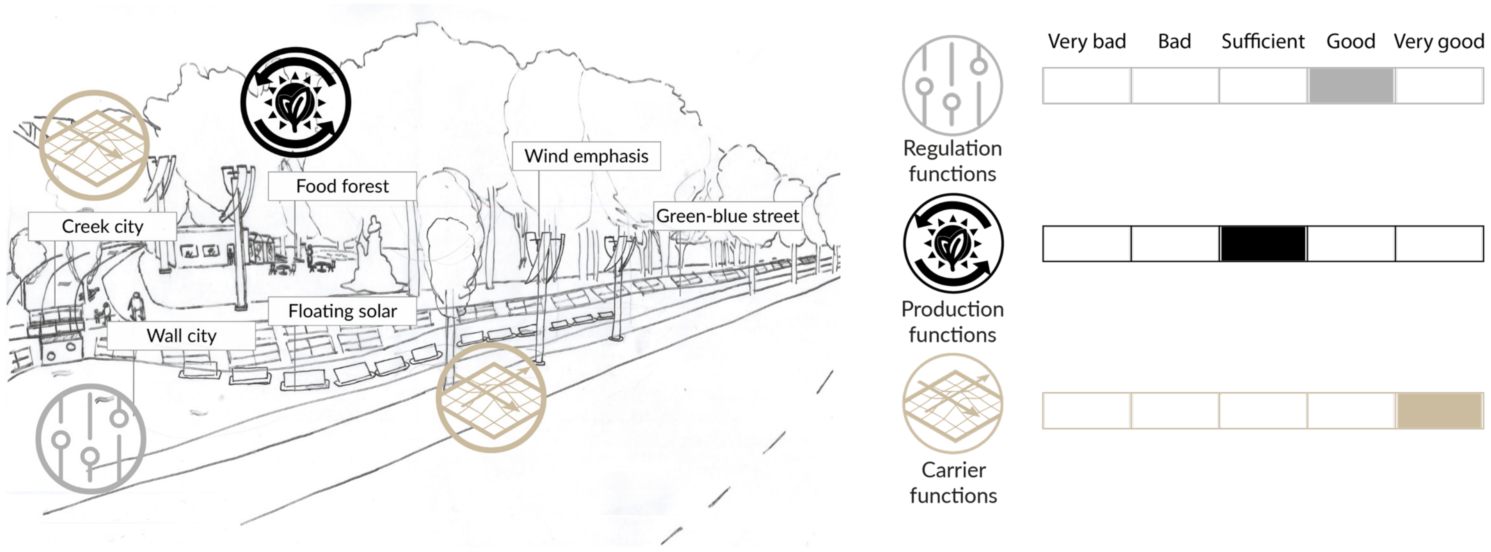


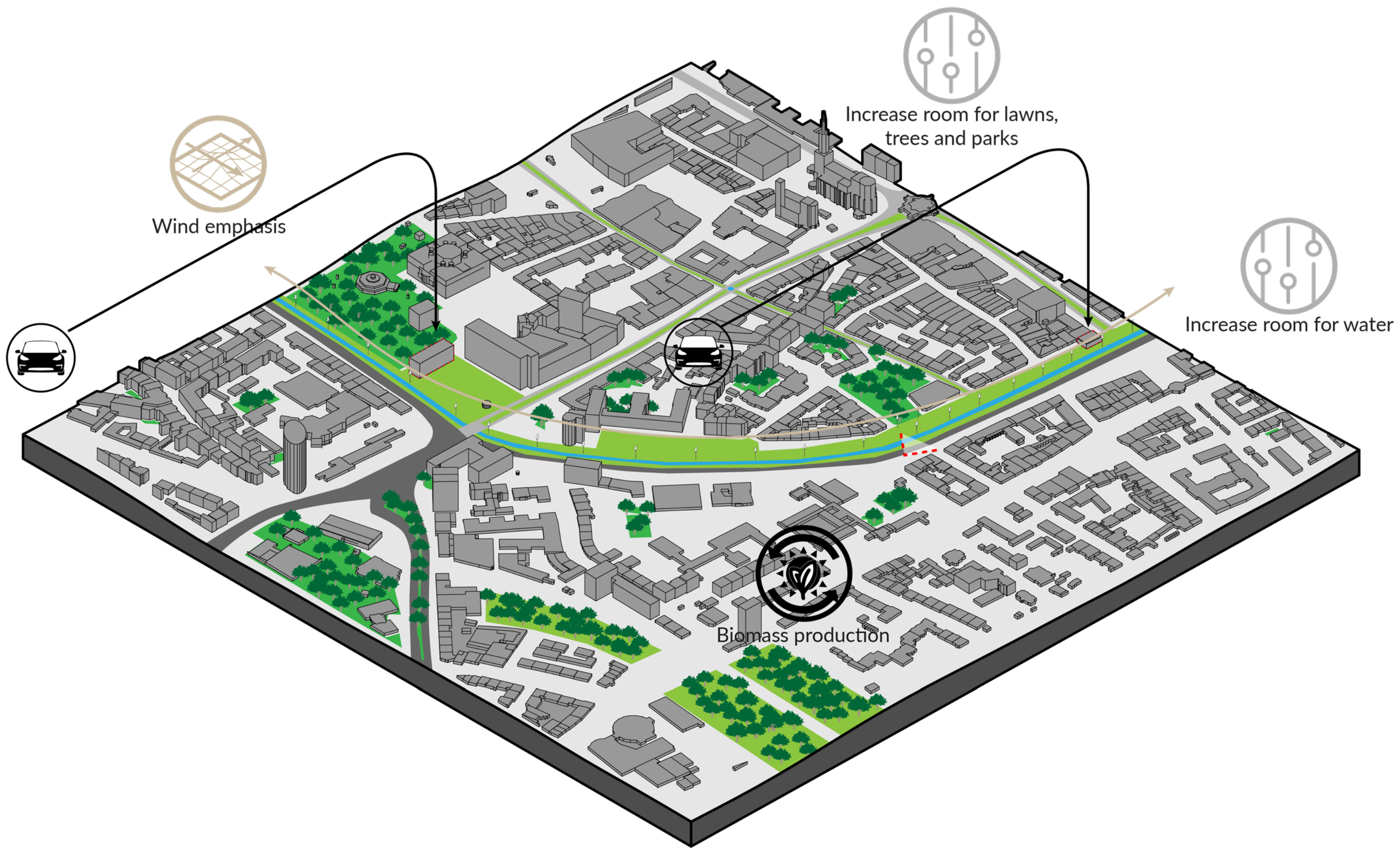
Design exploration | green urban area

Optimistic scenario



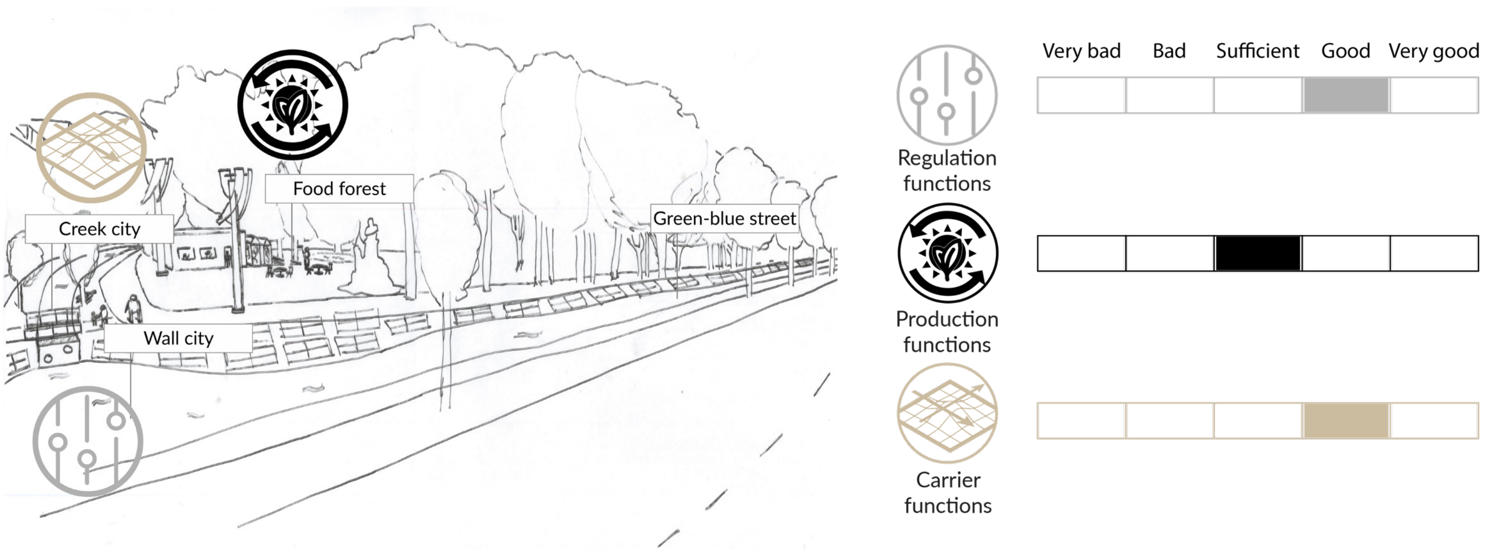
Pessimistic scenario



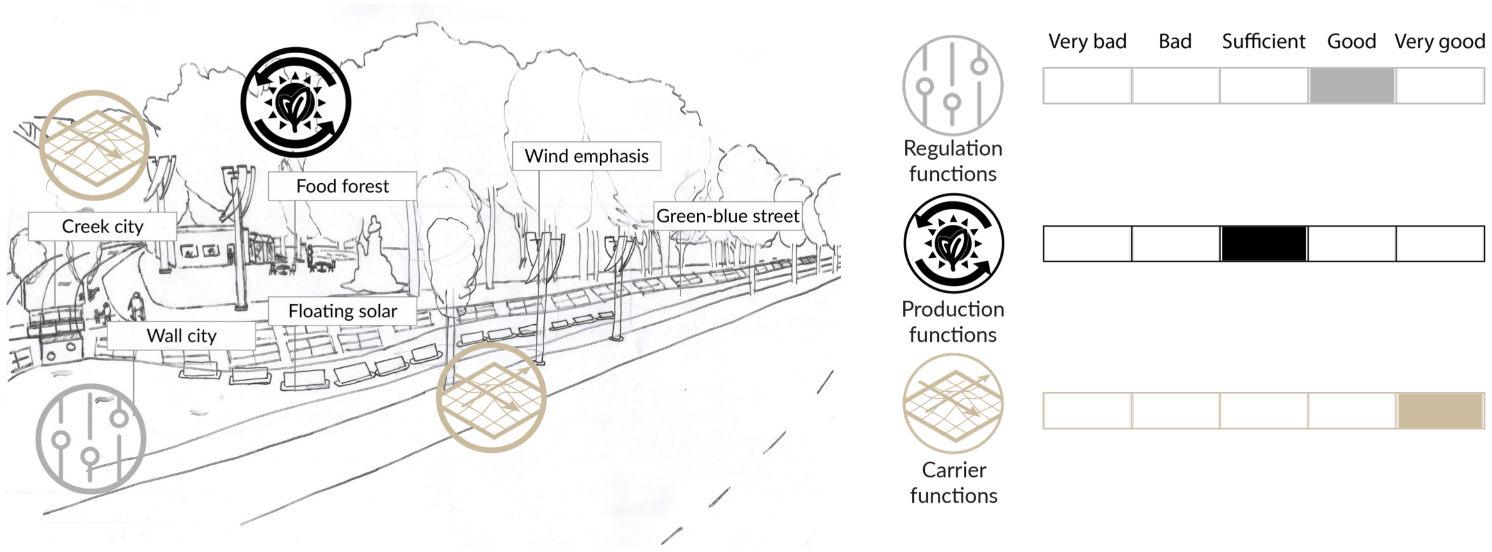


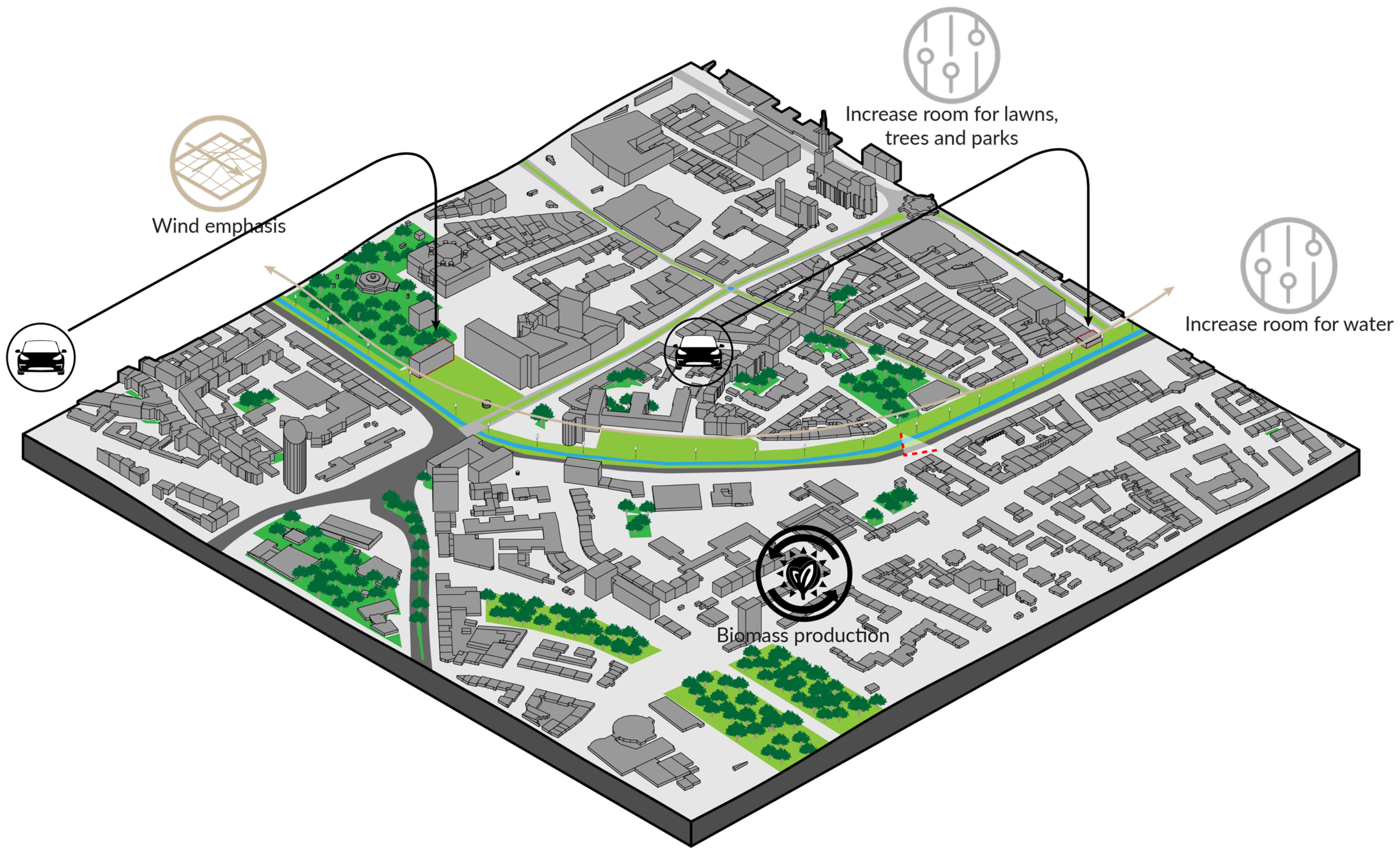
Design exploration | green urban area

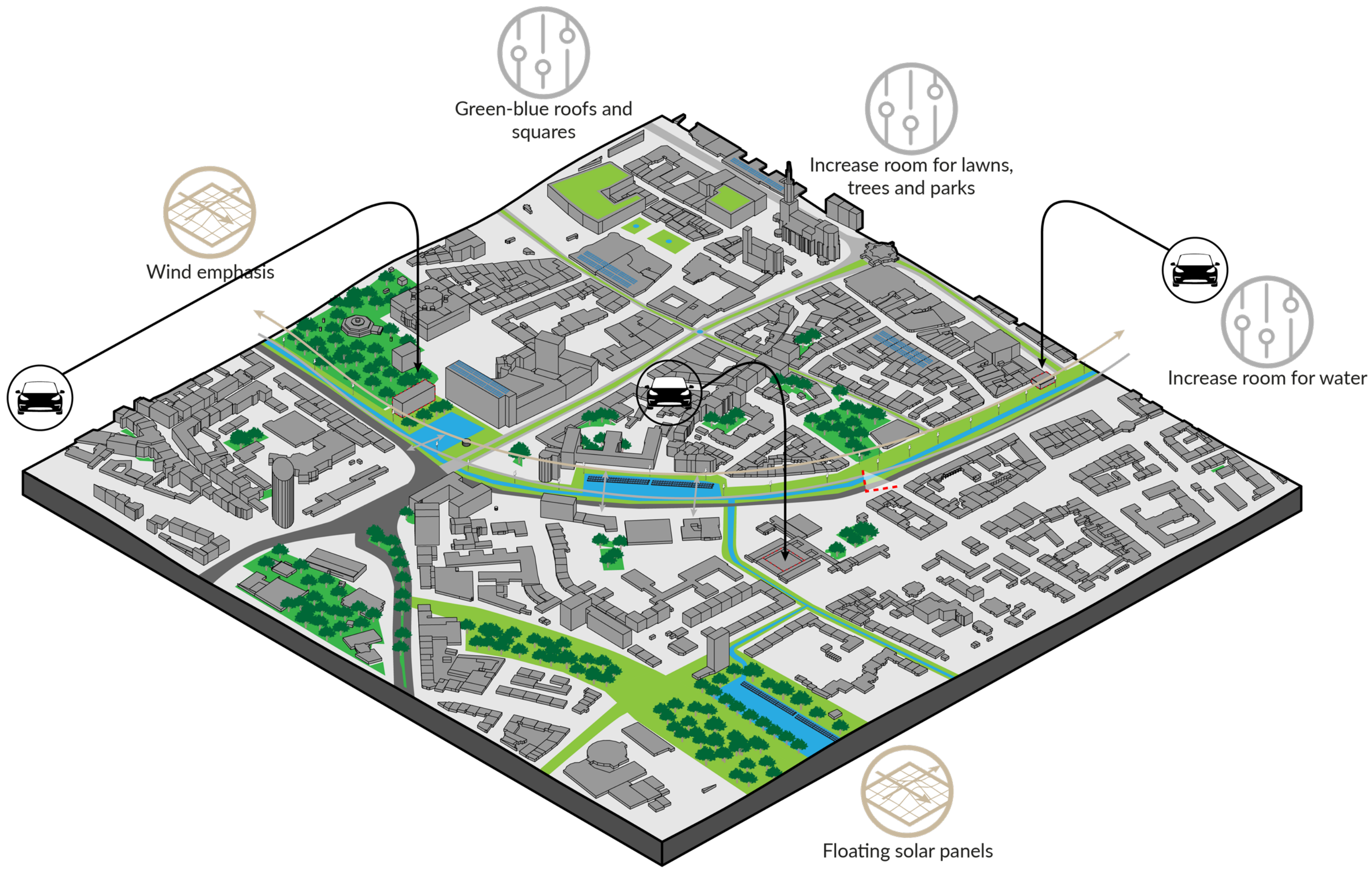
Optimistic scenario



Pessimistic scenario



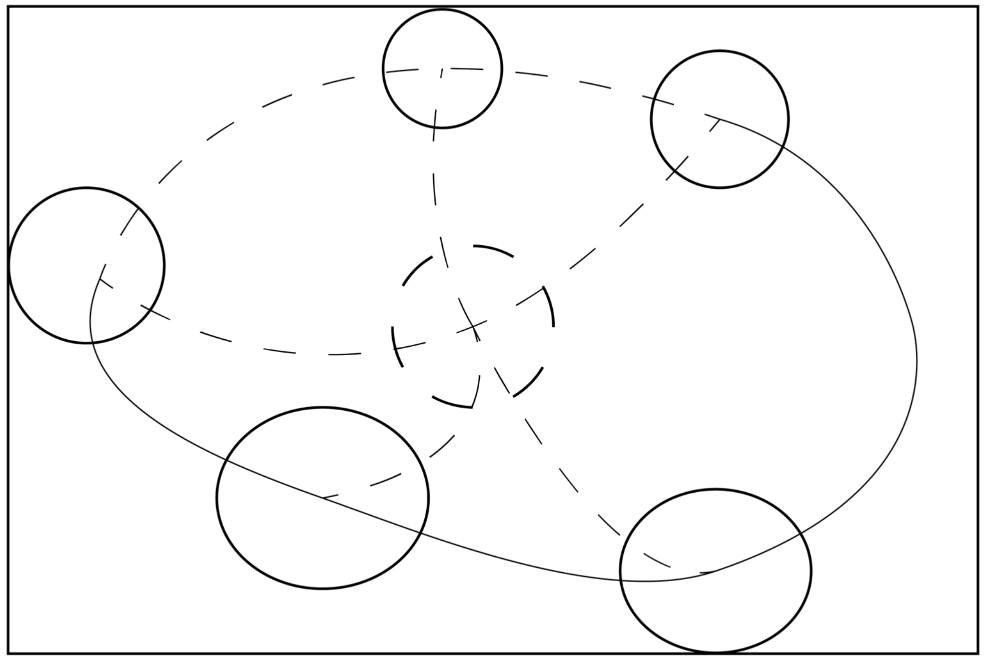




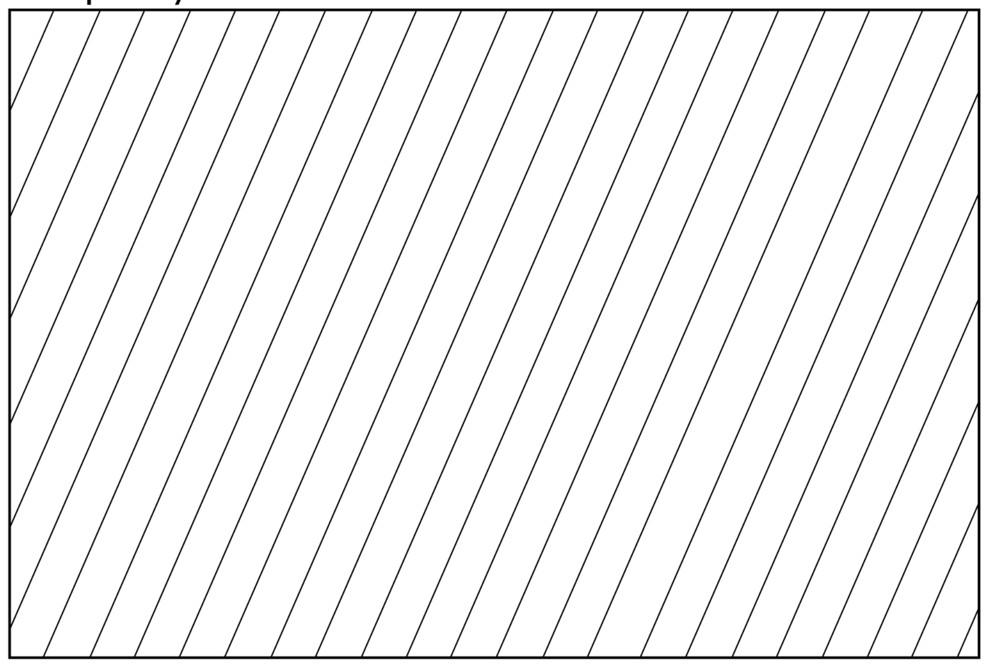
Design exploration | conclusions

Optimistic scenario - **Connect & Complement**

Network



Buffer capacity



New node in ecosystem network

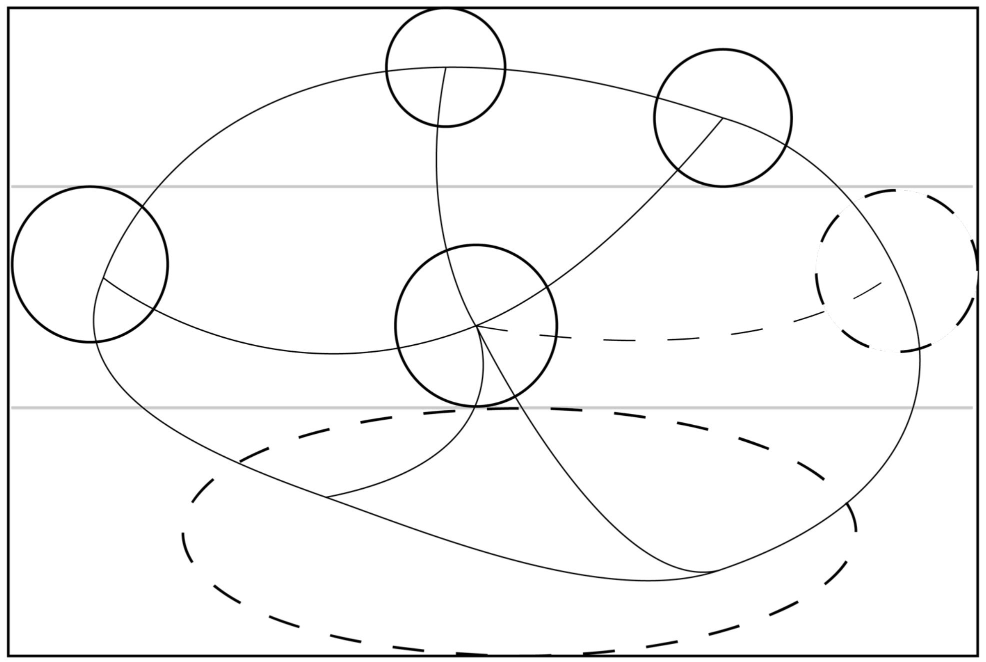
Node in ecosystem network

New connection in ecosystem network

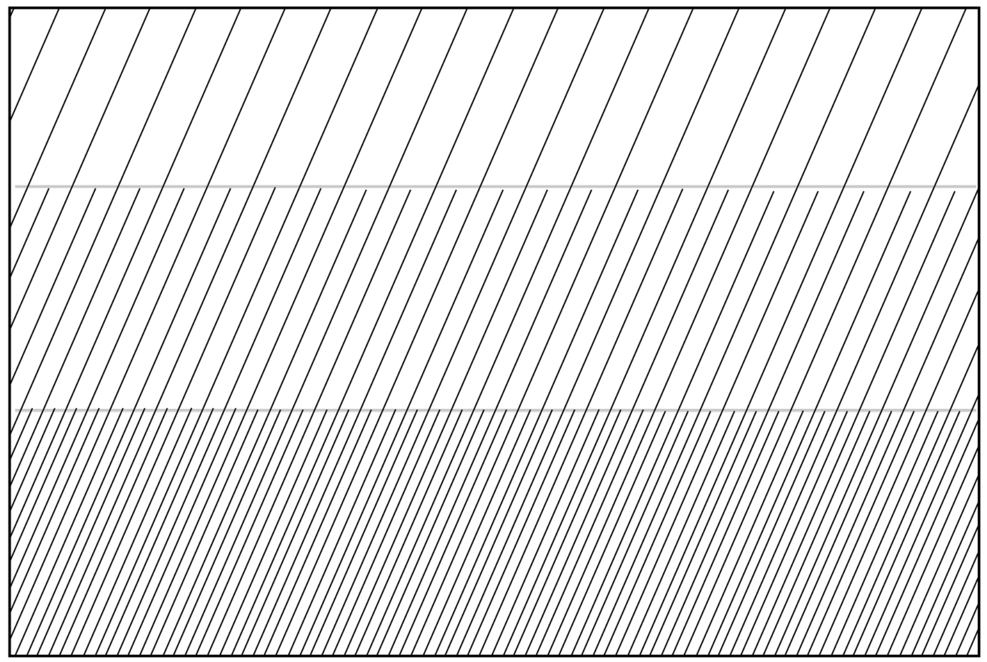
Connection in ecosystem network

Pessimistic scenario - **Buffer capacity (as) main driver**

Network



Buffer capacity



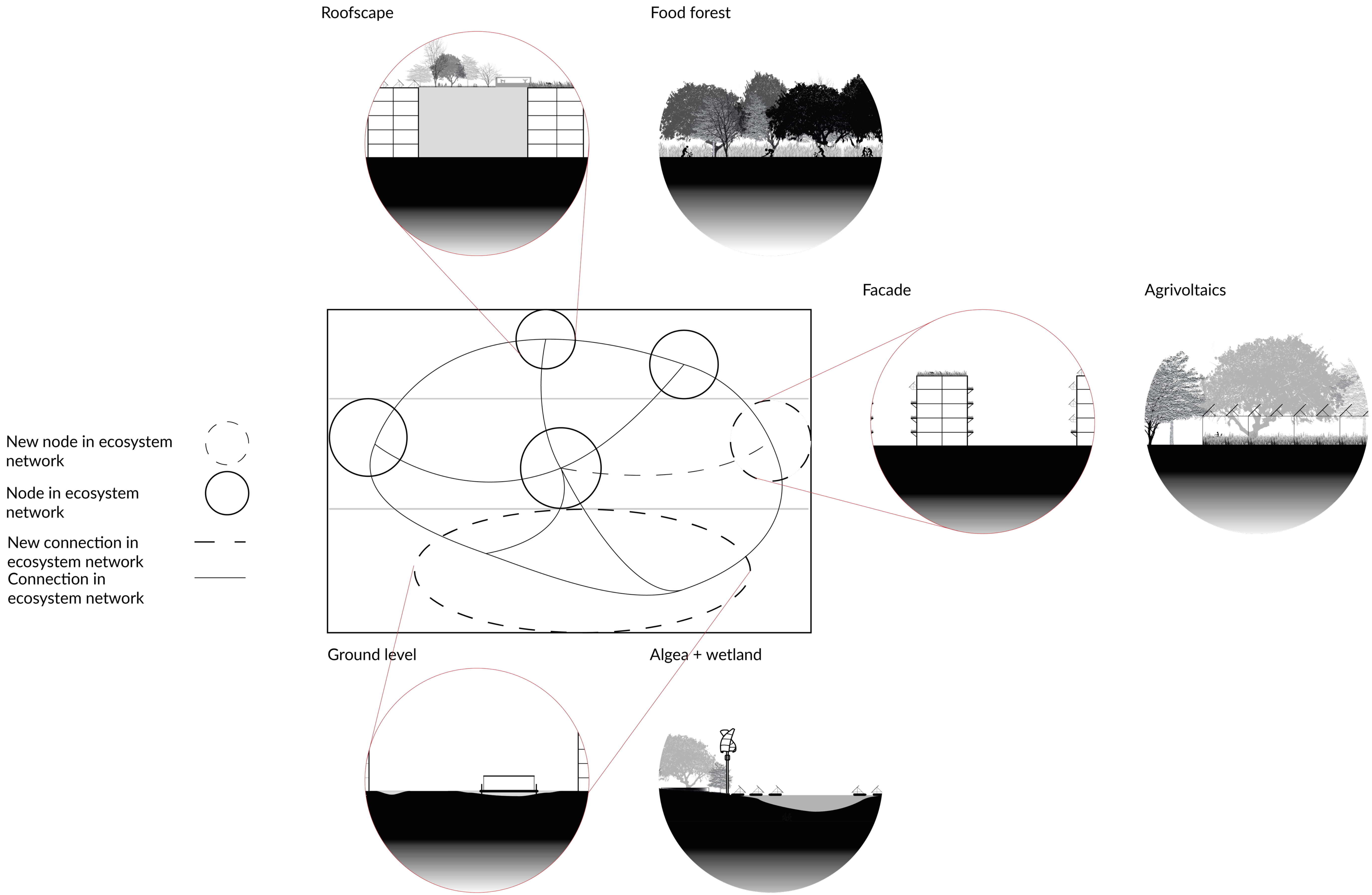
New node in ecosystem network

Node in ecosystem network

New connection in ecosystem network

Connection in ecosystem network

Design exploration | conclusions



Design exploration | patch strategy

Green urban area

Optimistic scenario

1 The implementation of the **Food forest**

1 The implementation of the **Hub city**

Parking spaces become available due to the implementation of hubs throughout the city

2 The implementation of the **Greenblue streets**

2 The implementation of the **Biomass forestation**

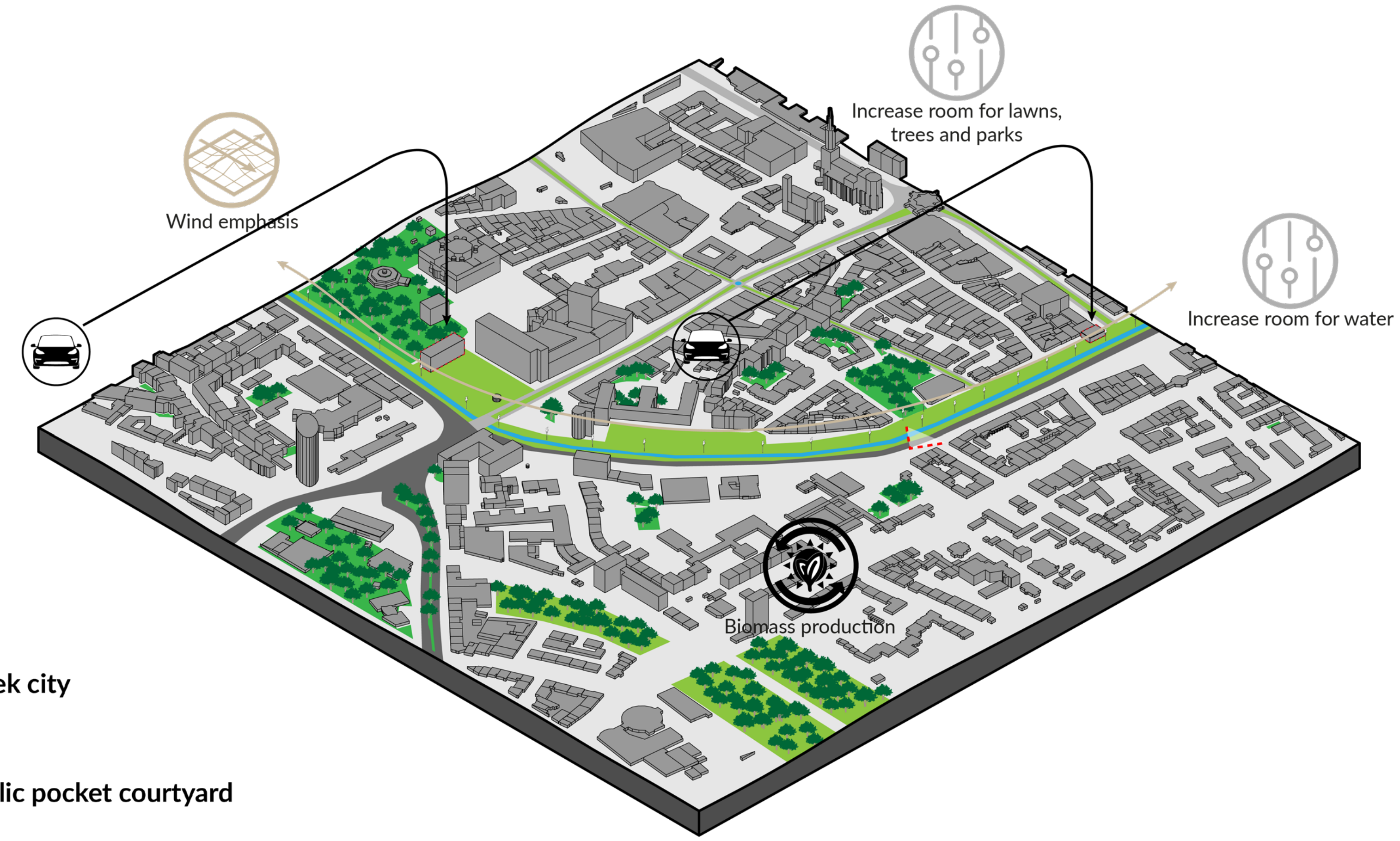
2 The implementation of the **Wall city**

2 The implementation of the **Wind emphasis**

Network (around core)

3 The implementation of the **Creek city**

3 The implementation of the **Public pocket courtyard**



Design exploration | patch strategy

Green urban area

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Network (in core & hydropower)

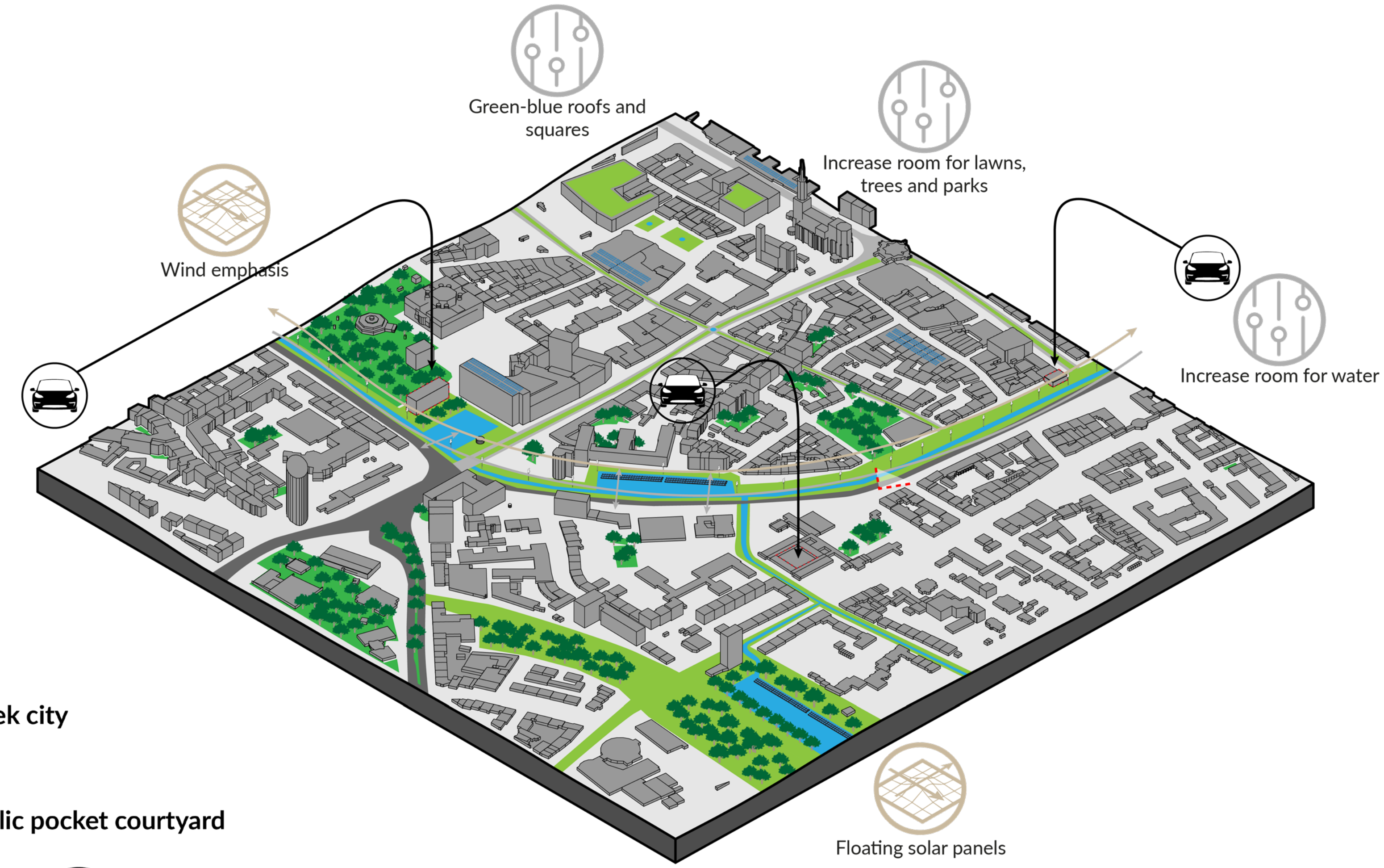
4 The implementation of the **Rooftop infrastructure**

4 The implementation of the **Water infrastructure**

Connected to water storage

5 The implementation of the **Floating solar**

Pessimistic scenario



Design exploration | local strategy

Green urban area

Optimistic scenario

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1 The implementation of the **Hub city**

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1 **Regulation & Subsidies**

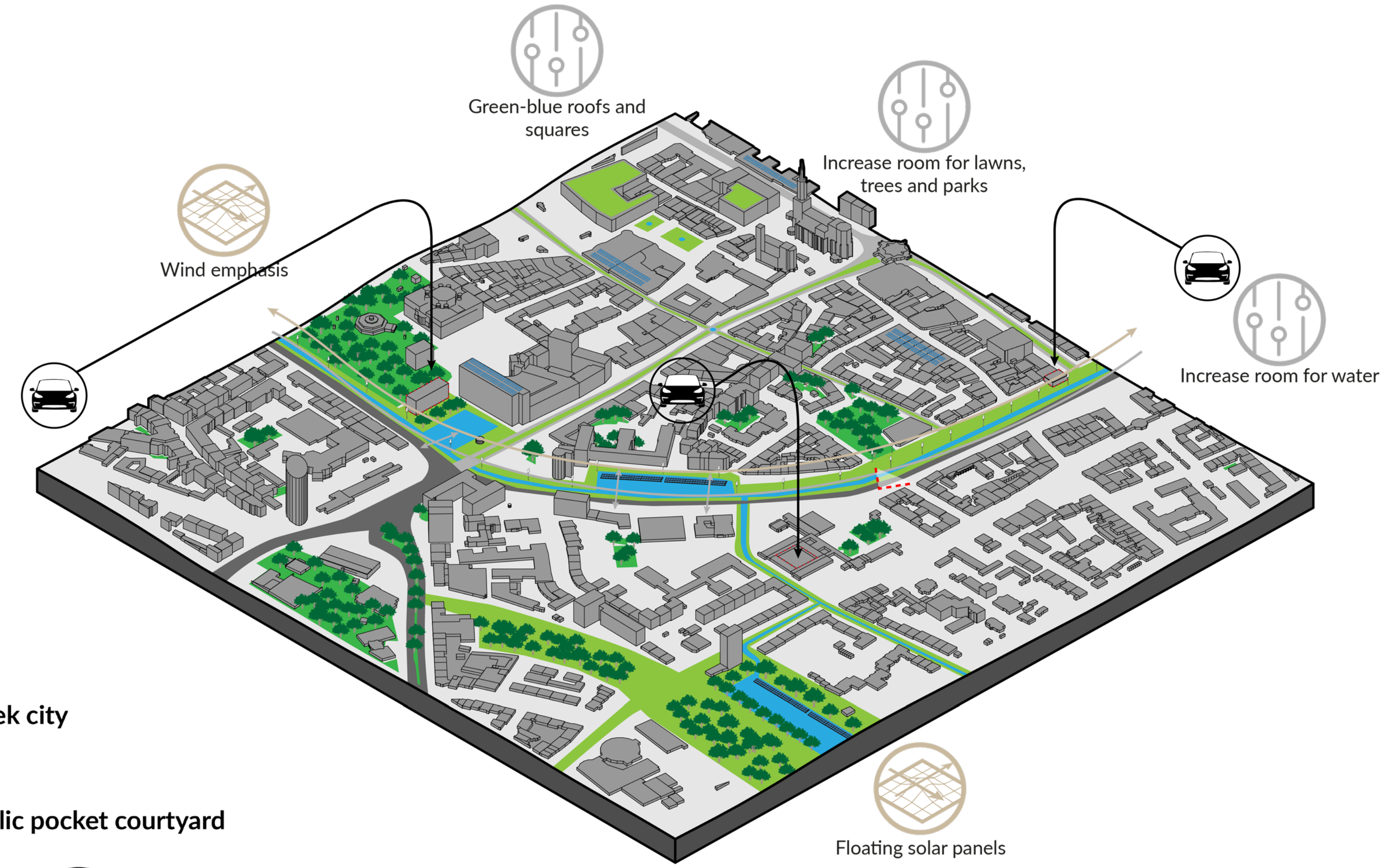
2 **Regulation**

3 **Subsidies**

4 **Regulations**

5 **Regulation**

Pessimistic scenario



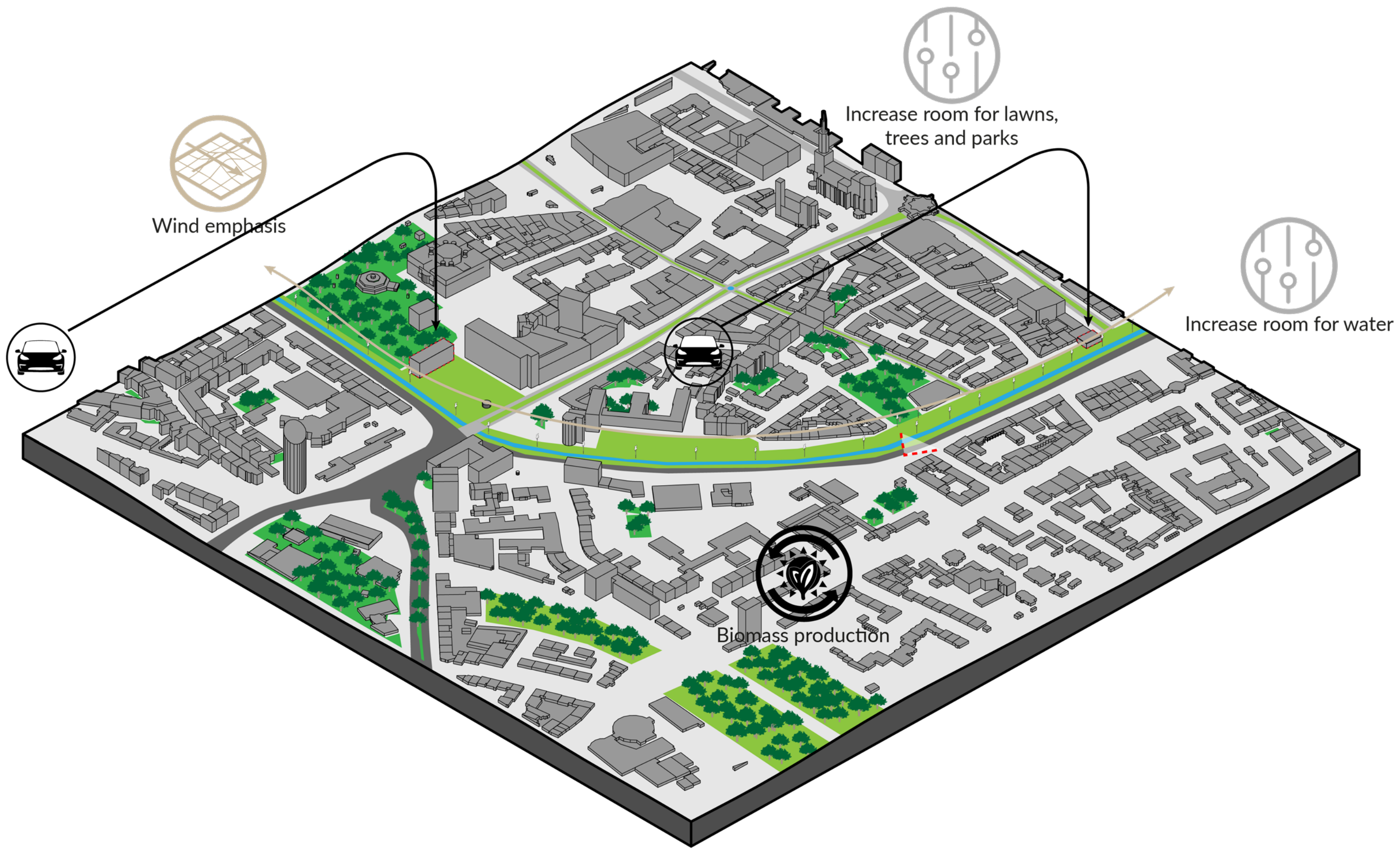
Design exploration | local hierarchy

Green urban areas

Concept for energy landscapes — Food forest
Energy landscape connection
Concept for mix — Creek city

Current state

Strategic component — Floodrisk area
Concept for climate adaptation — Wind emphasis
Climate adaptation connection



Floodrisk area

Current ecosystem

Waterbodies

Optimistic scenario

Hub city

Public pocket courtyard

Green-blue streets

Creek city

Food forest

Biomass forestation

Wall city

Wind emphasis

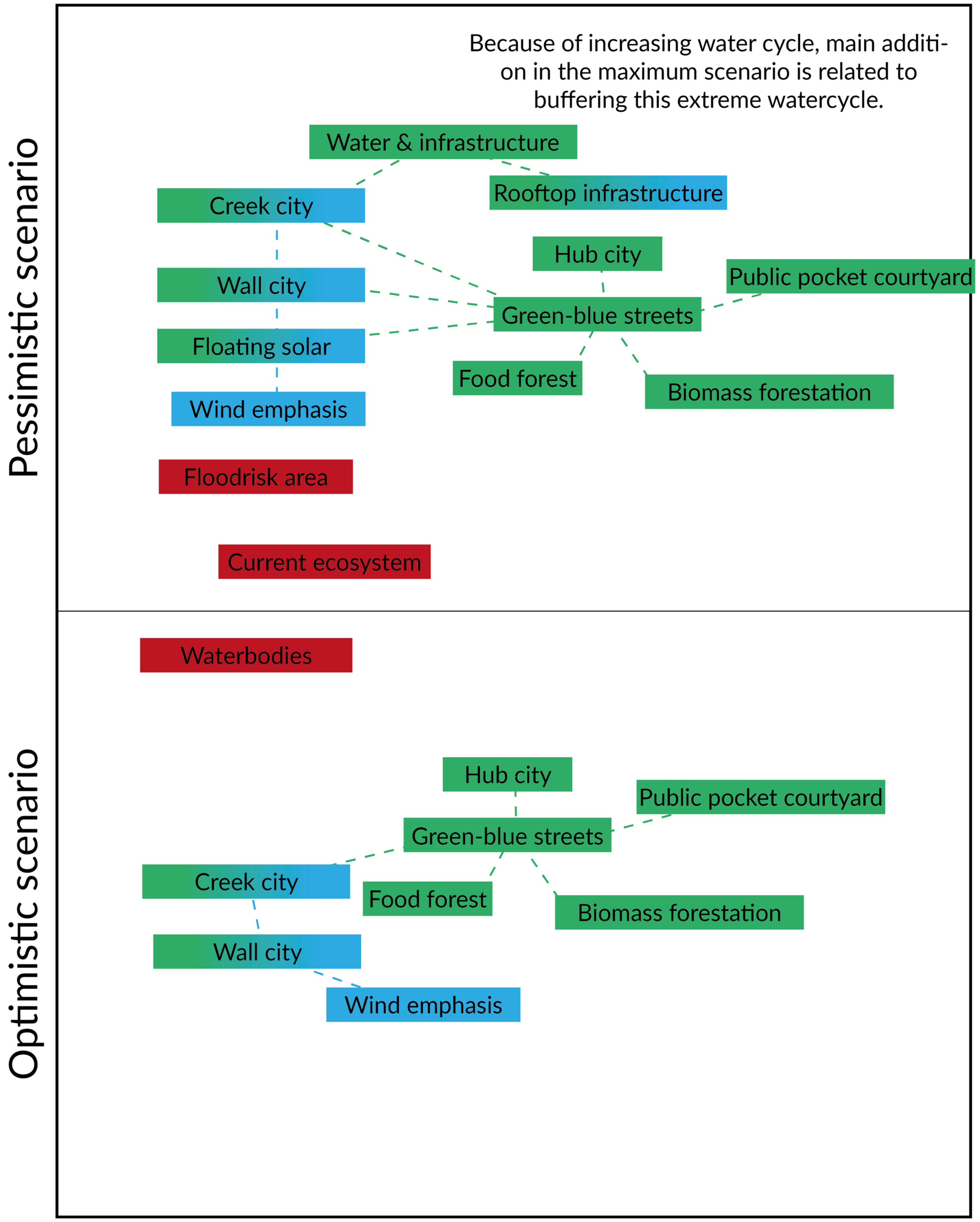
Design exploration | local hierarchy

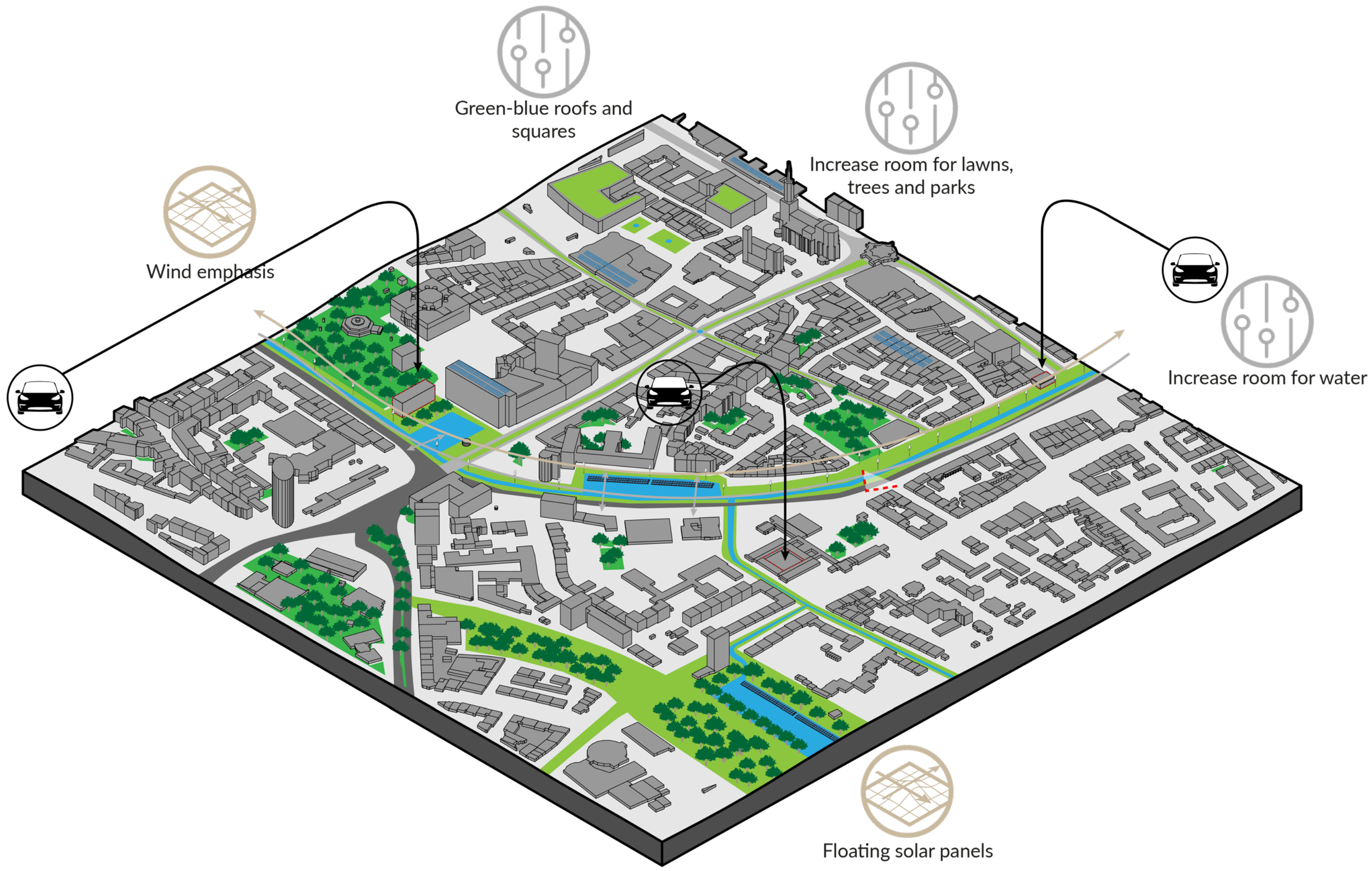
Green urban areas

Concept for energy landscapes — Food forest
Energy landscape connection
Concept for mix — Creek city

Strategic component — Floodrisk area
Concept for climate adaptation — Wind emphasis
Climate adaptation connection

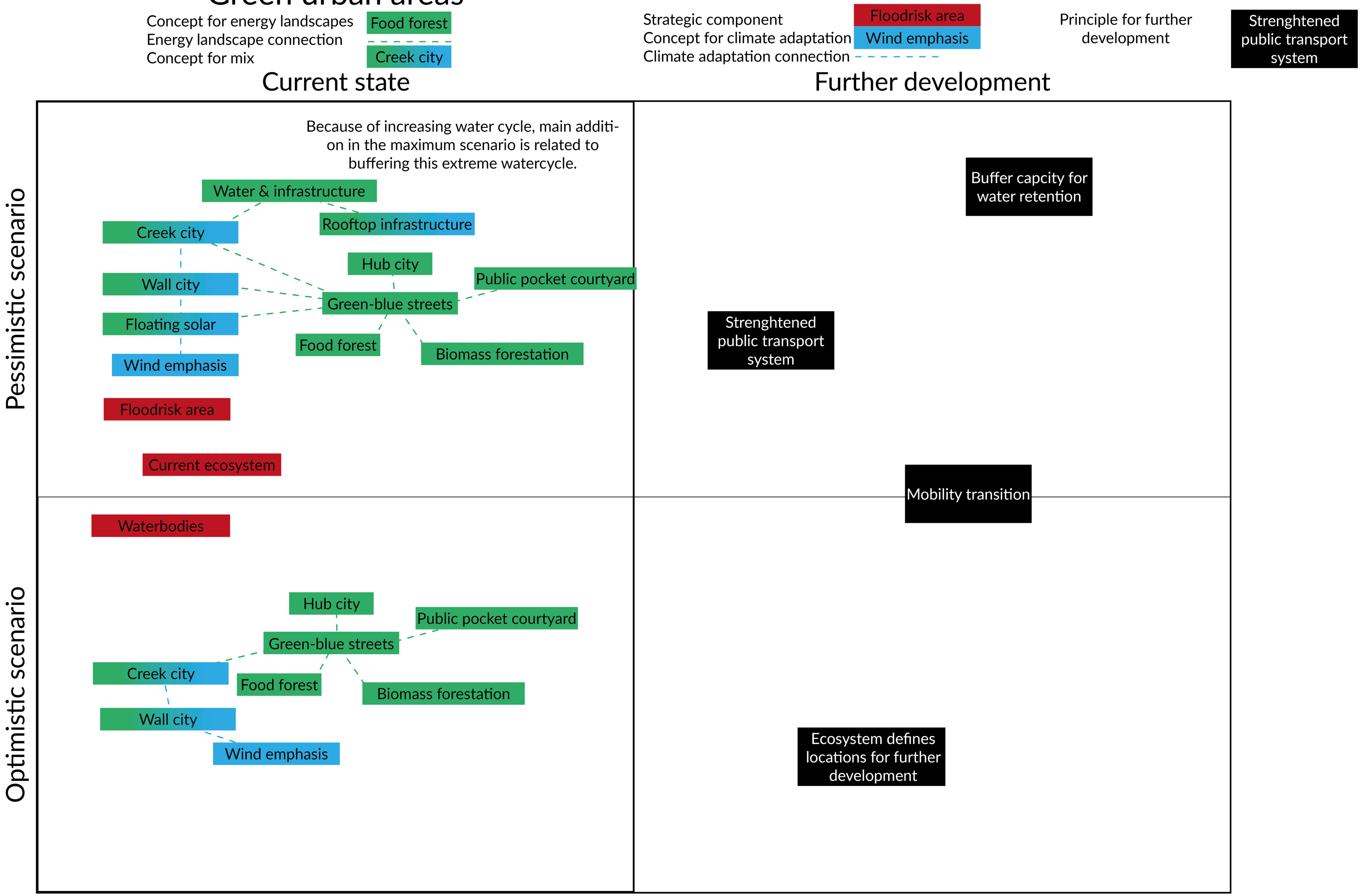
Current state





Design exploration | local hierarchy

Green urban areas



Design exploration | Strategic component

Floodrisk area

Current ecosystem

Waterbodies

Design exploration | strategic components

Category

Physical context

Floodrisk area

Height difference

Network of the context

Current ecosystem

Current energy network
human landscape

Functional context

Underused surfacas; roofs, streets, squares

Overpaved areas

Waterbodies

Current ecosystem

Design exploration | strategic components

Category

Physical context

Floodrisk area

Regulation functions · Production functions · Carrier functions

Height difference

Regulation functions · Production functions · Carrier functions

Network of the context

Current ecosystem

Regulation functions

Current energy network human landscape

Regulation functions · Production functions · Carrier functions

Functional context

Underused surfacas; roofs, streets, squares

Regulation functions · Production functions · Carrier functions

Overpaved areas

Regulation functions · Production functions · Carrier functions

Waterbodies

Regulation functions

Current ecosystem

Regulation functions · Production functions · Carrier functions

Strategy building | tasks per governance level

Scenario

Current situation	Optimistic scenario	Pessimistic scenario

Governance level

State level:
North-Rhine Westphalia

Incentivice, start and monitor paradigm shifts.
Create framework for compensation of people.

Regional level:
Regional Ruhr association

Define program requirements, start implementation, track of development, adjust concepts to changing scenarios.

Local level:
Municipalities

Implement concepts in local scale and adjust concepts to meet local demands.
Co-create final implementati-on with residents and users.

Strategy building | principles

Scenario

Current situation

Optimistic scenario

Pessimistic scenario

Governance level

Inform about behavioral change

Subsidies

State level:
North-Rhine Westphalia

Rules & regulations to transform concepts and implement new concepts

Allocate additional subsidies when moving from optimistic to pessimistic scenario

Regional level:
Regional Ruhr association

Rules, regulations & information about project implementation

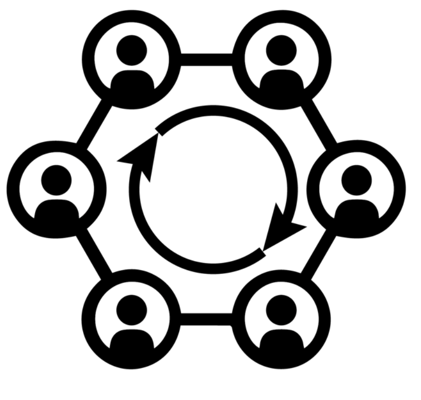
Local level:
Municipalities

Changes can be made on local scale to integrate solutions for other problems

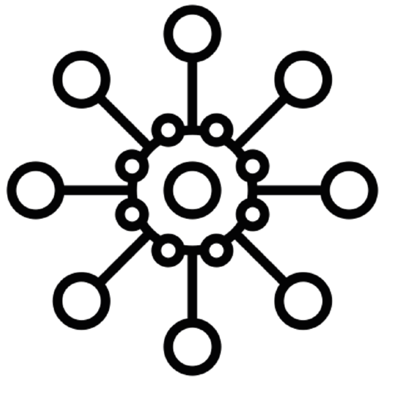
Adding local rules and regulations to project in regards to local problems. Implement projects into local area.

With the prospect of a rise of 2.5 degree in the near future, new concepts can be implemtented

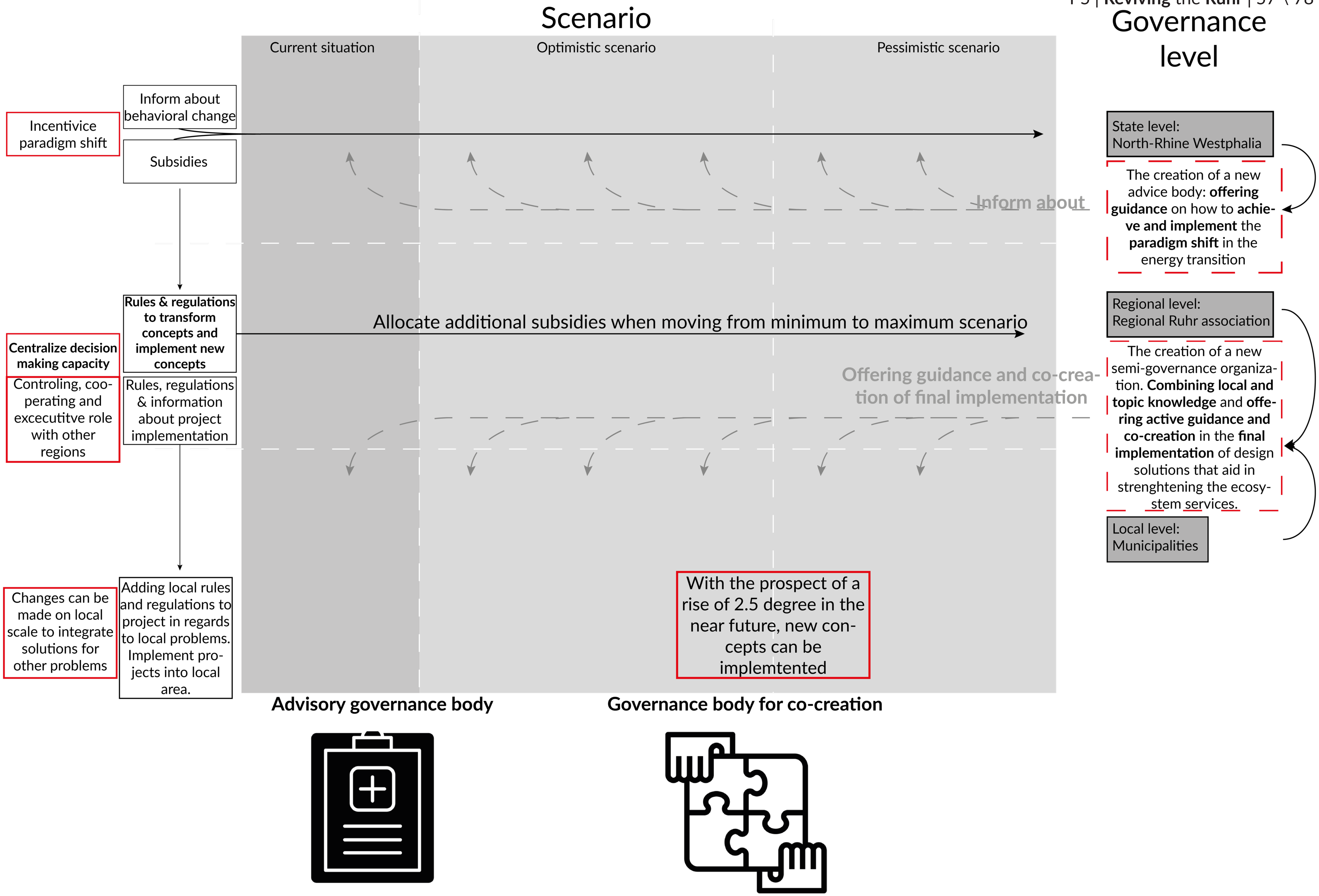
Social transition



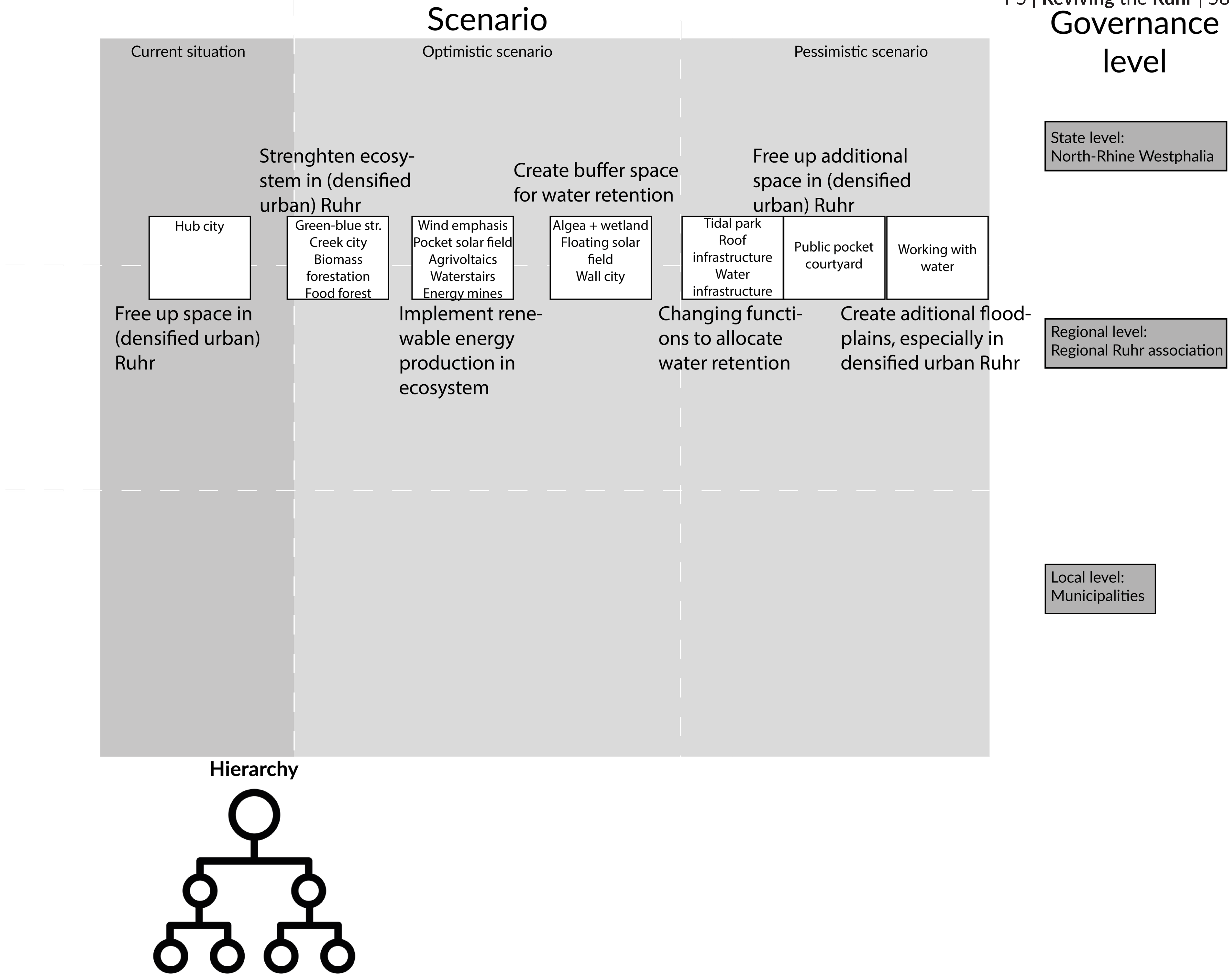
Centralized decision making power



Strategy building | governance bodies



Strategy building | paradigm shift



Strategy building | using the three categories

Spatial contextual characteristics

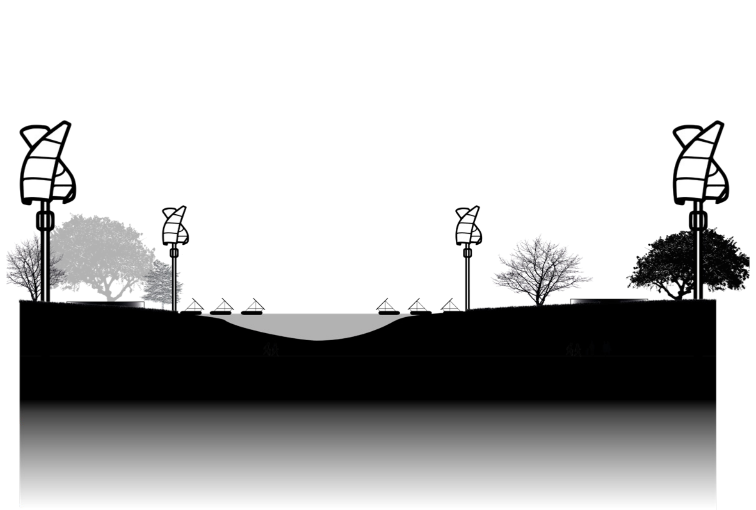
Physical context

Functional context

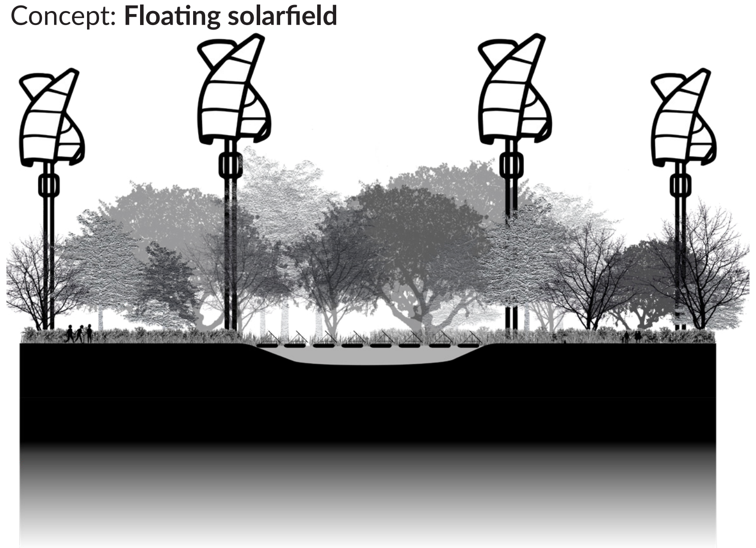
Network of the context

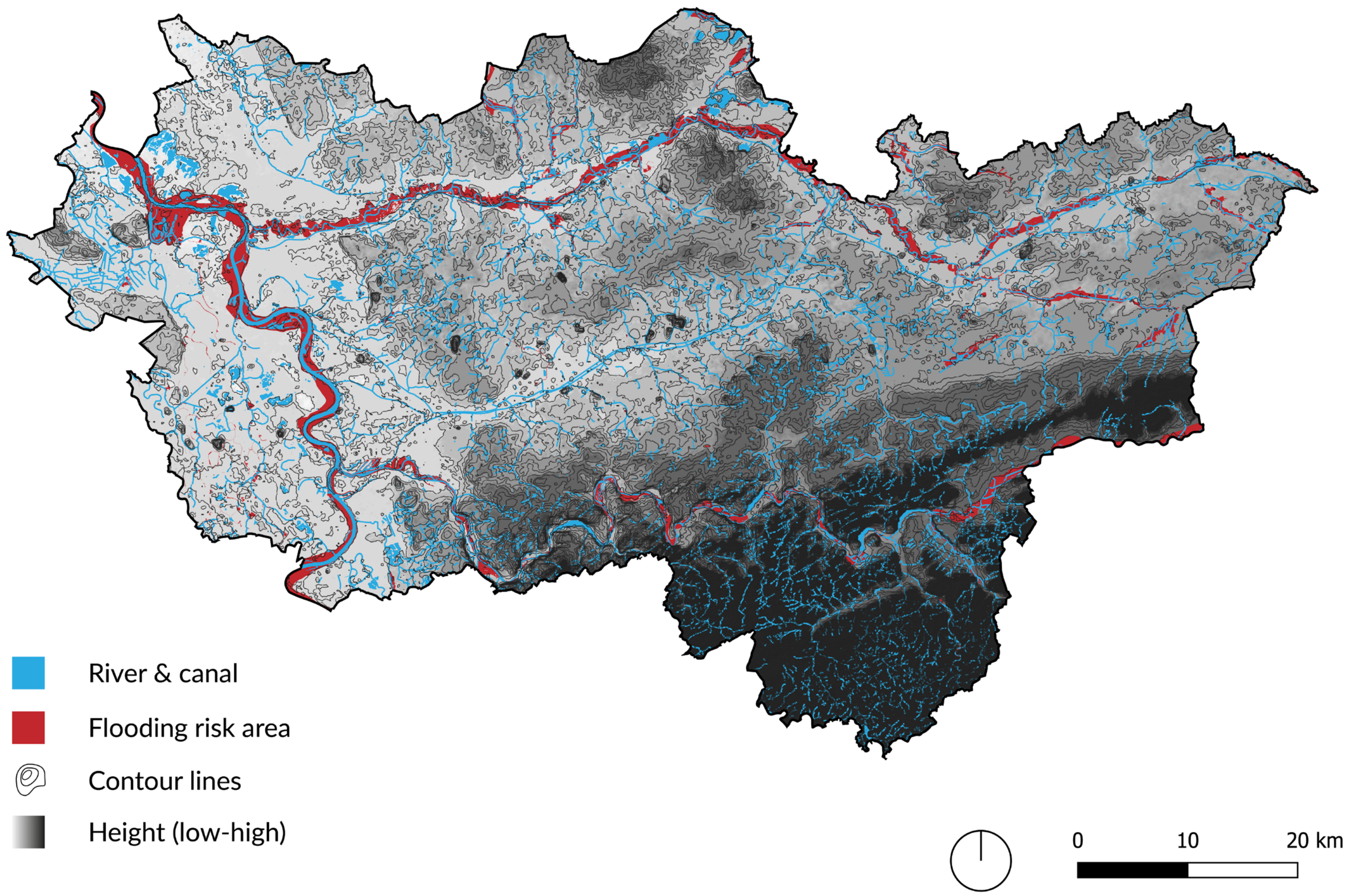
Strategy building | physical context

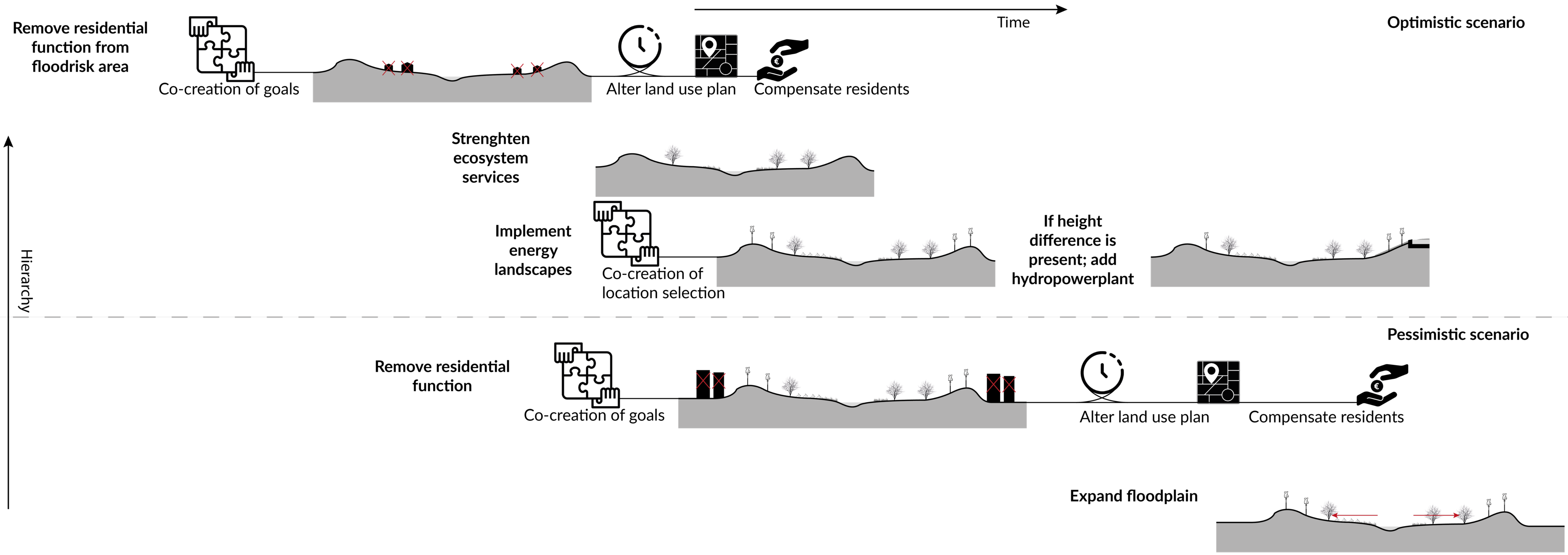
Concept: **Algea + wetland**



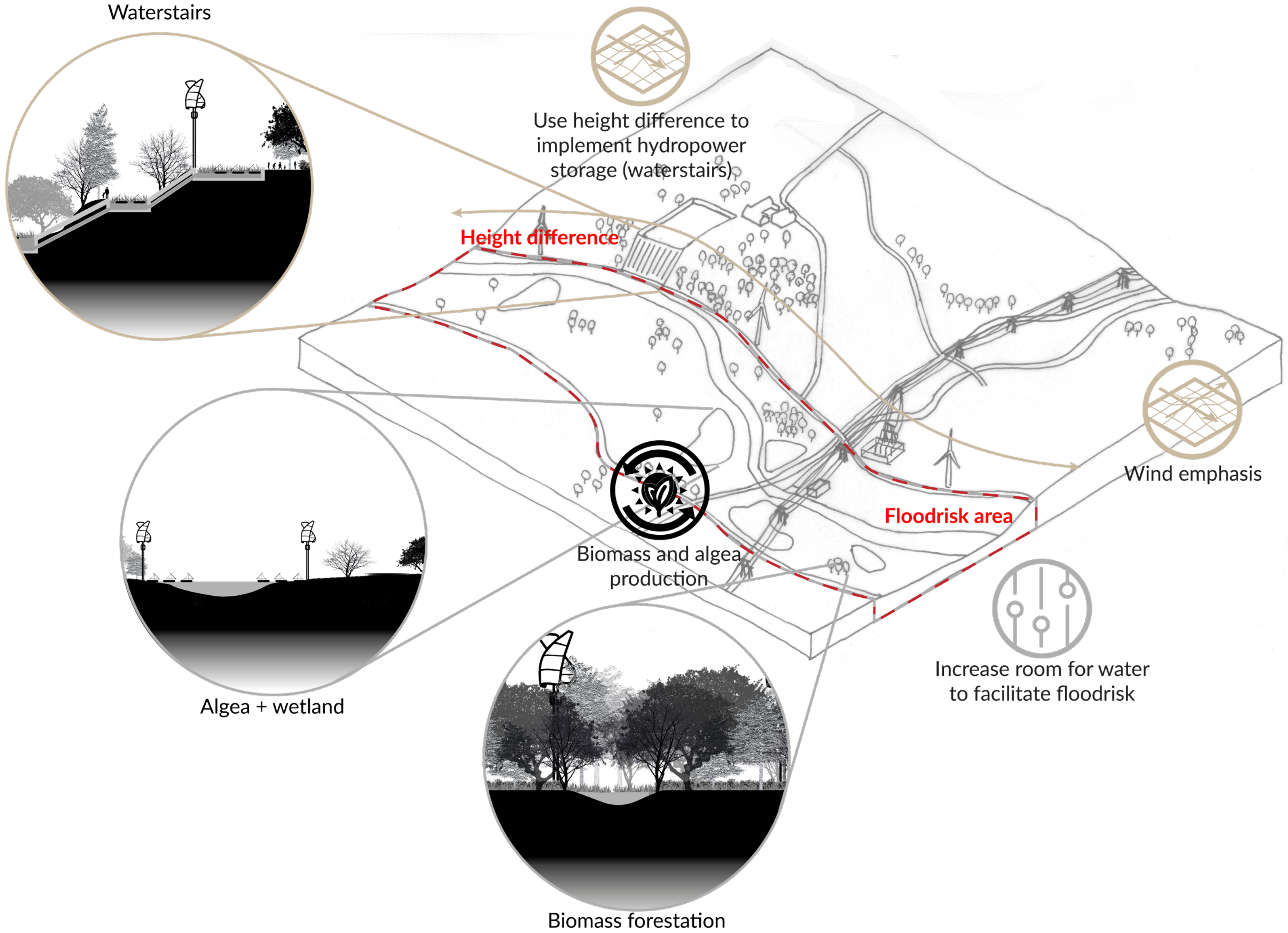
Concept: **Floating solarfield**







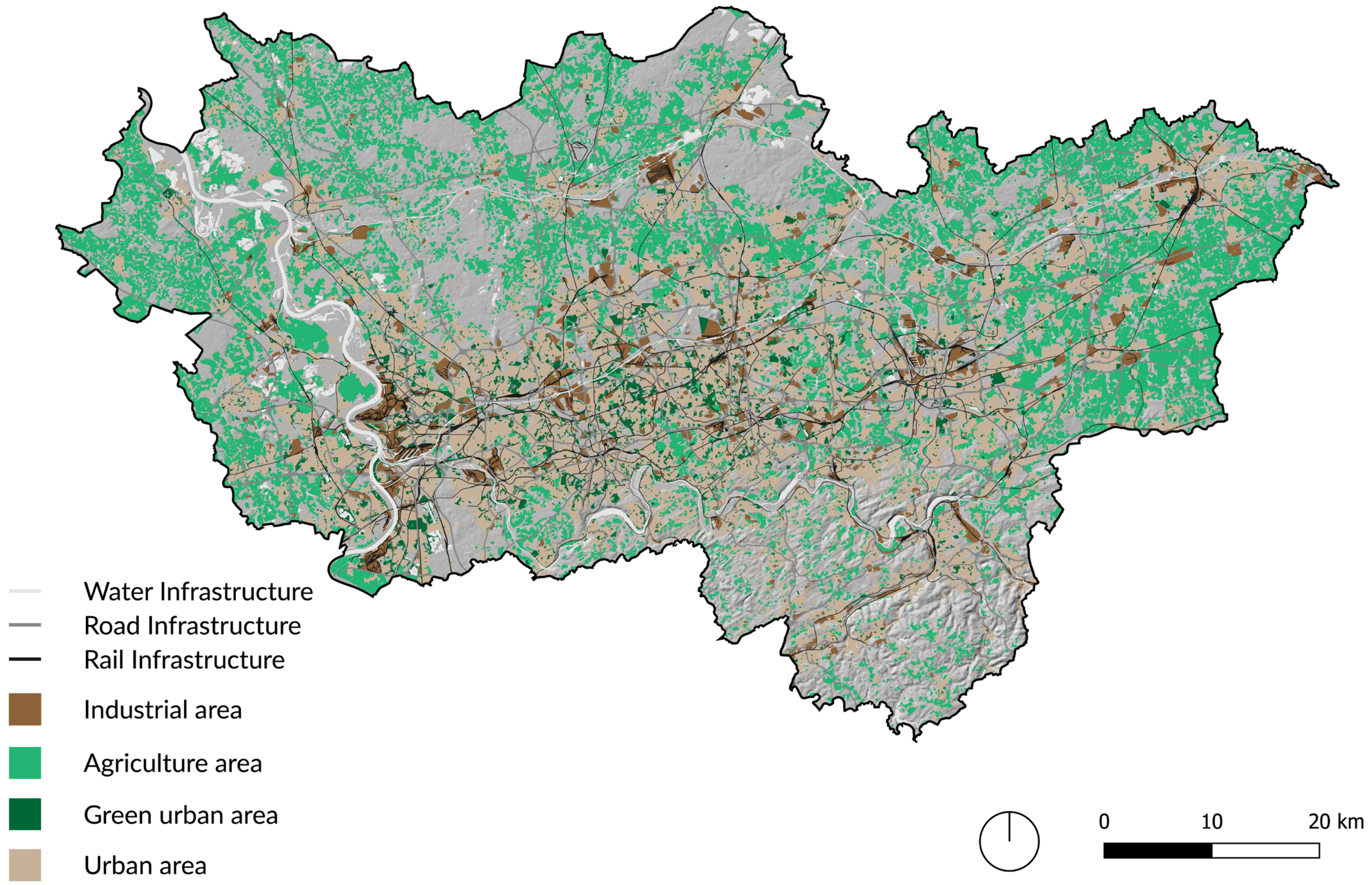
Strategy building | visualization of physical context



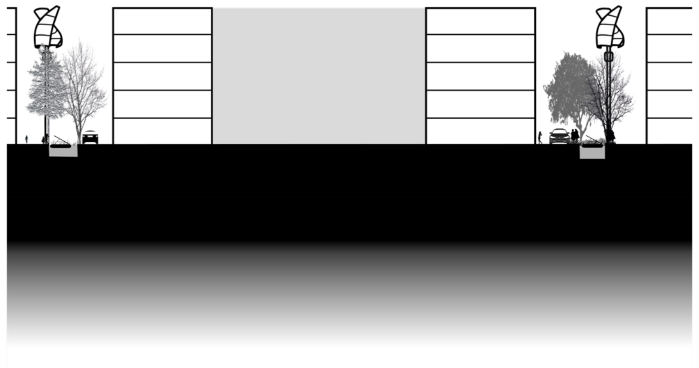
Height difference

Floodrisk area

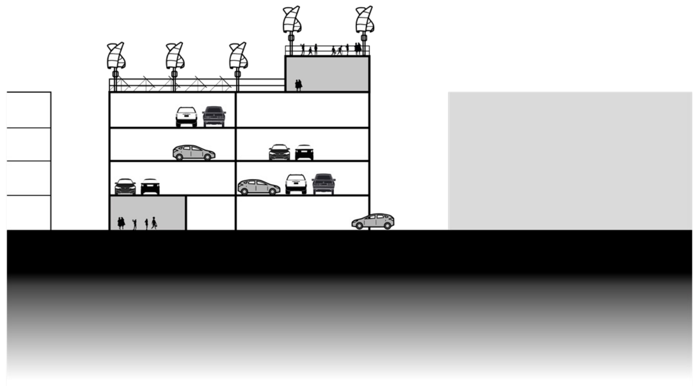
Strategy building | functional context

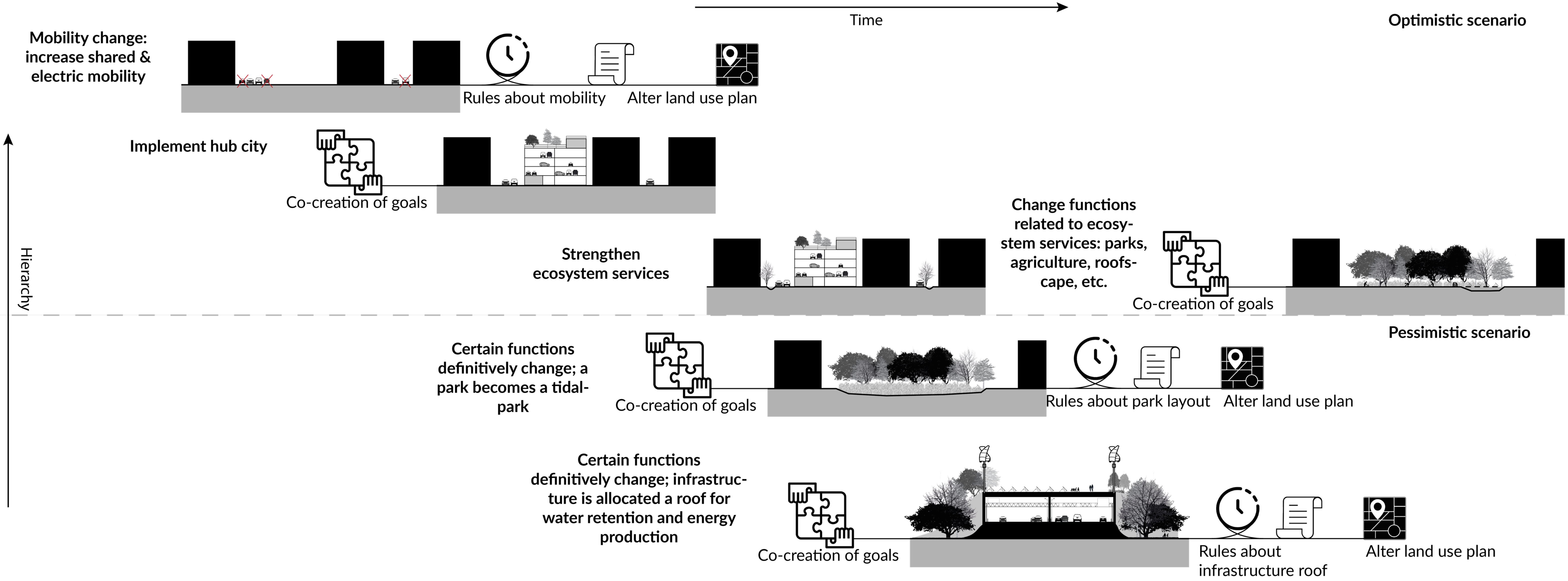


Concept: **Greenblue streets**

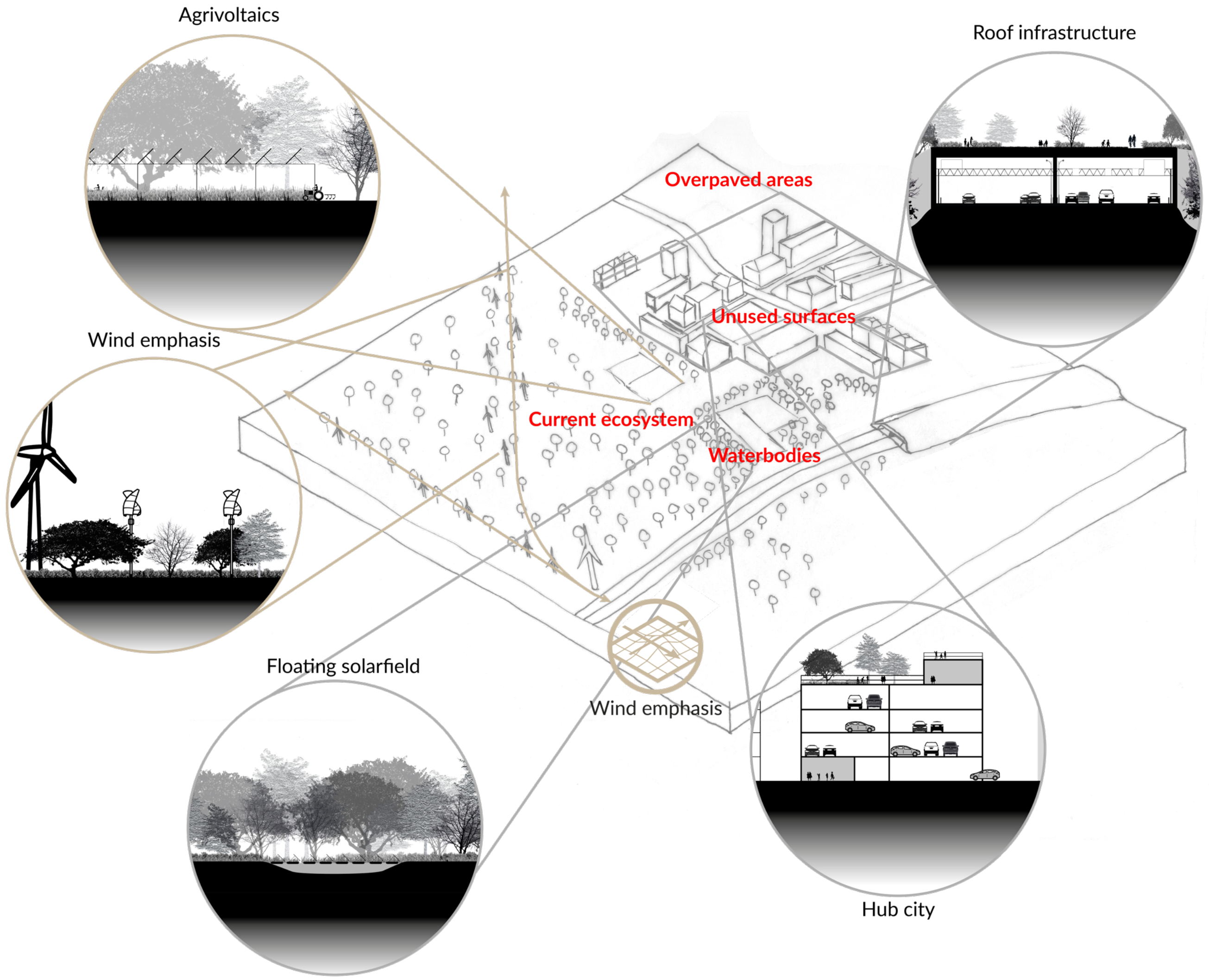


Concept: **Hub city**

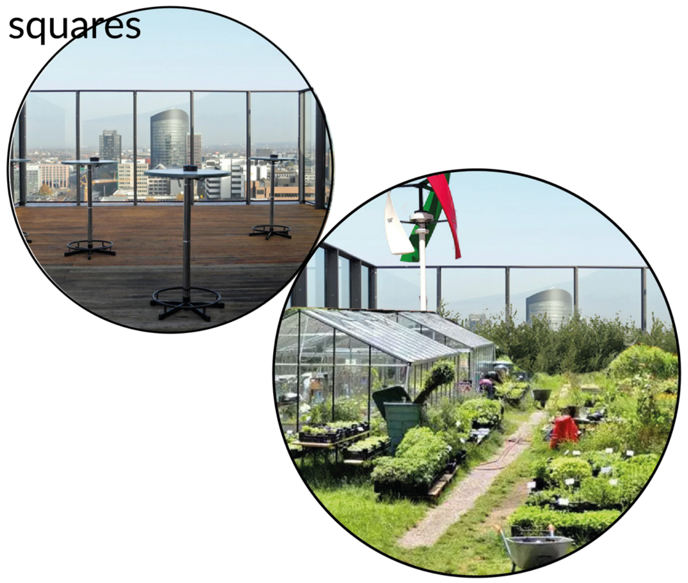




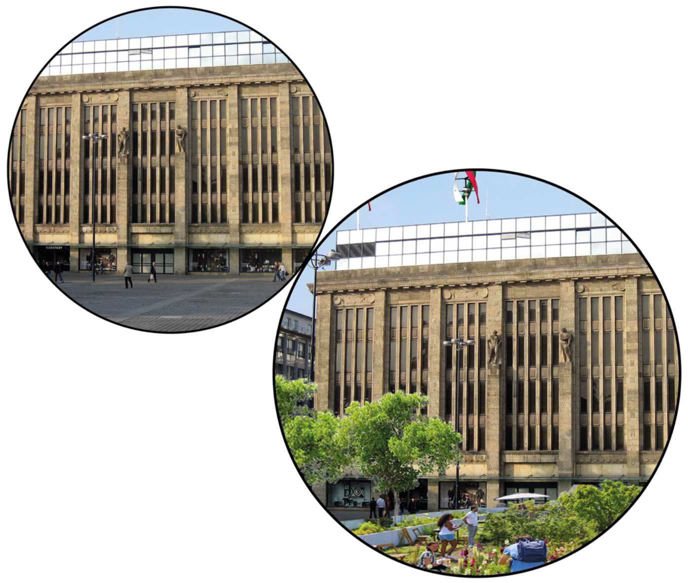
Strategy building | visualization of functional context



Underused surfacas; roofs, streets, squares



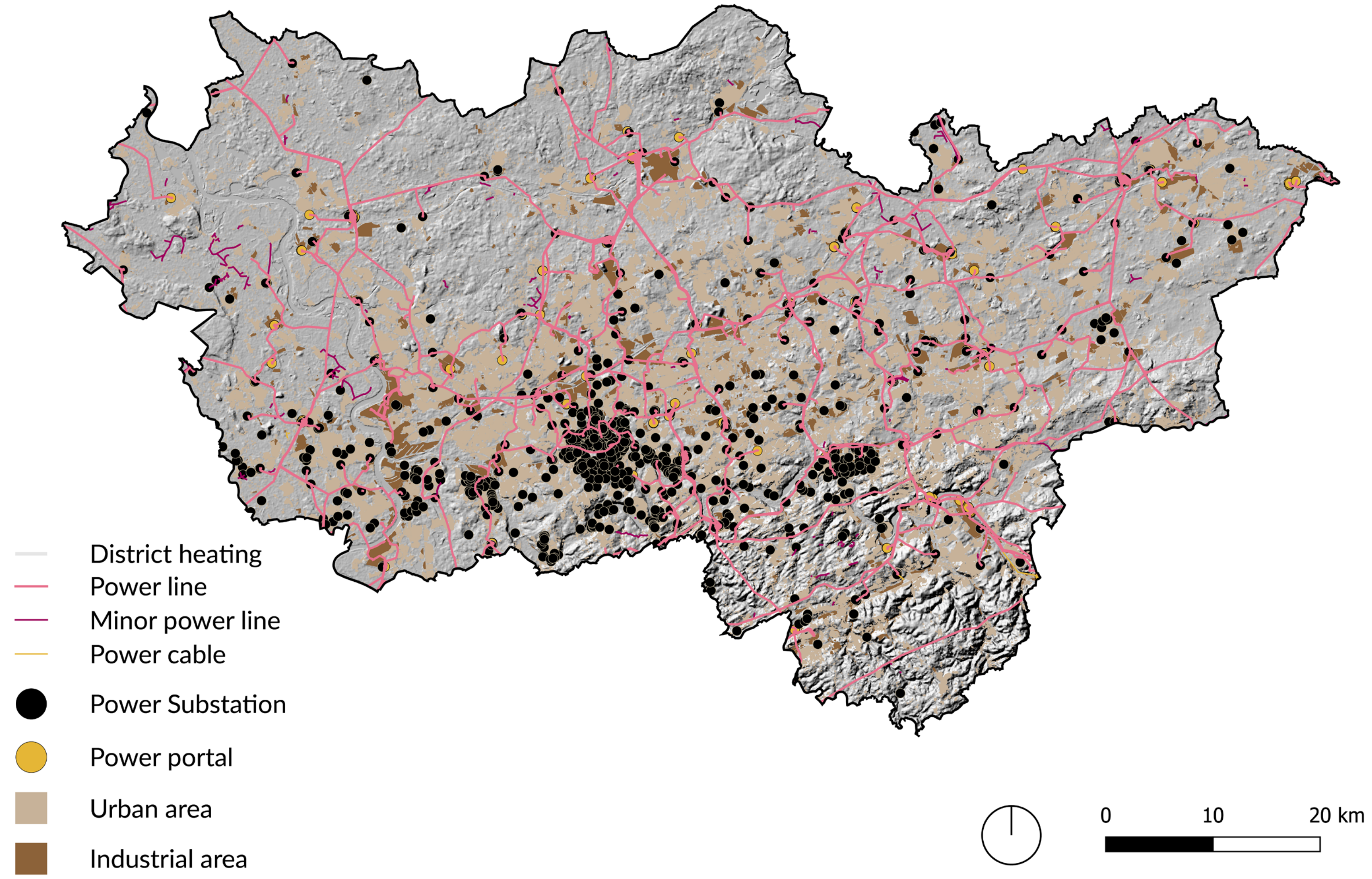
Overpaved areas



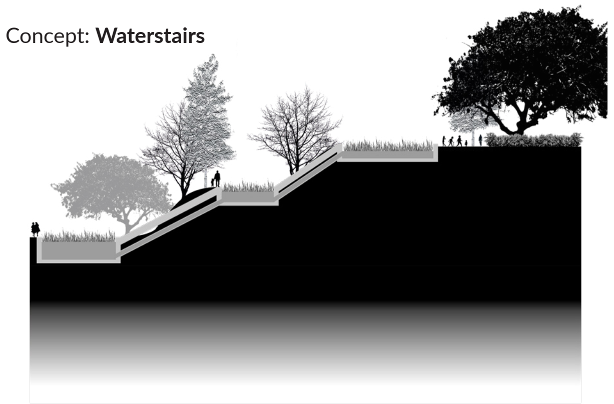
Waterbodies

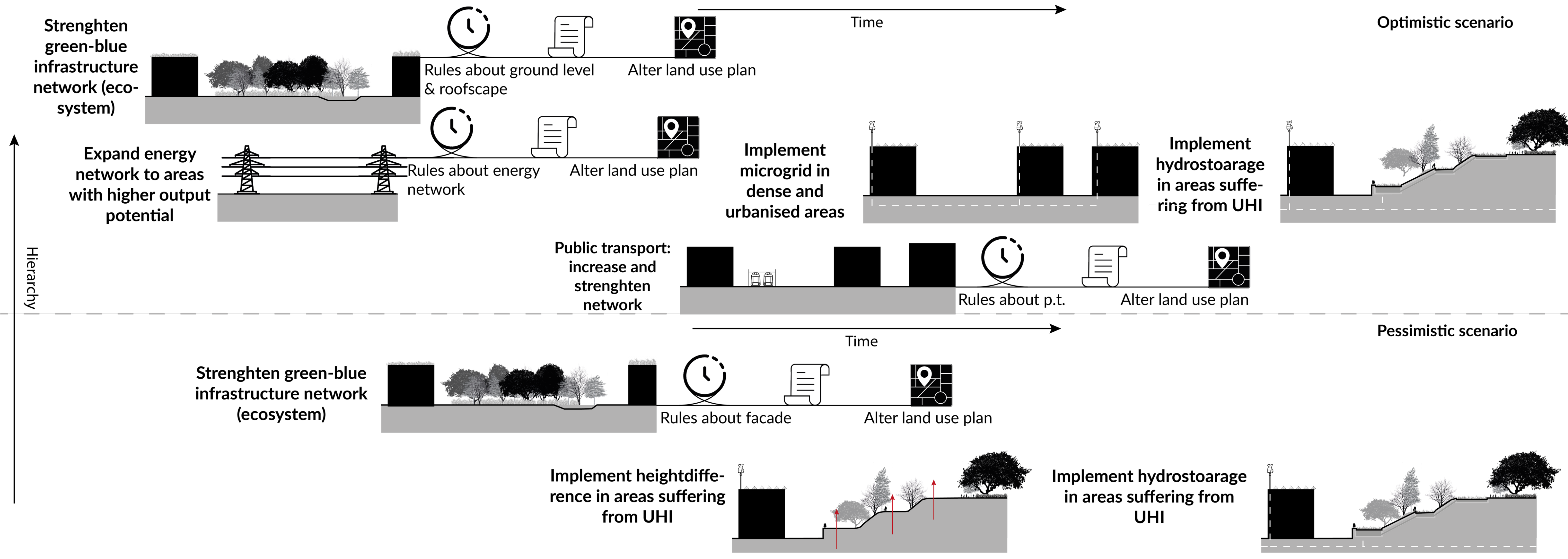
Current ecosystem

Strategy building | network of the context

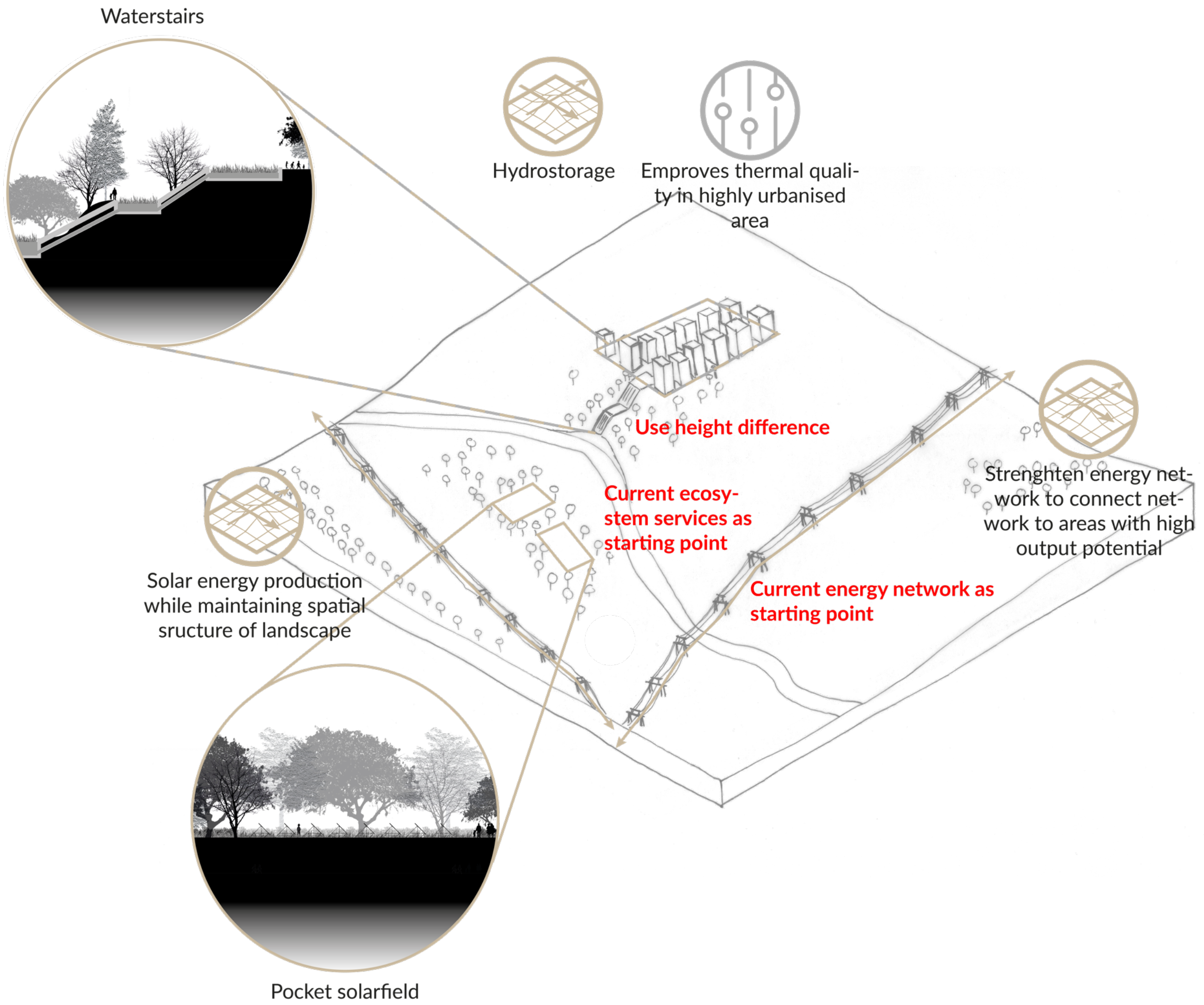


Concept: **Waterstairs**





Strategy building | visualization of network of the context



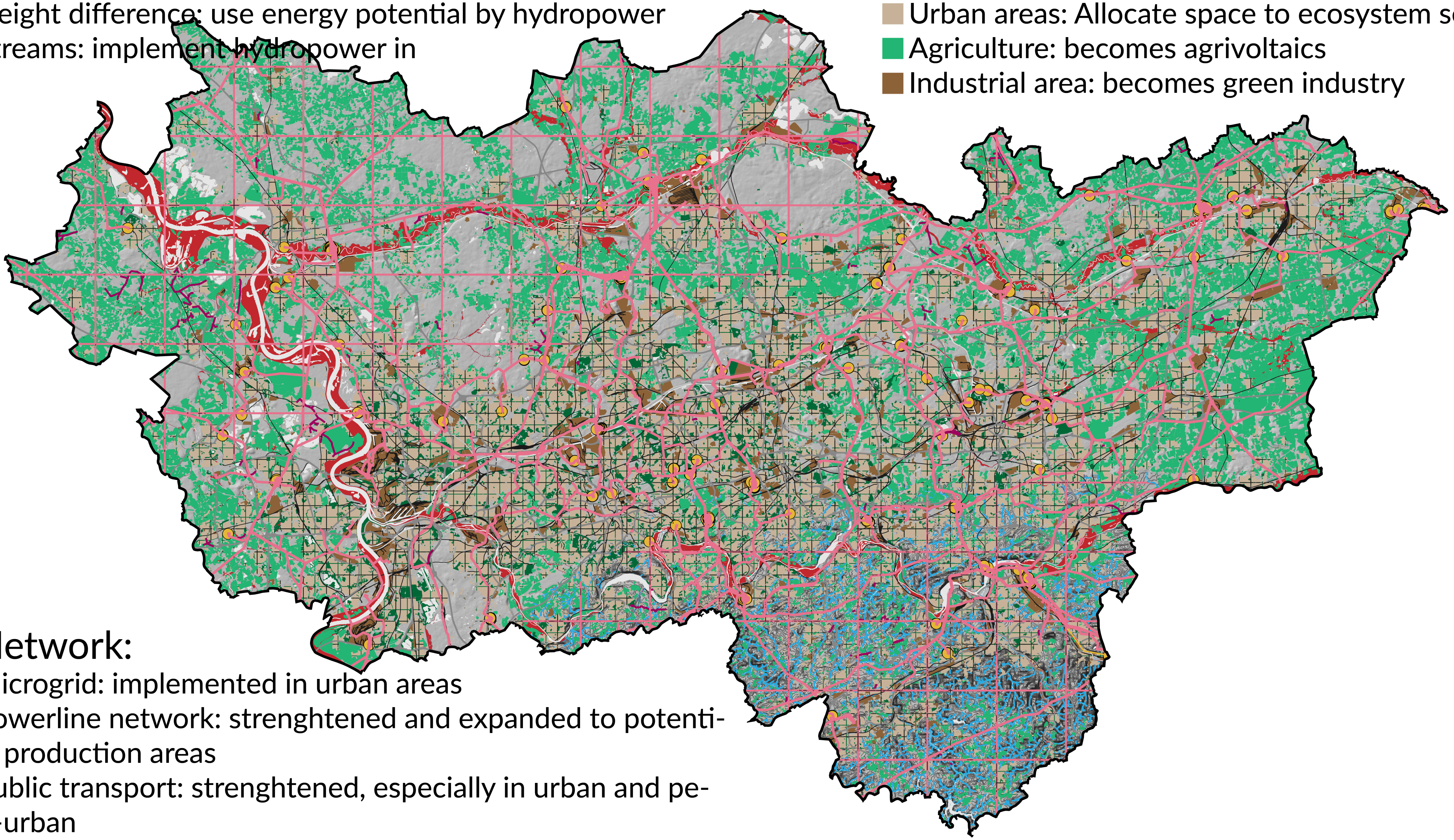
Current ecosystem

Current energy network
human landscape

Strategy building | regional

Physical:
- Floodrisk area: becomes green-blue production area
- Height difference: use energy potential by hydropower
- Streams: implement hydropower in

Functional:
- Green urban areas: becomes foodforest
- Urban areas: Allocate space to ecosystem services
- Agriculture: becomes agrivoltaics
- Industrial area: becomes green industry



Network:
- Microgrid: implemented in urban areas
- Powerline network: strenghtened and expanded to potenti-al production areas
- Public transport: strenghtened, especially in urban and pe-ri-urban
- Green-blue network: strenghtened in urban areas

Strategy building | paradigm shift

Primary energy conspumption

Transport - 30% of primary energy consumption

Industrial sector - 30% of primary energy consumption

Household sector - 30% of primary energy consumption

Trades & services - 10% of primary energy consumption

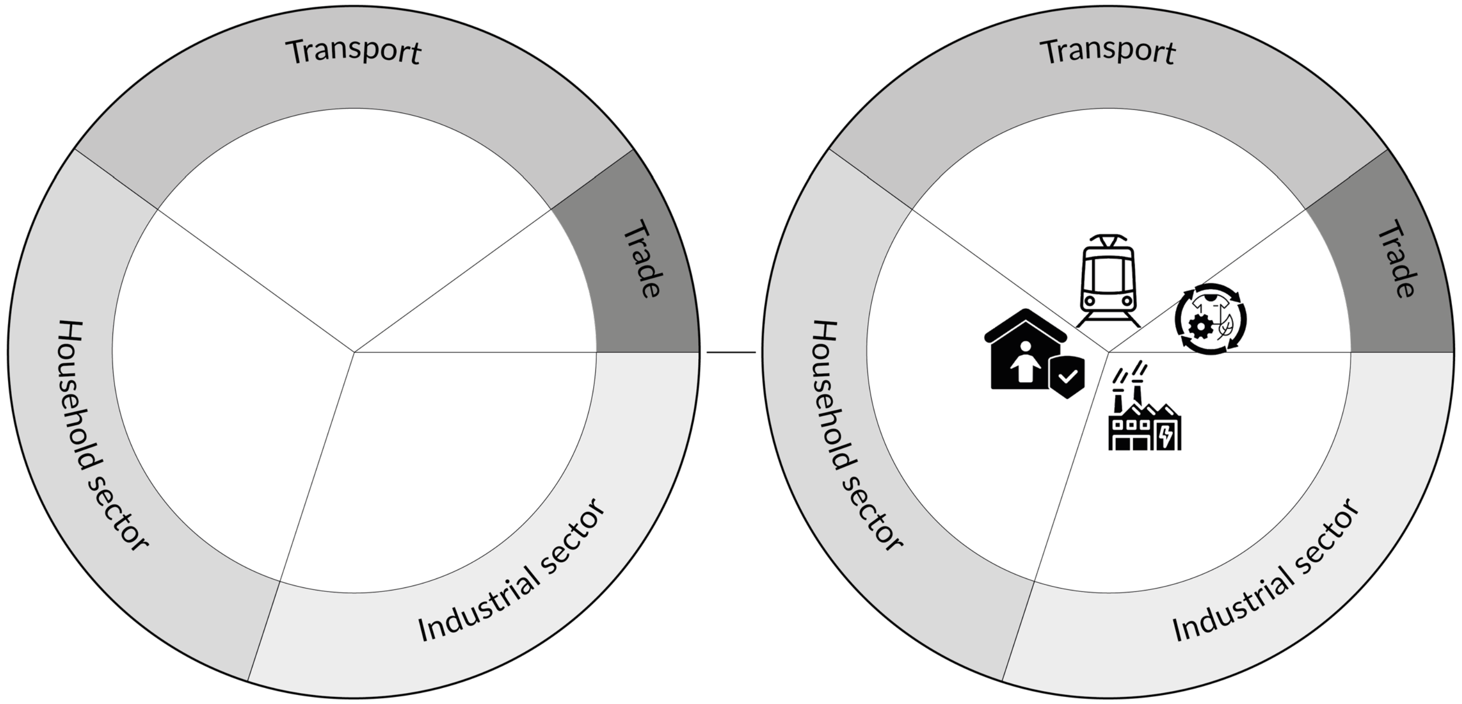
Paradigm shift

Transport - Move to electrical transport where possible.

Industrial sector - Electrification of production prosesses

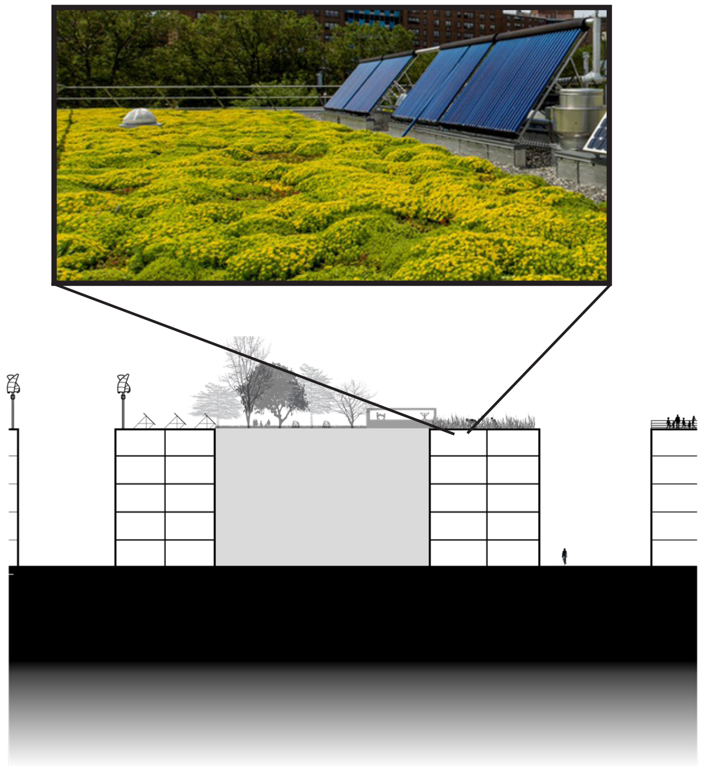
Household sector - Motivate households by co-creating goals and strategies

Trades & services - Circular economy

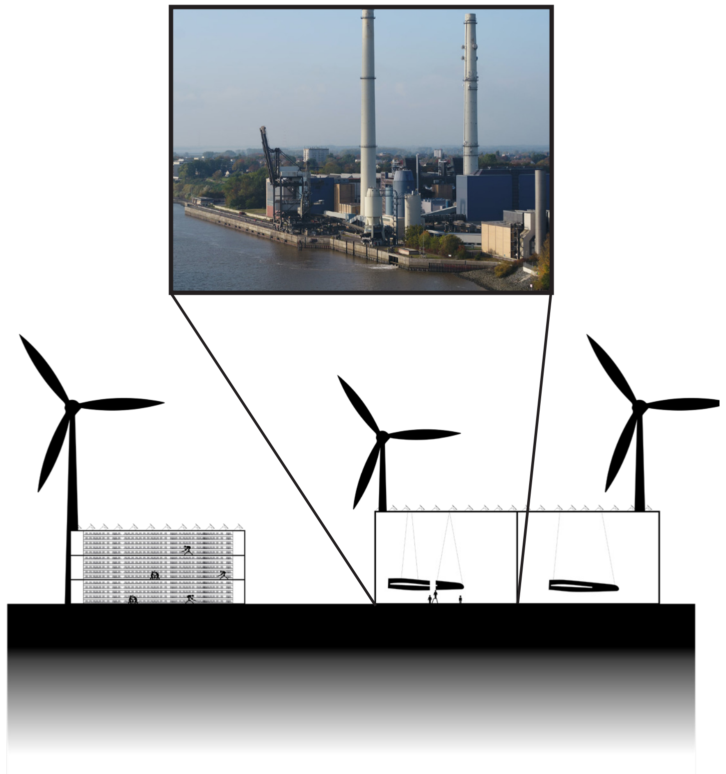


Trade sector - circular economy

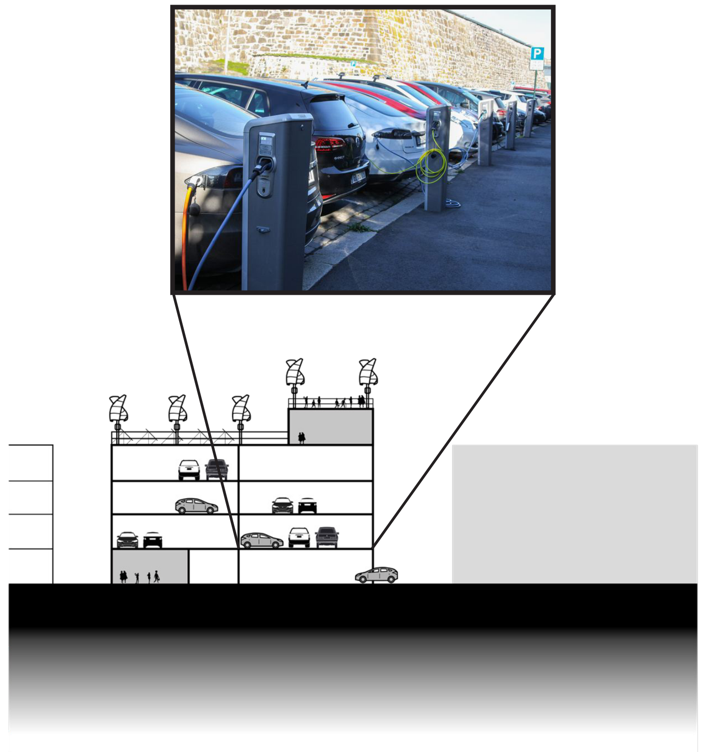
Household sector - green roof as isolation



Industrial sector - power to heat (PTH) plant



Transport sector - electric transport



Conclusions

How can a spatial development strategy for a climate resilient Ruhr area based on the specific peri-urban condition of the Ruhr lead to fulfillment for the now too limited energy transition?

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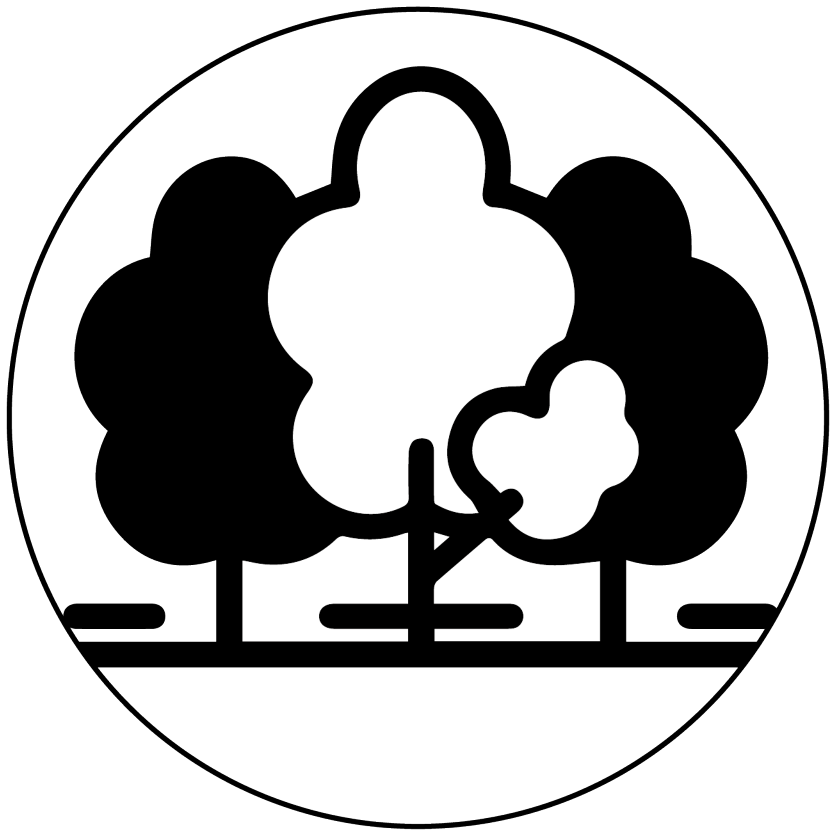
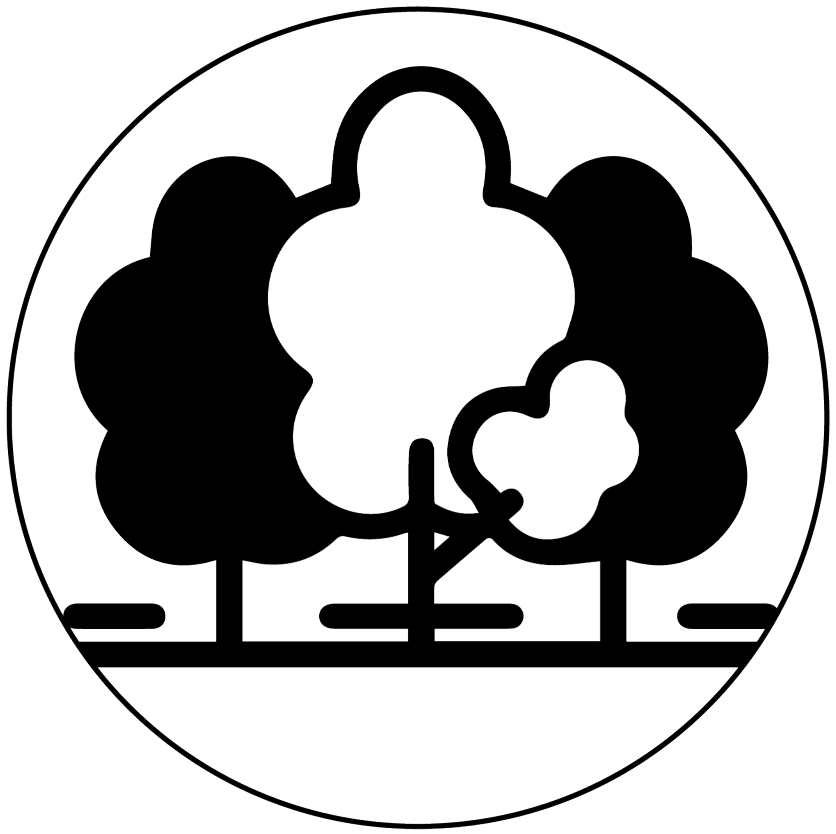
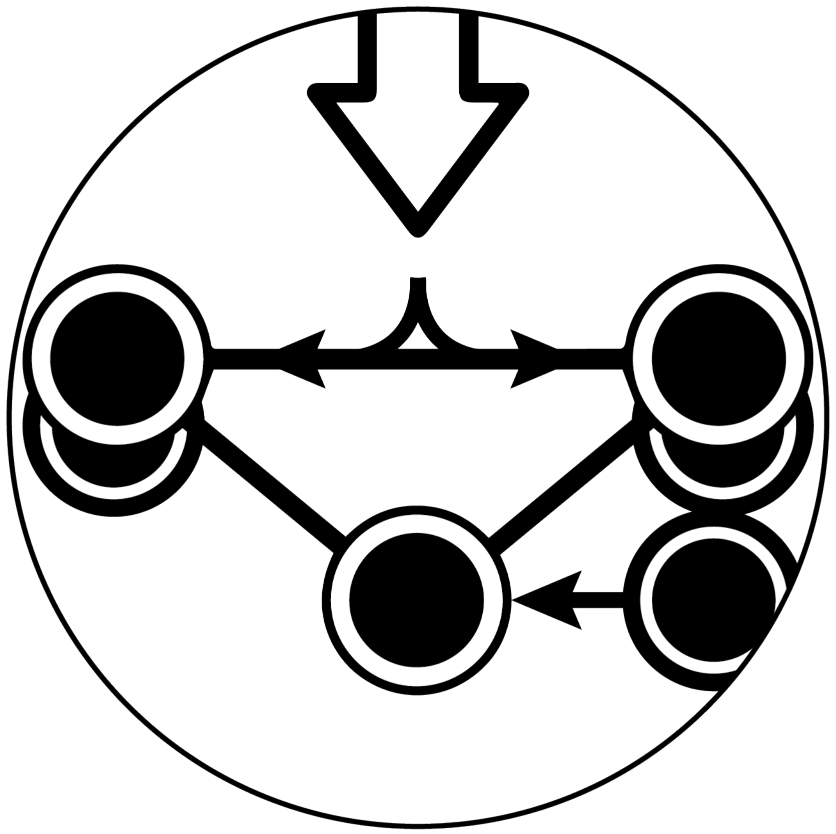


ecosystem services

How can a spatial development strategy for a climate resilient Ruhr area based on the specific peri-urban condition of the Ruhr lead to fulfillment for the now too limited energy transition?



ecosystem services



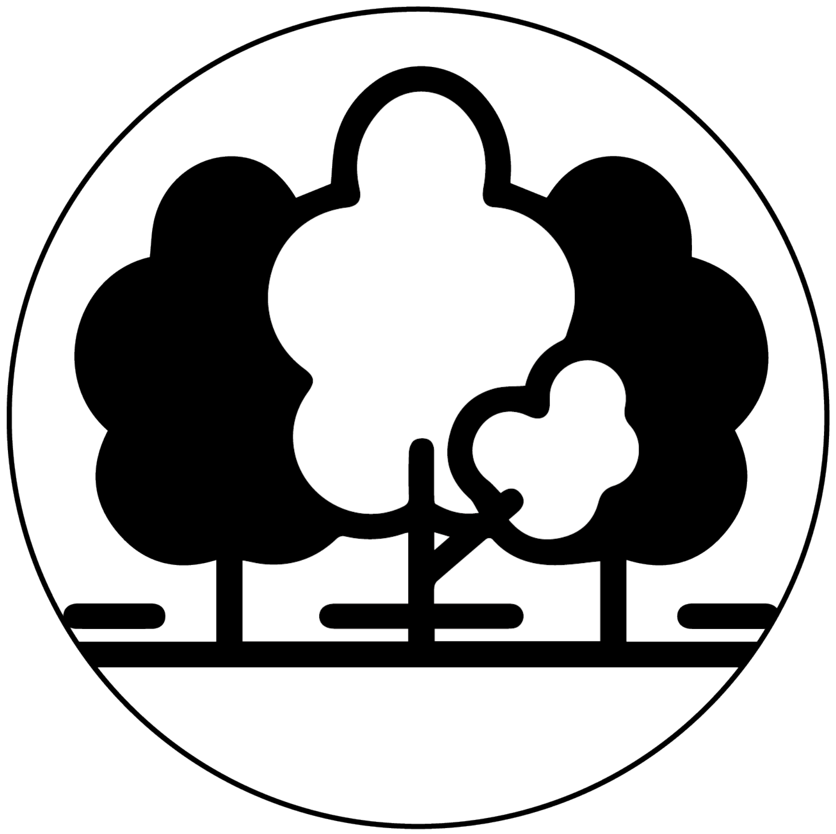
adaptability through modularity
and redundancy through flexibility

How can a spatial development strategy for a climate resilient Ruhr area based on the specific peri-urban condition of the Ruhr lead to fulfillment for the now too limited energy transition?

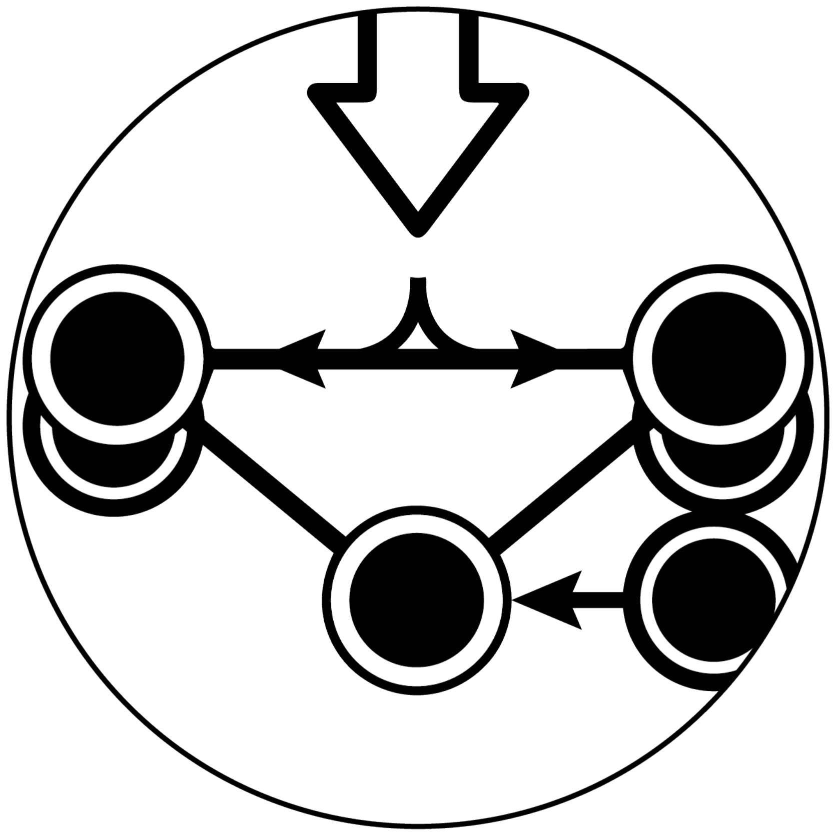
Resilience functions / Assesement

Resilience functions		Very bad	Bad	Sufficient	Good	Very good
Adaptability through modularity					X	
Redundancy throught flexibility					X	
Safe failure	?					
Regulation function					X	
Production function				X		
Carrier function					X	

How can a spatial development strategy for a climate resilient Ruhr area based on the specific peri-urban condition of the Ruhr lead to fulfillment for the now too limited energy transition?



ecosystem services

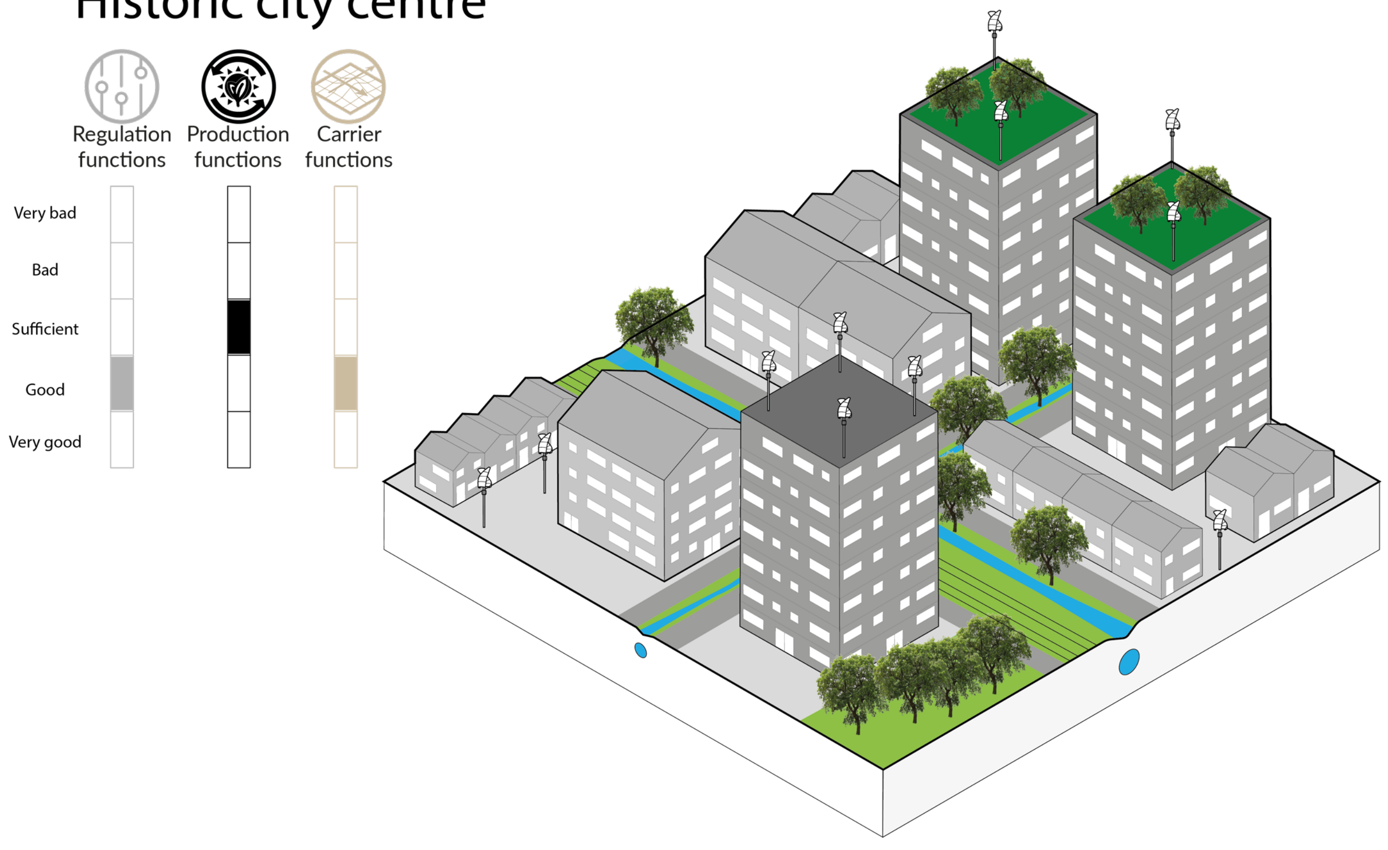


adaptability through modularity
and redundancy through flexibility

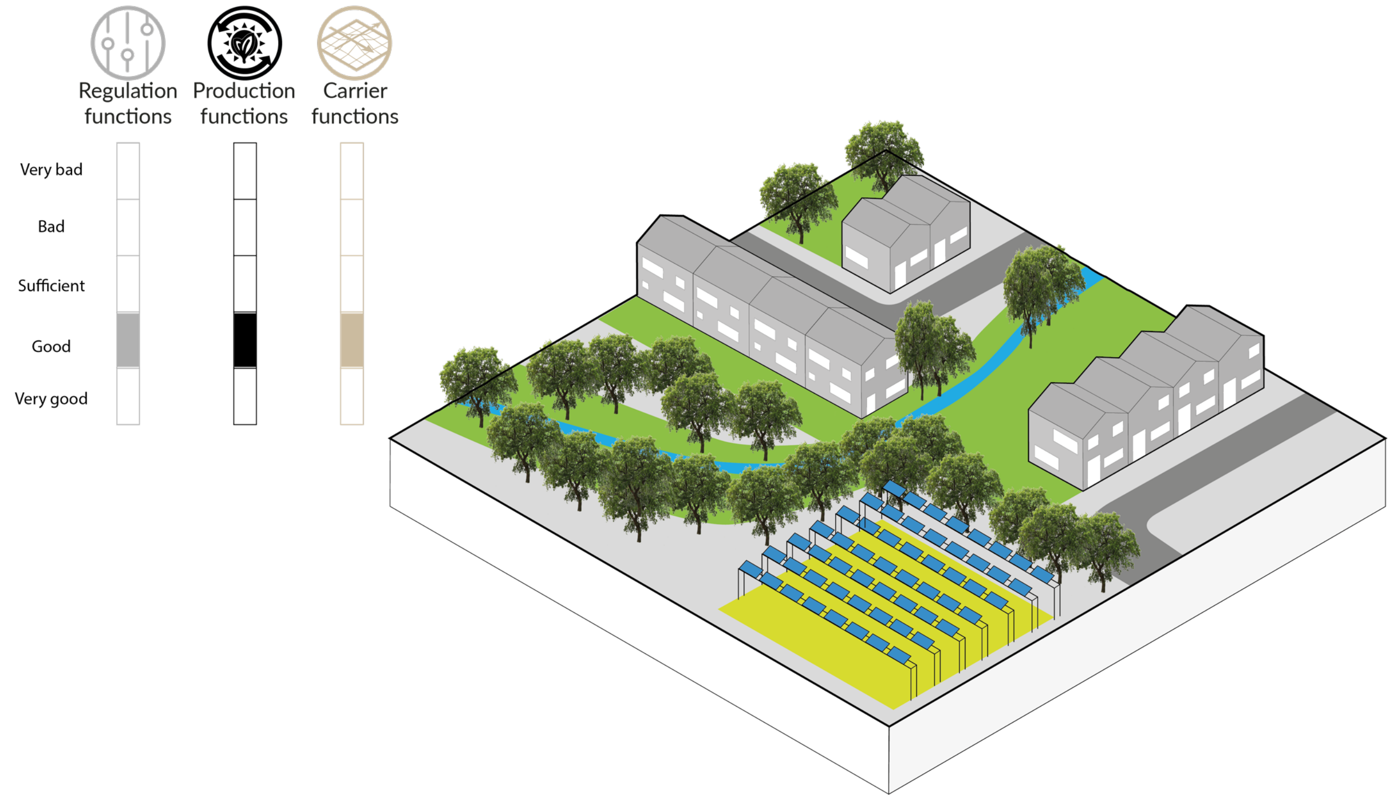
site specific characteristics

Future implications

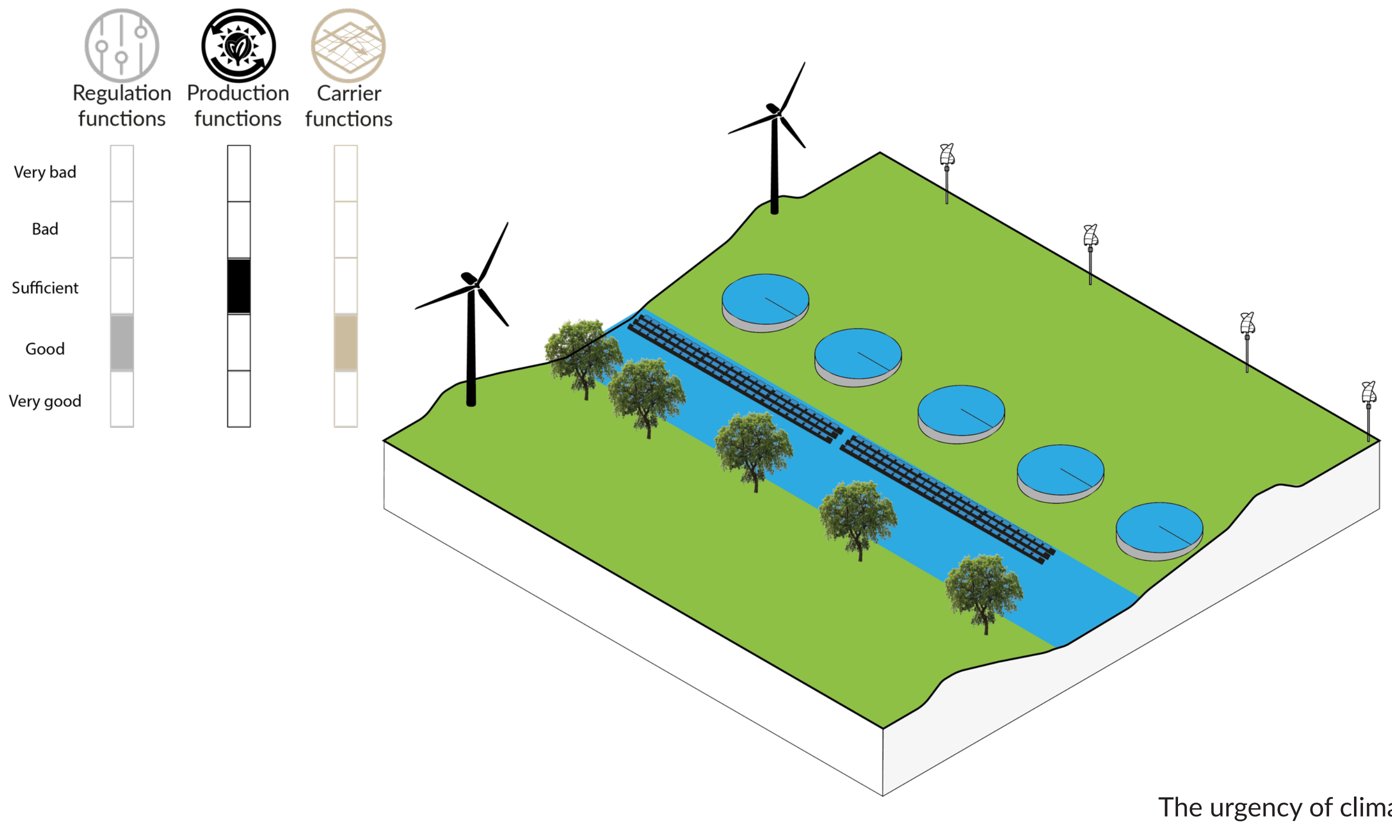
Historic city centre



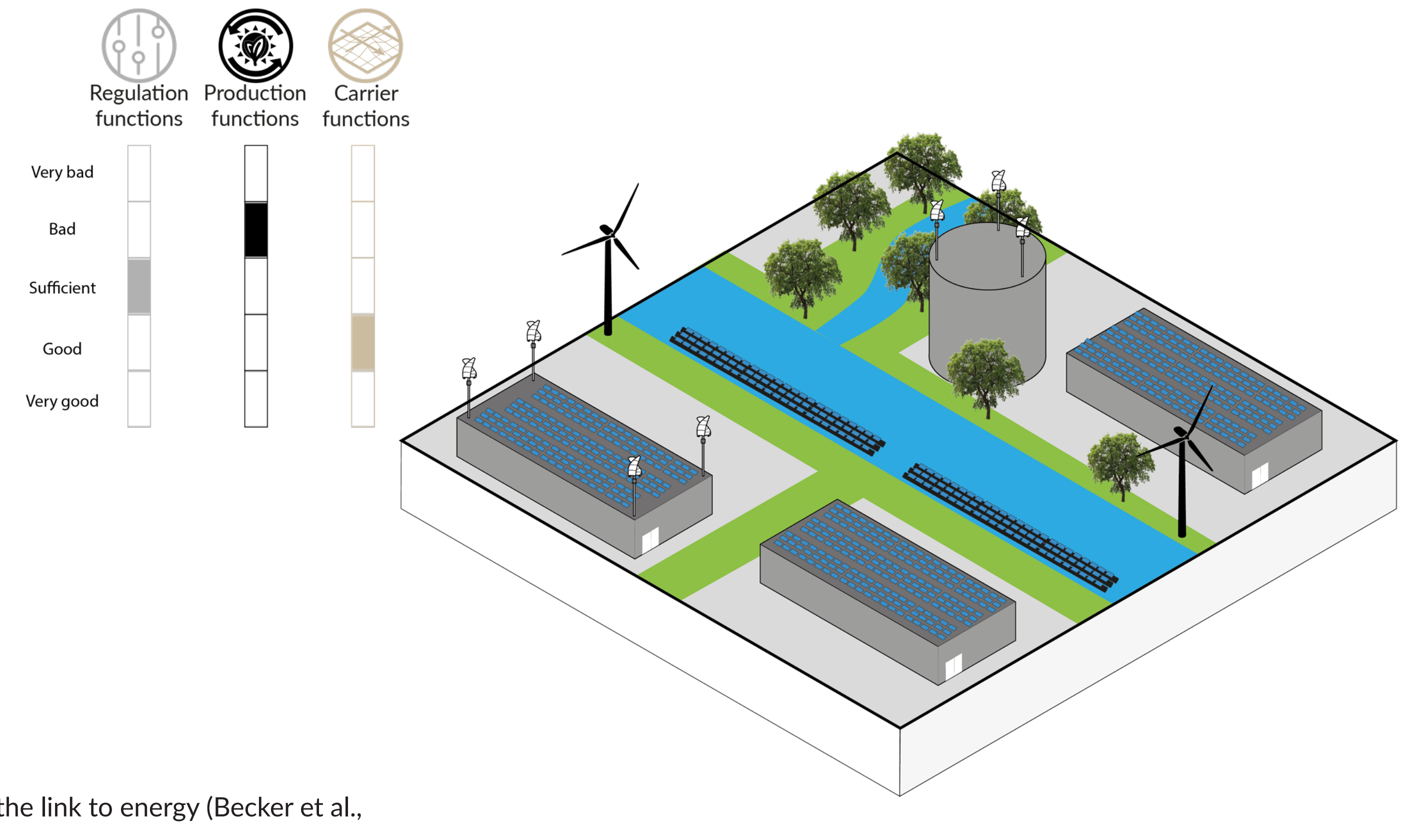
Peri-urban area



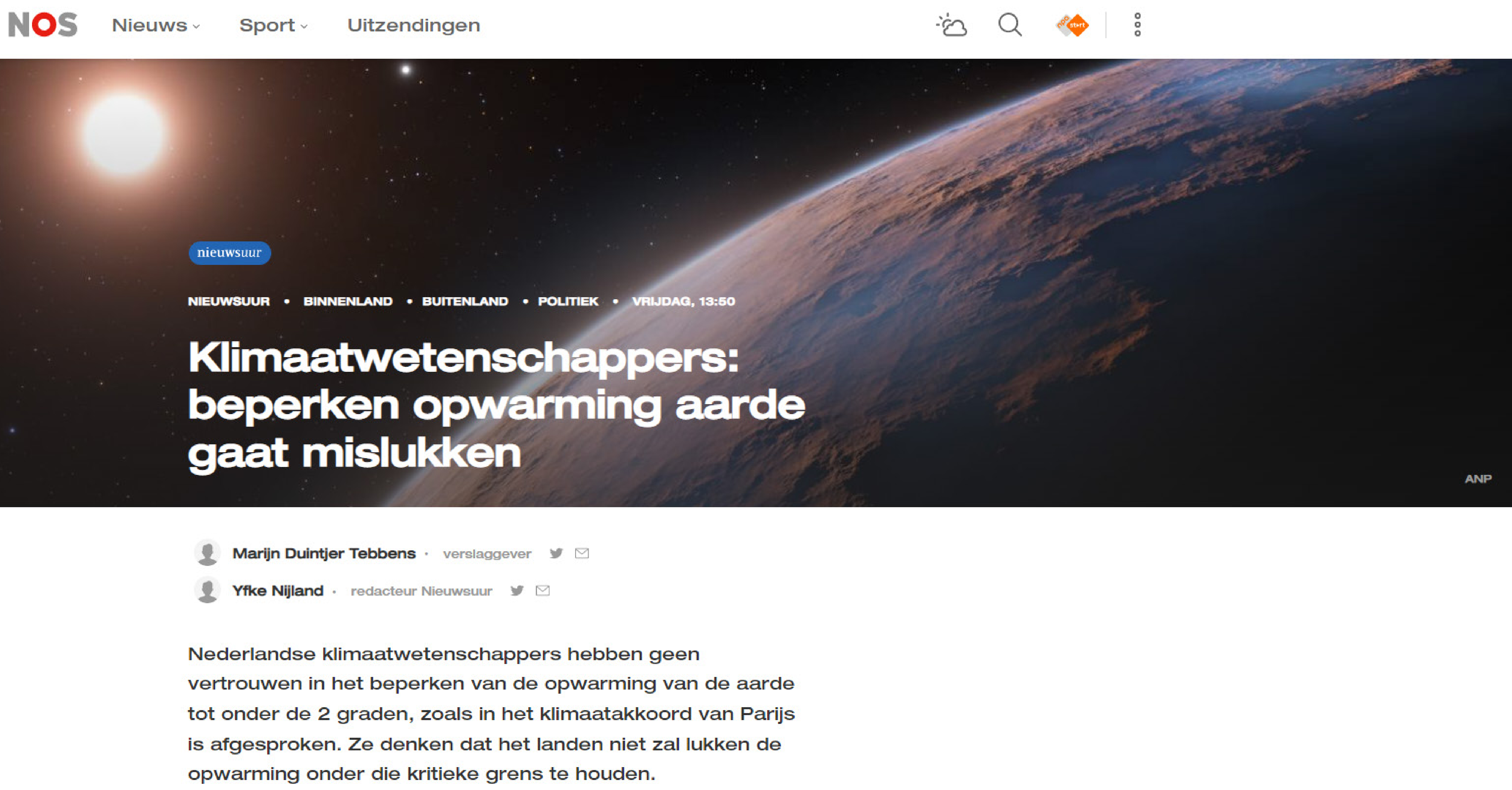
Floodrisk area



Industrial area



The urgency of climate change and the link to energy (Becker et al., 2017 ; McGrath, 2021).



NOS Nieuws Sport Uitzendingen

nieuwsuur

NIEUWSUUR • BINNENLAND • BUITENLAND • POLITIEK • VRIJDAG, 13:50

Klimaatwetenschappers: beperken opwarming aarde gaat mislukken

ANP

Marijn Duintjer Tebbens · verslaggever

Yfke Nijland · redacteur Nieuwsuur

Nederlandse klimaatwetenschappers hebben geen vertrouwen in het beperken van de opwarming van de aarde tot onder de 2 graden, zoals in het klimaatakkoord van Parijs is afgesproken. Ze denken dat het landen niet zal lukken de opwarming onder die kritieke grens te houden.

Uncertainty in global temperature rise (NOS, 2021).

Revived Ruhr

Prepared the Peri-urban Ruhr for an uncertain energy & climate future.

Sources:

The goal for the energy transition are clearly described. With the overall strategy defined, as well as the spatial manifestation of the different patches and their total area in the Ruhr, a brief calculation can be made on the quantification of the propositions.

Following the spatial analysis of the Ruhr area, the dimensions of certain areas were determined. Furthermore, following a literature review, the output potential of several renewable energy sources were defined.

With the dimensions of the patches defines as well, an educated guess can now be made on how many output per area I propose in my design in the optimistic and pessimistic scenario of these patches. Based on a literature review, we assume that the 25% of the potential area for each renewable energy source is available (Barrington-Leigh & Ouliaris, 2017).

This results in the following calculation;
Optimistic: potential output per patch for the optimistic scenario / area of patch * 25% patch area in the Ruhr.
Maximum: potential output per patch for the optimistic scenario / area of patch * 25% patch area in the Ruhr.

This calculation is visualized in figure 120. It indicates that both for the optimistic as well as for the pessimistic scenario, my proposed designs meet the goals for each of the scenarios.

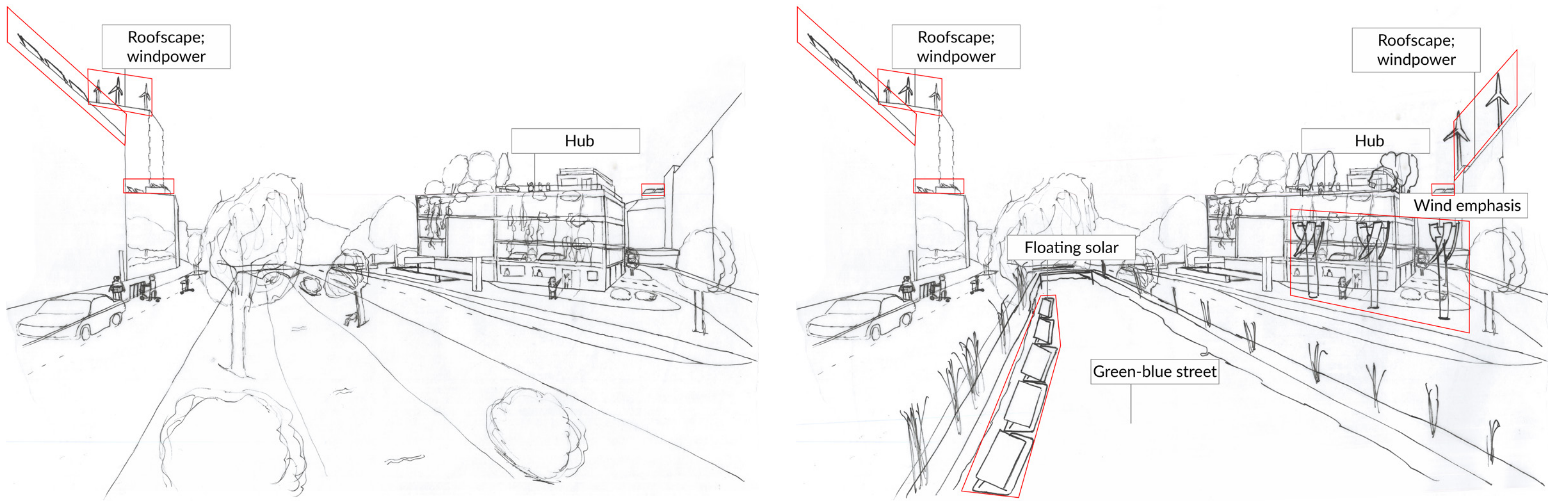


Figure 7: Calculation of energy output per patch in optimistic (left) and pessimistic (right) scenarios (author, 2022. Derived from Barrington-Leigh & Ouliaris, 2017 and Copernicus, 2018).

	historic city centre	riverbank / wetland	green urban area
optimistic	18401976,35	35450527	35137,
pessimistic	33762816,63	93236476	238933

	peri-urban area	industrial area
optimistic	1296632	3222934
pessimistic	32835669	8152127

				Goal
total optimistic	58407207	58,40721	GWH	53 GWH
total pessimistic	1,7E+08	170,3764	GWH	115 GWH

Figure 6: Calculation of area and energy potential (author, 2022. Derived from Barrington-Leigh & Ouliaris, 2017 and Copernicus, 2018).

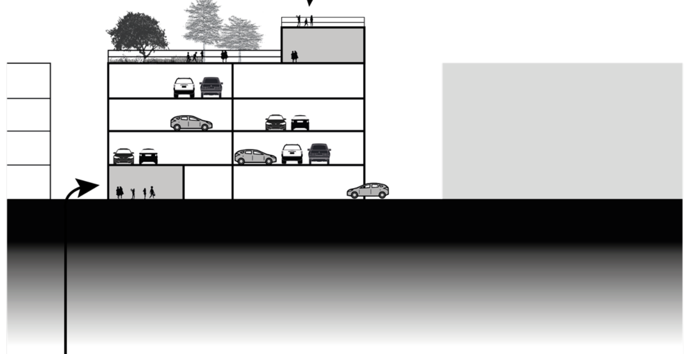
The proposed strategy has a more social approach, which has been visualized in the regional representation of the strategy and is further elaborated here.

The implementation of the concepts on the local scale is a responsibility for the municipality. This has been done to give the municipality the opportunity, to adopt concepts to local problems or opportunities. A hub could be combined with a gym, a supermarket, a selling point for the urban farming or a supermarket.

Furthermore, co-creation is used to aid in the participation of residents as well as other actors. This is done using the method described in figure 116. This moves from the solution of a current problem to the definition of a future problem, and is done using the second new governance body, combining local and topic knowledge.

By doing so, Anna and Peter can voice their questions and remarks about the changes they are about to experience.

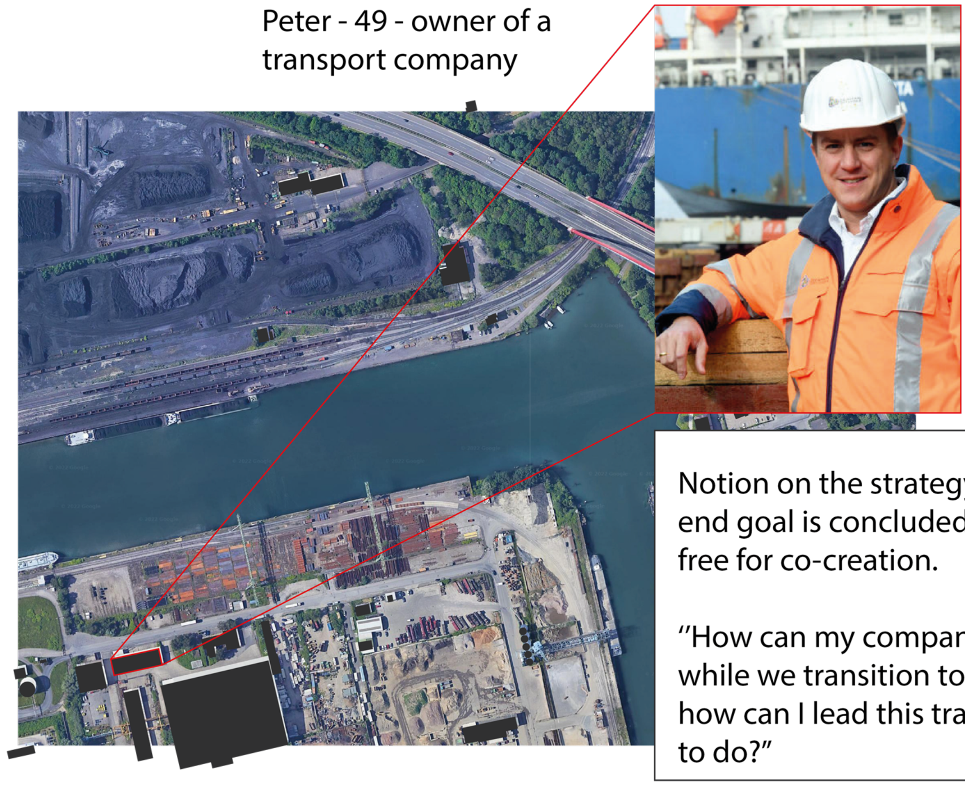
Gym? Tourist information point?



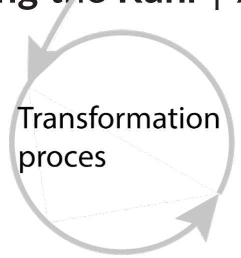
Supermarket? Urban farming selling point?

Moment of interaction between actors and governance body

Peter - 49 - owner of a transport company

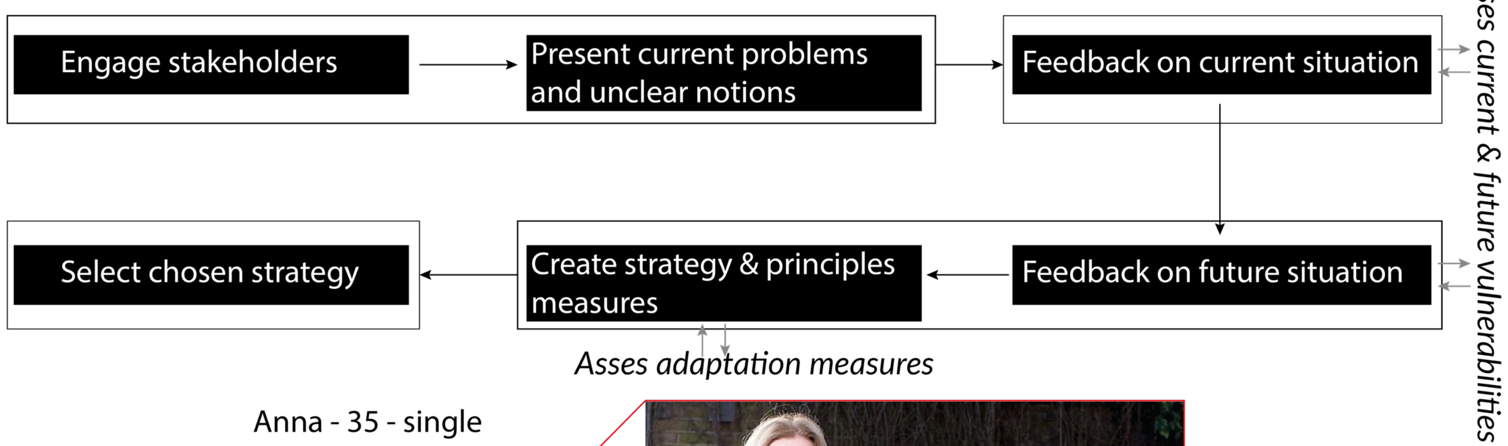


Adviced by the new local governance body



Notion on the strategy of greening his business. The end goal is concluded, the road towards that goal is free for co-creation.

"How can my company remain economically feasible, while we transition to a more greener approach and how can I lead this transition, without being told what to do?"



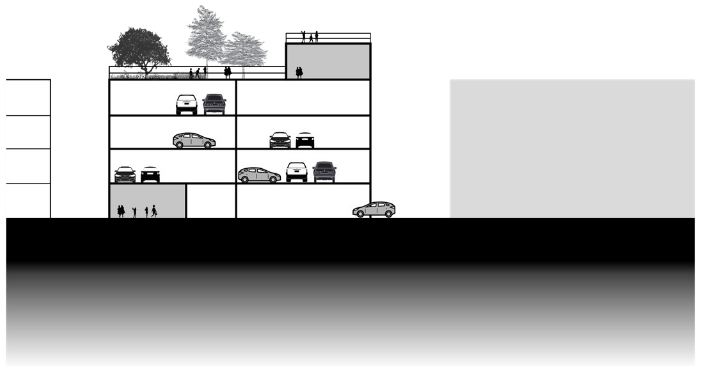
Anna - 35 - single mother of two young children

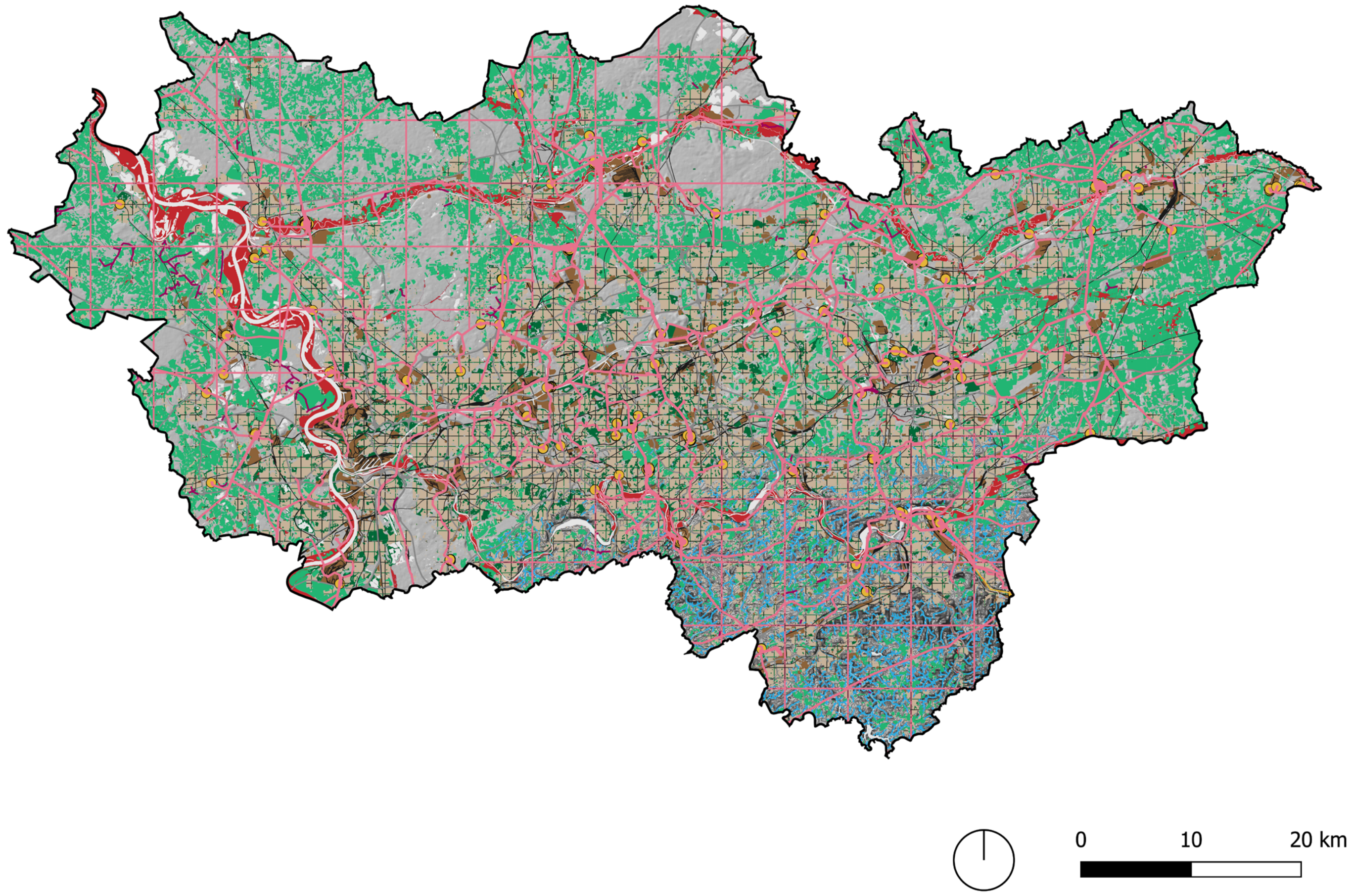
Notion on the final implementation of selling points, the final detailing of the connection of the new creek to the current spatial structure.

"What extra function would be beneficial for the neighborhood and what functions would my two boys like to see added to this neighborhood?"

Figure 8: Co-creation method and implementation in the Ruhr area (author, 2022. Based on Dias et al., 2020).

Assesment





Ecosystem services

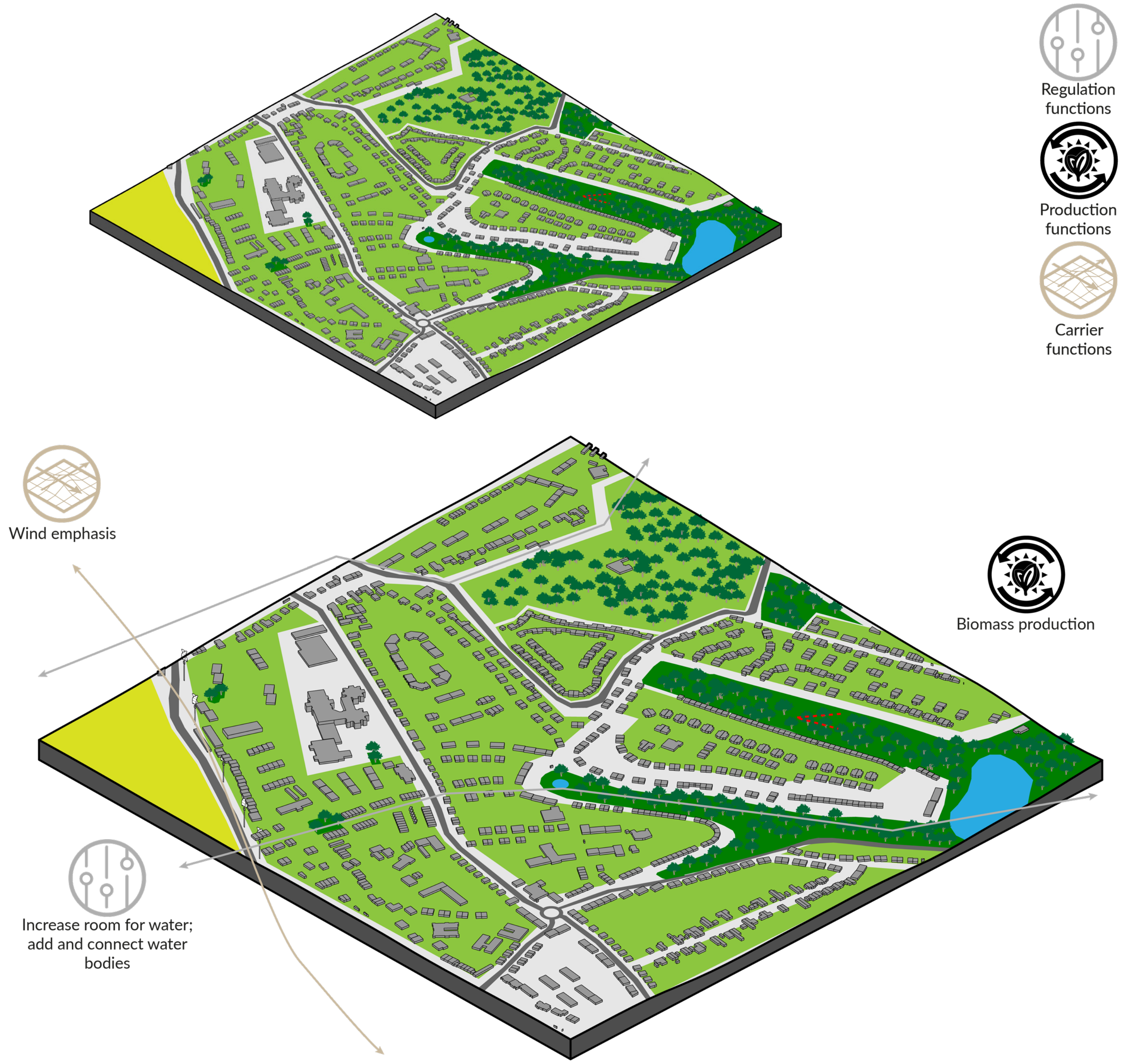
Assesment

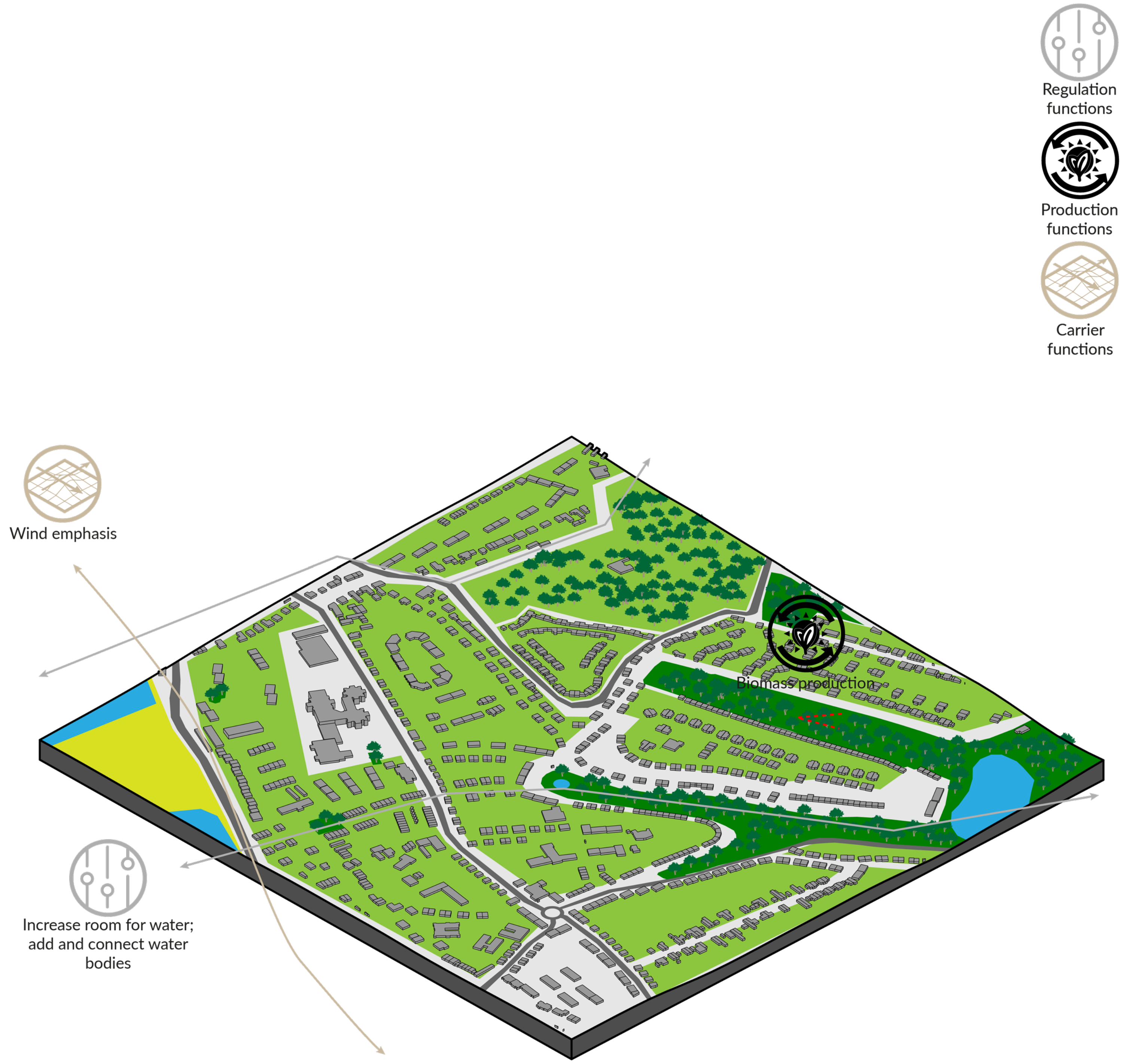
Regulation functions	Very bad	Bad	Sufficient	Good	Very good
Climate regulation		X			
Water regulation			X		
Water supply		X			
Soil retention		X			
Produce functions					
Raw materials		X			
Carrier functions					
Cultivation			X		
Energy-conversion	X				

Resilience functions

Assesment

	Very bad	Bad	Sufficient	Good	Very good
Flexibility and diversity				X	
Redundancy and modularity				X	
Safe failure ?					
Synergies with social, economic and environmental notions			X		
Efficiency of energy production			X		
Efficiency of energy timewise				X	


Regulation functions
Production functions
Carrier functions
Wind emphasis
Biomass production
Increase room for water; add and connect water bodies


Regulation functions
Production functions
Carrier functions
Wind emphasis
Biomass production
Increase room for water; add and connect water bodies


Regulation functions
Production functions
Carrier functions

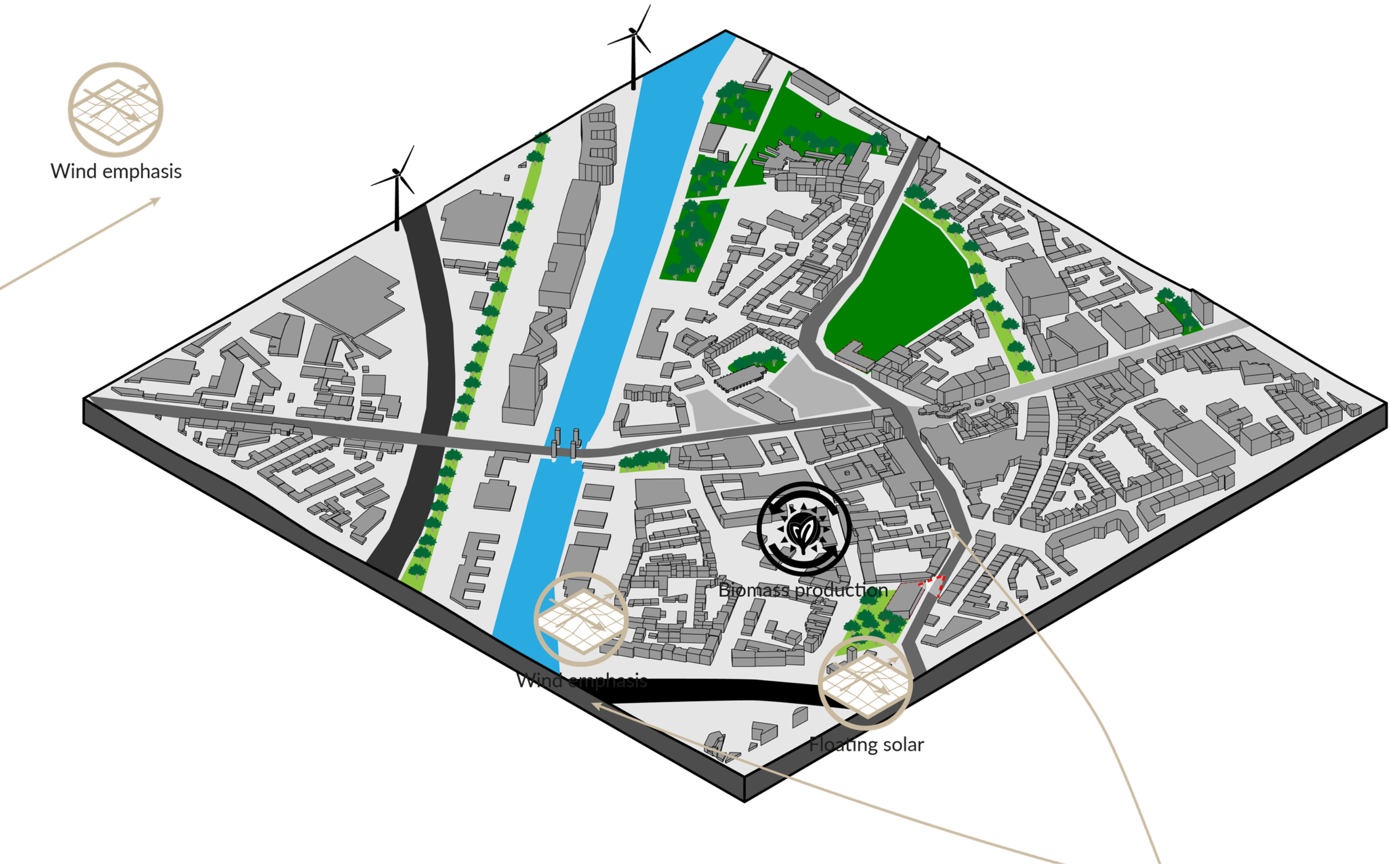

Regulation functions
Production functions
Carrier functions

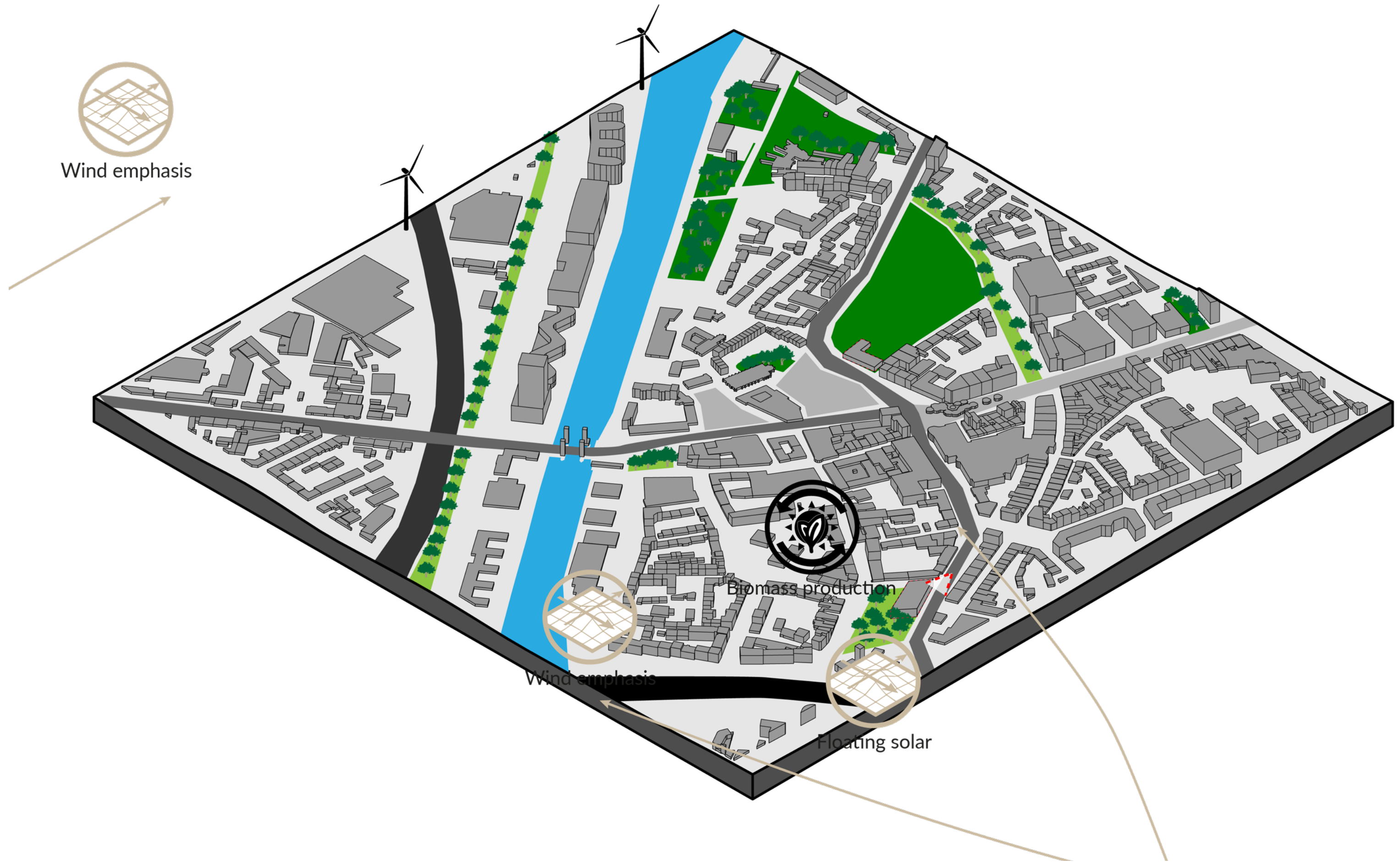

Increase room for water to facilitate floodrisk
Wind emphasis

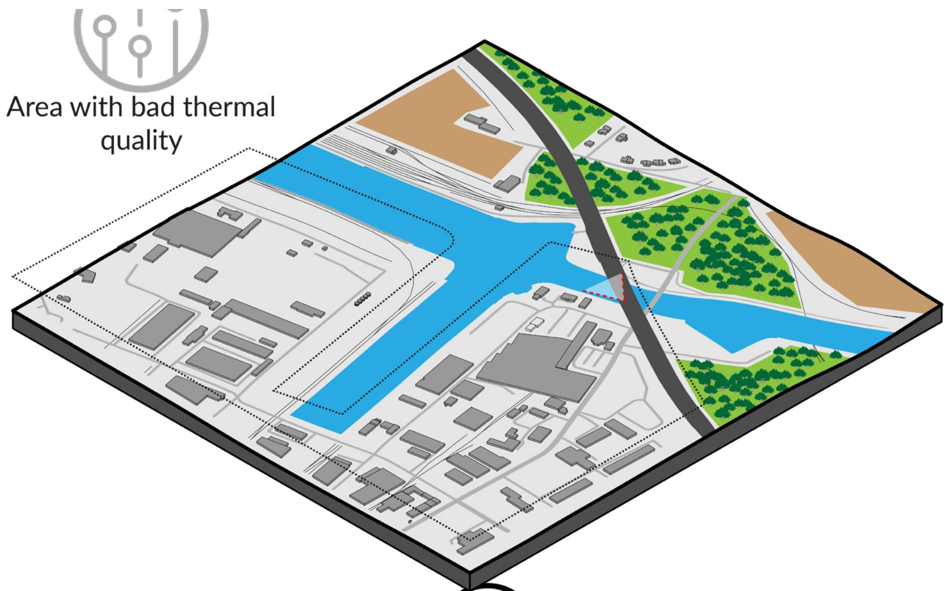

Wind emphasis
Increase room for water to facilitate floodrisk
Wind emphasis


Regulation
functions

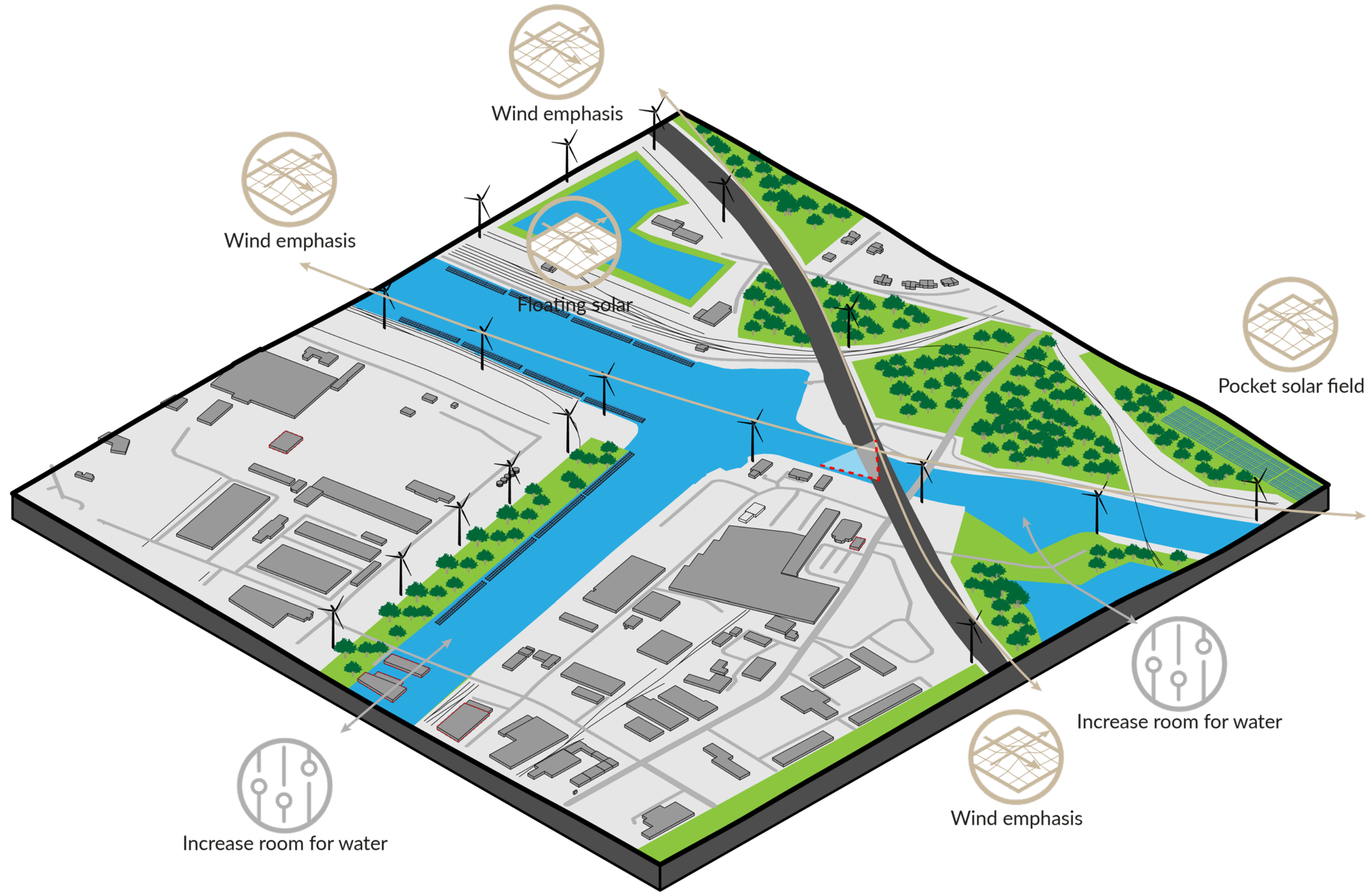

Regulation
functions
Production
functions
Carrier
functions

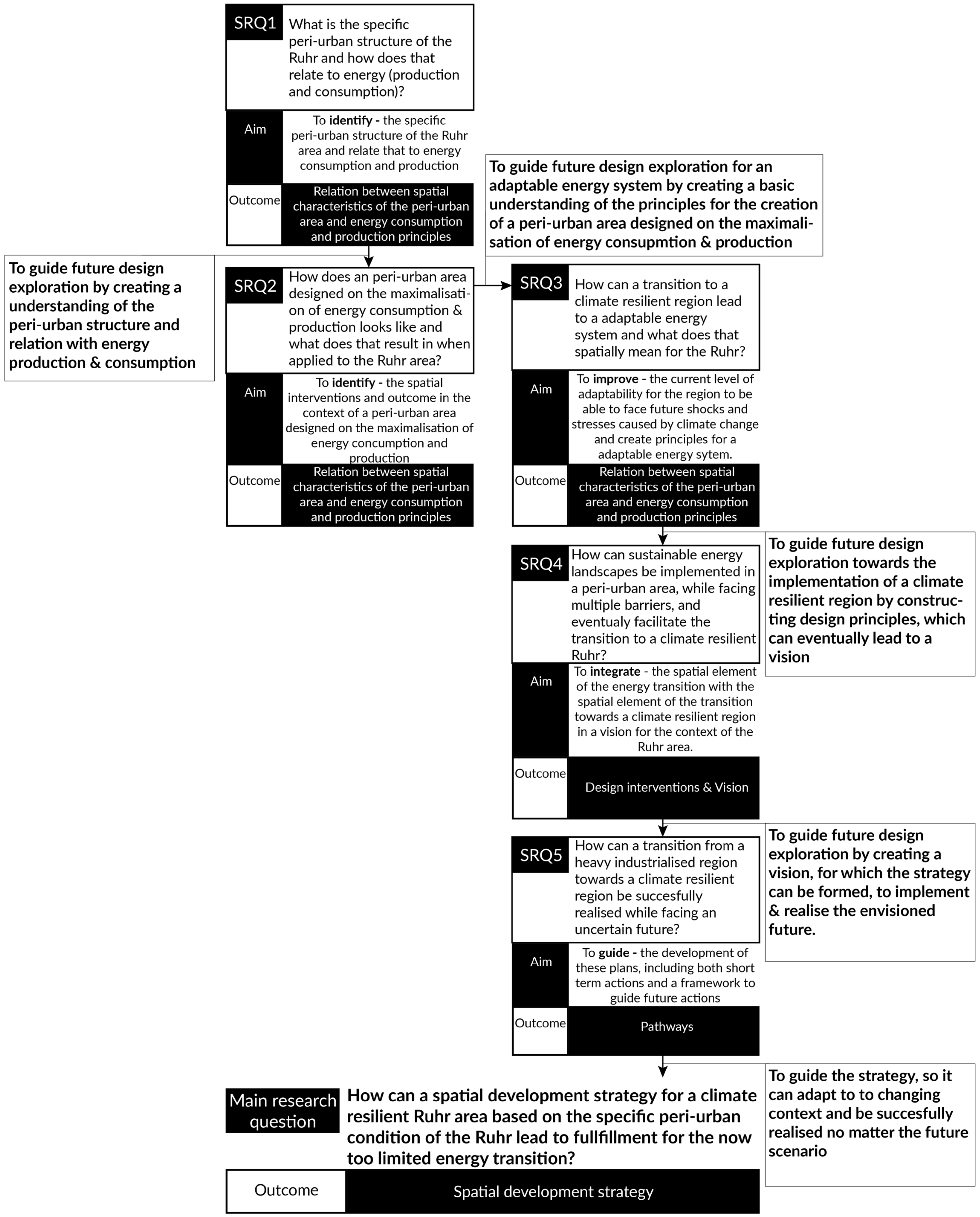

Wind emphasis
Biomass production
Wind emphasis
Floating solar


Wind emphasis
Biomass production
Wind emphasis
Floating solar


Area with bad thermal
quality


Biomass production
Wind emphasis
Floating solar
Pocket solar field
Increase room for water
Wind emphasis
Increase room for water


Wind emphasis
Wind emphasis
Floating solar
Pocket solar field
Increase room for water
Wind emphasis
Increase room for water


SRQ1
What is the specific peri-urban structure of the Ruhr and how does that relate to energy (production and consumption)?
Aim
To **identify** - the specific peri-urban structure of the Ruhr area and relate that to energy consumption and production
Outcome
Relation between spatial characteristics of the peri-urban area and energy consumption and production principles
To guide future design exploration by creating a understanding of the peri-urban structure and relation with energy production & consumption
SRQ2
How does an peri-urban area designed on the maximalisation of energy consumption & production looks like and what does that result in when applied to the Ruhr area?
Aim
To **identify** - the spatial interventions and outcome in the context of a peri-urban area designed on the maximalisation of energy concumption and production
Outcome
Relation between spatial characteristics of the peri-urban area and energy consumption and production principles
To guide future design exploration for an adaptable energy system by creating a basic understanding of the principles for the creation of a peri-urban area designed on the maximalisation of energy consupmtion & production
SRQ3
How can a transition to a climate resilient region lead to a adaptable energy system and what does that spatially mean for the Ruhr?
Aim
To **improve** - the current level of adaptability for the region to be able to face future shocks and stresses caused by climate change and create principles for a adaptable energy sytem.
Outcome
Relation between spatial characteristics of the peri-urban area and energy consumption and production principles
SRQ4
How can sustainable energy landscapes be implemented in a peri-urban area, while facing multiple barriers, and eventualy facilitate the transition to a climate resilient Ruhr?
Aim
To **integrate** - the spatial element of the energy transition with the spatial element of the transition towards a climate resilient region in a vision for the context of the Ruhr area.
Outcome
Design interventions & Vision
To guide future design exploration towards the implementation of a climate resilient region by constructing design principles, which can eventually lead to a vision
SRQ5
How can a transition from a heavy industrialised region towards a climate resilient region be succesfully realised while facing an uncertain future?
Aim
To **guide** - the development of these plans, including both short term actions and a framework to guide future actions
Outcome
Pathways
To guide future design exploration by creating a vision, for which the strategy can be formed, to implement & realise the envisioned future.
Main research question
How can a spatial development strategy for a climate resilient Ruhr area based on the specific peri-urban condition of the Ruhr lead to fullfillment for the now too limited energy transition?
Outcome
Spatial development strategy
To guide the strategy, so it can adapt to to changing context and be succesfully realised no matter the future scenario

Main research question

How can a spatial development strategy for a climate resilient Ruhr area based on the specific peri-urban condition of the Ruhr lead to fullfillment for the now too limited energy transition?

Approach	The main approach of the thesis is based on systemic design thinking. This method structures the thesis and guides the process.
Aim	Research how the construction of a resilient region can lead to the fullfillment of the energy transition by the means of sustainable energy landscapes in the context of the peri-urban structure of the Ruhr
Outcome	Spatial development strategy

SRQ1 What is the specific peri-urban structure of the Ruhr and how does that relate to energy (production and consumption)?

Approach	Netzstadt approach
Method	Mapping, Energy potential mapping, literature study, Morphological analysis, Physiological analysis, Site visit
Aim	To **identify** - the specific peri-urban structure of the Ruhr area and relate that to energy consumption and production
Outcome	Relation between spatial characteristics of the peri-urban area and energy consumption and production principles

SRQ2 How does an peri-urban area designed on the maximalisation of energy consumption & production looks like and what does that result in when applied to the Ruhr area?

Approach	Maximalisation & Research by design
Method	Design exploration, Mapping, Literature study
Aim	To **identify** - the spatial interventions and outcome in the context of a peri-urban area designed on the maximalisation of energy concumption and production
Outcome	Regional and urban design (and systems) principles & Urban design interventions

SRQ3 How can a transition to a climate resilient region lead to a adaptable energy system and what does that spatially mean for the Ruhr?

Approach	Socio-ecological metabolism & research by design
Method	Literature study, Physiological analysis, Energy potential mapping, Mapping, Morphological analysis, design exploration
Aim	To **improve** - the current level of adaptability for the region to be able to face future shocks and stresses caused by climate change and create principles for a adaptable energy sytem.
Outcome	Regional design (and systems) principles & Design interventions

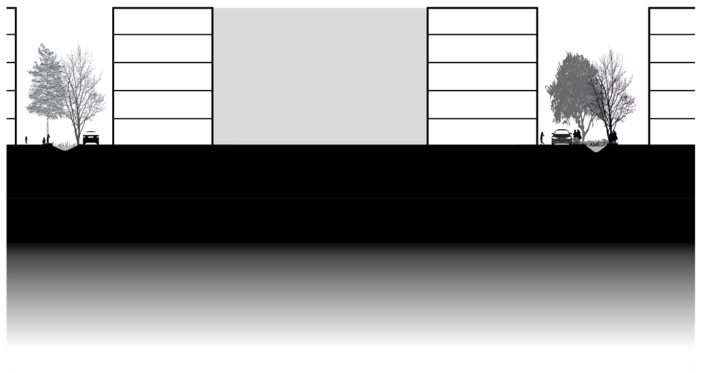
SRQ4 How can sustainable energy landscapes be implemented in a peri-urban area, while facing multiple barriers, and eventualy facilitate the transition to a climate resilient Ruhr?

Approach	Research by design
Method	Design exploration, Mapping, Literature study
Aim	To **integrate** - the spatial element of the energy transition with the spatial element of the transition towards a climate resilient region in a vision for the context of the Ruhr area.
Outcome	Design interventions

SRQ5 How can a transition from a heavy industrialised region towards a climate resilient region be succesfully realised while facing an uncertain future?

Approach	Dynamic adaptive policy pathways
Method	Literature study, Policy analysis, Stakeholder analysis, Mapping, Design exploration
Aim	To **guide** - the development of these plans, including both short term actions and a framework to guide future actions
Outcome	Principles & strategy

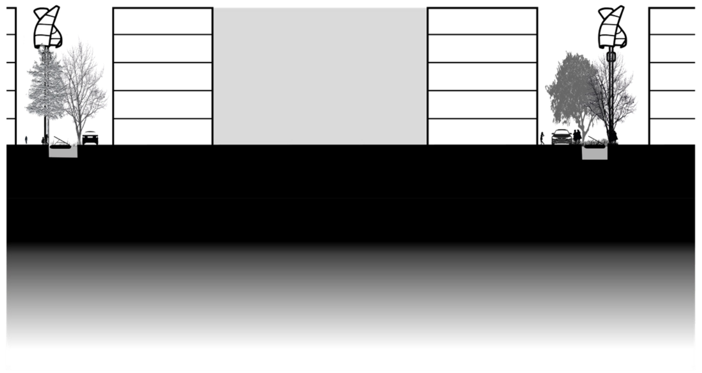
Concept: **Greenblue streets**
Minimum scenario



Description of concept:
Streets where the main principle is the implementation of green and blue; public recreational and environmental creeks and meadow. This has a cooling effect and adapting effect in terms of heavy drought and precipitation.

Hierarchy:
Hub city, Creek city, Wall city, Waterfront

Concept: **Greenblue streets**
Maximum scenario



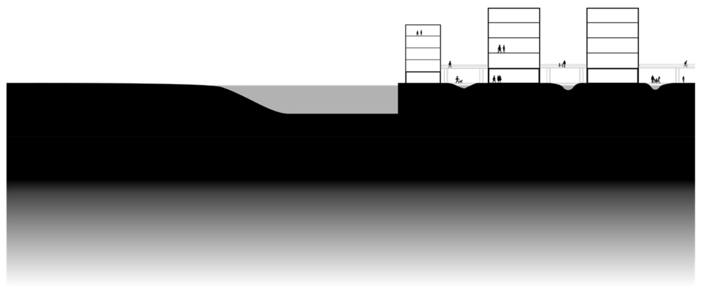
Description of concept:

The streems are transformed to form narrow canals, with a open bottom. This is done to further increase the capacity of this stream in times of heavy precipitation. Furthermore, energy production is added to the streets, in the shape of microwind turbines and floating solar panels.

Concept: **Tidal park**
Minimum scenario

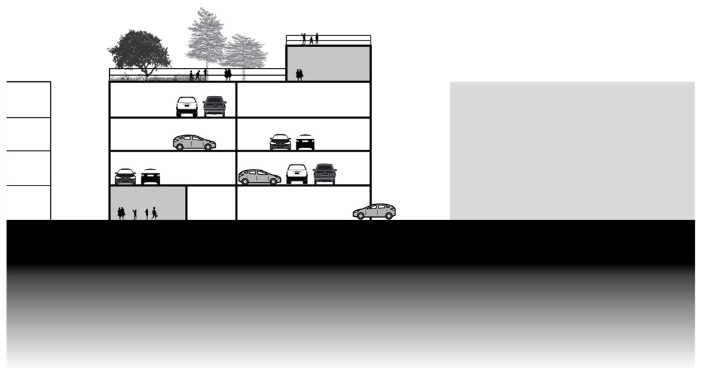
Description of concept:
An area, that is outerdike or innerdike, that is a public park, which depending on the water level, is either flooded, partly flooded or not flooded at all.

Concept: **Working with water**
Minimum scenario



Description of concept:
Where important regions close to water where a flooding risk is present, where buildings and the ground level are modified to work with water. Trenches are dug to and strategic new entrances are created.

Concept: **Hub city**
Minimum scenario

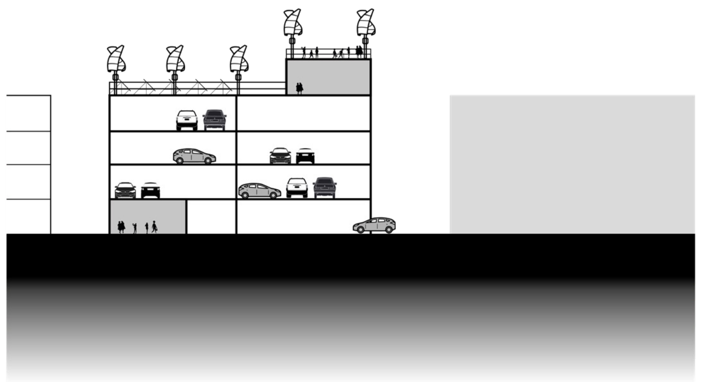


Description of concept:
A hub city is an area where parking is tackled centralised. This is done in a hub, a multilayered parking facility with a public function on the roof and in the plinth.

Hierarchy:
Linked to greenblue streets, wall city, creek city,

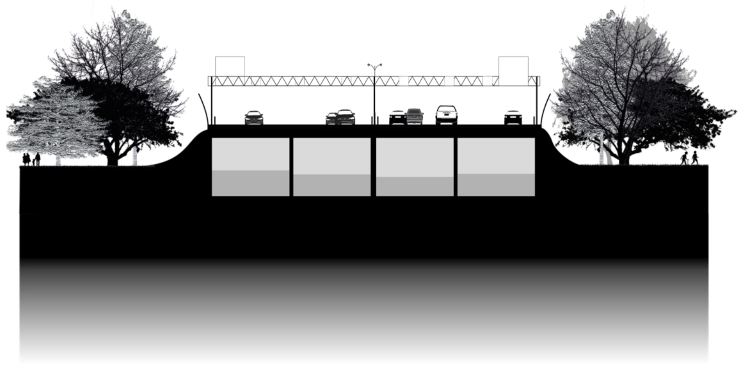
System requirements:
Mobility transformation

Concept: **Hub city**
Maximum scenario



Description of concept:
The hub city is transformed from a concept with urban farming to a concept with solar and wind production on the roof. This is done to optimise the potential of this surface.

Concept: **Water & infrastructure**
Minimum scenario

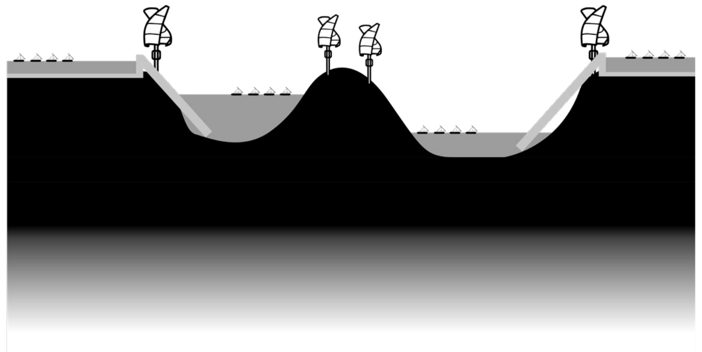


Description of concept:
Infrastructure in a highly densified area has the capacity to store water in times of major precipitation, this can be strategically implemented in, around and especially below infrastructure.

Concept: **Energy mines**
Minimum scenario

Description of concept:
A former mine or storage for bulk transformed to a biomass forest,. This biomass can be harvested from where electricity or fuel can be produced.

Concept: **Energy mines**
Maximum scenario



Description of concept:
A former mine or storage for bulk transformed to a energy landscape, the shapes dictate the renewable energy source, with wind driven energy production on the higher parts and solar energy production on the sides of these 'hills'.

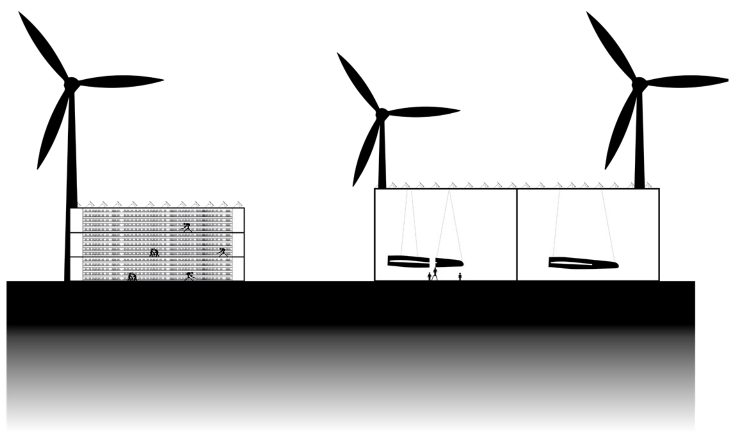
Concept: **Food forest**
Minimum scenario

Description of concept:
A food forest is a biomass production site where urban farming is implemented. The level of biomass production is a variable, depending on the scenario. With the minimum scenario, places for recreation are implemented.

Concept: **Food forest**
Maximum scenario

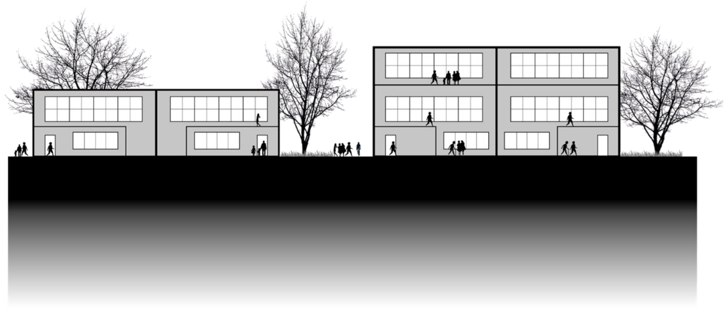
Description of concept:
A food forest in the maximum scenario is transformed from a an area with a recreational component to an area for the production of energy and food.

Concept: **Energy = economy**
Minimum scenario



Description of concept:
Economic development is based on principles for sustainable energy landscape components or processes aiding climate adaptation, such as vertical farming or the production of windmill components.

Concept: **Loft urbanisation**
Minimum scenario

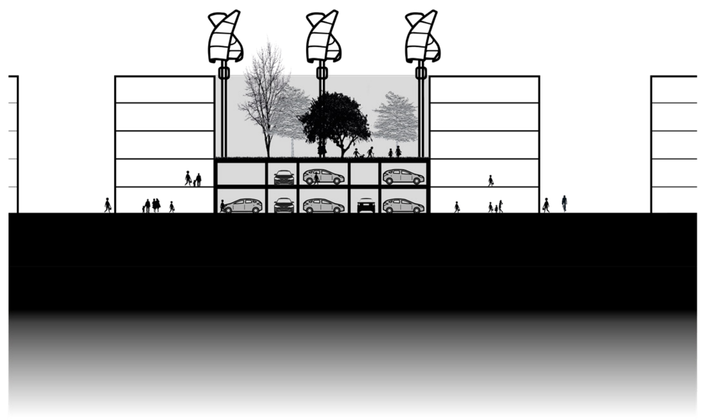


Description of concept:
Transformation from industrial building (loods??) to a residential building. In this way, buildings are re-used and former industrial areas are kept intact and alive, with a transformation of service taking place.

Concept: **Public pocket courtyard**
Minimum scenario

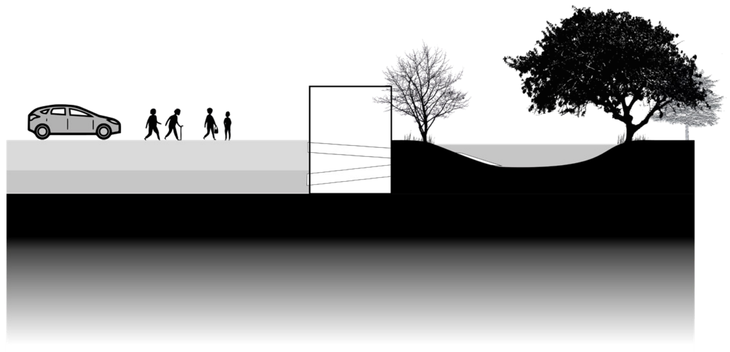
Description of concept:
A courtyard that is transformed to a public area, where, depending on the context, the courtyard is transformed to a smaller public park, hub, or a combination of this.

Concept: **Public pocket courtyard**
Maximum scenario



Description of concept:
In the maximum scenario, the height can be adjusted, with the plinths of buildings activated.

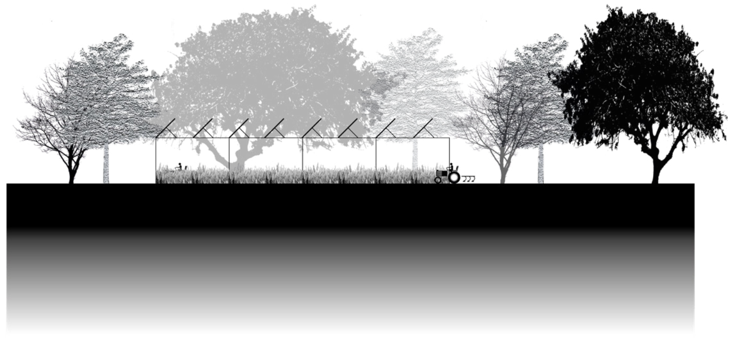
Concept: **Creek city**
Minimum scenario



Description of concept:
Street where water is retained and transported through the city to counter UHI and provide public green area. These creeks are connected to a major river, canal or waterreservoir, where the height level provides results in potential energy.

Hierarchy:
Linked to greenblue streets

Concept: **Agrivoltaics**
Minimum scenario

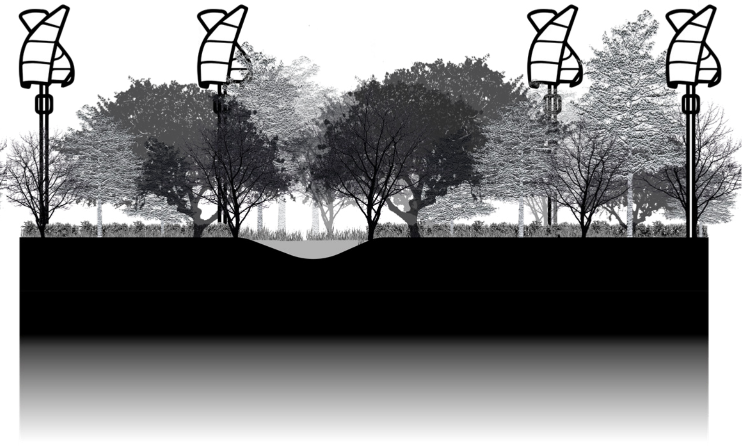


Description of concept:
A combination of agriculture and pv voltaics. This increases the efficiency of the agricultural process and protects the crops in times of extreme weather.

Concept: **Biomass forestation**
Minimum scenario

Description of concept:
Biomass forestation is an an concept that is defined, designed and maintained for the sole production of biomass. In the minimum scenario this can be combined with a recreational value of walking or resting, in a small park like setting.

Concept: **Biomass forestation**
Maximum scenario



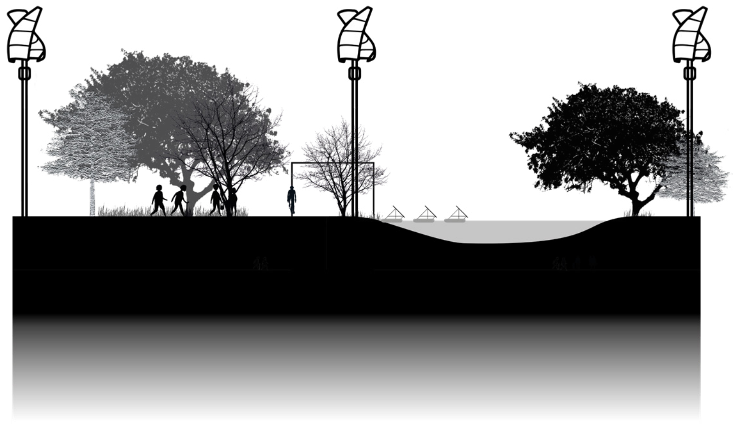
Description of concept:
Biomass forestation is an an concept that is defined, designed and maintained for the sole production of biomass. In the maximum scenario this can be combined with wind emphasis and solar production. Some area's can even be transformed to aquaculture, where biomass is produced in partly submerged areas.

Concept: **Wall city**
Minimum scenario

Description of concept:
A wall city is an area where the old (historical) wall of a city is reactivated and transformed into a ribbon park, with water, wind emphasis in a recreational park.

Hierarchy:
Combined with Hub city, greenblue streets and creek city.

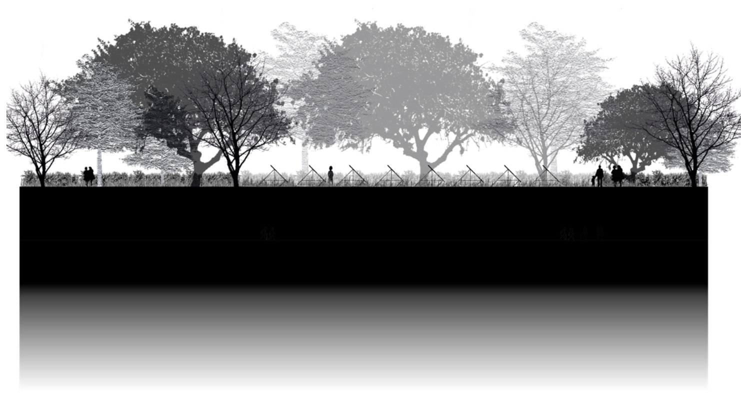
Concept: **Wall city**
Maximum scenario



Description of concept:
In the maximum scenario, floating solar panels and hydropowerplants are added.

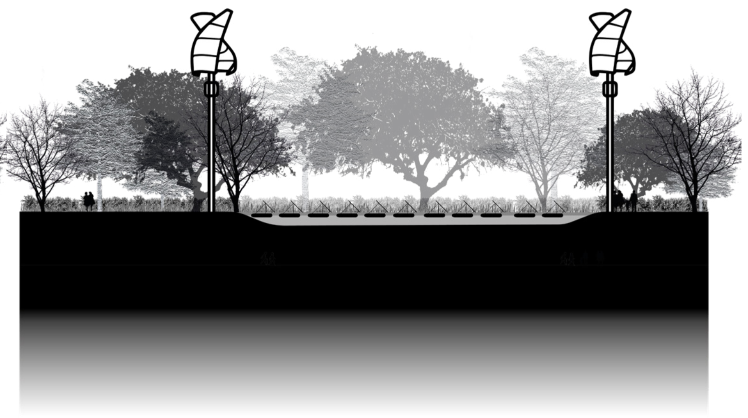
Hierarchy:
Combined with creekcity, greenblue streets, hub city.

Concept: **Pocket solar field**
Minimum scenario



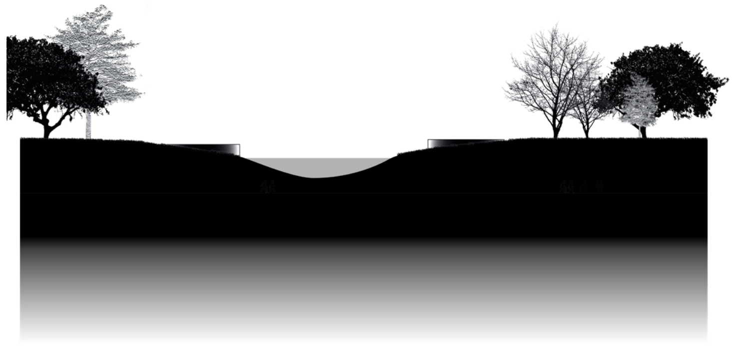
Description of concept:
A pocket solar field is a solar field that is shielded by surrounding (food) forests or other agricultural or ecological areas, disguising it and shielding it from the view of residents.

Concept: **Pocket solar field**
Maximum scenario



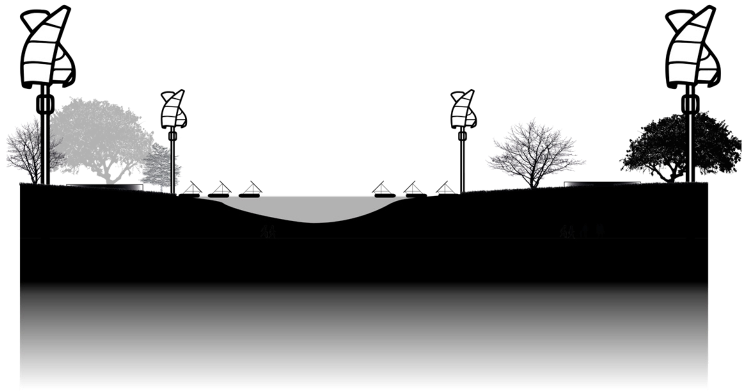
Description of concept:
A pocket solar field is a solar field that is shielded by surrounding (food) forests or other agricultural or ecological areas from the view of residents. In the maximum scenario this can be transformed to a floating solar field, with water retention wind emphasis or transformed to a tidal park with solar energy power.

Concept: **Algea + wetland**
Minimum scenario



Description of concept:
An area that is a wetland, where the buffer areas, or areas that are unlickely to be flooded are areas where algeas are produced. This algea production can be used for biofuel. In the minimum scenario, this wetland has a recreational function.

Concept: **Algea + wetland**
Maximum scenario

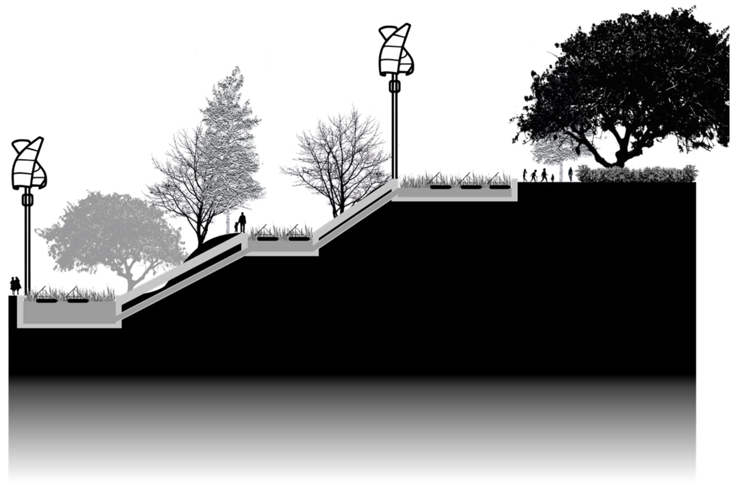


Description of concept:
An area that is a wetland, where the buffer areas, or areas that are unlickely to be flooded are areas where algeas are produced. This algea production can be used for biofuel. In the maximum scenario, this is combined with floating solar and wind emphasis. wetland has a recreational function.

Concept: **Waterstairs**
Minimum scenario

Description of concept:
Waterbody's, different in size, all with a height level towards each other. This height difference creates potential energy, which can be transformed to kinetic energy. In this way, this offers a possiblity to produce and store energy through water.

Concept: **Waterstairs**
Maximum scenario

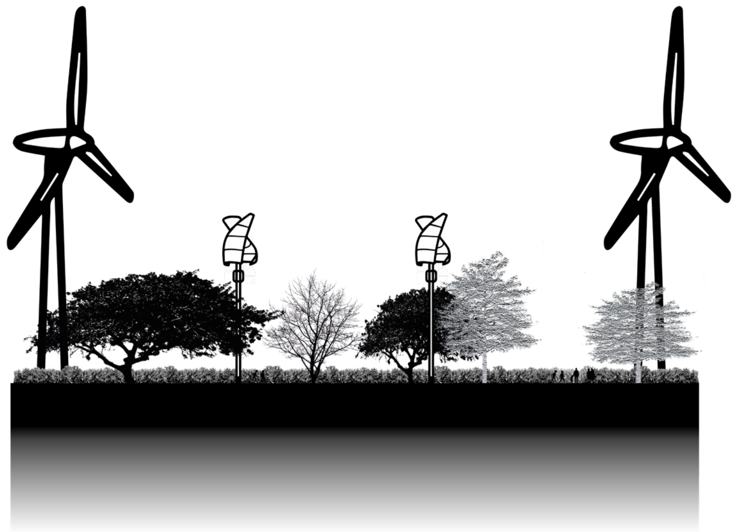


Description of concept:
In a maximum scenario, these waterbodies can house floating solar panels, bio-mass forestation in a aquaculture way or become a tidal park.

Concept: **Wind emphasis**
Minimum scenario

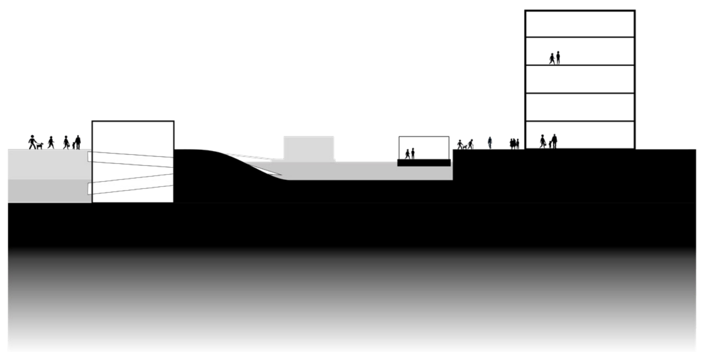
Description of concept:
Wind emphasis is the implementation of wind turbines on a line in the (urban) landscape, to emphasize that line. The level of wind turbines differentiates in the scenarios. In the minimum scenario, these turbines can be implemented in (crouded) urban areas.

Concept: **Wind emphasis**
Maximum scenario



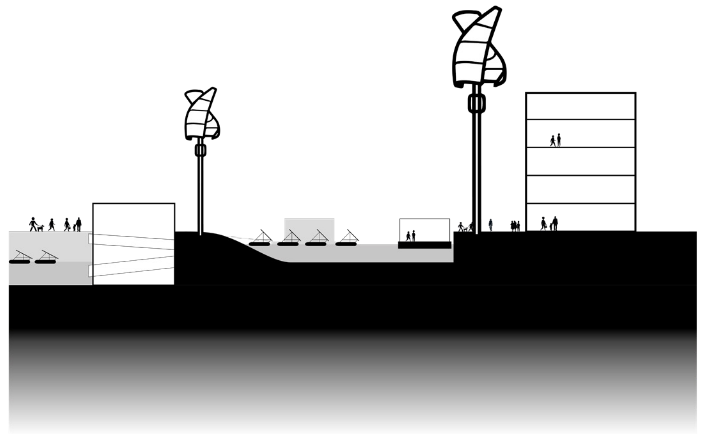
Description of concept:
Wind emphasis is the implementation of wind turbines on a line in the (urban) landscape, to emphasize that line. The level of wind turbines differentiates in the scenarios. In the maximum scenario, these turbines are bigger in size, placed further a part and have certain rules and regulations in the distance to certain surrounding functions.

Concept: **Urban energy waterfront**
Minimum scenario



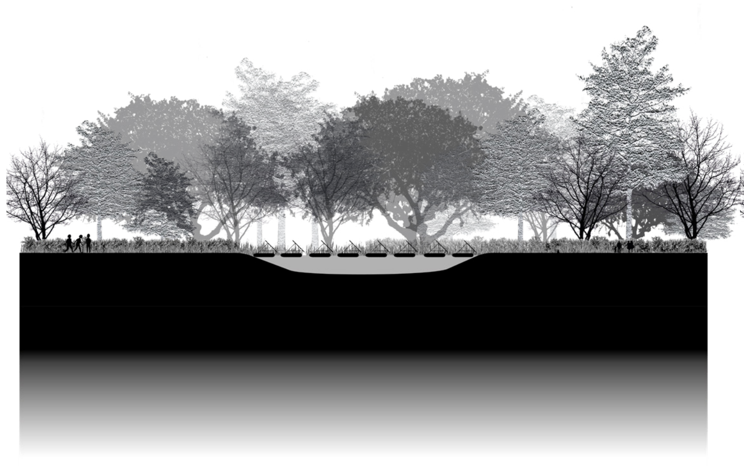
Description of concept:
A urban waterfront is an area , , where urbanisation is taking part on and close to the water.

Concept: **Urban energy waterfront**
Maximum scenario



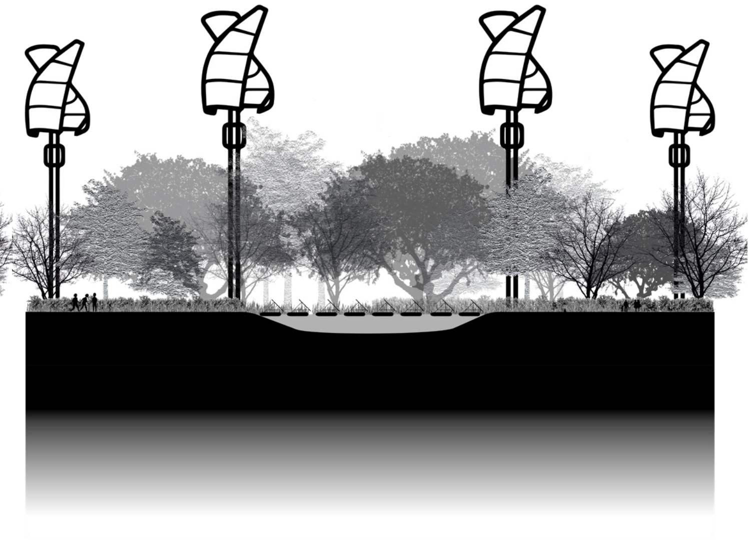
Description of concept:
with wind emphasis, hydropowerplants as a consequence of creek city and floating solarpanels

Concept: **Floating solarfield**
Minimum scenario



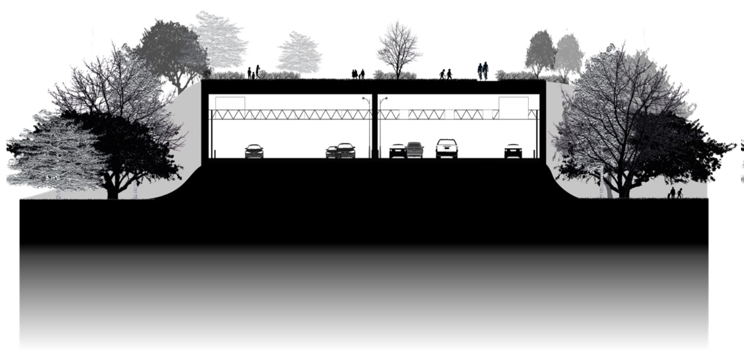
Description of concept:
Floating solar are several solar panels on a water body, they are floating and can thus adapt to the different water levels.

Concept: **Floating solarfield**
Maximum scenario



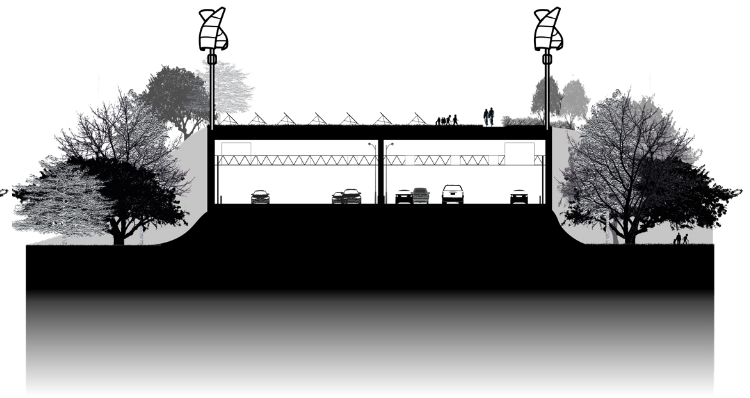
Description of concept:

Concept: **Roof infrastructure**
Minimum scenario



Description of concept:
Infrastructure can be fitted with a roof, which can function as a ecological wedge in a city. This ecological function can also play a part in the water retention system of an area.

Concept: **Roof infrastructure**
Maximum scenario



Description of concept:
In the maximum scenario, (a part of) this area can be fitted with either solar panels or wind turbines.

Agriculture

+
Multilayered, agriculture and solar and wind energy production

Biomass production

Biodiversity and ecologic corridor along edges

Implemented in urban areas

-
Production of greenhouse gasses

Effect on groundwater

Production is heavily climate dependant

Park

+
Countering air and noise pollution

Multilayered, water retention and energy production can be imbedded in the fabric

Biodiversity and ecologic corridor

Leisure (reduce stress)

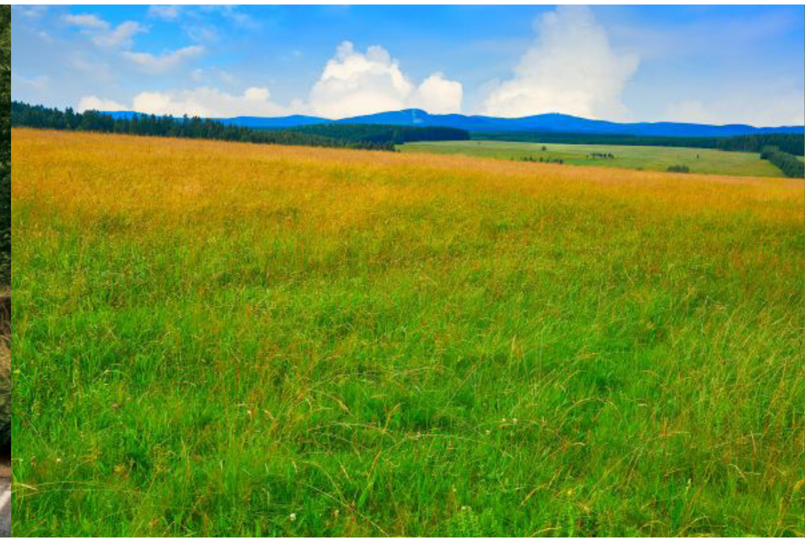
Countering UHI, cooling and shading

Pocketpark can be imbedded in urban fabric

social (meeting), Economic (increase value of area) and Enviromental (Water retention) consequences.

-
Altering the park could alter/damage the ecologic structure

Meadow



+
multilayered, solar and wind

Biodiversity and ecologic corridor along edges

Cooling

transform to agriculture

suitability for biomass production?

water retention?

certain geographical condition might make it suitable for hydropower and hydrostorage

-
Altering the meadow could alter/damage the ecologic structure

Forest

+
CO² storage

Biodiversity and ecologic corridor

Suitability for biomass production

Leisure (reduce stress)

Countering UHI, cooling and shading

Water retention

-
Altering the forest could alter/damage the ecologic structure

Wetland

+
Water retention

Biodiversity and ecologic corridor

Buffer space

Countering UHI, cooling and shading

Adjusted to serve as energy landscape, hydropower

-
Altering the wetland could alter/damage the ecologic structure

River

+
Water retention

Biodiversity and ecologic corridor

Hydropower

Hydrostorage

Countering UHI, cooling and shading

-
Altering the river could alter/damage the ecologic structure

Creates a physical barriere between both sides of river

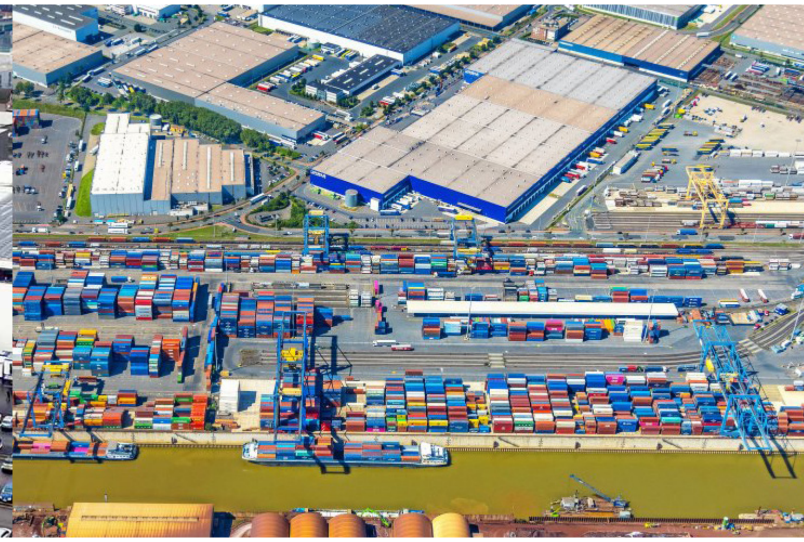
Buseniss sector / service sector

+
Vast paved parking area, suitable for multifunctional use, solar carports, wind energy production and urban creek for countering UHI.

Roof area highly suitable for solarpanels.

-
Paved parking area is not suitable for transforming to urban creek, due to parkingpressure.

Logistic area



+
Vast paved area, suitable for multifunctional use, solar and wind energy production

If close to canal, hydrostorage could be implemented

Logistic area is often a node in a network, could function as a node in energy network

-
Logistics sector is a heavily polutant sector, requires a lot of energy.

Canal

+
Cooling

Ecologic corridor and Biodiversity along embankment

Water retention

Biodiversity and ecologic corridor

Hydropower

Hydrostorage
Countering UHI, cooling and shading

-
Embankment disallows canal to be ecologic node, where crossing from one side to the other is not possible.

Is restricted in possibilities due to foremost transport and logistical function as corridor in network.

Industrial area

+
Needs to transform

Morphological shapes offer possiblity to implement sustainable energy production into the area

heat network, residual heating

-
Identity, so morphologically characteristics have value and can not be altered.

Pollutant

City centre

source

+

Due to design, sufficient open space is generated

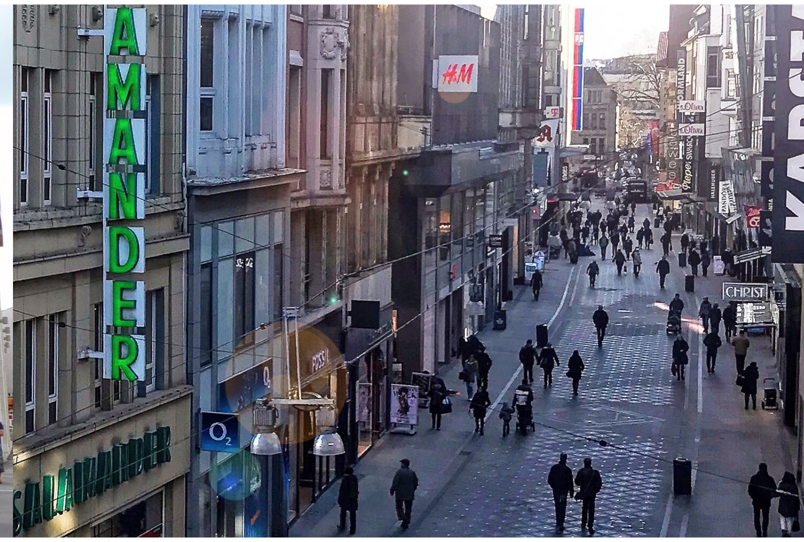
-
Often monofunctionally designed, not active throughout the entire day.

When closed, socially unsafe (mono-functional)

Lack of green spacces, designed for cars

Water retention is lacking

Historic city centre



+

Designed for pedestrian

Economic strong area

Multifunctional

High concentration and variation of functions, creates attraction and economic value

-

UHI, due to design and materialisation

Lack of green spaces

Water retention is lacking

Leisure and sports area

source

+

lot of green open space

applicable for solar and microwind

could be transformed to ecological corridor

-
Area works because of easthetics. Implementation of energy landscapes should be carefully considerated.

Public space

+
Multifunctional

Multilayered

Solar, urban elements

Temporal

-
possible negative outcome

what are barriers for implementing this

In Urban areas, mostly paved,

Lack of ecologic corridor

Energy landscape (renewable energy source)

+

Sufficient open spaces
Could be connected to ecologic corridor
Water retention could be imbedded in the patch

-
implementation aesthetically influences area

Energy landscape (non-renewable energy source)

+

Drosscape, so a lot of possiblities

either hydropower, hydrostorage

-

Soil needs to be regenerated

ecologically unconnected

Low density suburb (very low density urban fabric)

+
sufficient open green spaces

node/corridor in ecologic network

biomass production

solar energy production

could alter urban area to become, biomass production hub

Water retention is done naturally

-
car dependant

monofunctional

poorly connected

Green suburb (low density urban fabric)

+
sufficient open green spaces

node/corridor in ecologic network

could alter urban area to become, sustainable energy production hub, due to sufficient possibilities for energy production

playes key role due to availability of certain functions in relation to other smaller settlements in the surrounding

Water retention is done naturally

-
car dependant

Urban area (continuous urban fabric)

+
Designed for pedestrian

Well connected, public transport

Multifunctional

With concentration of network operators, heat network is possible

Roofstructure could be altered to function as a second groundlevel, with green rooftops and urban farming

-
UHI

No ecologic corridor

No open space, buffering is not possible, solutions only possible in multi-layered way.

Water retention is not possible naturally

Road network

source

+

Due to function, possible to implement solar and wind energy production

aesthetically, (almost) anything is possible

Forms long nodes, could be linked to ecologic and energy network

-

Forms a barrier, fron one side to another side for network operators such as residents or animals

Peri-urban (medium density urban fabric)

+
node/corridor in ecologic network

playes key role due to availability of certain functions in relation to other smaller settlements in the surrounding

connected via public transport and car

-
Located between edges, sufficient open space is lacking

Potential urban (disc. dense urban fabric)

+

Designed for pedestrian as well as car

Well connected, via car and public transport

Concentration of function and variation of function

Microgrid is possible

-
Clear ecologic corridor is lacking

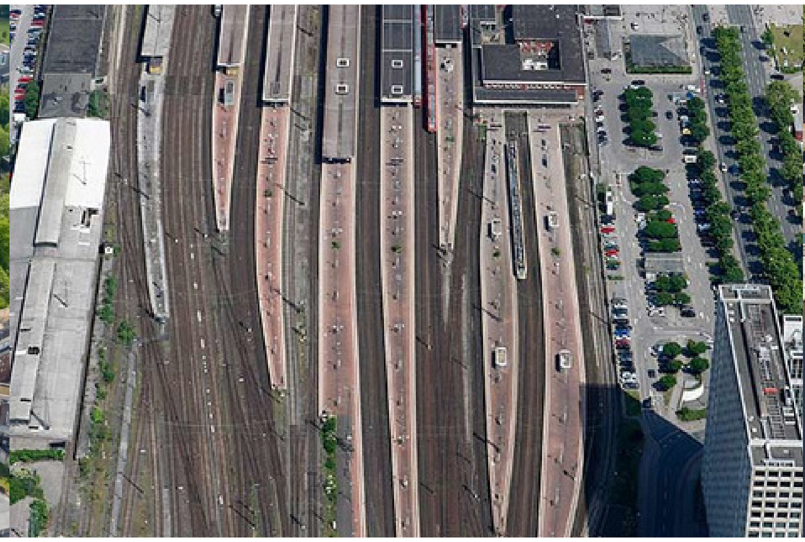
Water retention is lacking

Lack of open spaces

No ecologic corridor

UHI

Rail network



+

Due to function, possible to implement solar and wind energy production

aesthetically

Forms long nodes, could be linked to ecologic and energy network

-

Forms a barrier, fron one side to another side for network operators such as residents or animals

Lack of sufficient green and open spaces

Lack of ecologic corridor

Water network

+
Water retention

Biodiversity and ecologic corridor

Hydropower

Hydrostorage

Countering UHI, cooling and shading

-
Altering the river could alter/damage the ecologic structure

Creates a physical barriere between both sides of river

Buffering needs to be taken into account, since flooding has enormous influences

Energy network

+

ecologic corridor

water retention

sufficient open space

solar and wind production can be added to network

-

certain functions are excluded from use, due to safety

Heat, below ground
Fuel, transported, otherwise below ground
Electricity

Ecologic network

+

Can be transformed to implement secondary function in relation to energy production

UHI

Can serve multiple functions, as long as it is connected to network

-

Altering the structure could alter/damage the ecologic structure

Certain functions are excluded, to preserve the ecological function