Strategic planning of energy landscape

Synergies and trade-offs in Parkstad

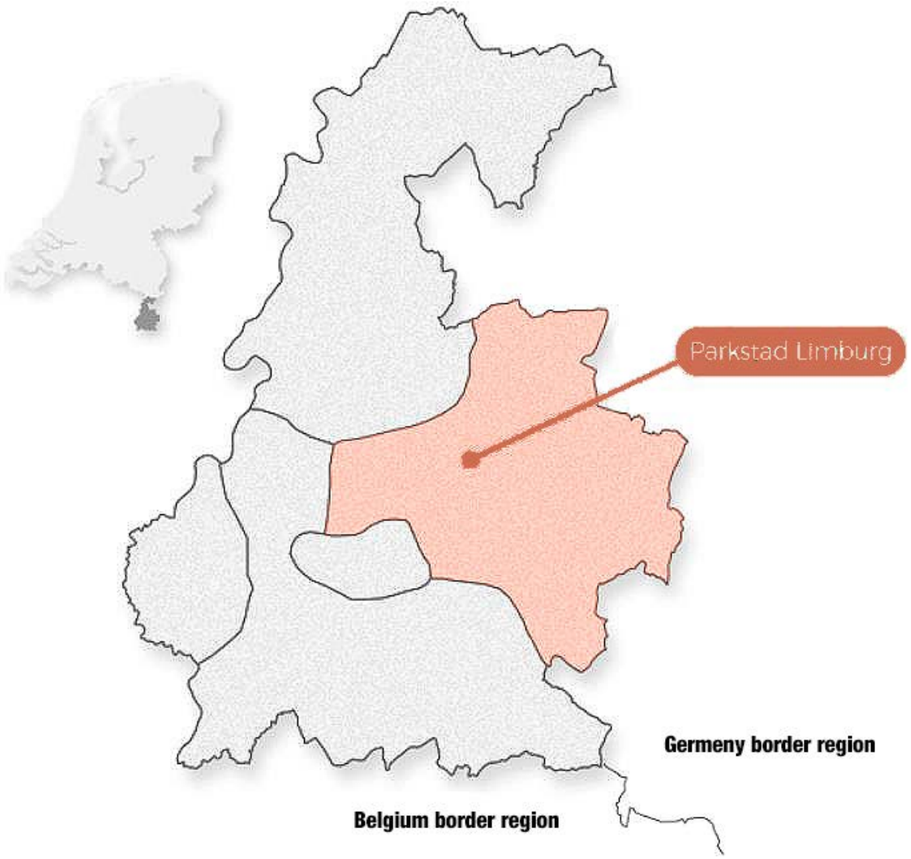


Yueting Wang
Landscape Architecture MSc Thesis

PARKSTAD

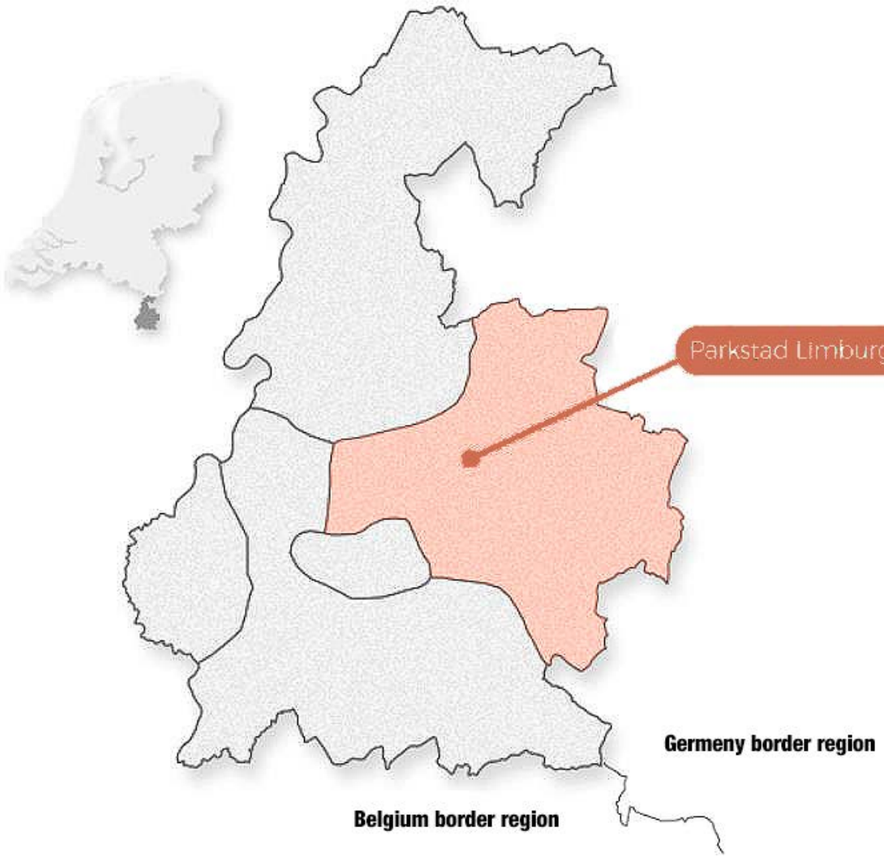
History and now

Location


Parkstad Limburg
Germeny border region
Belgium border region



Location


Parkstad Limburg
Germeny border region
Belgium border region


Heerlen

Netherlands

41.526 km2

16.500.000 pop.

395 inh/km2

Northern Netherlands

8.327 km2

1.700.000 pop.

204 inh/km2

South Holland

2818 km2

3.500.000 pop.

1227 inh/km2

South Limburg

670 km2

650.000 pop.

966 inh/km2

Parkstad

211.1 km²

245109 pop.

1161 iha/km²

Roman period
50 BC



Medieval
1500s



ON I
1899



Decided to close state mines
1965



The last coal mine was closed
1974



Several attemps
All failed
1975-1995



Plan Gravenrode Park
1995



IBA Parkstad
2014



State Mine Wilhelmina



Mine Hendrik



ON II



Schutterspark



Shop Schunck





Trap Wilhelminaberg & Snowworld



Golfbaan Brunssum



Mondo Verde



BloteVoetenpark



Glaspaleis

Around 1900, the formerly agricultural area rapidly developed as the epicentre of Dutch coal mining. Mining for coal was so lucrative that the eastern part of Zuid-Limburg region adapted everything to this source of income. Almost everyone worked down the mines in the 1950's.

PROSPERITY

Within a few decades the regional landscape transformed from countryside to something in-between urban and suburban. Typical of the region is its fragmented urban landscape: without a really clear urban centre, it is rather a collection of neighbourhoods, where you often not really know in which city or village you are.

Apart from the dominated coal mine. The rural economy in Parkstad also underwent a structural transformation between 1850 and 1940. A first key factor was the switch from arable farming system to animal husbandry and horticulture. The second development was internationalisation and world wild integration of agricultural and food market.

The mining industry disappeared as quickly as it emerged. Most former mining complexes were demolished and replaced by nature areas, parks or housing areas, but the former miners hardly profited from those new jobs, so the city begint to shrink. There are lots of empty streets, shops.

SHRINKAGE

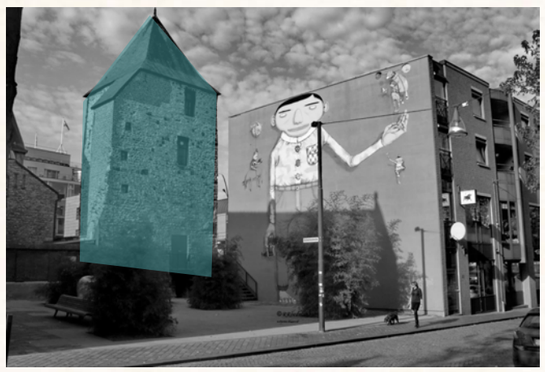
The depressed economic environment leads to a high rate of unemployment, and it causes a lot of social problem as well. In the Netherlands, so far shrinkage is mainly happening at the peripheral edges of the country, but an urbanized area as Parkstad is facing to the same problem.

Problem: vacany, eging population and unemployment rate

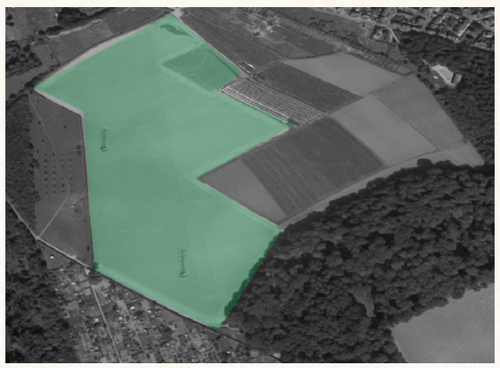


















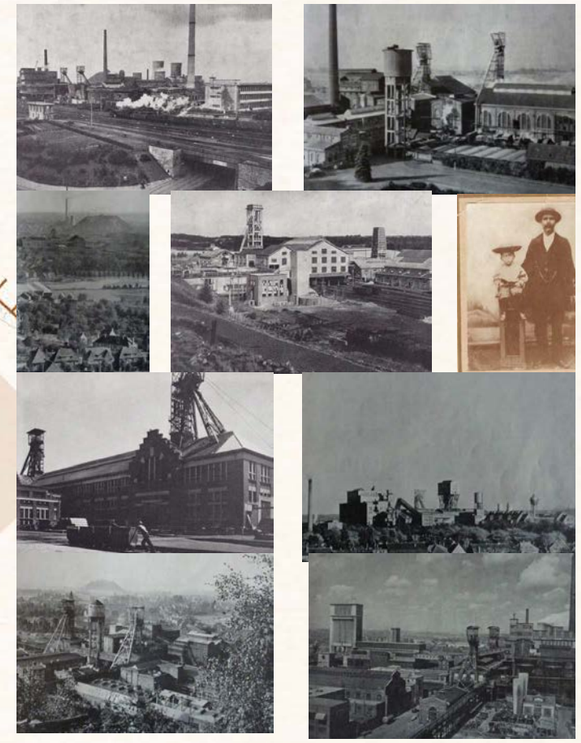
Research question:

What are the energy-conscious spatial strategies, to integrate with energy sinks, urban green network, and differentiation of niches, to facilitate sustainable energy landscape design to improve environmental quality in Parkstad?

LANDSCAPE

Typology

Coal mining history





Private mines
State mines
Coal mine district
Coal mine concession
Mine railway
Public railway
Faults

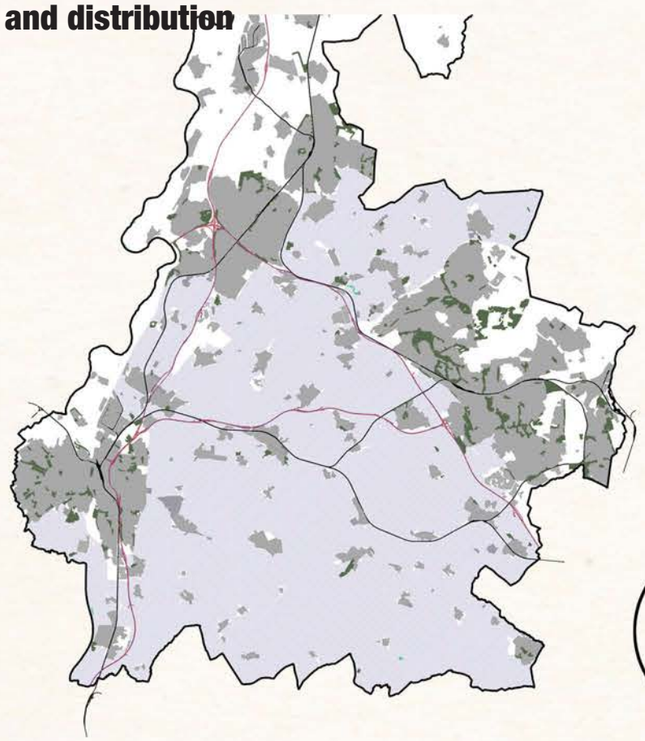
0 5 10 km

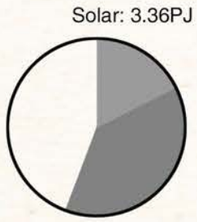
http://www.limburgsemijnen.nl/

HEERLEN (L.)

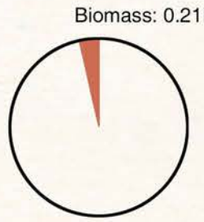
Steenkolenmijn „Oranje-Nassau I“

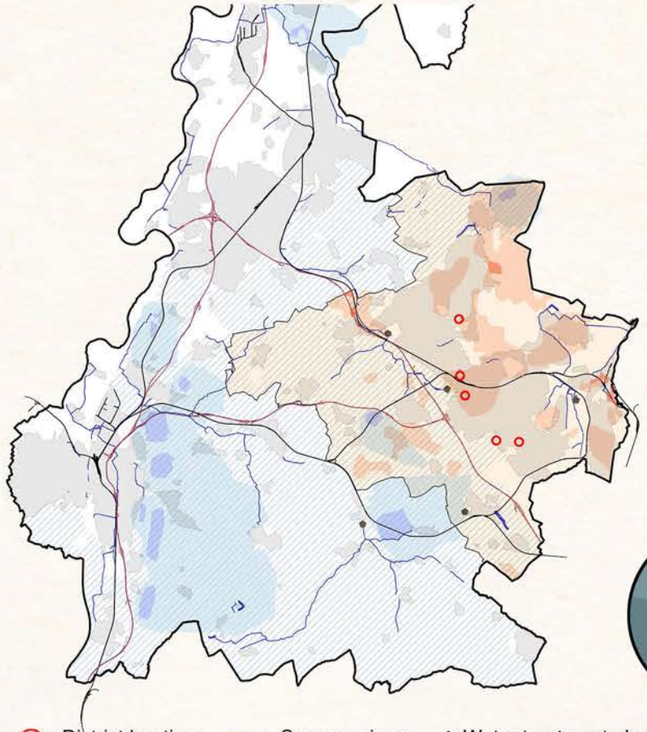
Energy status and distribution

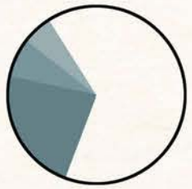












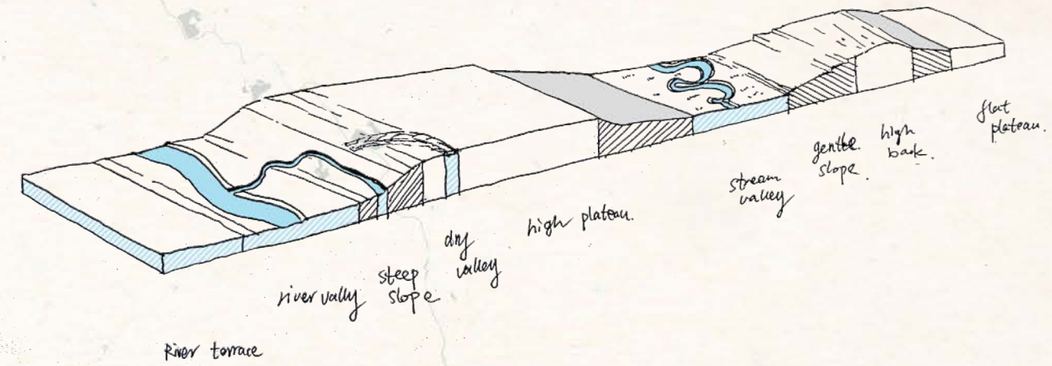




District heating
Sewage pipes
Water treatment plant
Ground heat
Very good
Good
Moderate

Silent zone
National landscape
Flight tunnel
Existing wind turbines
Business park
150kv voltage line

Topography

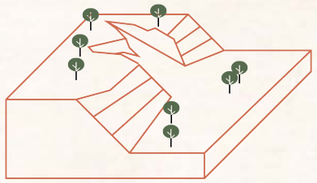

river valley
steep slope
dry valley
high plateau
stream valley
gentle slope
high bank
flat plateau
river terrace


valley floor
isolated hill
quarry
slope < 4 degree
slope > 4 degree
plateau
intermediate terrace
0
5
10 km

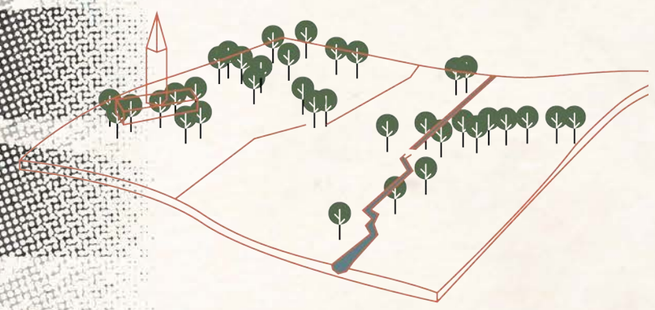




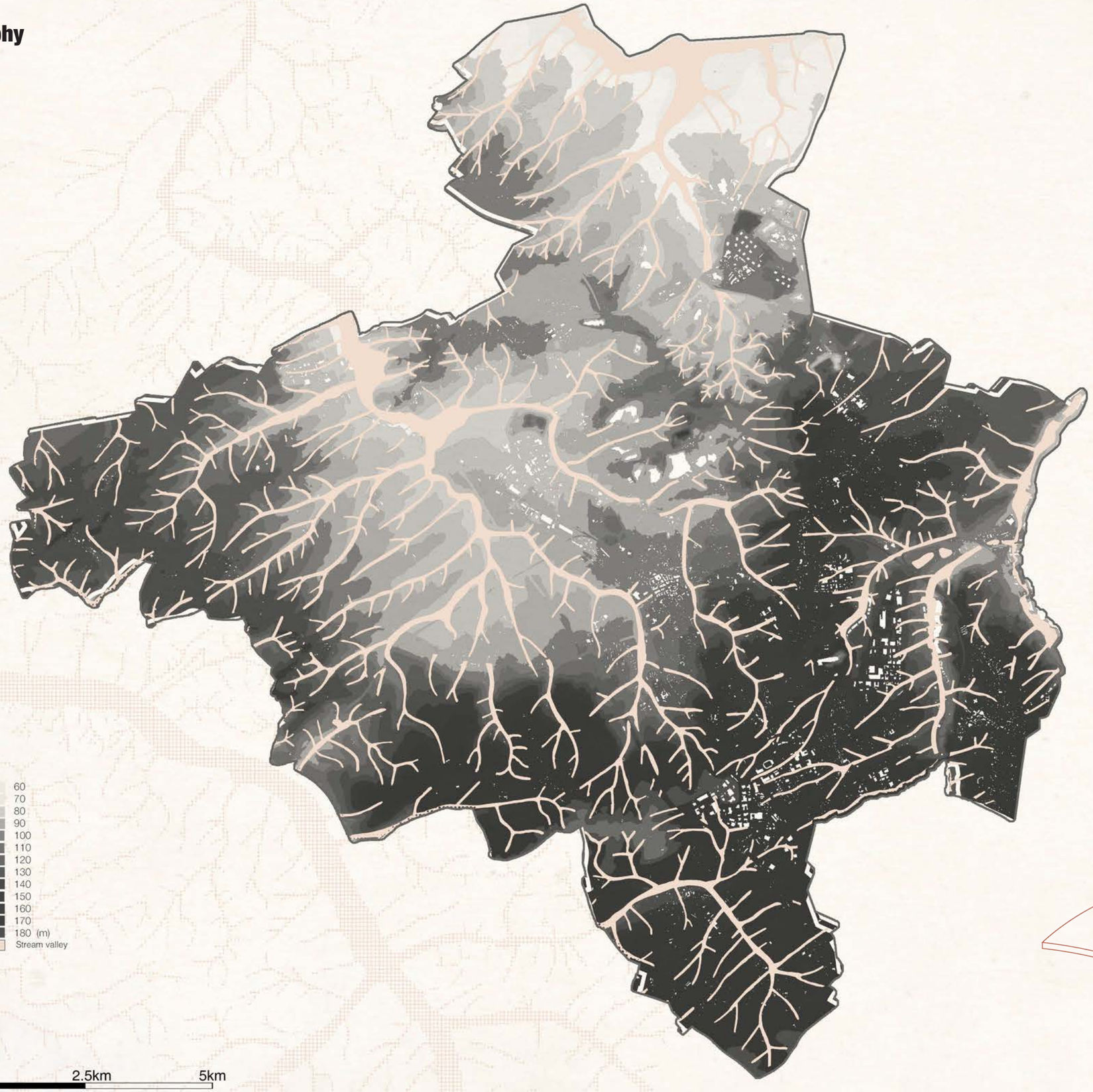
Topography

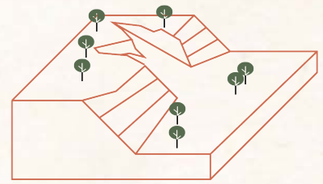




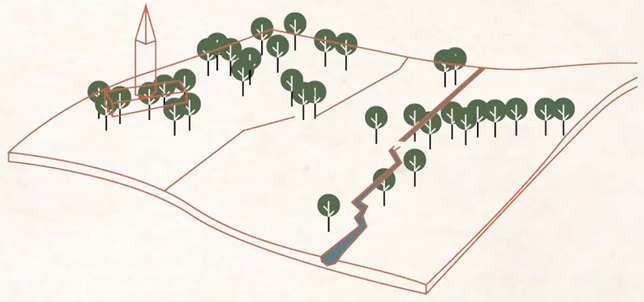


Topography


60
70
80
90
100
110
120
130
140
150
160
170
180 (m)
Stream valley
0
2.5km
5km

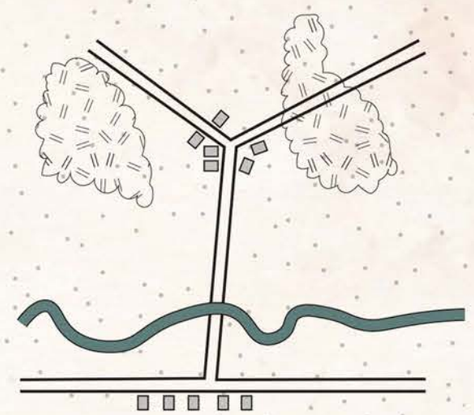


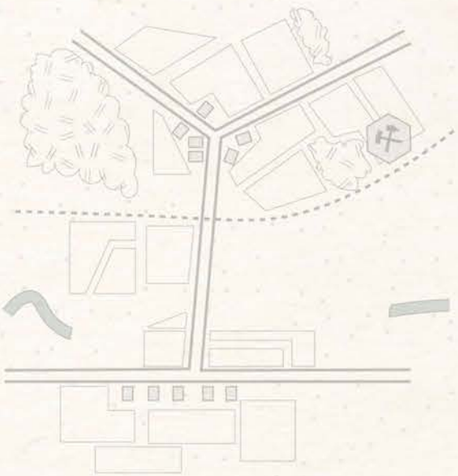




City sprawl and its relationship with landscape

Before-1900





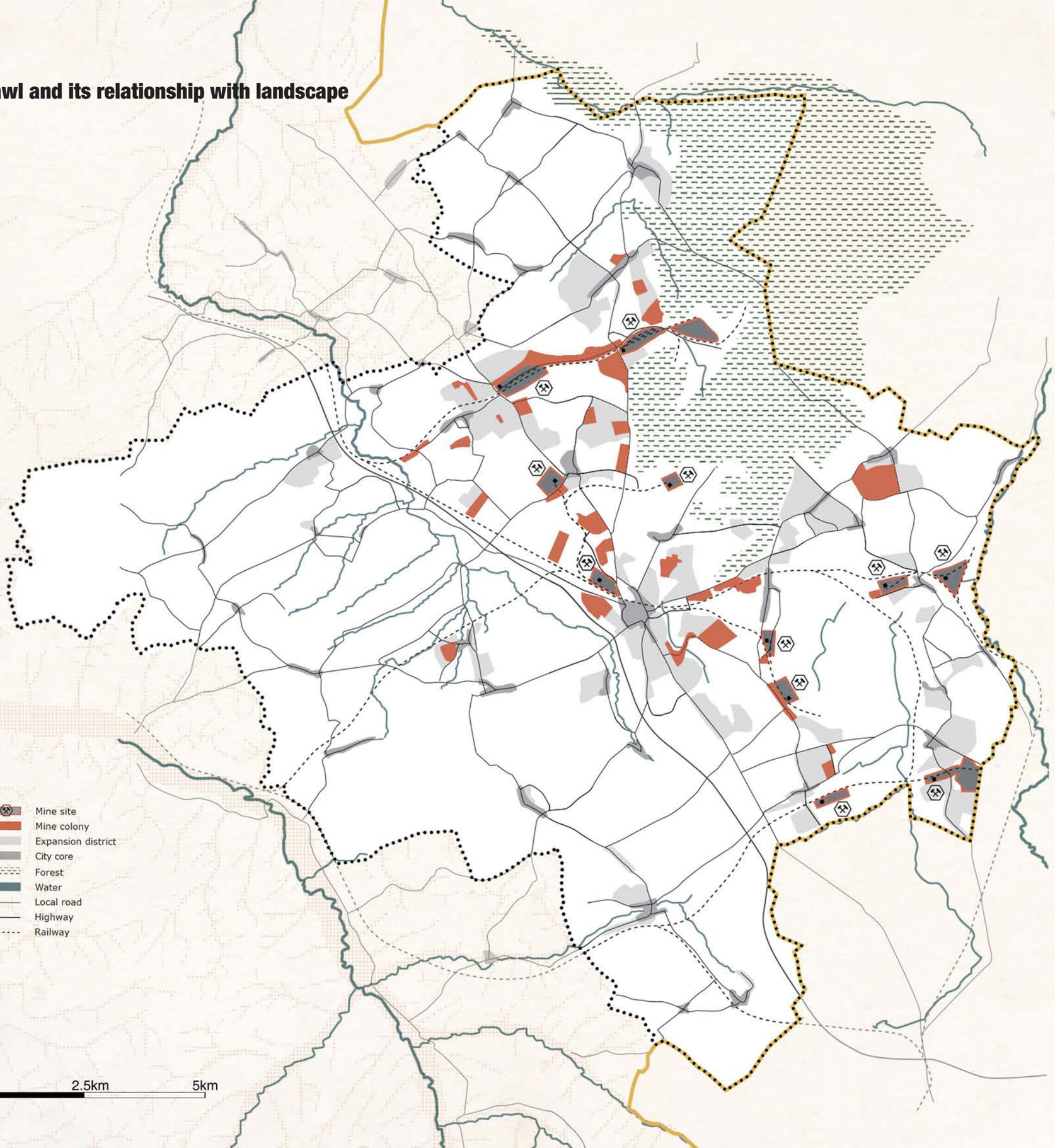


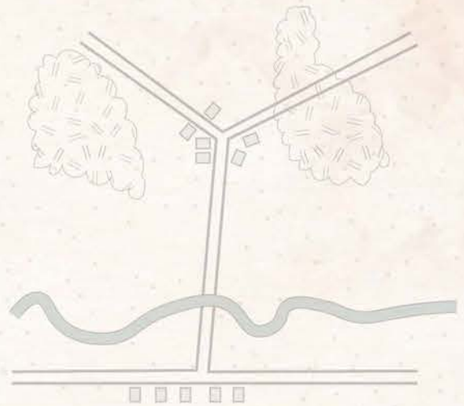
Meadow
Forest
Water
City core
Castle
Parkstad border
Country border

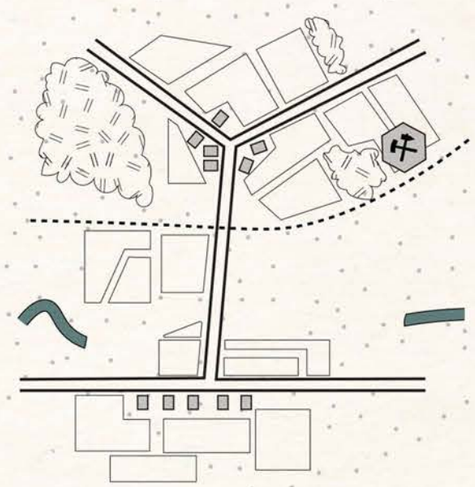
0 2.5km 5km

CIty sprawl and its relationship with landscape

1945-1965







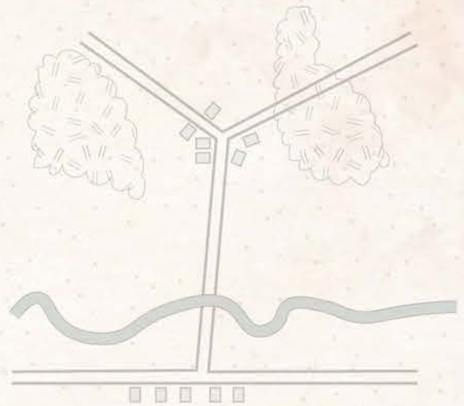


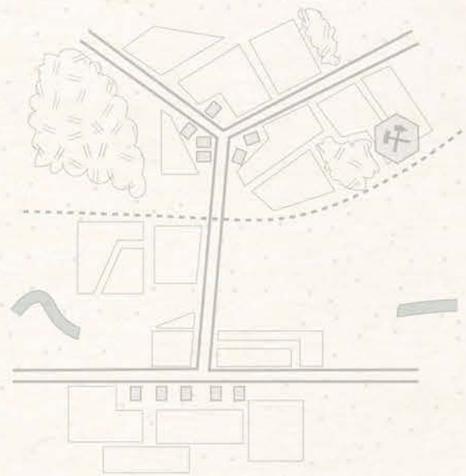
CIty sprawl and its relationship with landscape

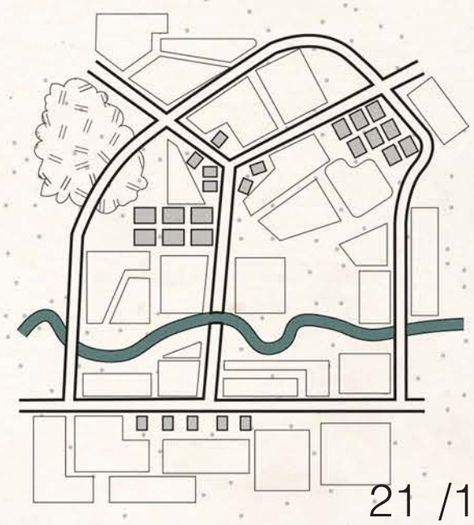
1965-Now

City core
Expansion district
Recreation
Bedded terrain
Forest
Water
Local road
Regional road
Highway
Railway

0 2.5km 5km







ENERGY

Dashboard

1. Wind
- Wind turbines
- Building-related wind turbines

2. Water
- Small-scale hydropower installations

3. Biomass
- Landfill gas
- Manure
- Verge cuttings
- Woody biomass
- Straw
- Energy crop

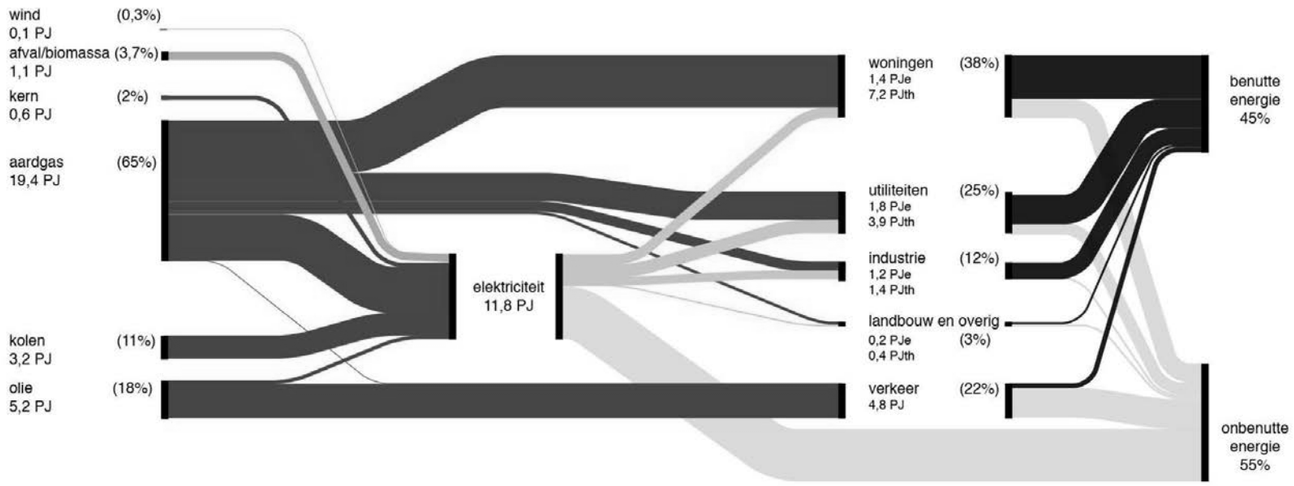
4. Heat-cold storage
- Open / closed system
- Vertical soil heat exchanger
- Mine water

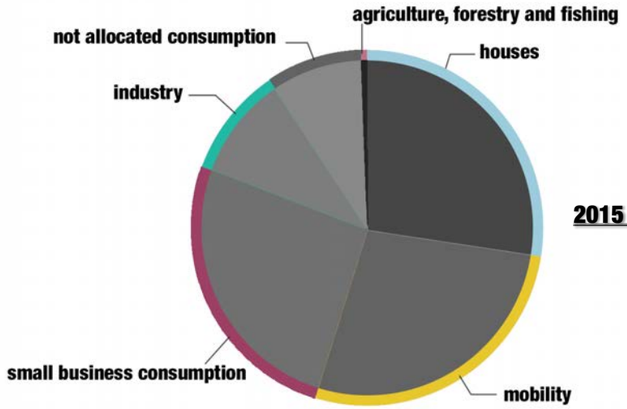
5. Sun
- Solar panels (PV)
- Solar collectors
- Asphalt collectors



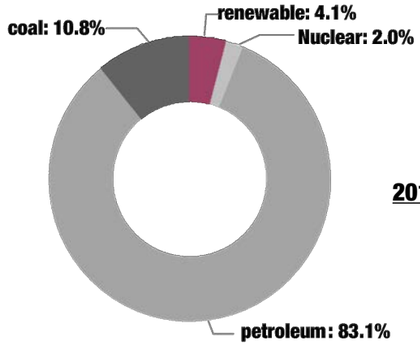
2,525 participants 34,951 panels installed 7,361,353 kWh per year 2,613,280 saved CO2

Energy status

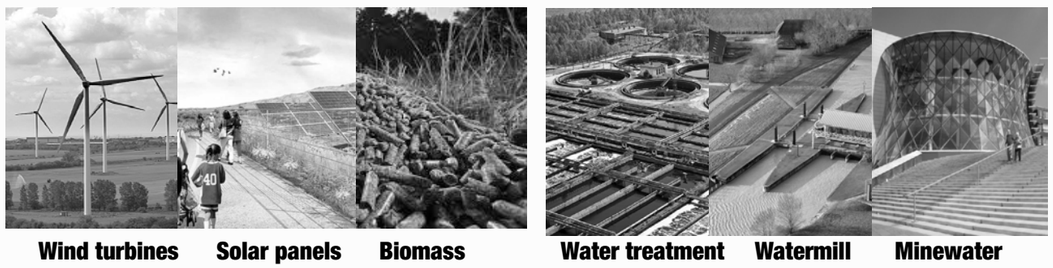


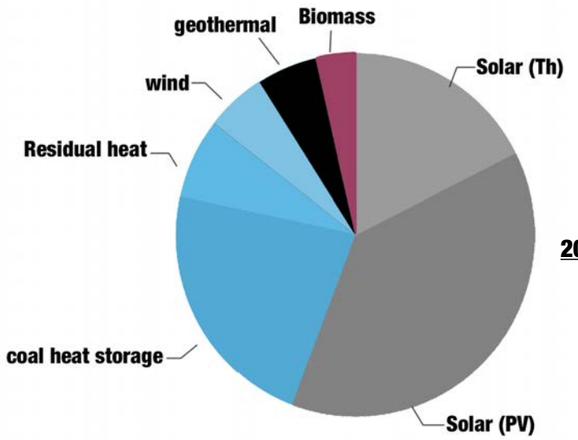


2015 Energy demond per sector



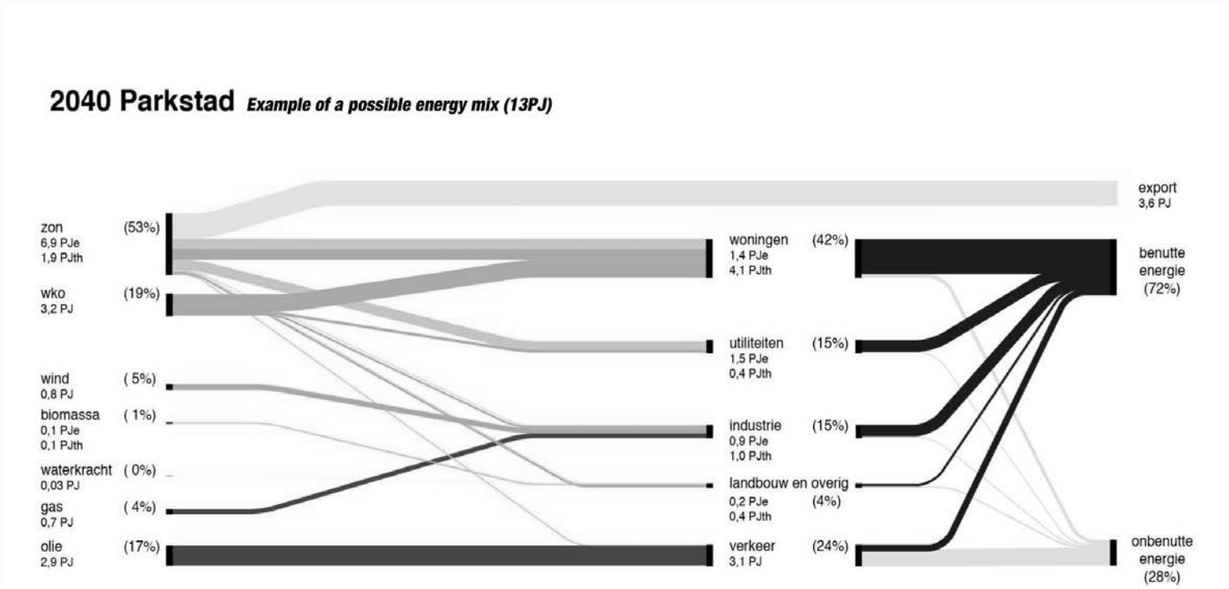
2015 Share energy sources

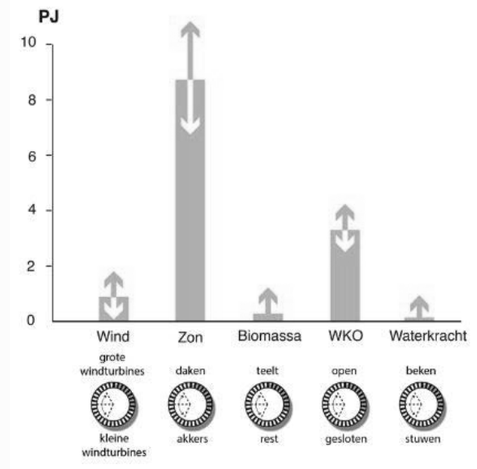


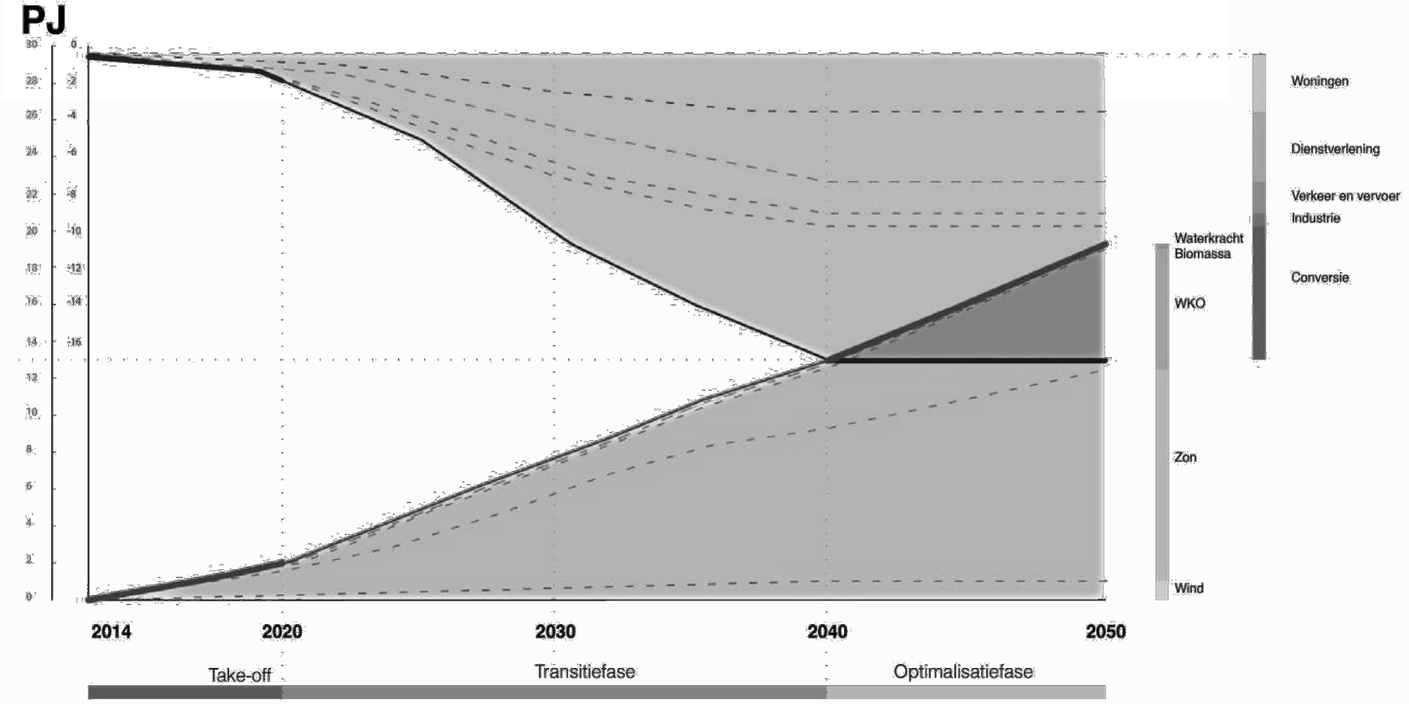


2015 Potential per renewable energy

Expectations





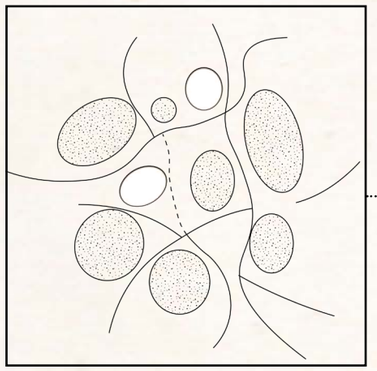


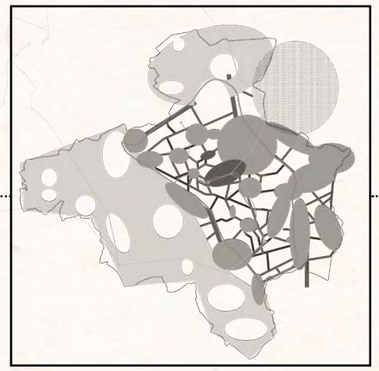
Ambition chart energy transition Parkstad Limburg

STRATEGIES

Regional plan

Strategy 1

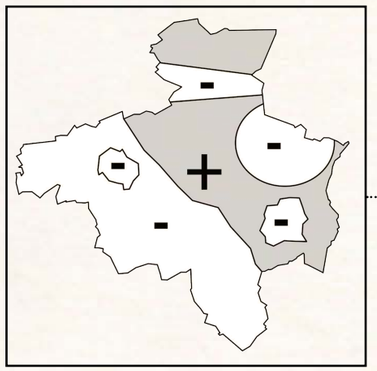


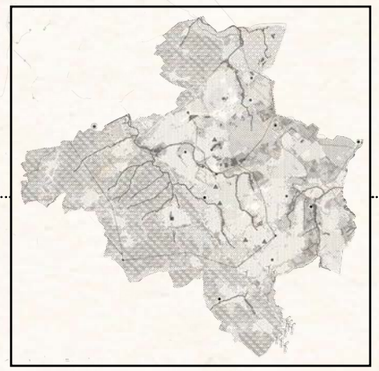


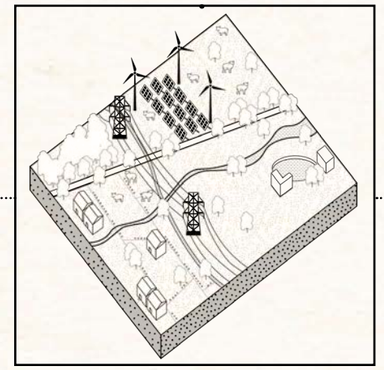


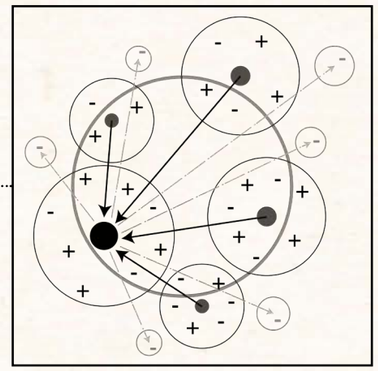


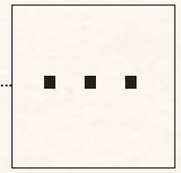
Strategy 2





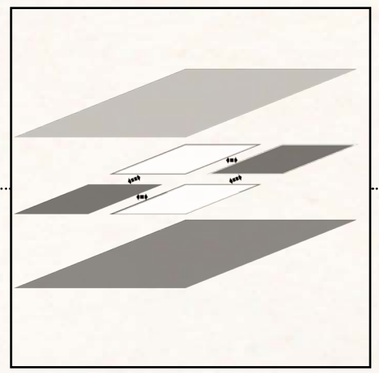


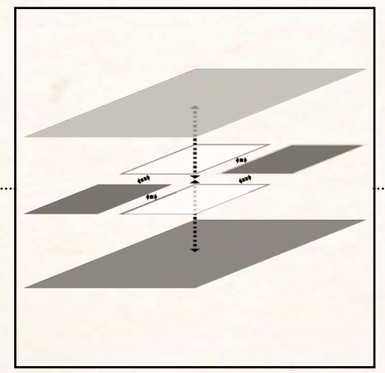


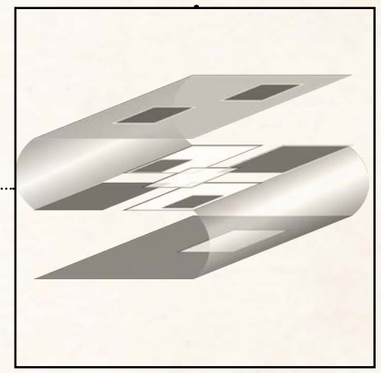


Strategy 3



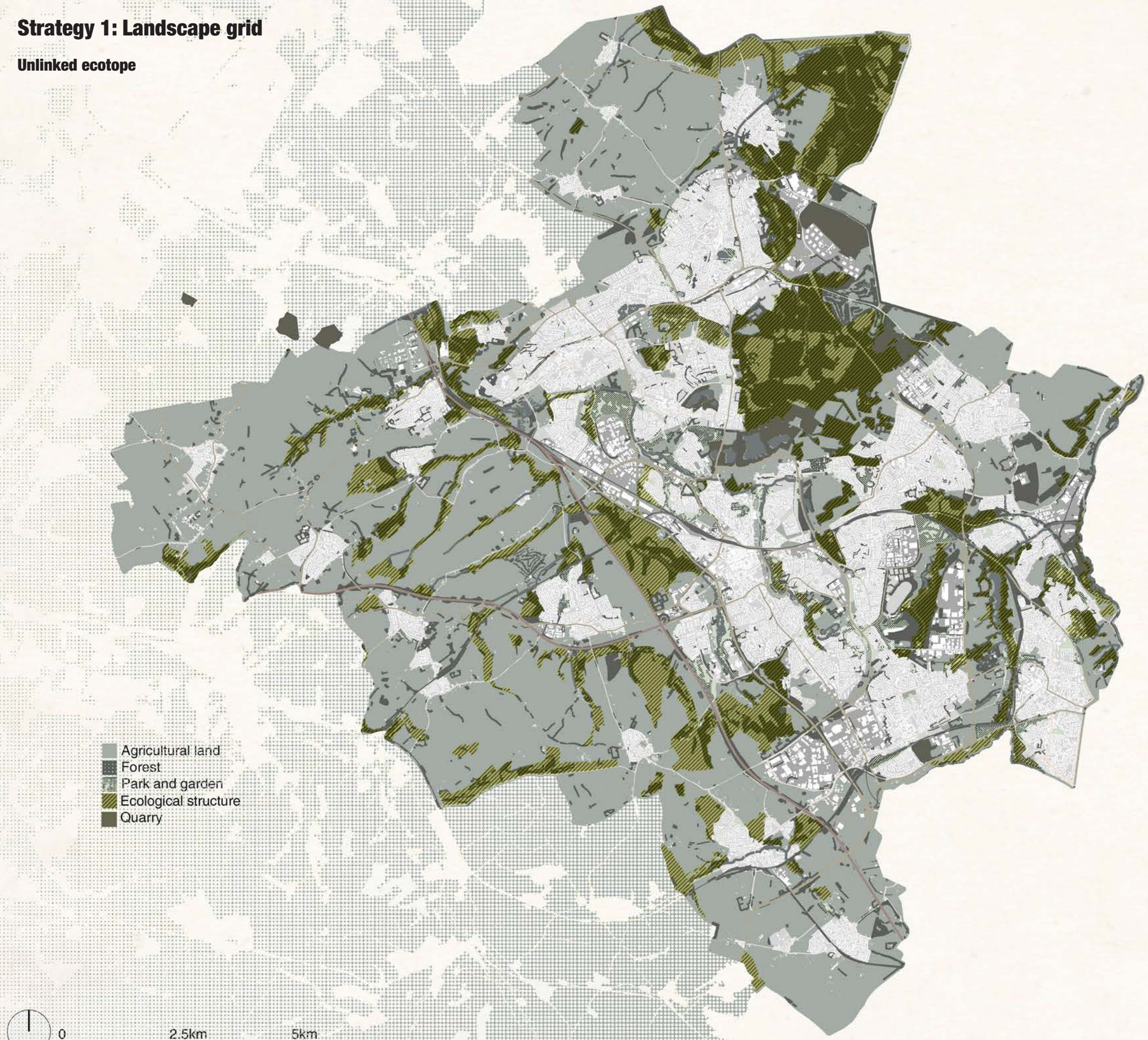






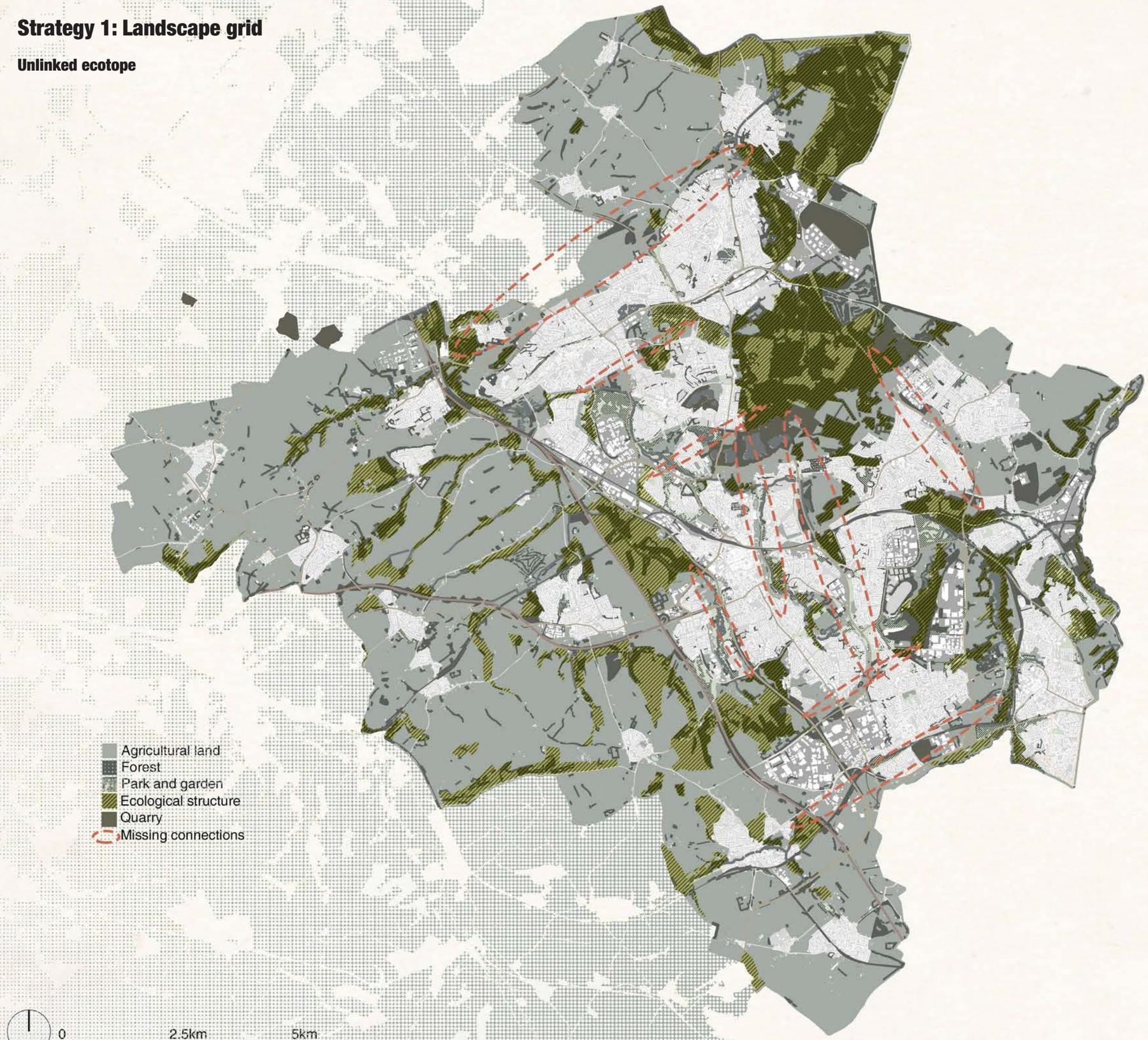
Strategy 1: Landscape grid

Unlinked ecotope



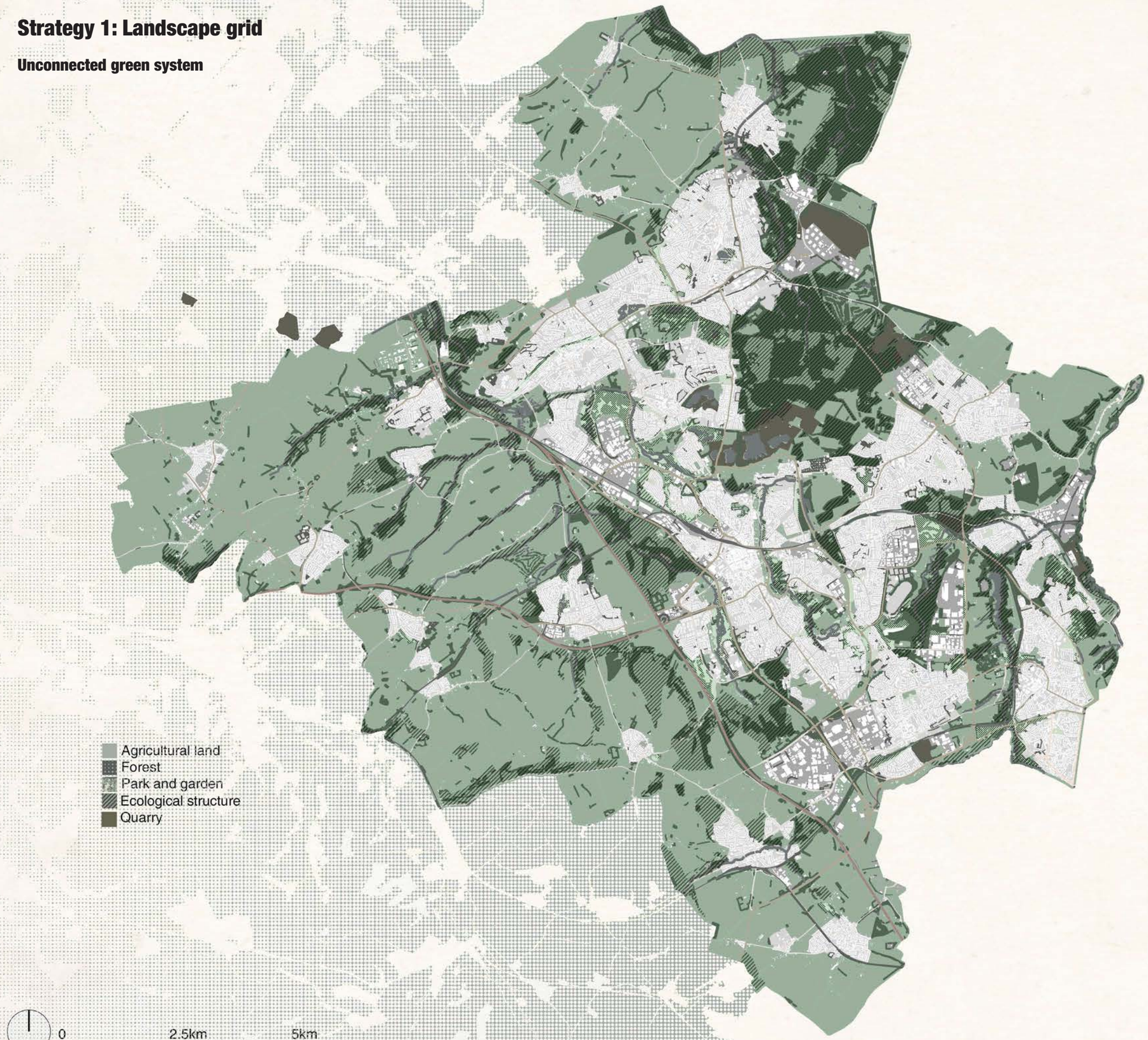
Strategy 1: Landscape grid

Unlinked ecotope



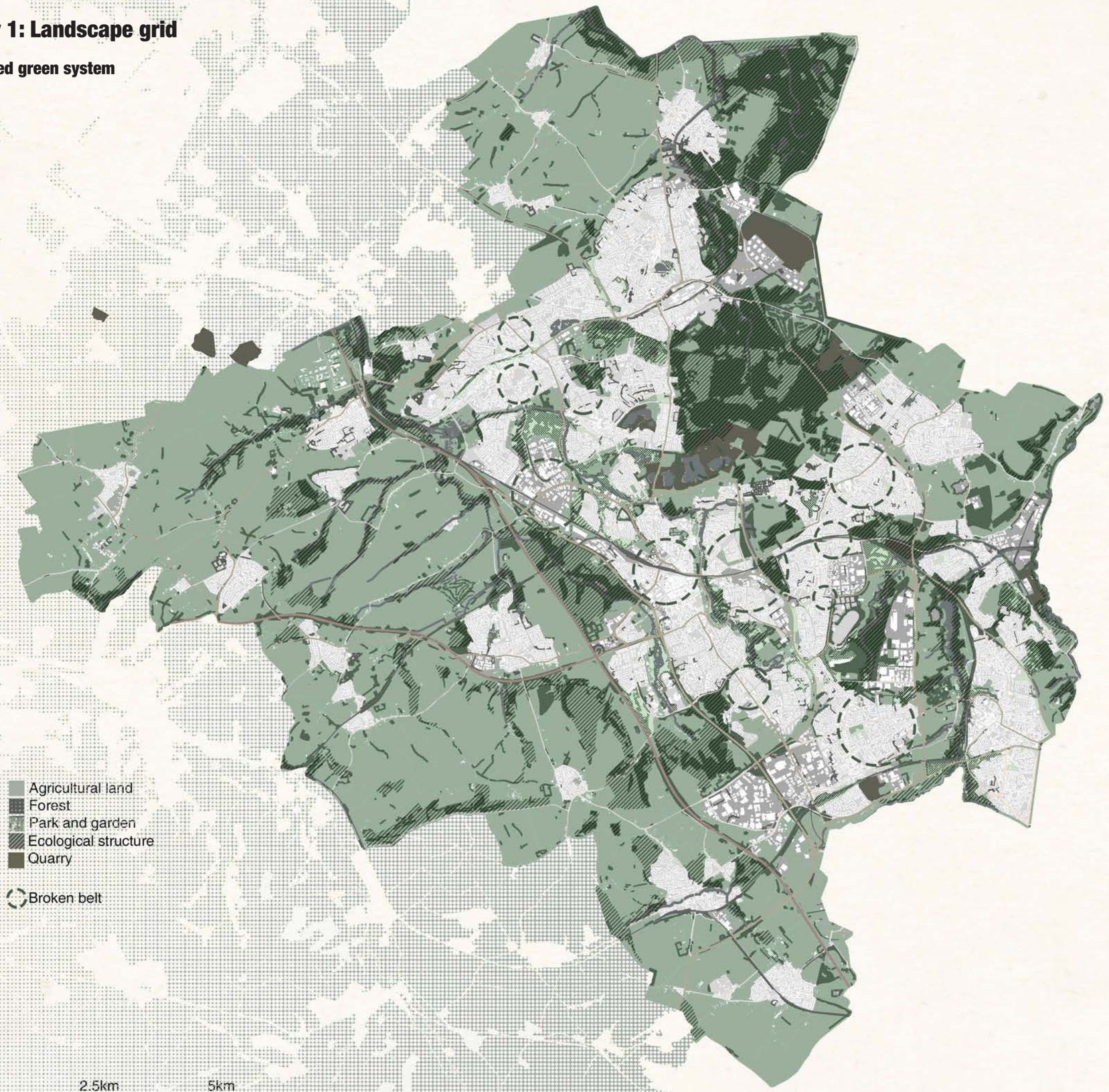
Strategy 1: Landscape grid

Unconnected green system



Strategy 1: Landscape grid

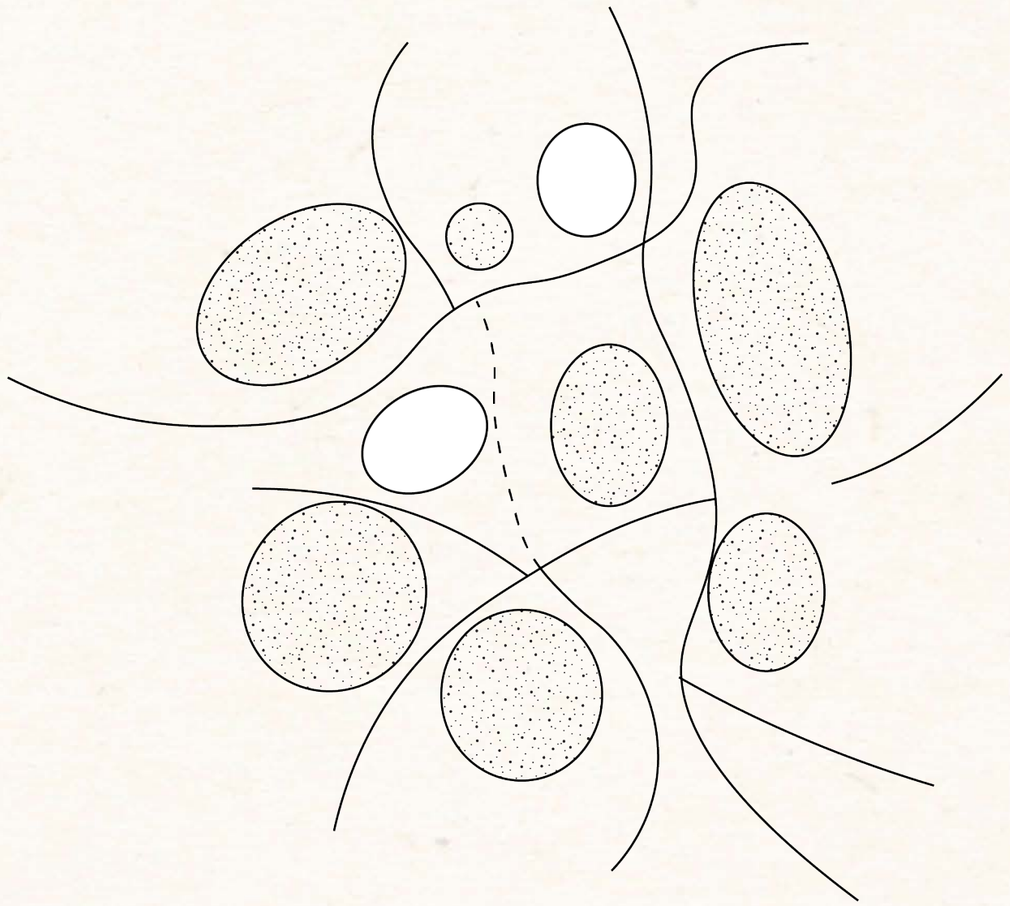
Unconnected green system



Strategy 1: Landscape grid

Disconnected Parkstad

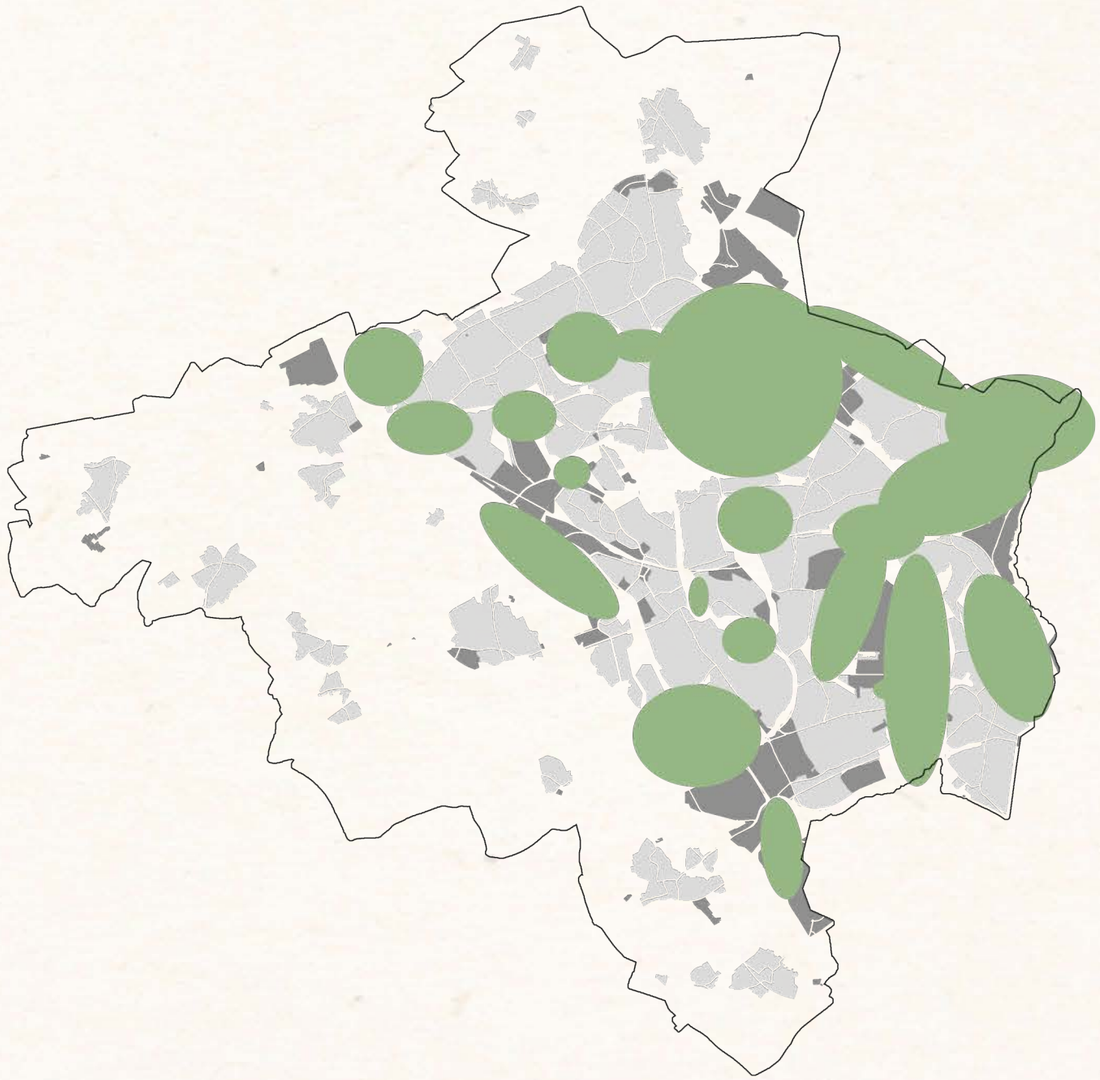
Problem



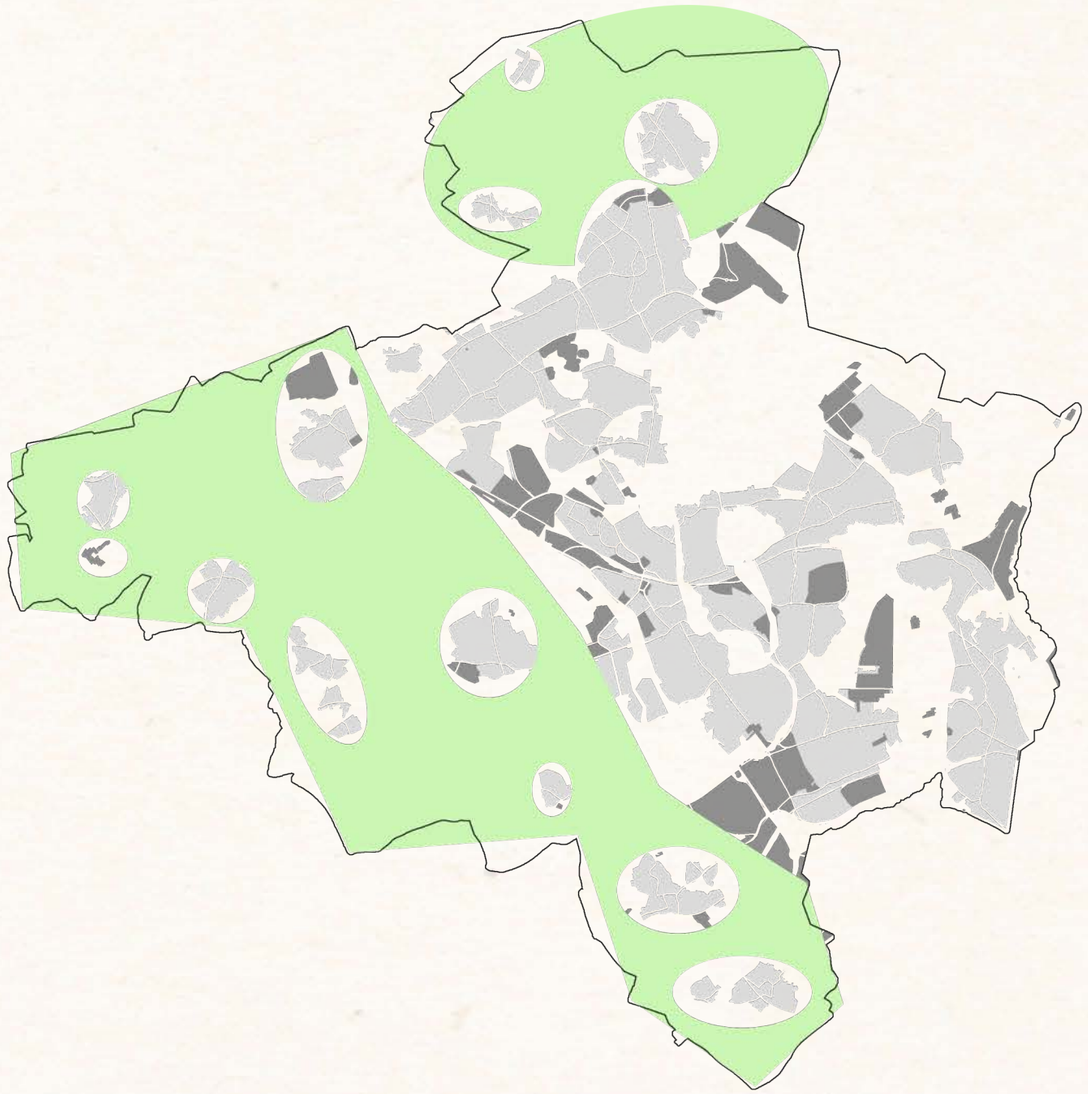
Strategy 1: Landscape grid



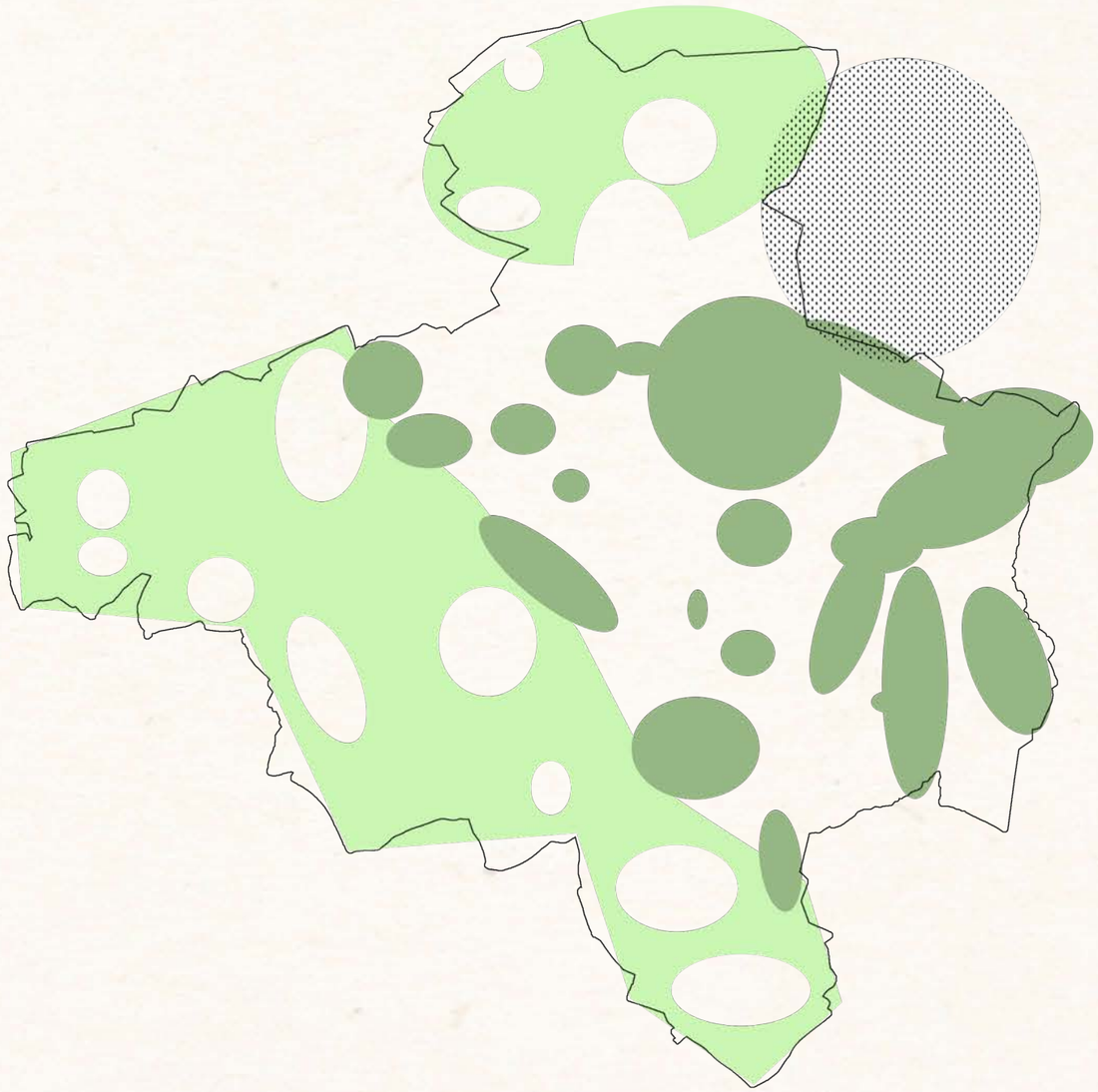
Strategy 1: Landscape grid



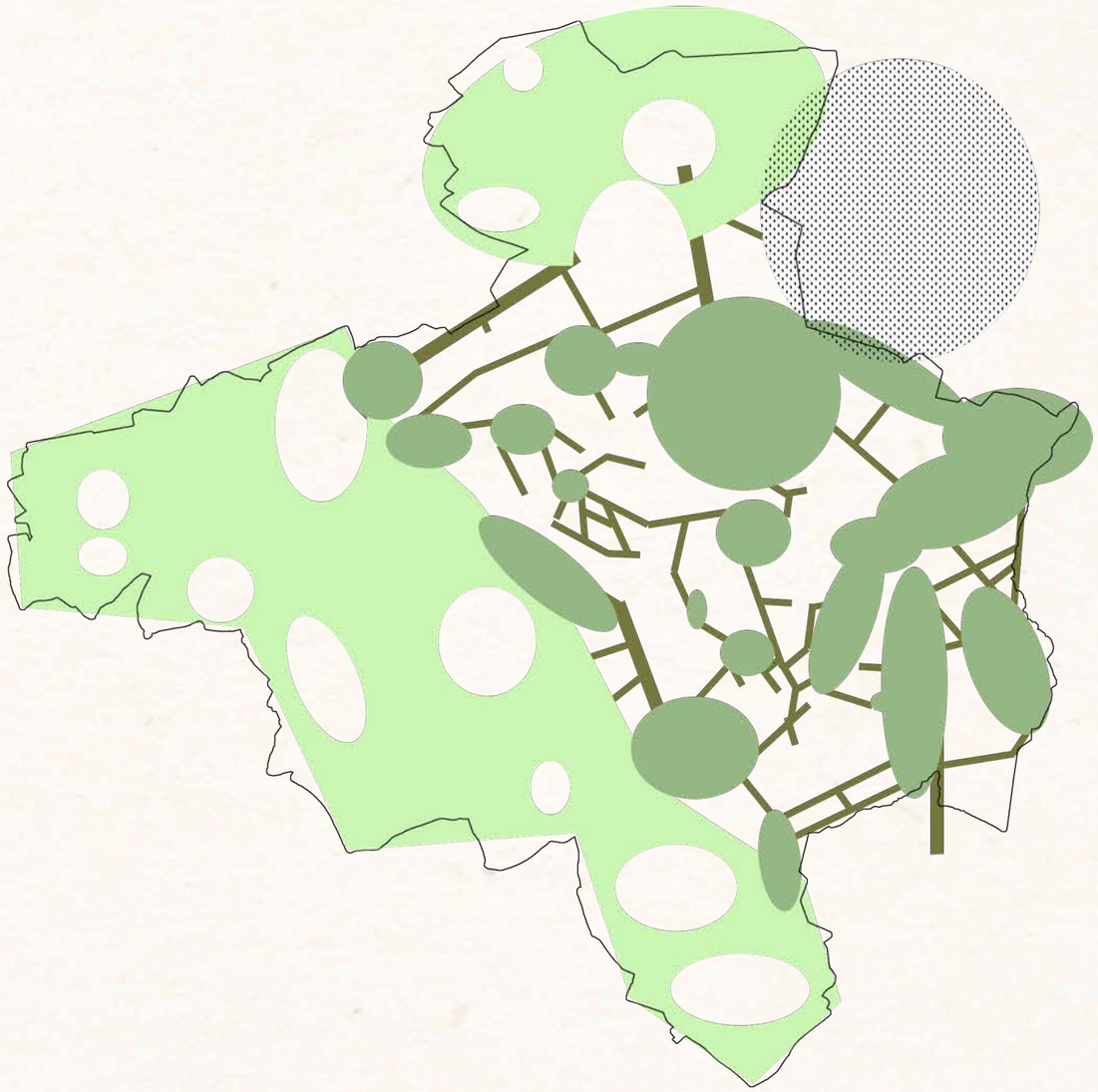
Strategy 1: Landscape grid



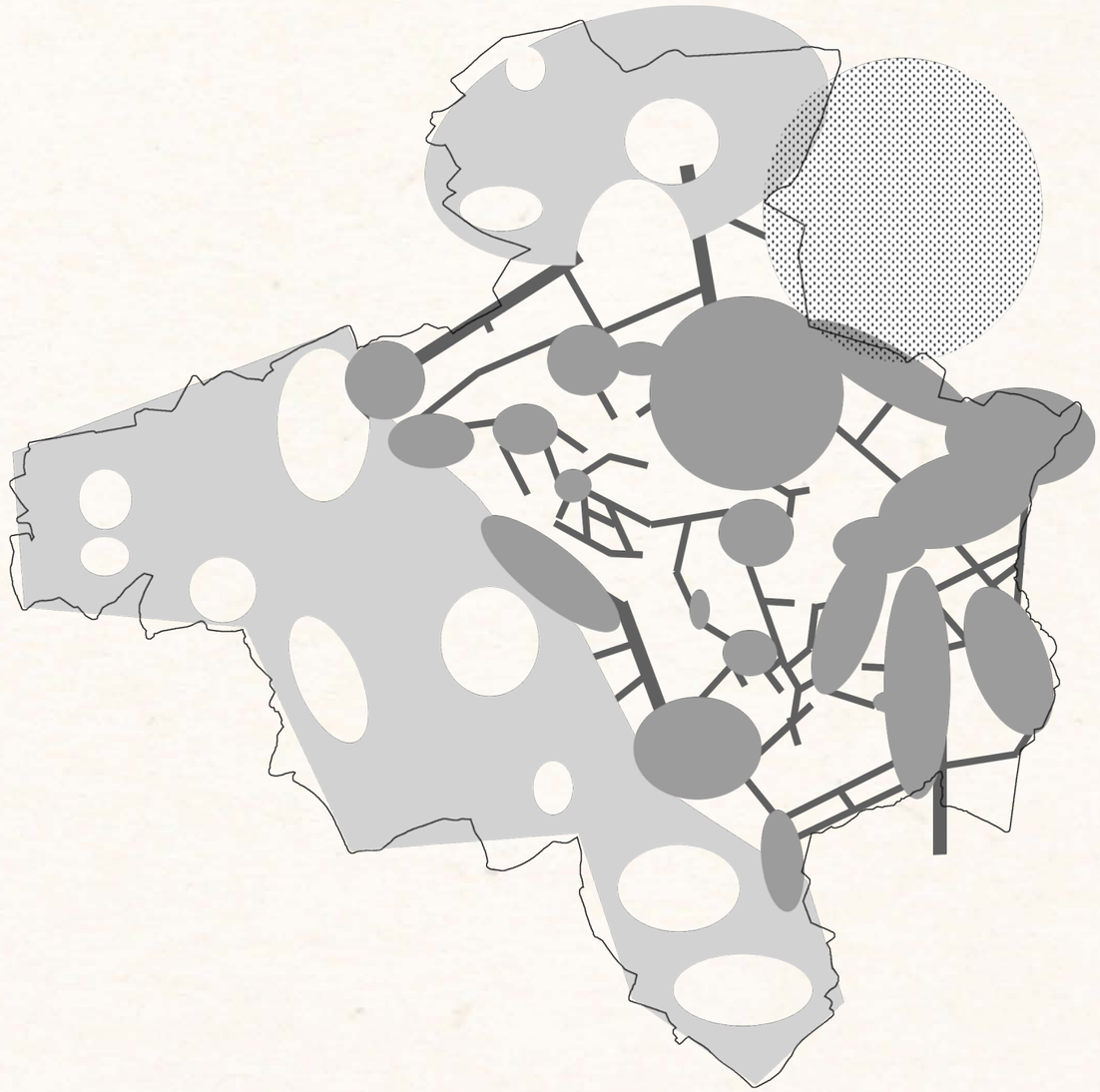
Strategy 1: Landscape grid



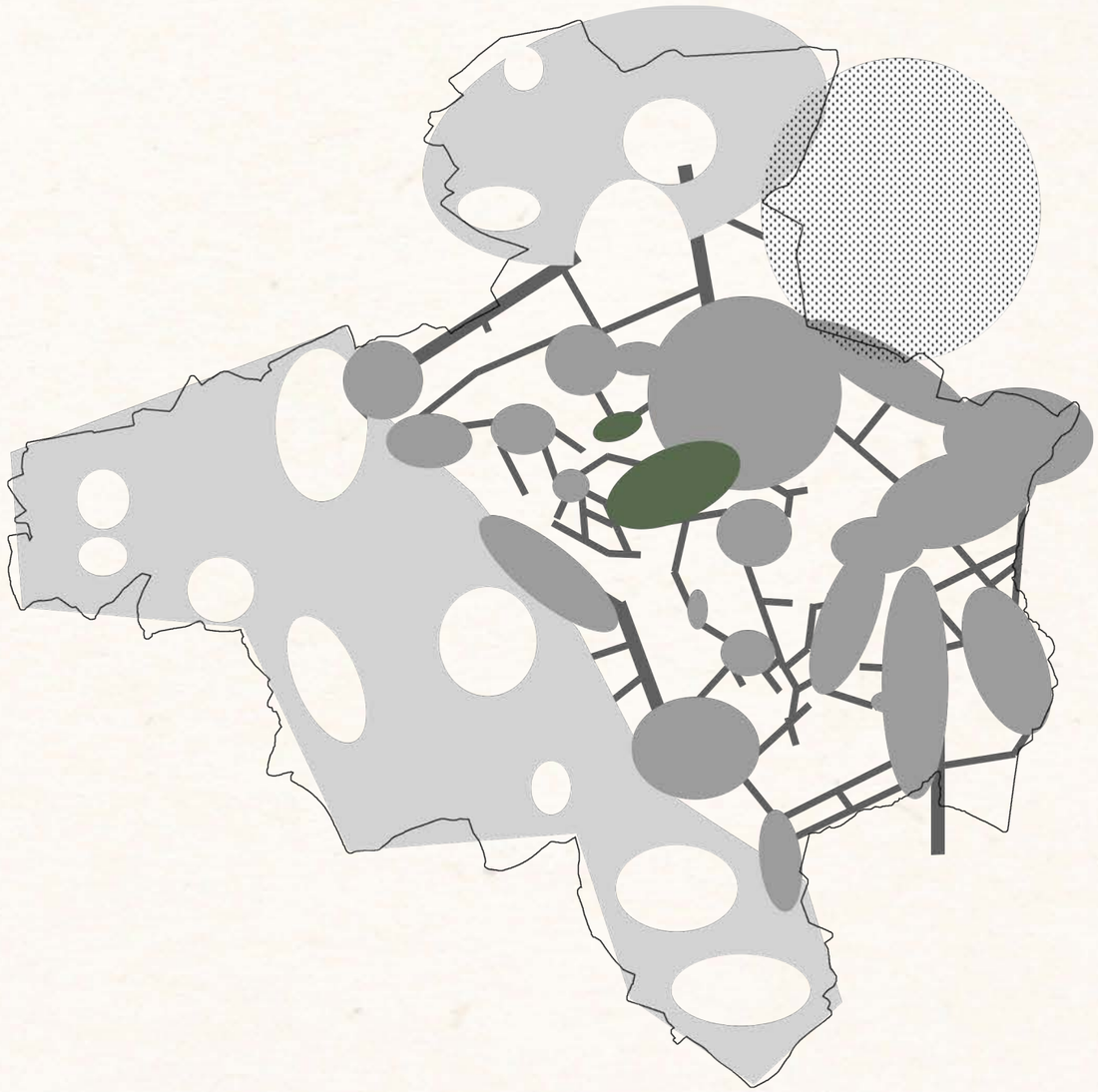
Strategy 1: Landscape grid



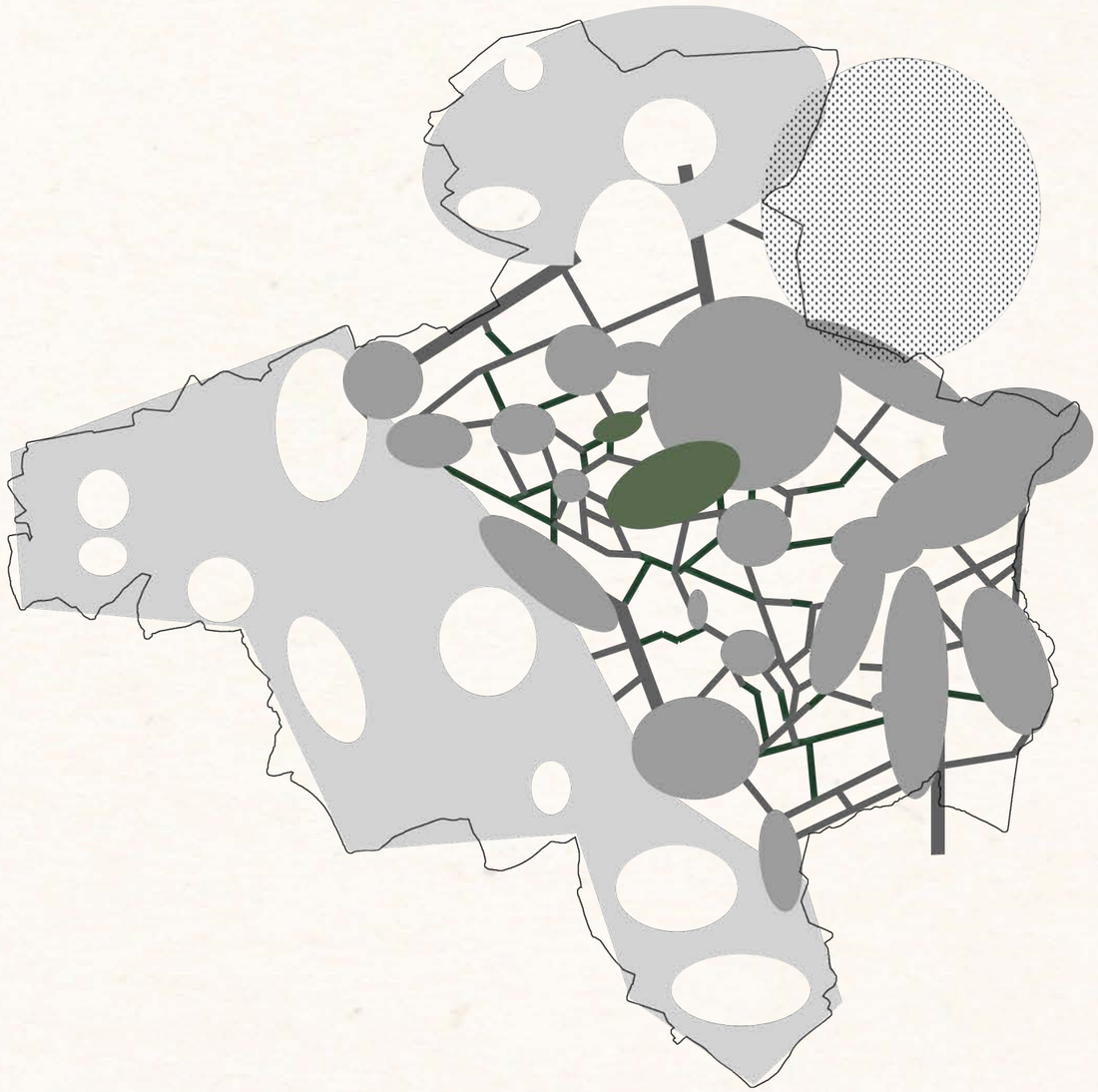
Strategy 1: Landscape grid



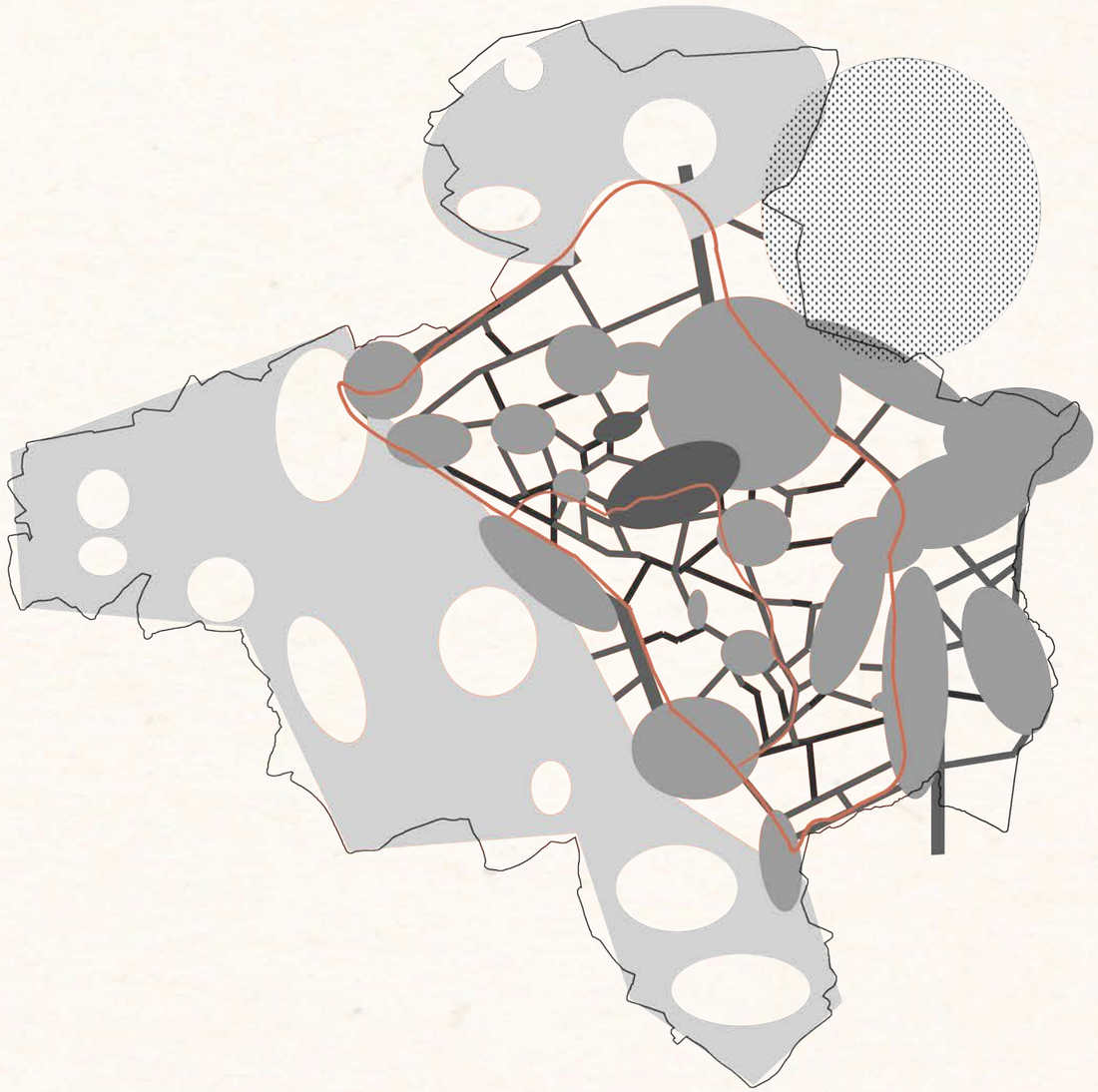
Strategy 1: Landscape grid



Strategy 1: Landscape grid



Strategy 1: Landscape grid



Strategy 1: Landscape grid



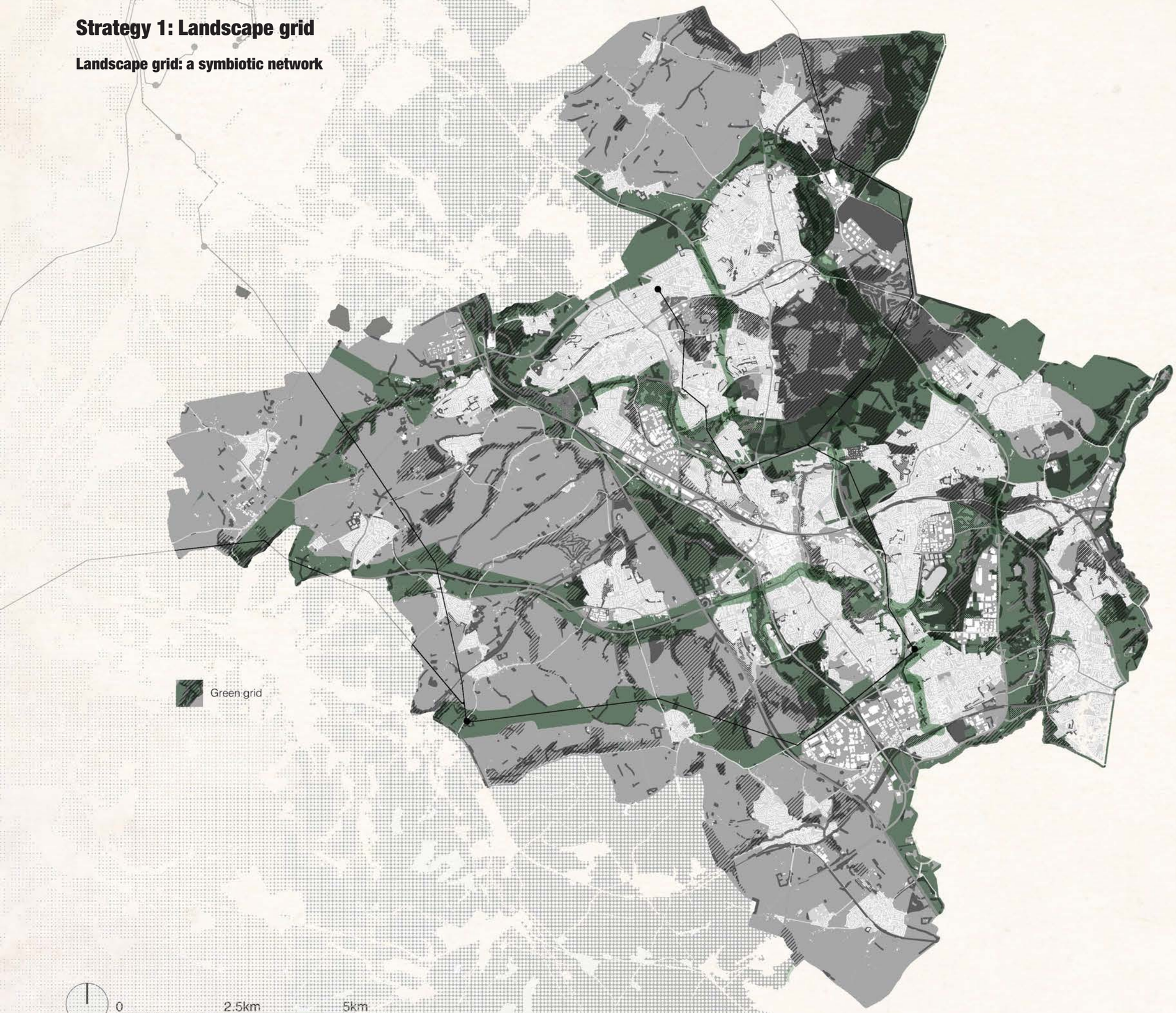
Strategy 1: Landscape grid

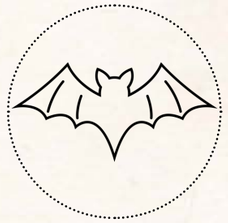
Landscape grid: a symbiotic network

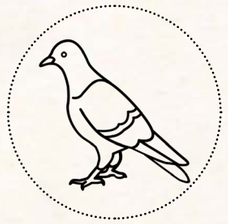


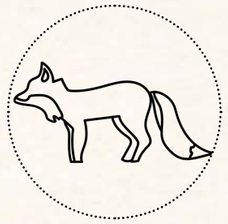
Strategy 1: Landscape grid

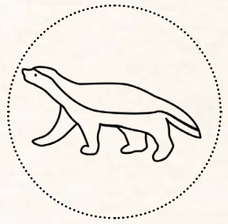
Landscape grid: a symbiotic network

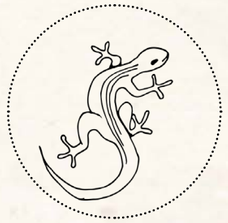












Strategy 1: Landscape grid

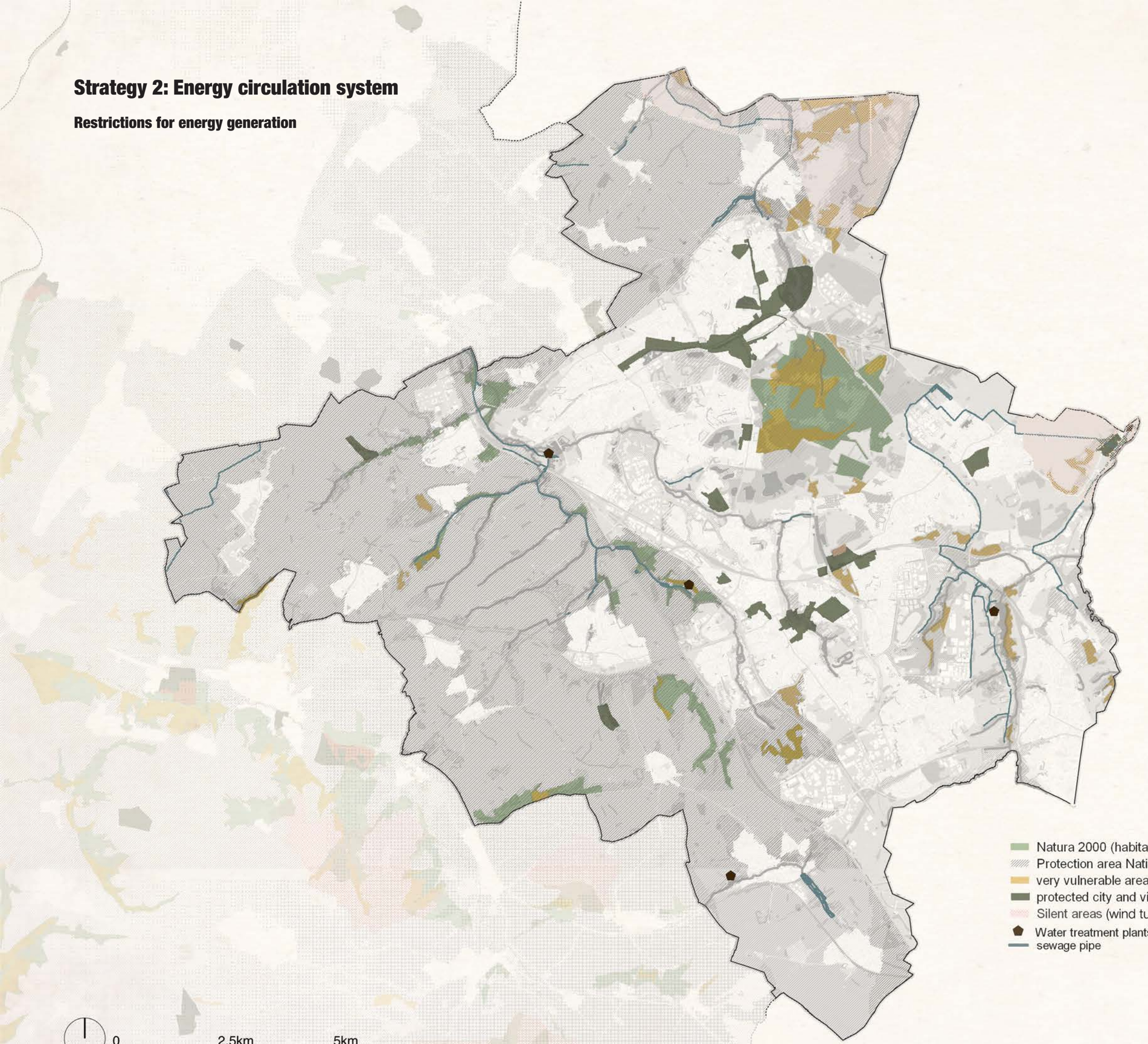






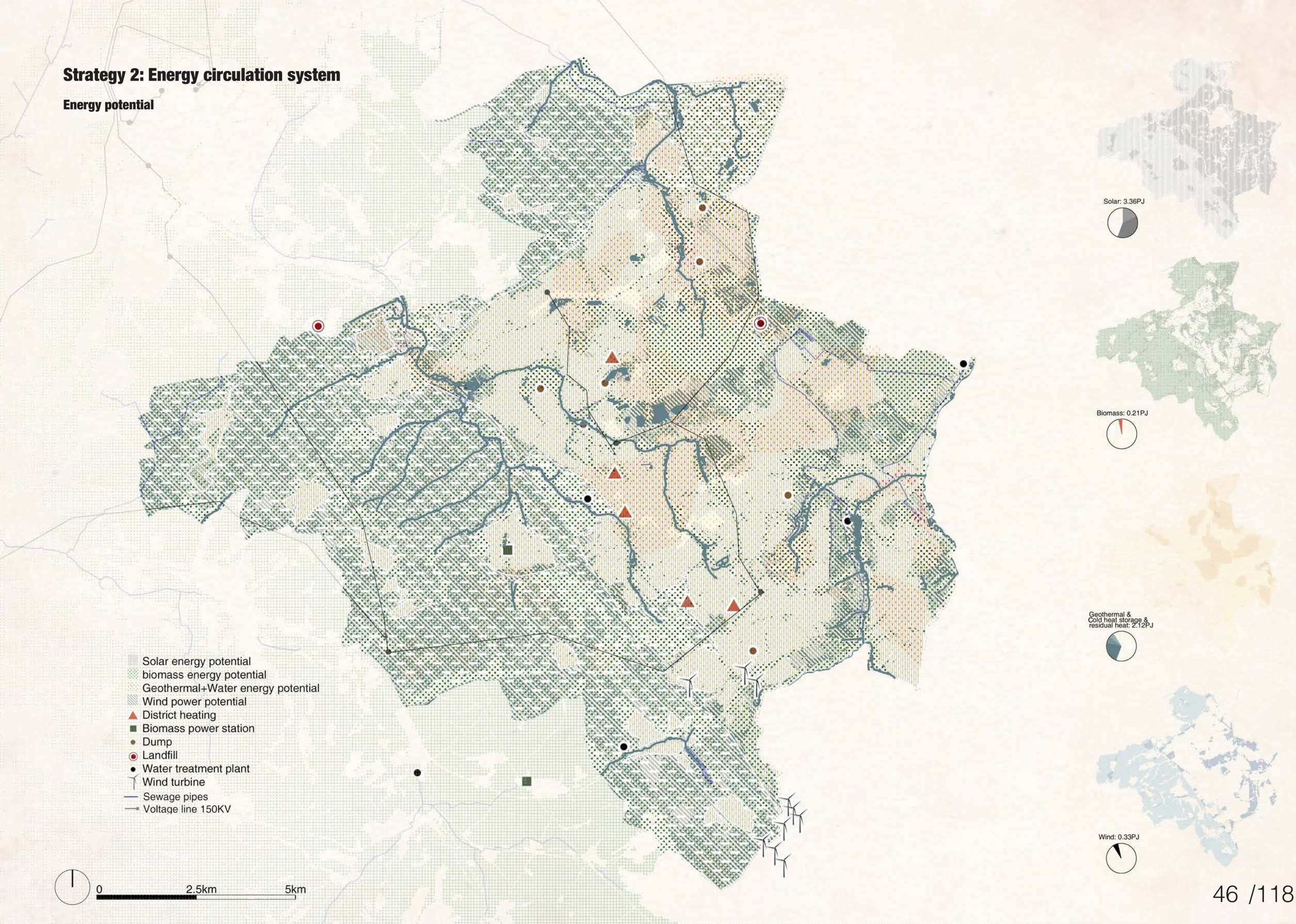
Strategy 2: Energy circulation system

Restrictions for energy generation



Strategy 2: Energy circulation system

Energy potential



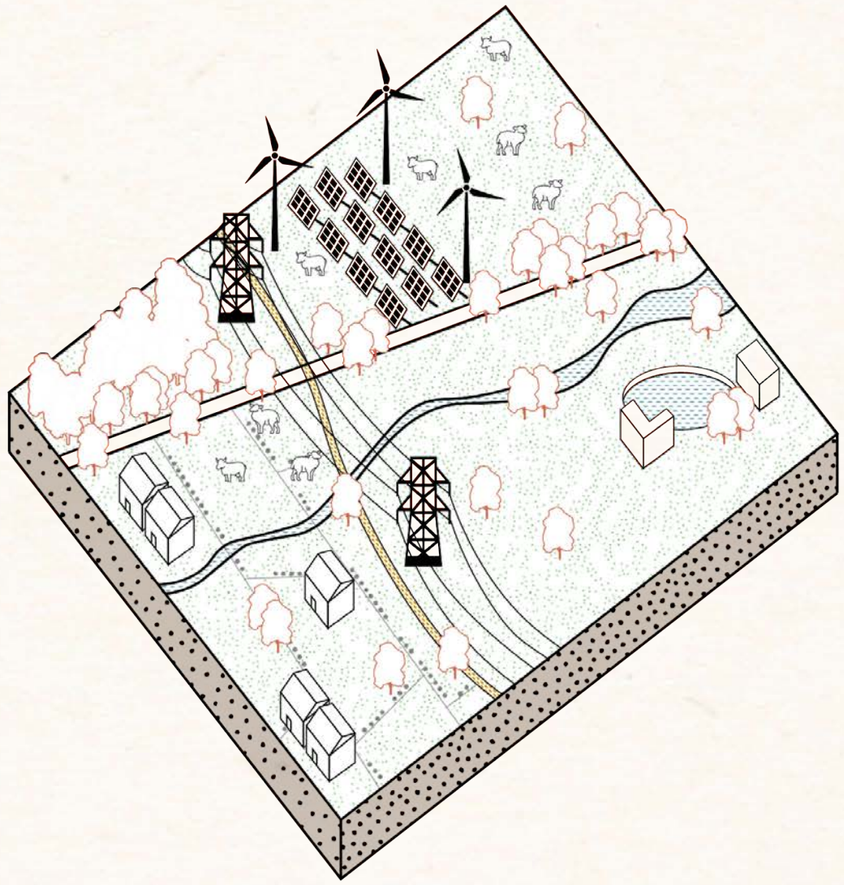
Strategy 2: Energy circulation system

Prototype: energy park



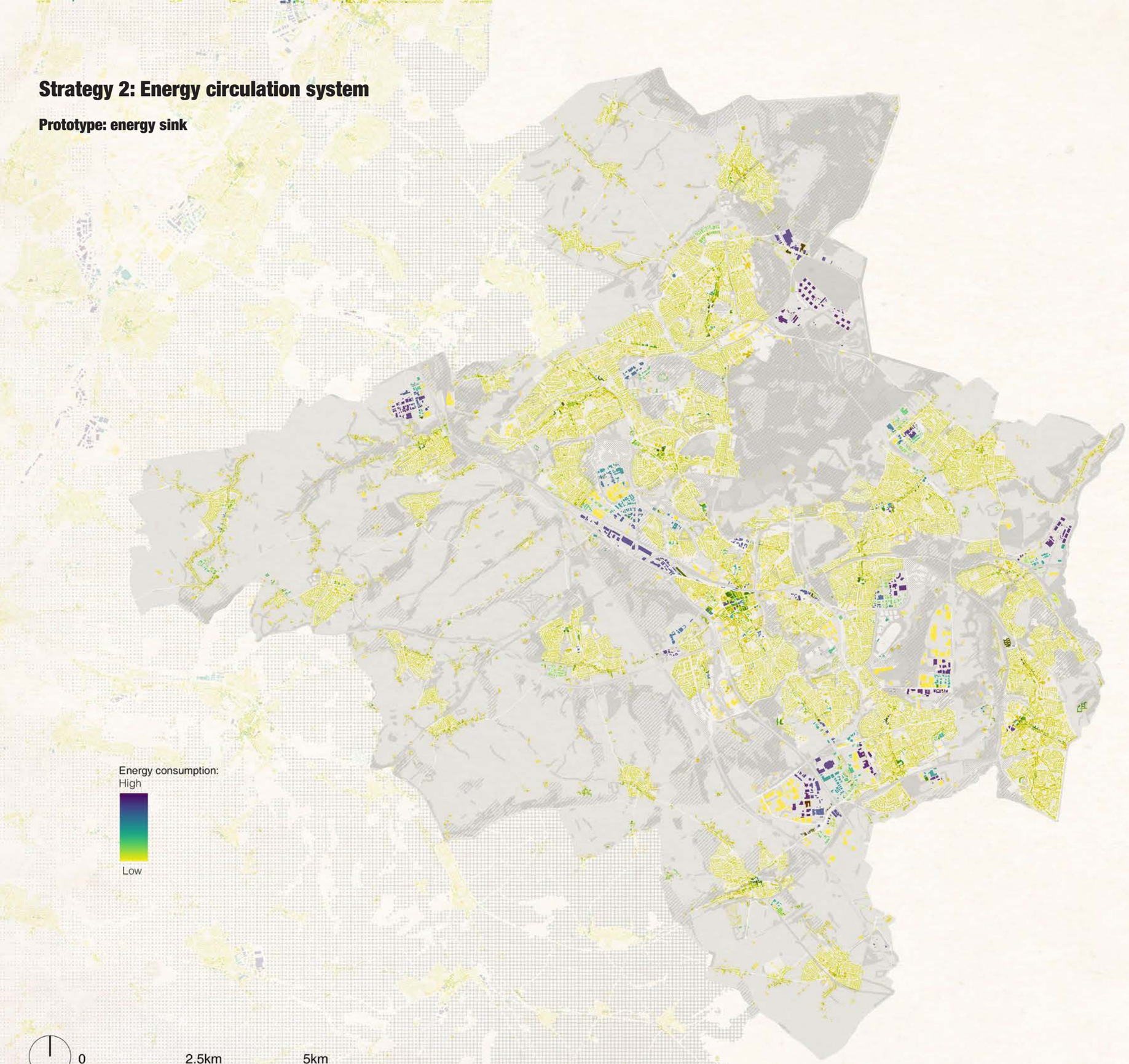
Strategy 2: Energy circulation system

Prototype: energy park



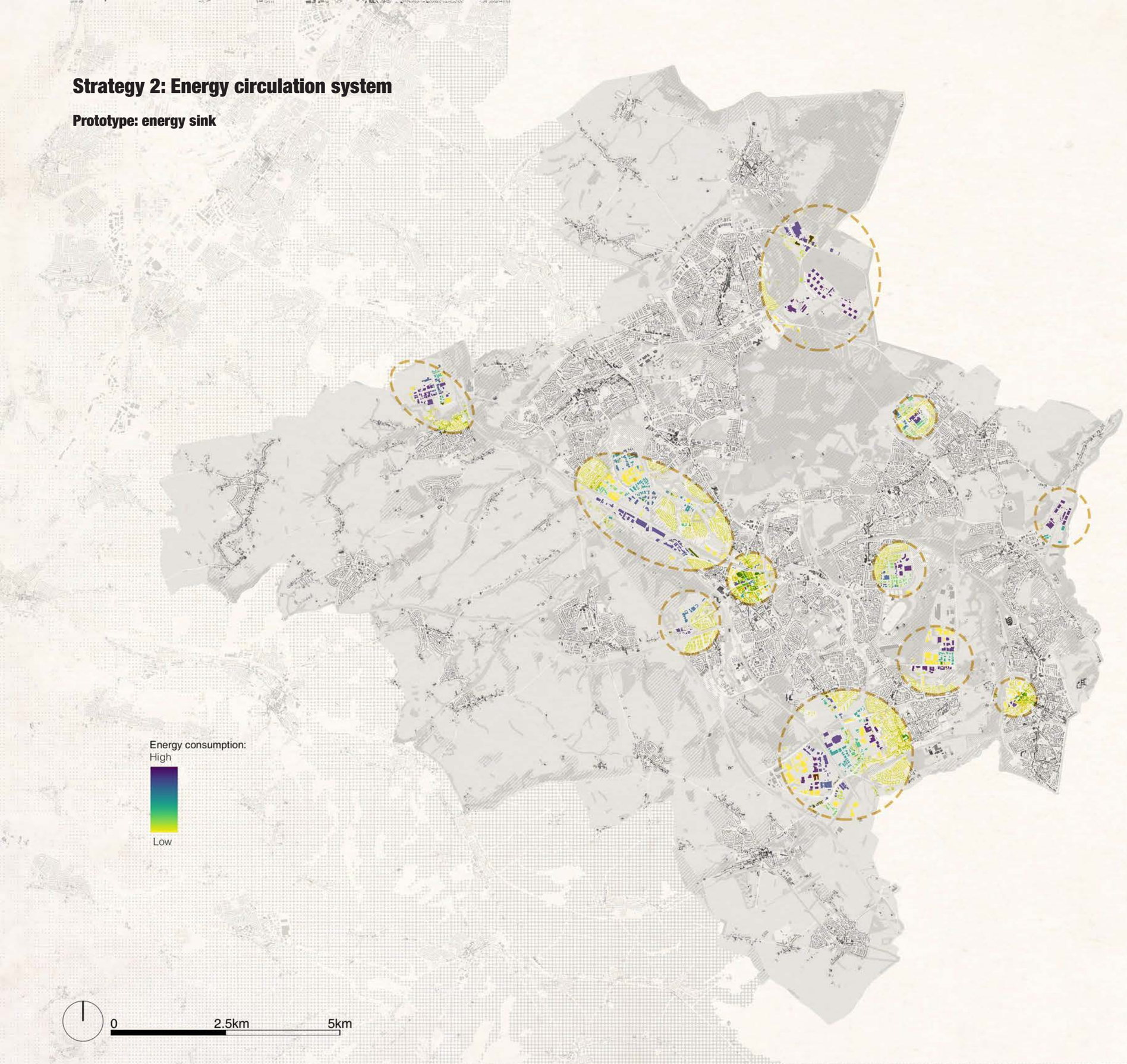
Strategy 2: Energy circulation system

Prototype: energy sink



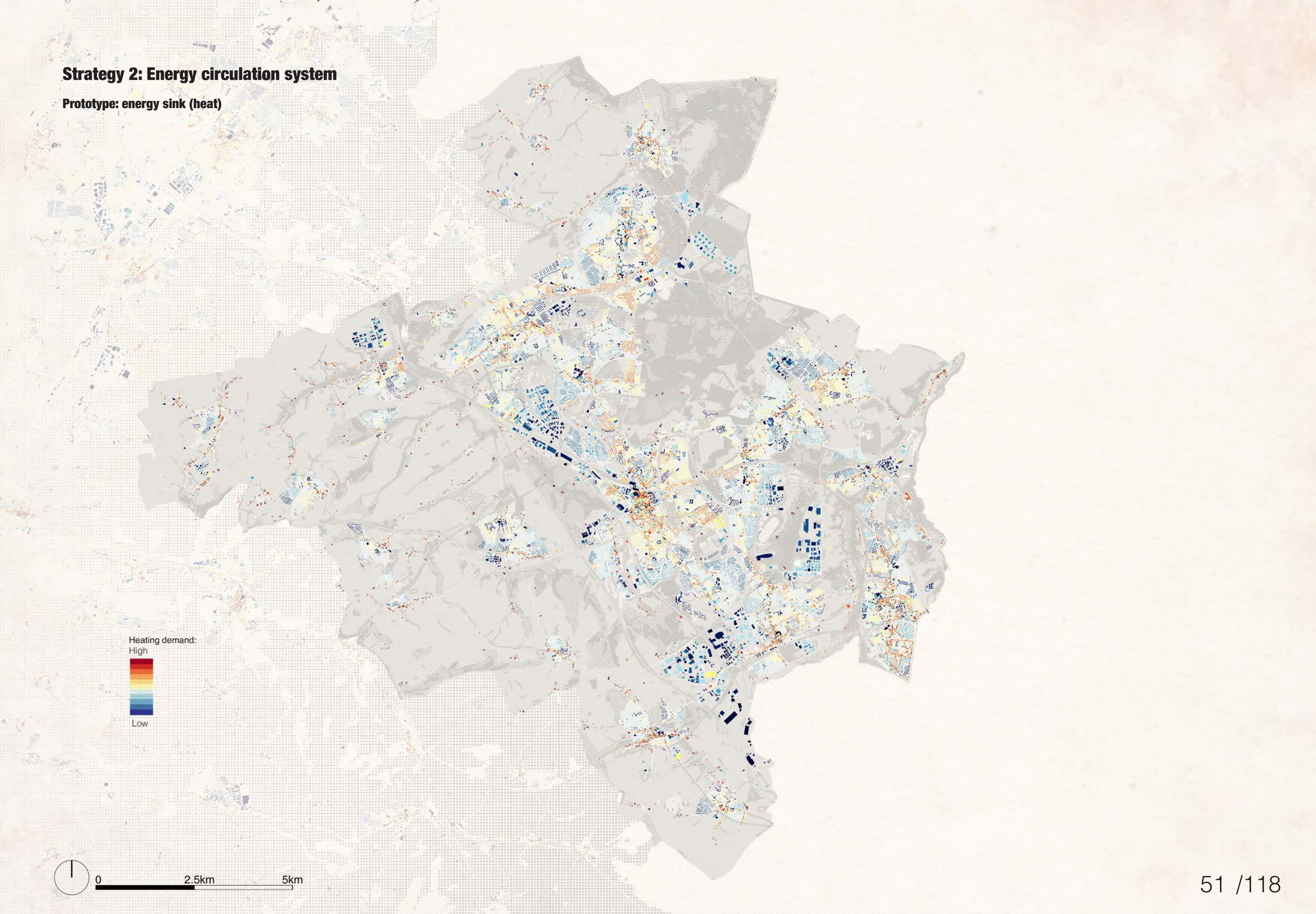
Strategy 2: Energy circulation system

Prototype: energy sink



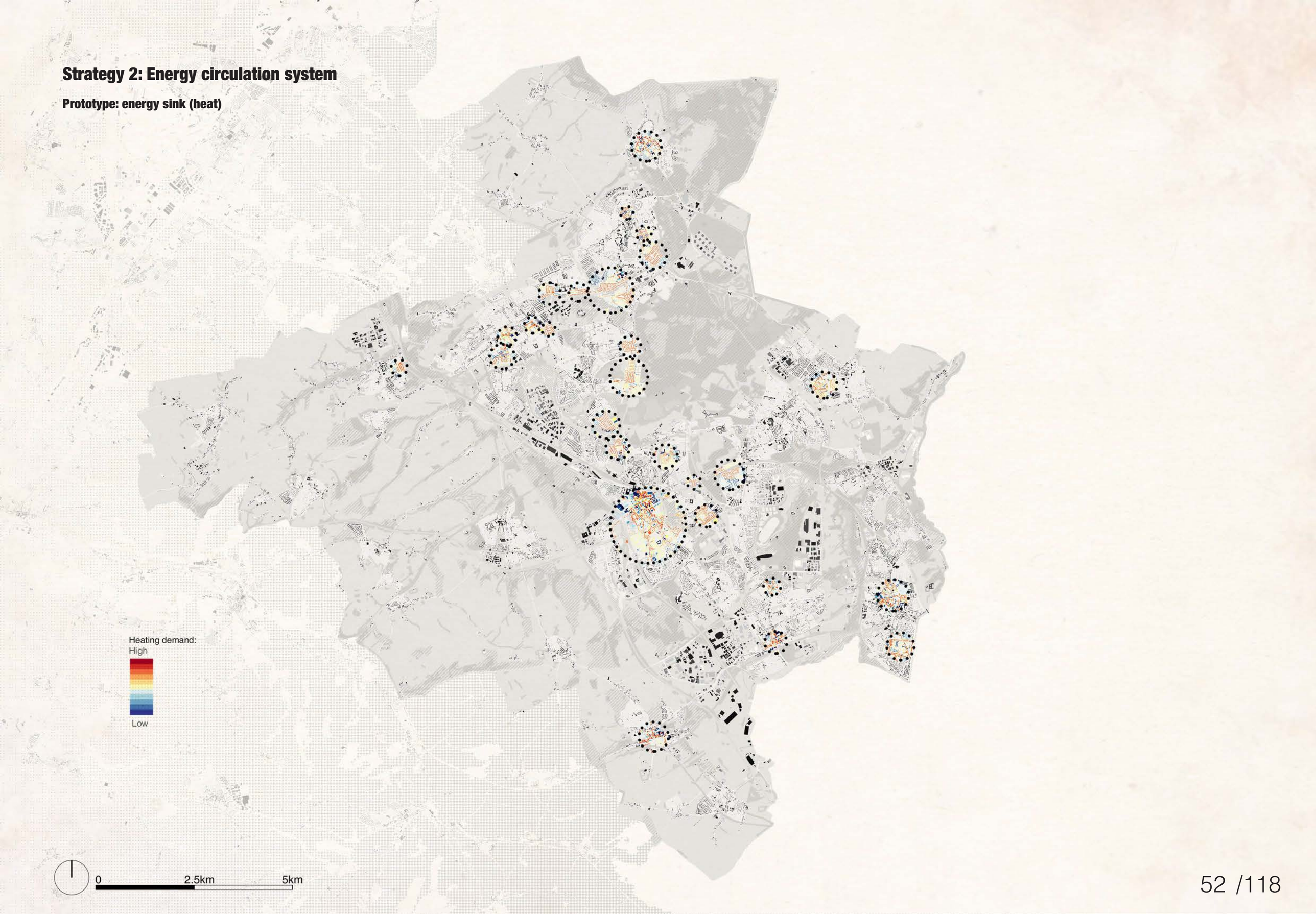
Strategy 2: Energy circulation system

Prototype: energy sink (heat)



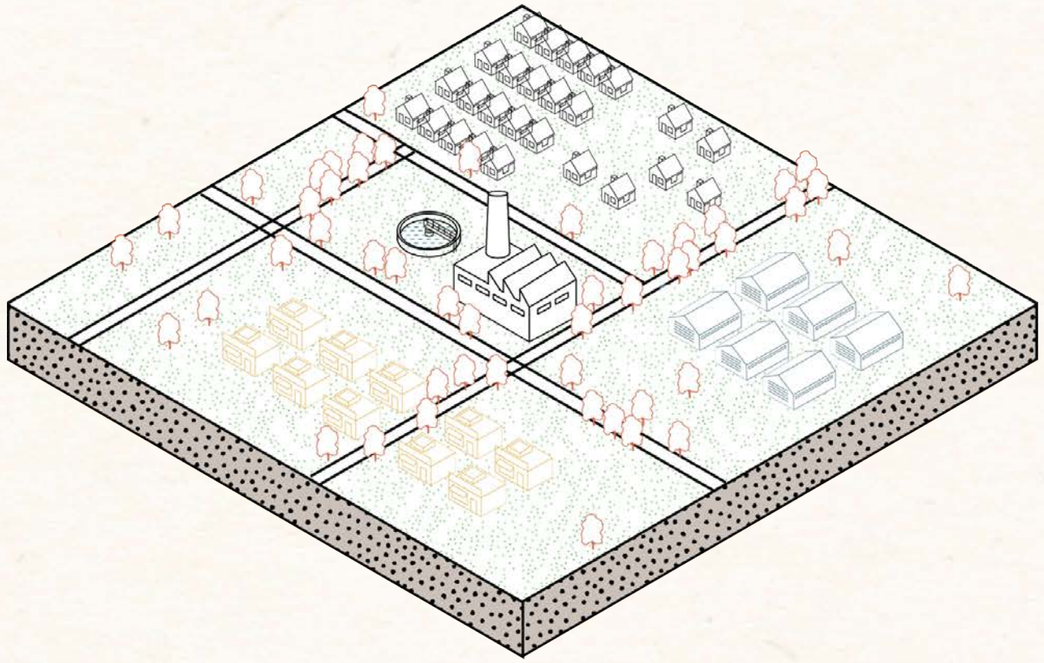
Strategy 2: Energy circulation system

Prototype: energy sink (heat)



Strategy 2: Energy circulation system

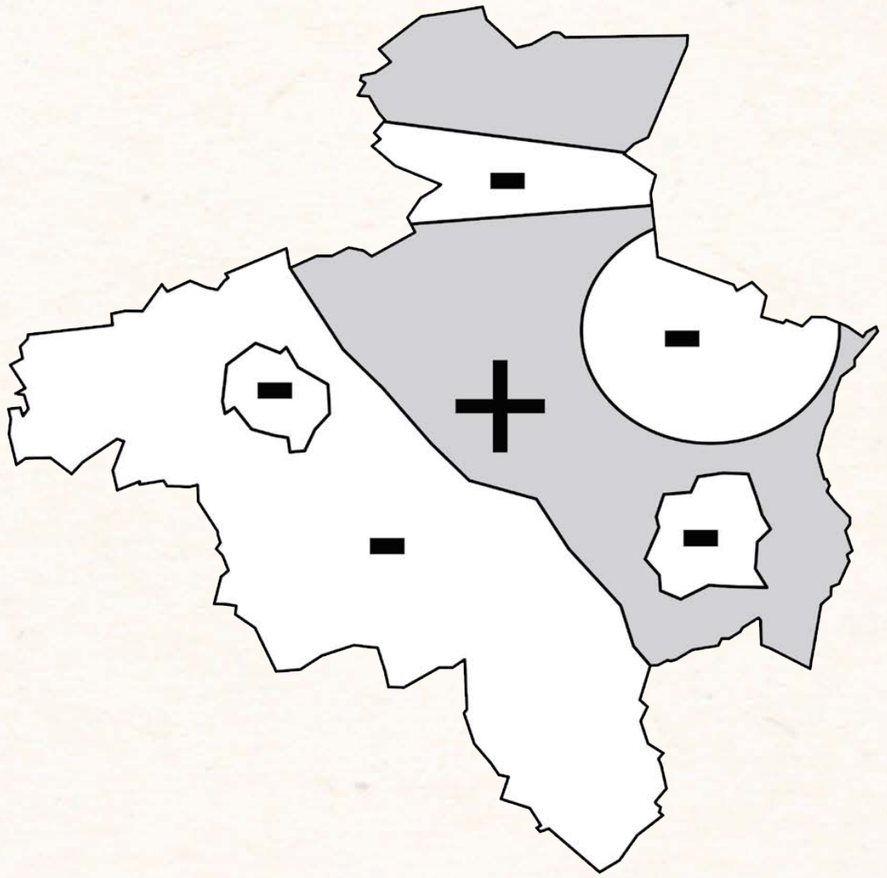
Prototype: energy sink



Strategy 2: Energy circulation system

Imbalanced Parkstad

Problem



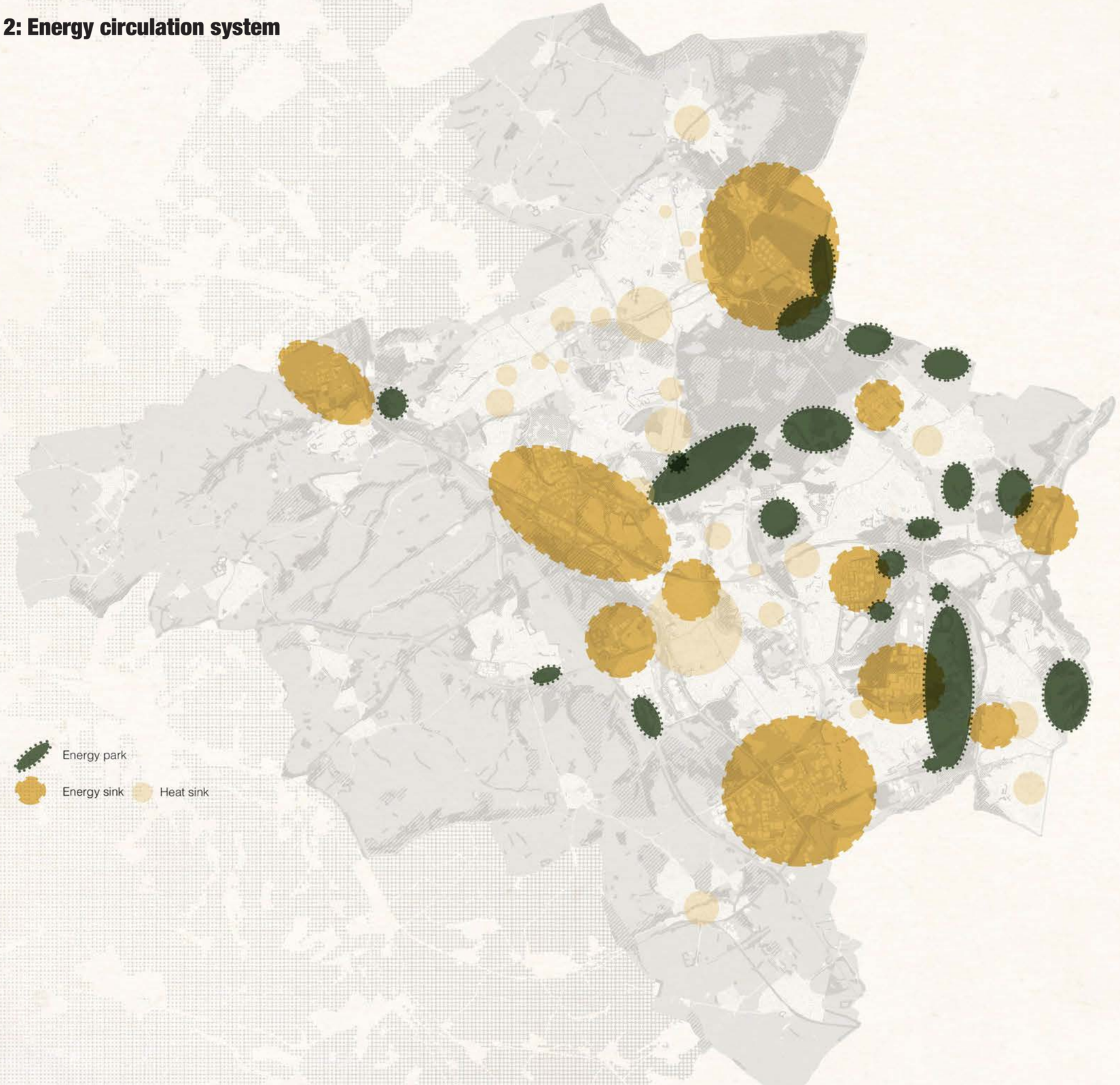
Strategy 2: Energy circulation system



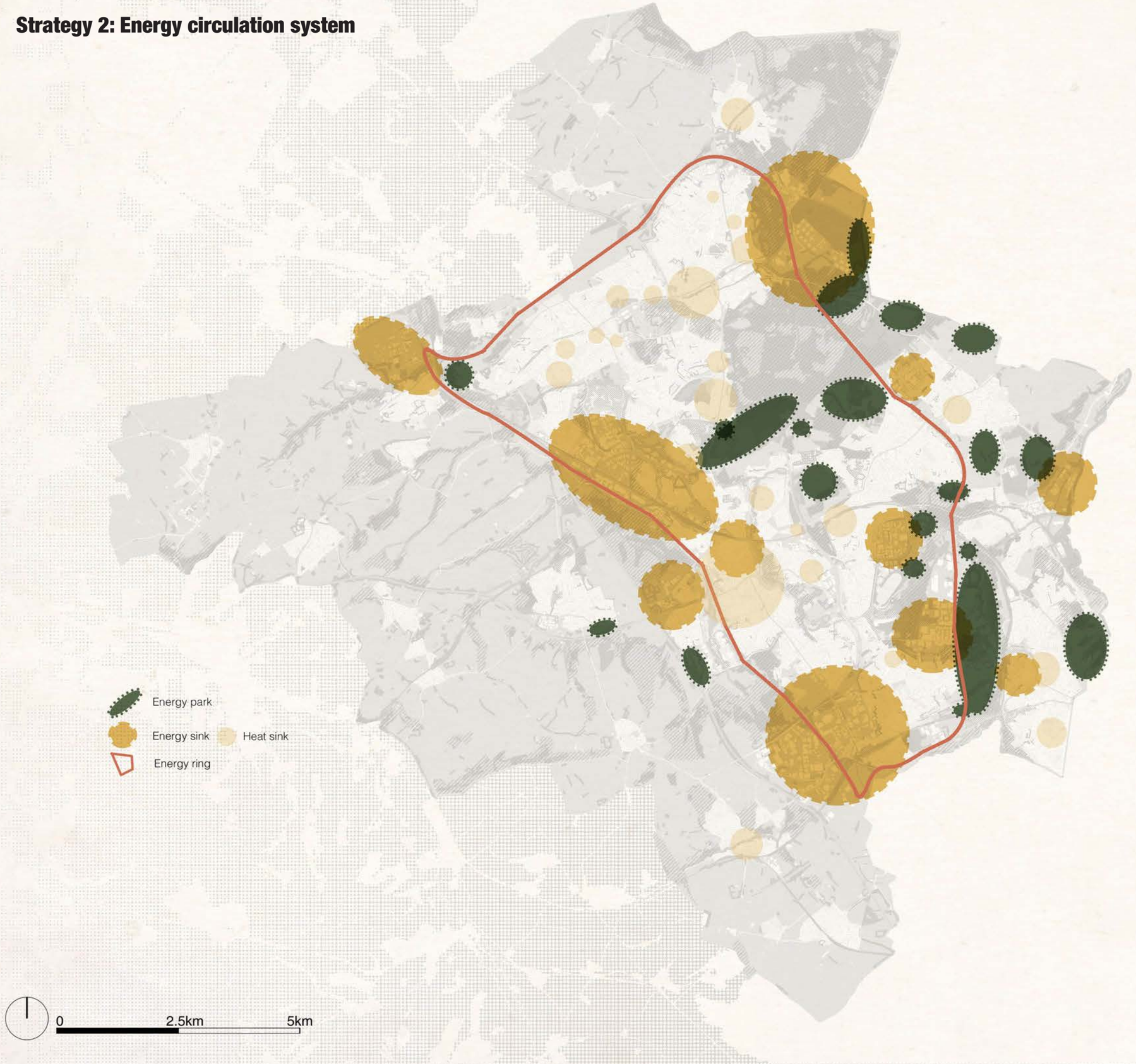
Strategy 2: Energy circulation system



Strategy 2: Energy circulation system



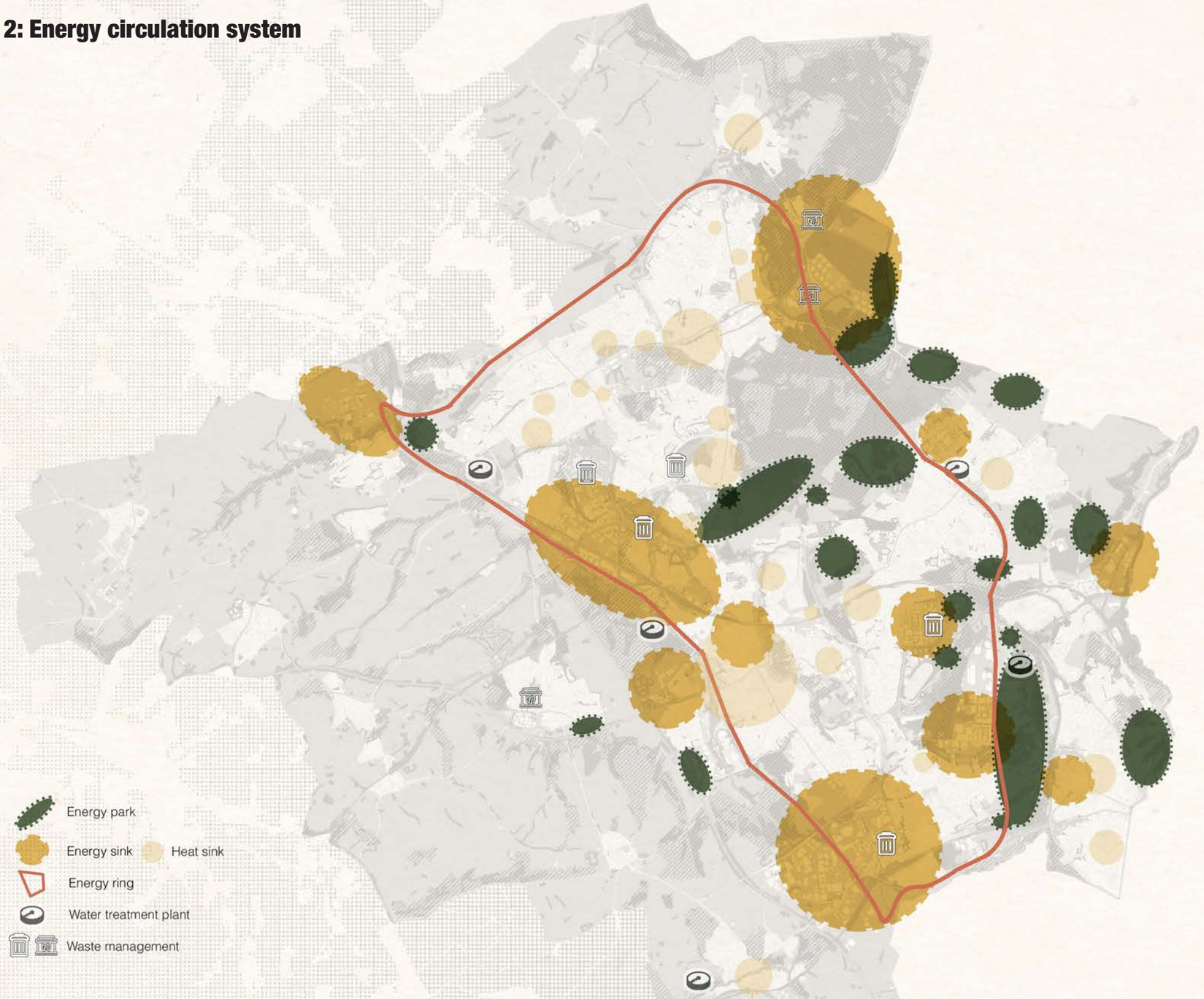
Strategy 2: Energy circulation system



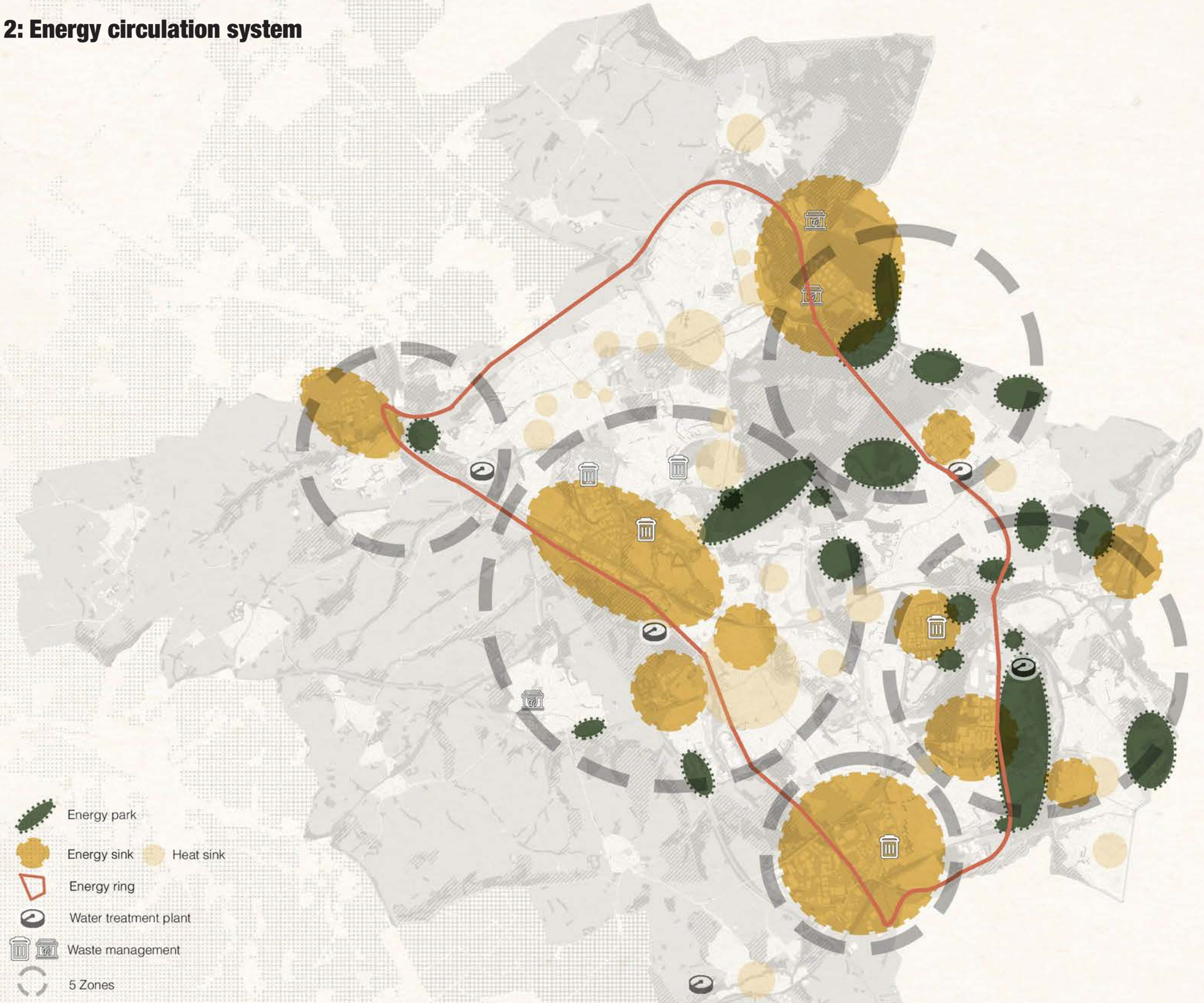
Strategy 2: Energy circulation system



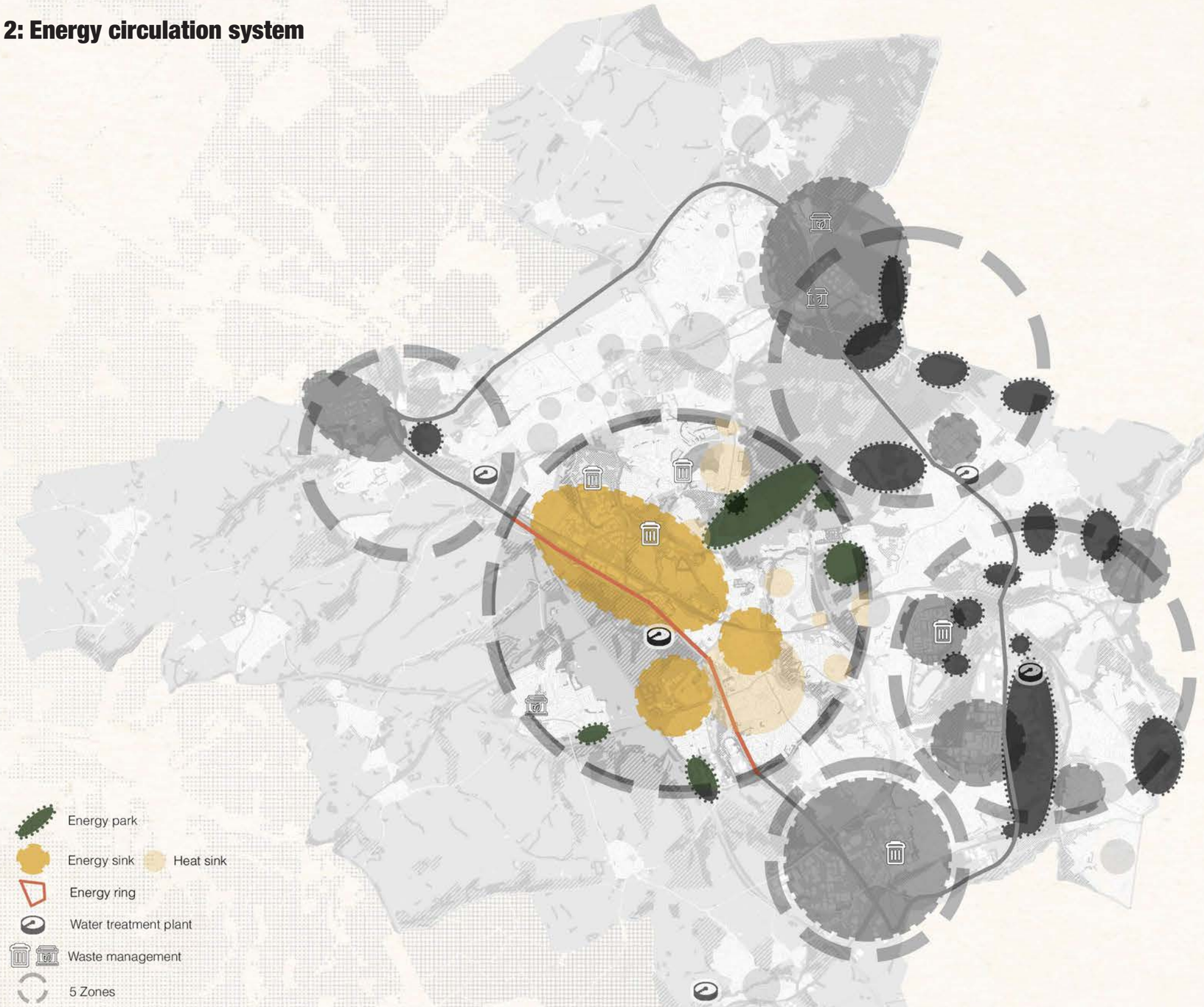
Strategy 2: Energy circulation system



Strategy 2: Energy circulation system

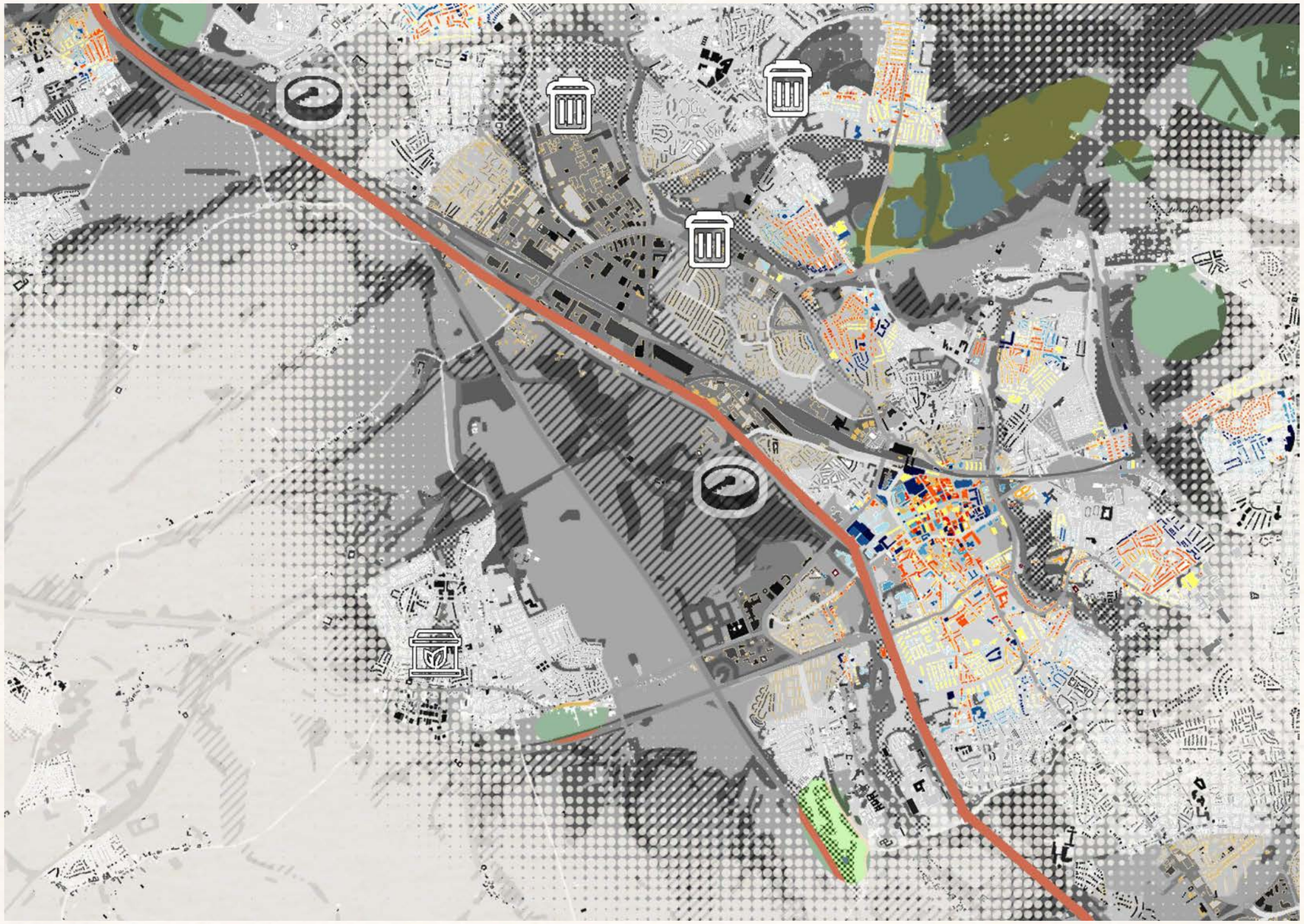


Strategy 2: Energy circulation system



Strategy 2: Energy circulation system

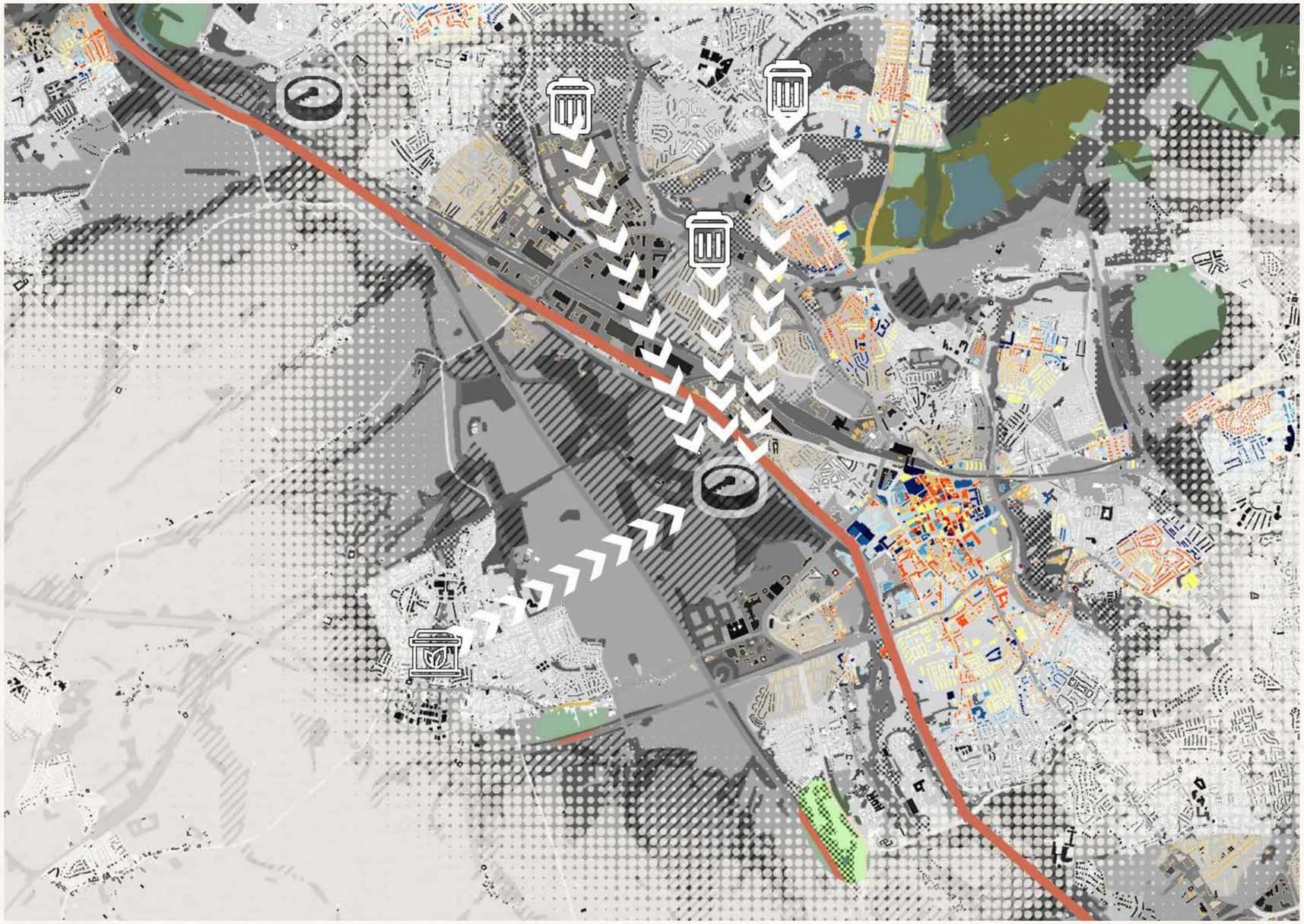
1. Source and sink mechanism

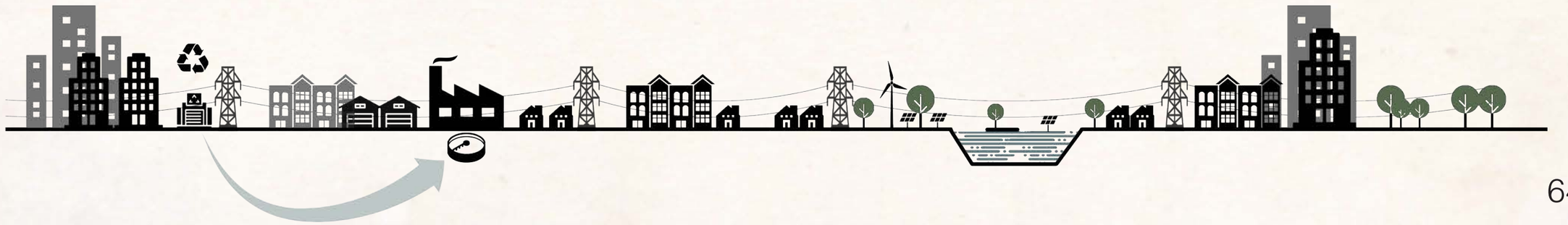




Strategy 2: Energy circulation system

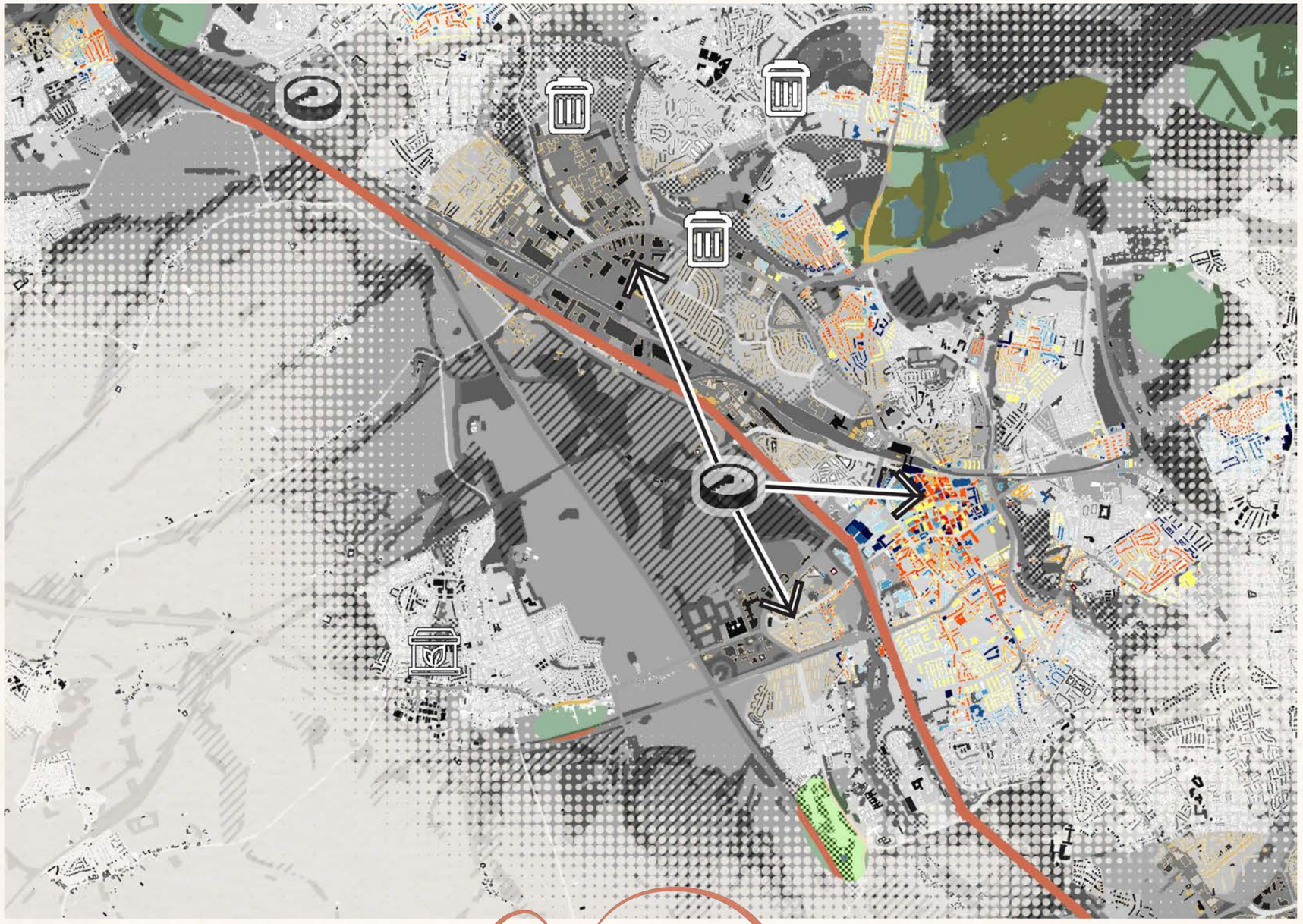
1. Source and sink mechanism

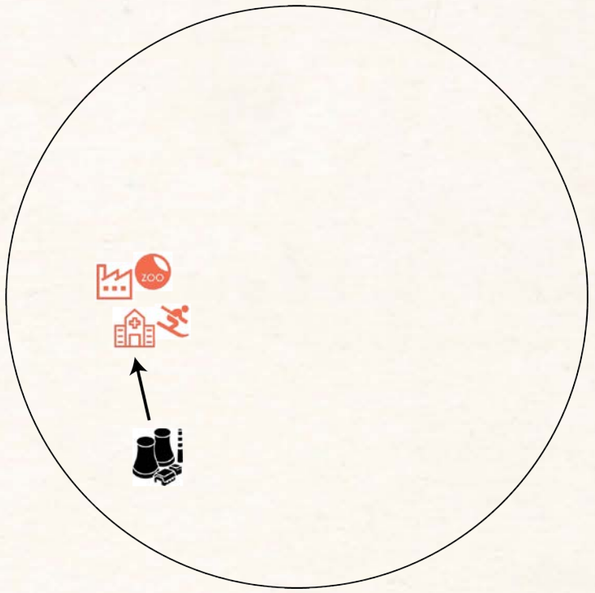




Strategy 2: Energy circulation system

1. Source and sink mechanism

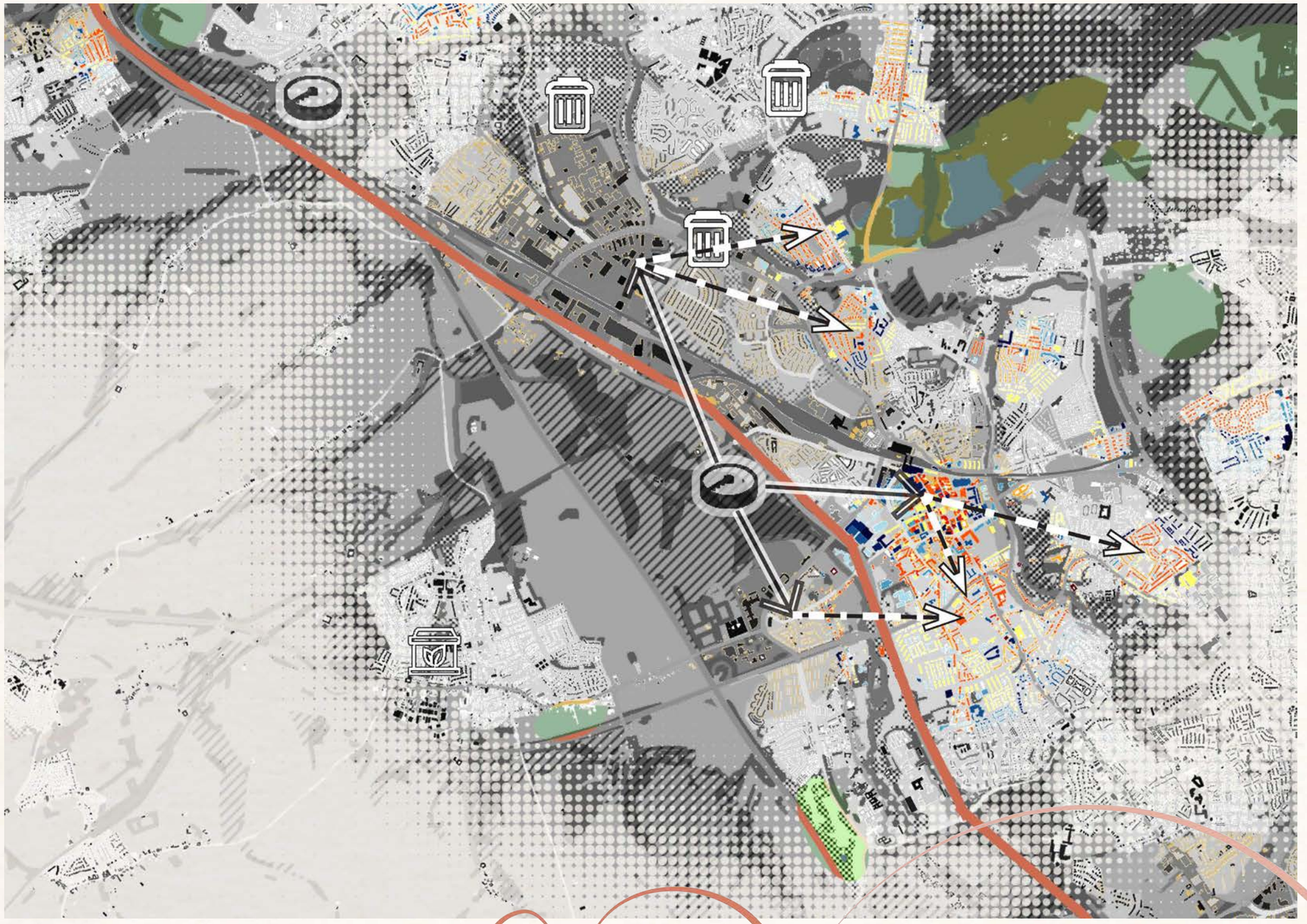


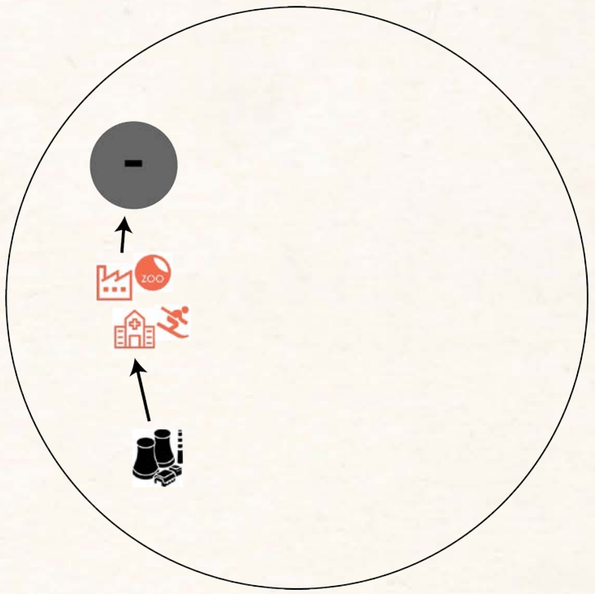


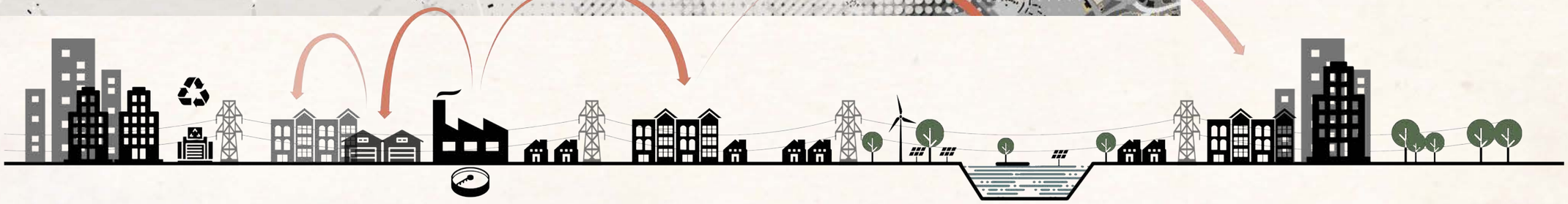


Strategy 2: Energy circulation system

1. Source and sink mechanism

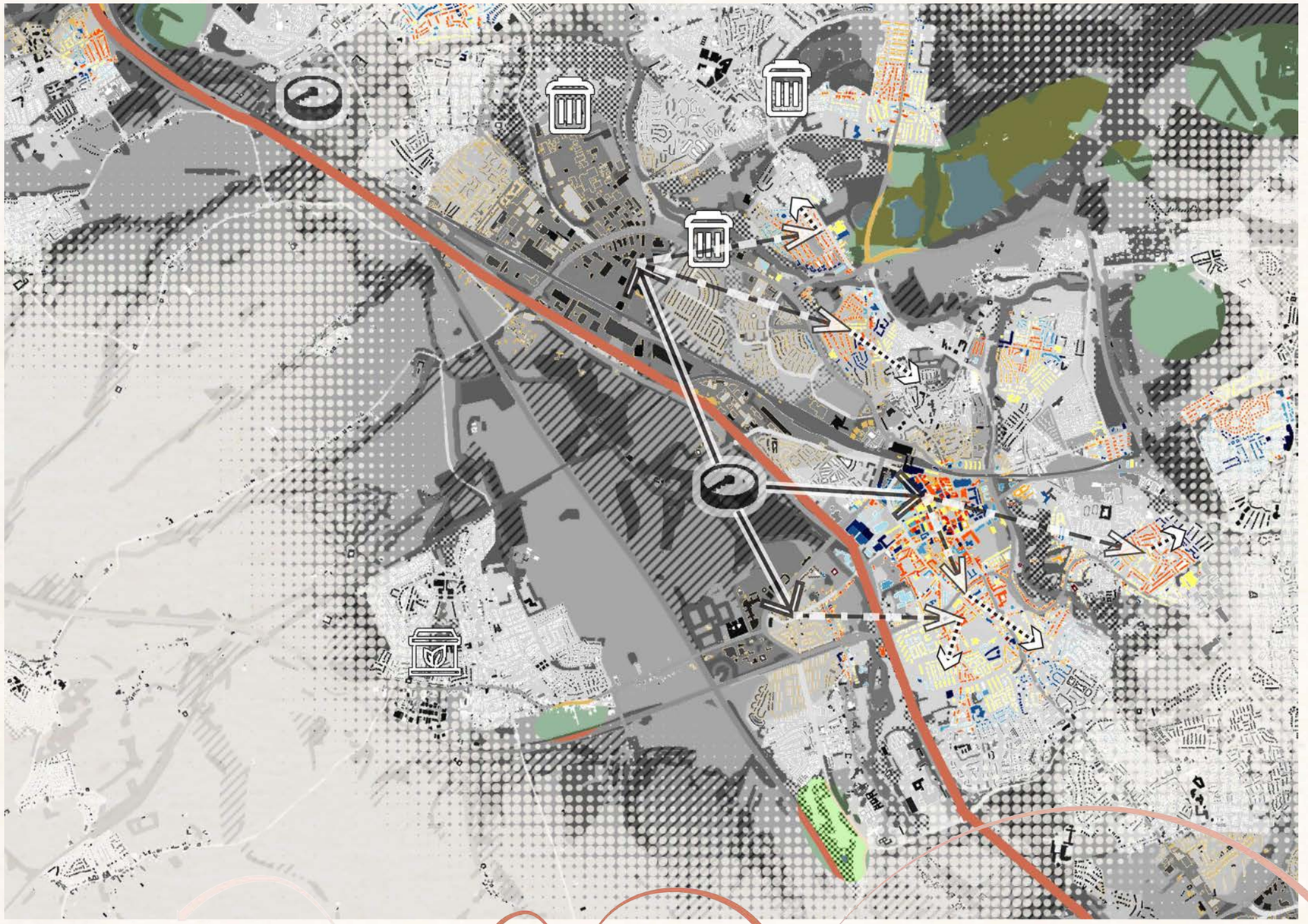


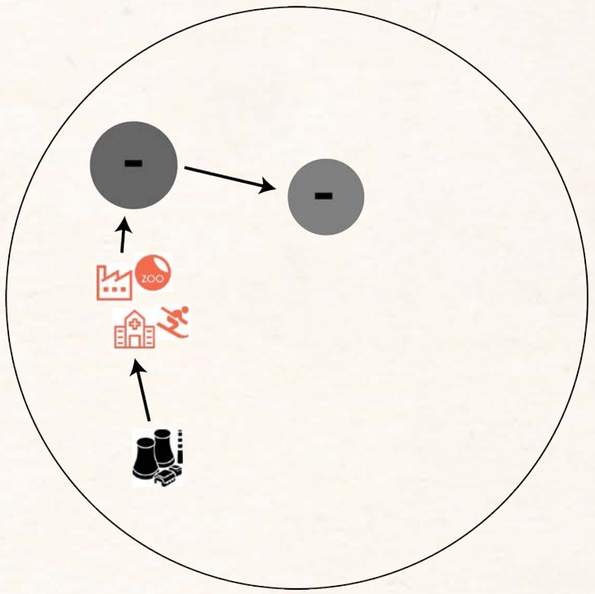




Strategy 2: Energy circulation system

1. Source and sink mechanism

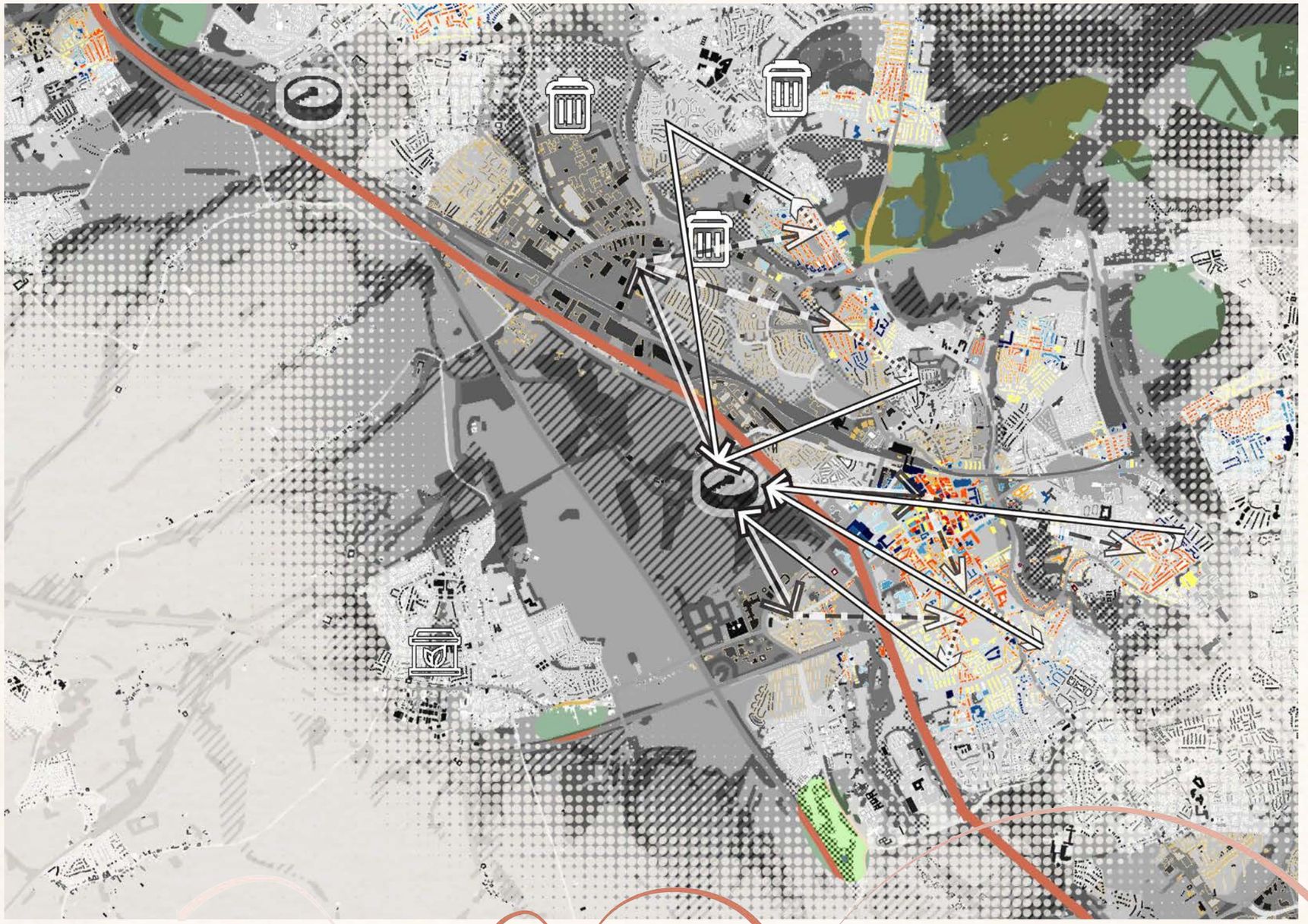


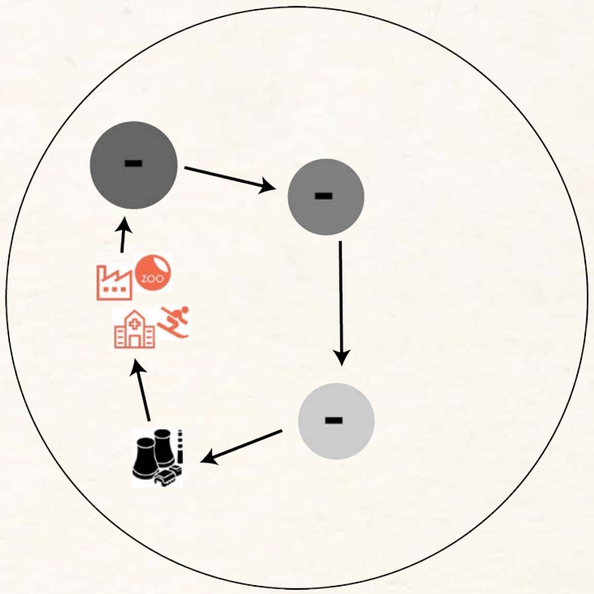




Strategy 2: Energy circulation system

1. Source and sink mechanism

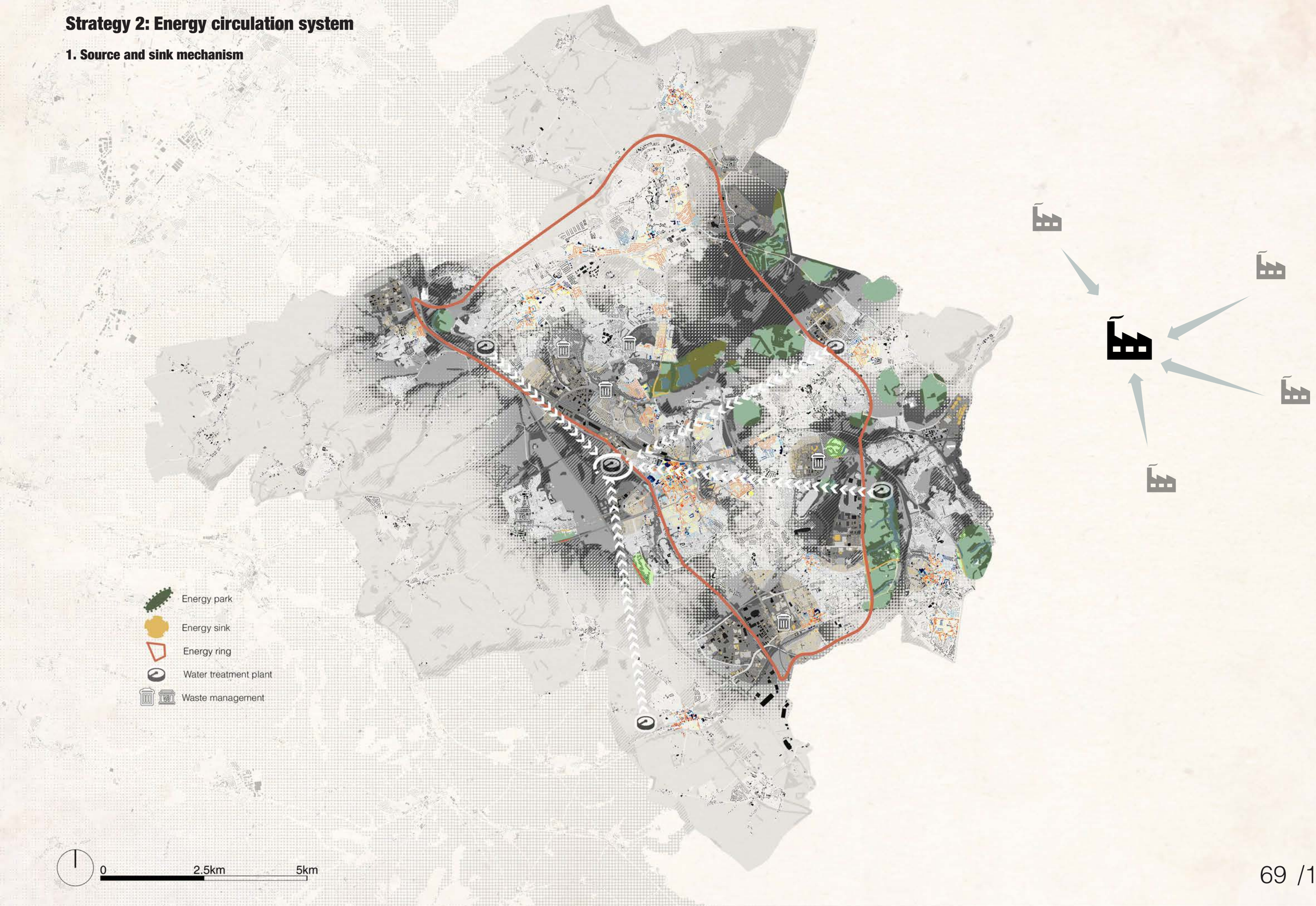






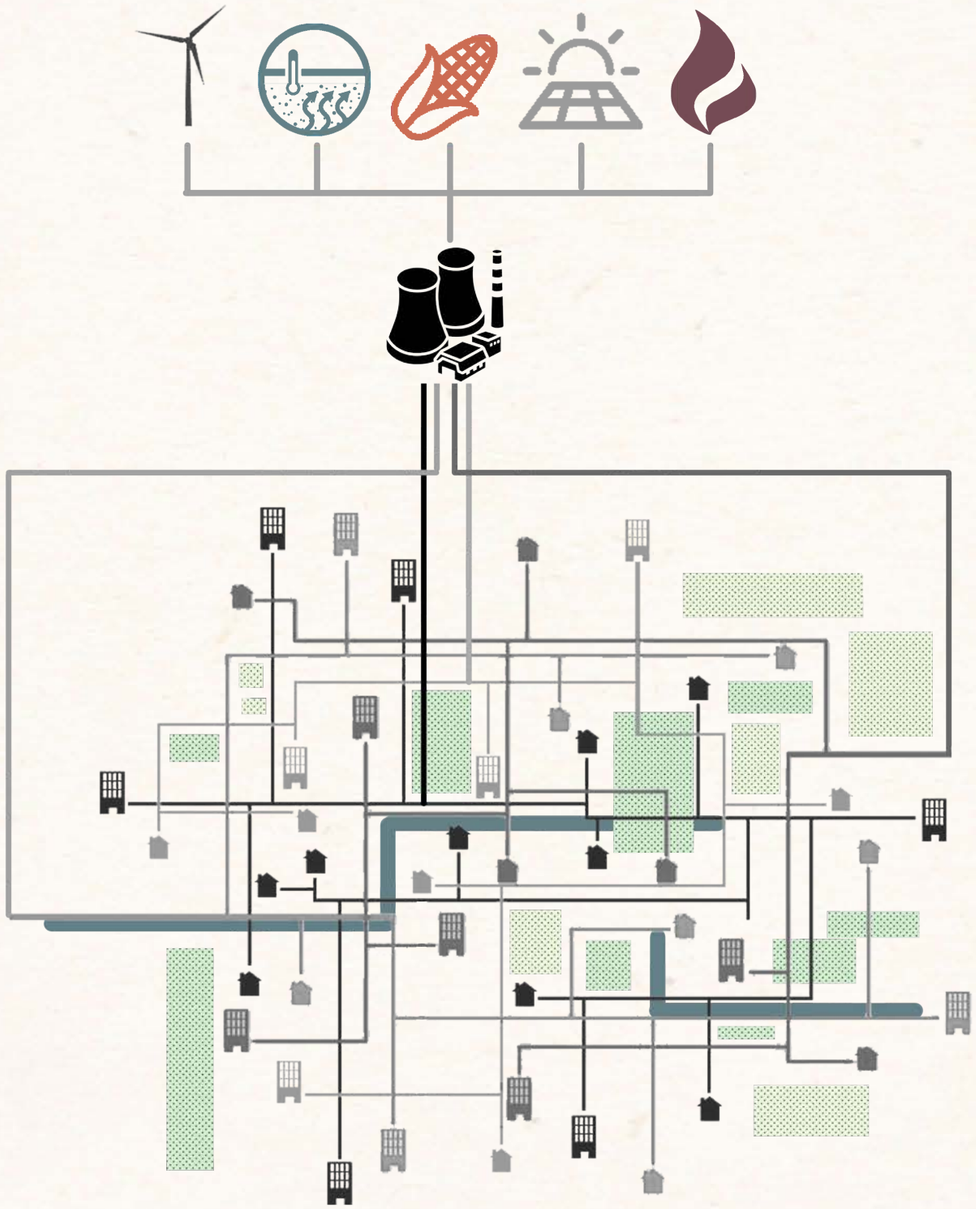
Strategy 2: Energy circulation system

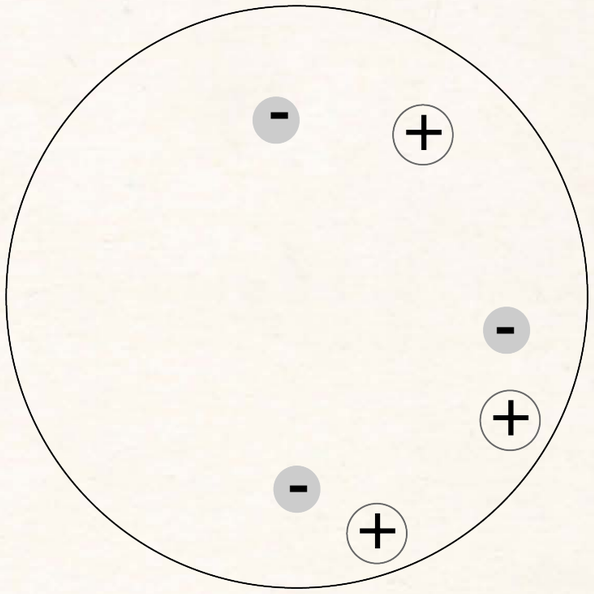
1. Source and sink mechanism



Strategy 2: Energy circulation system

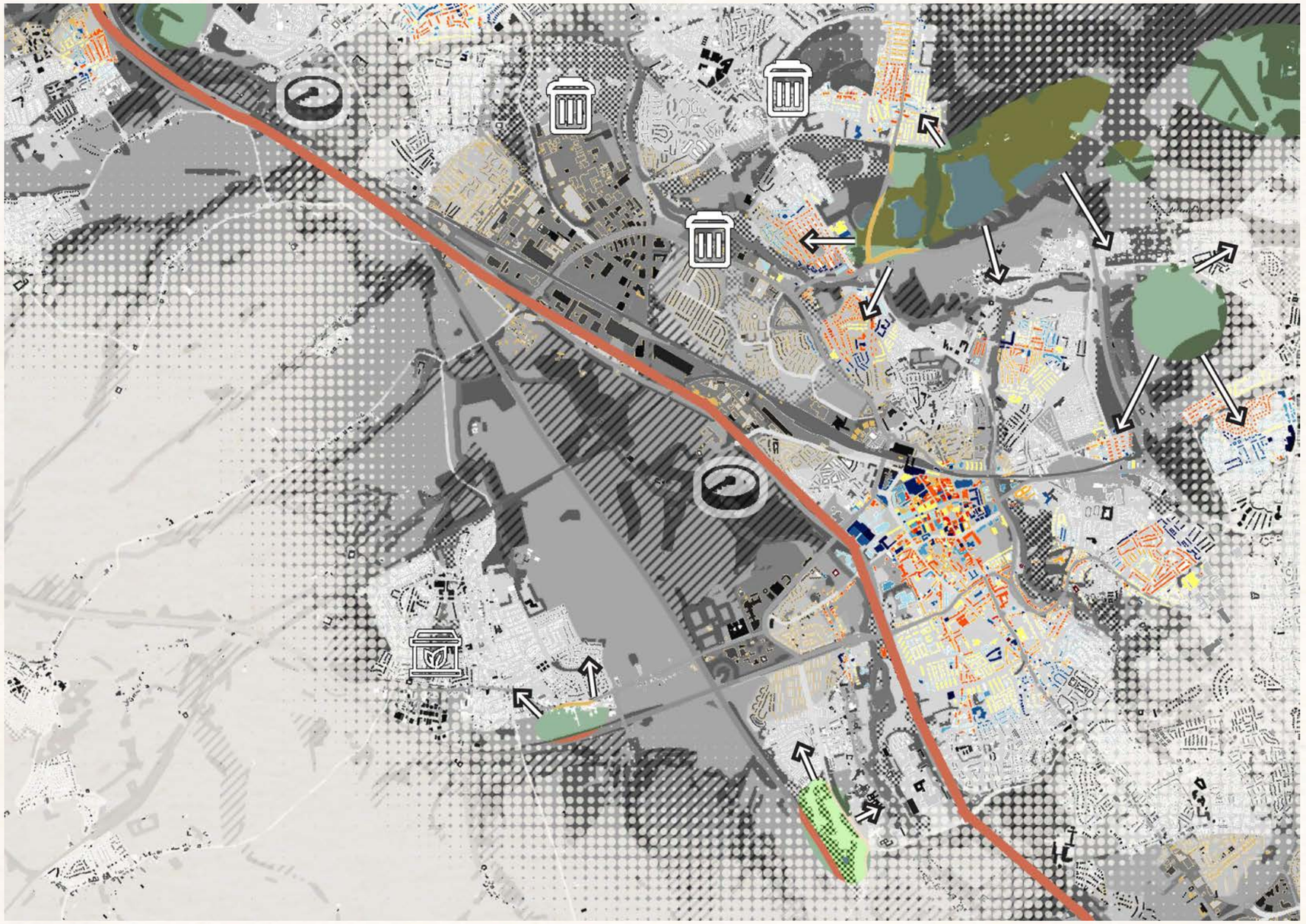
2. Supplement: Energy park mechanism

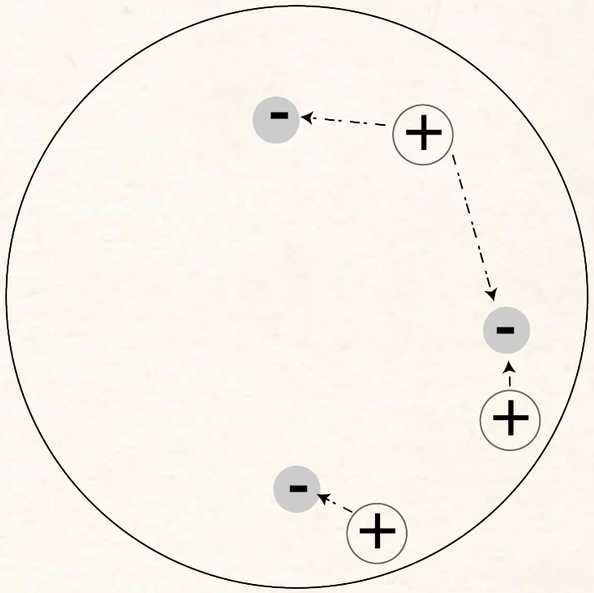




Strategy 2: Energy circulation system

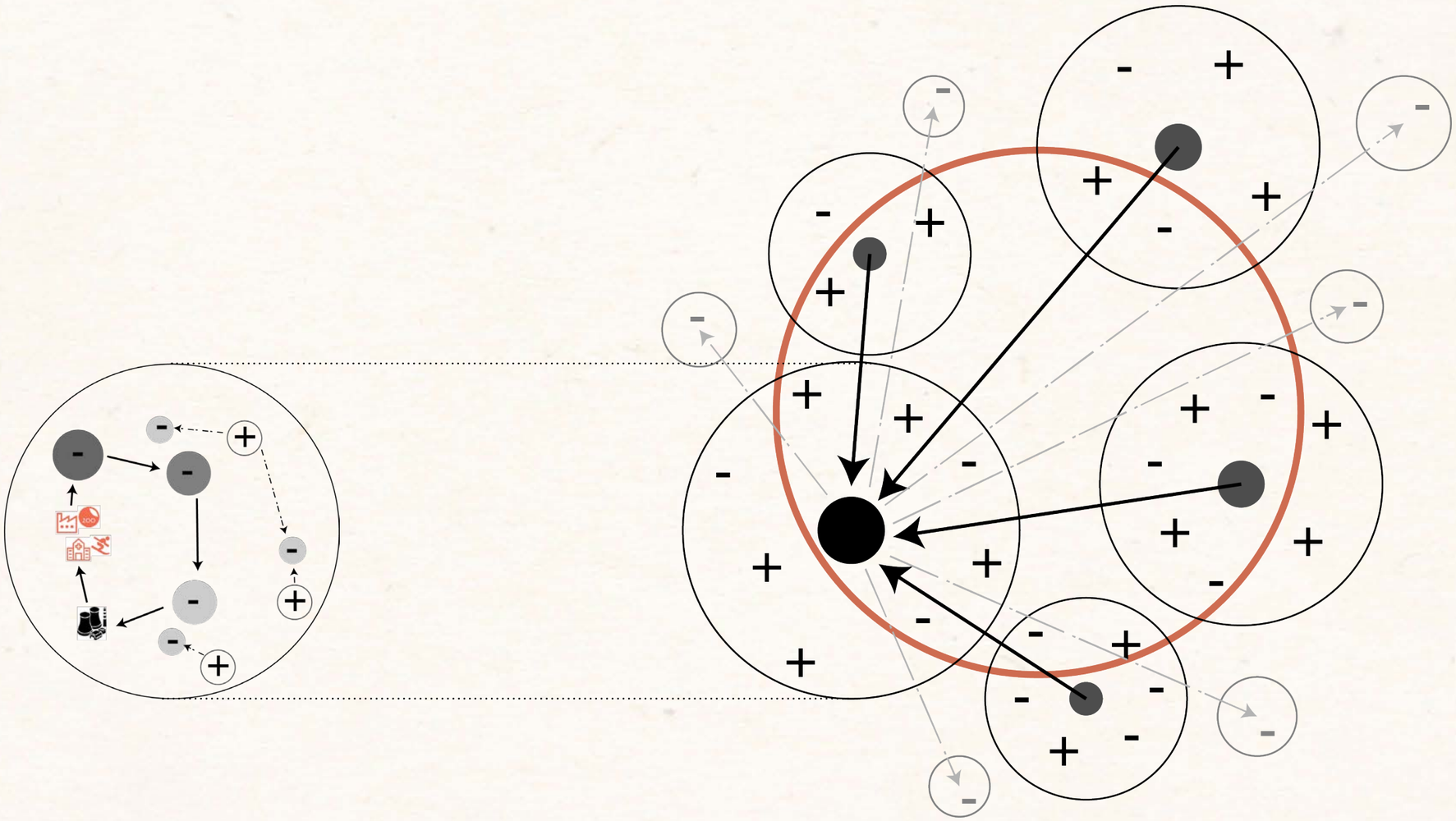
2. Supplement: Energy park mechanism







Strategy 2: Energy circulation system



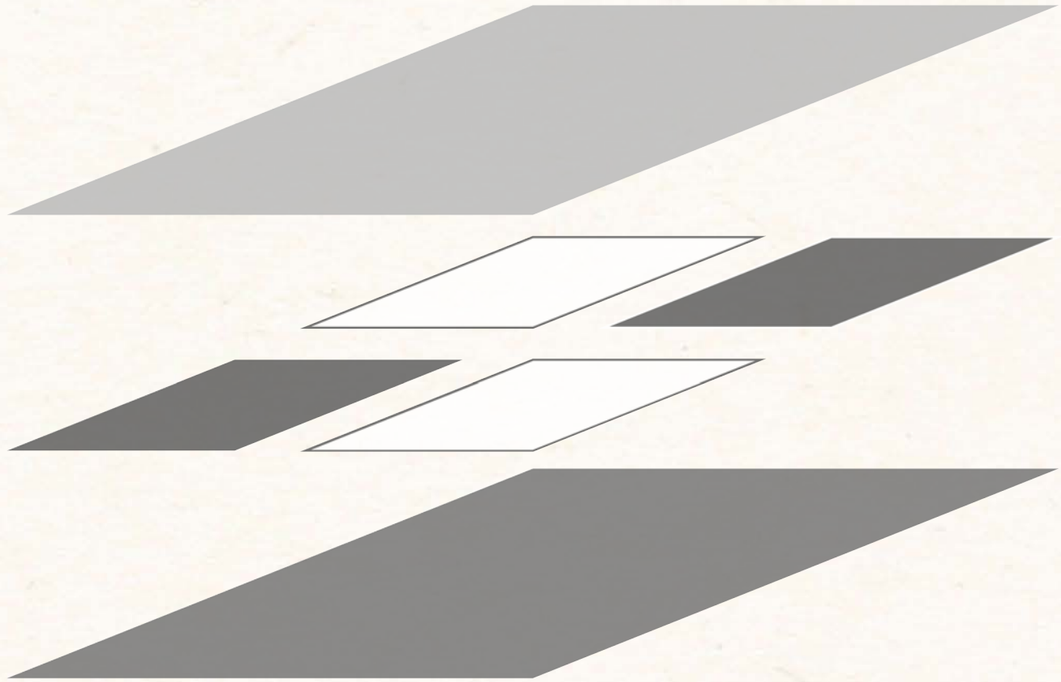
Strategy 2: Energy circulation system



Strategy 3: Spatial composition

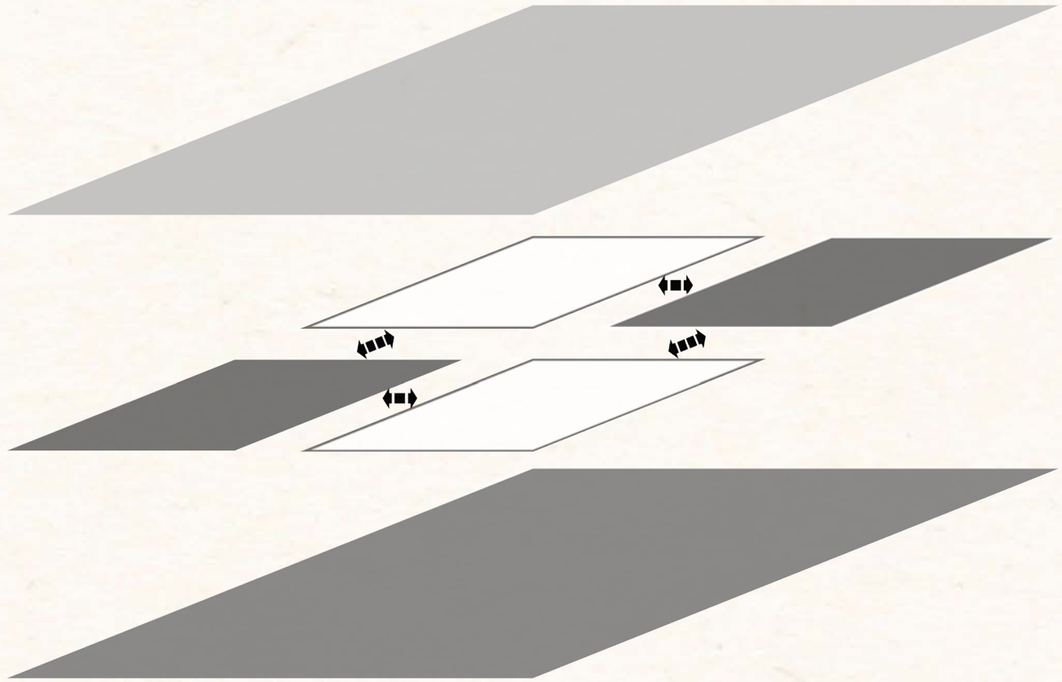
Delaminated Parkstad

Problem



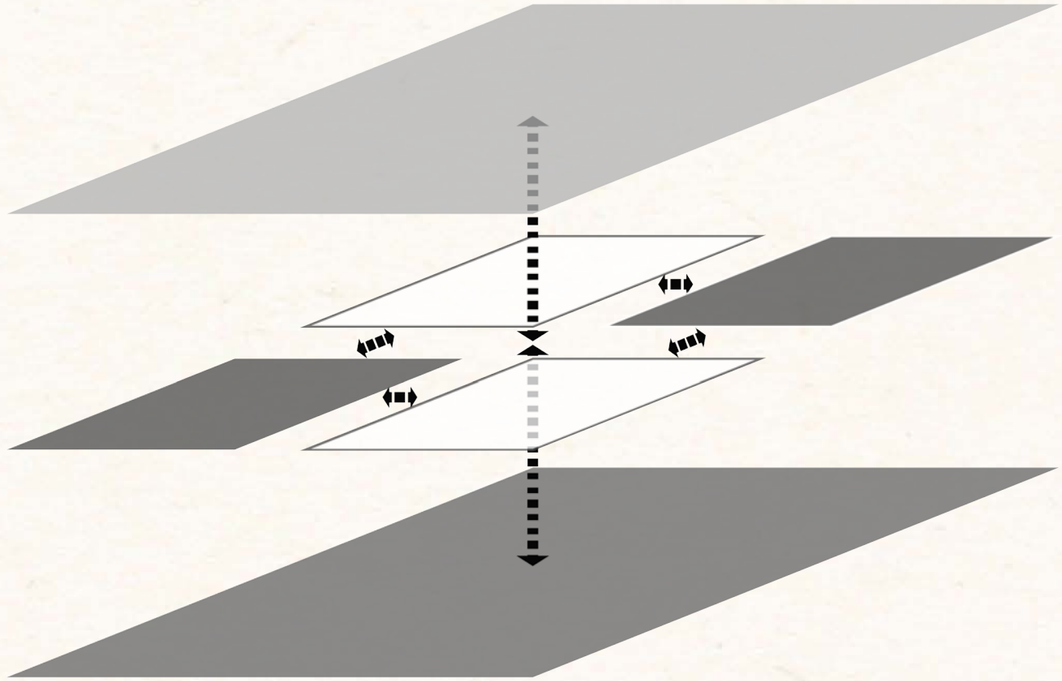
Strategy 3: Spatial composition

1. horizontal



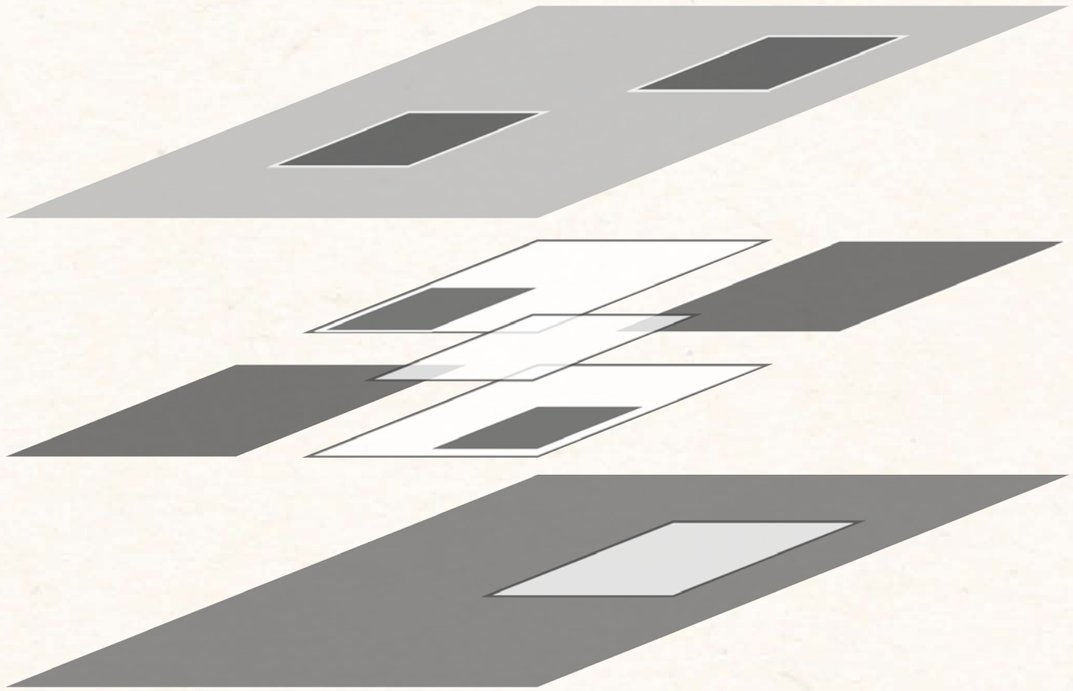
Strategy 3: Spatial composition

2. Vertical



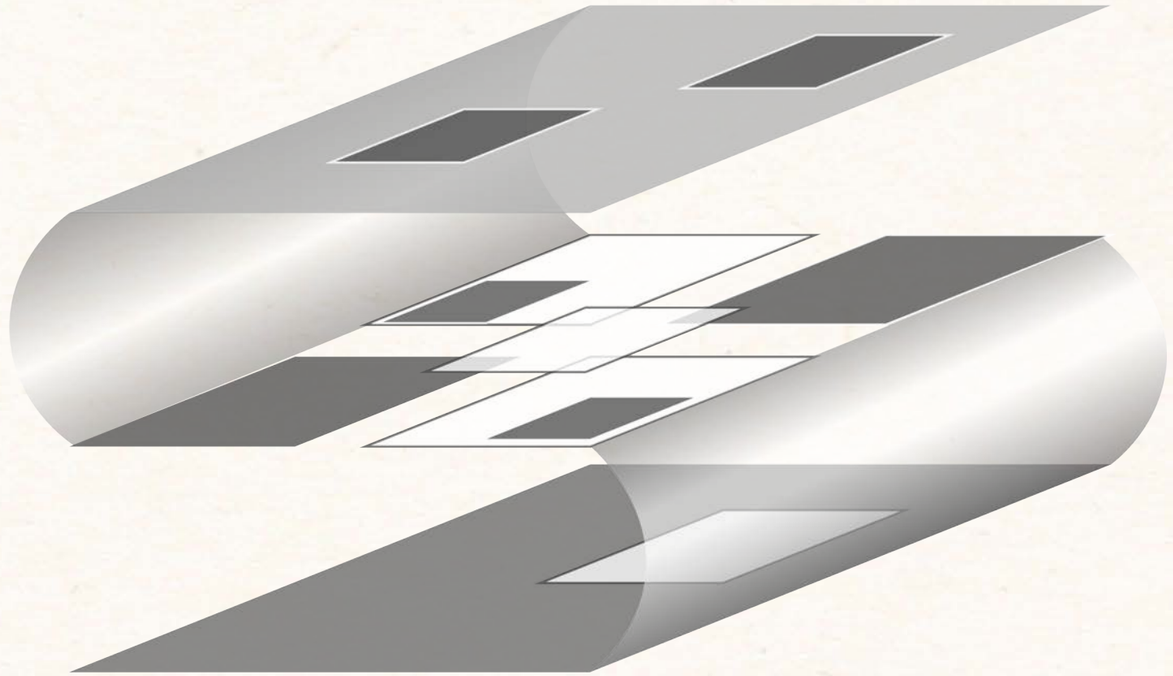
Strategy 3: Spatial composition

3. Permeation



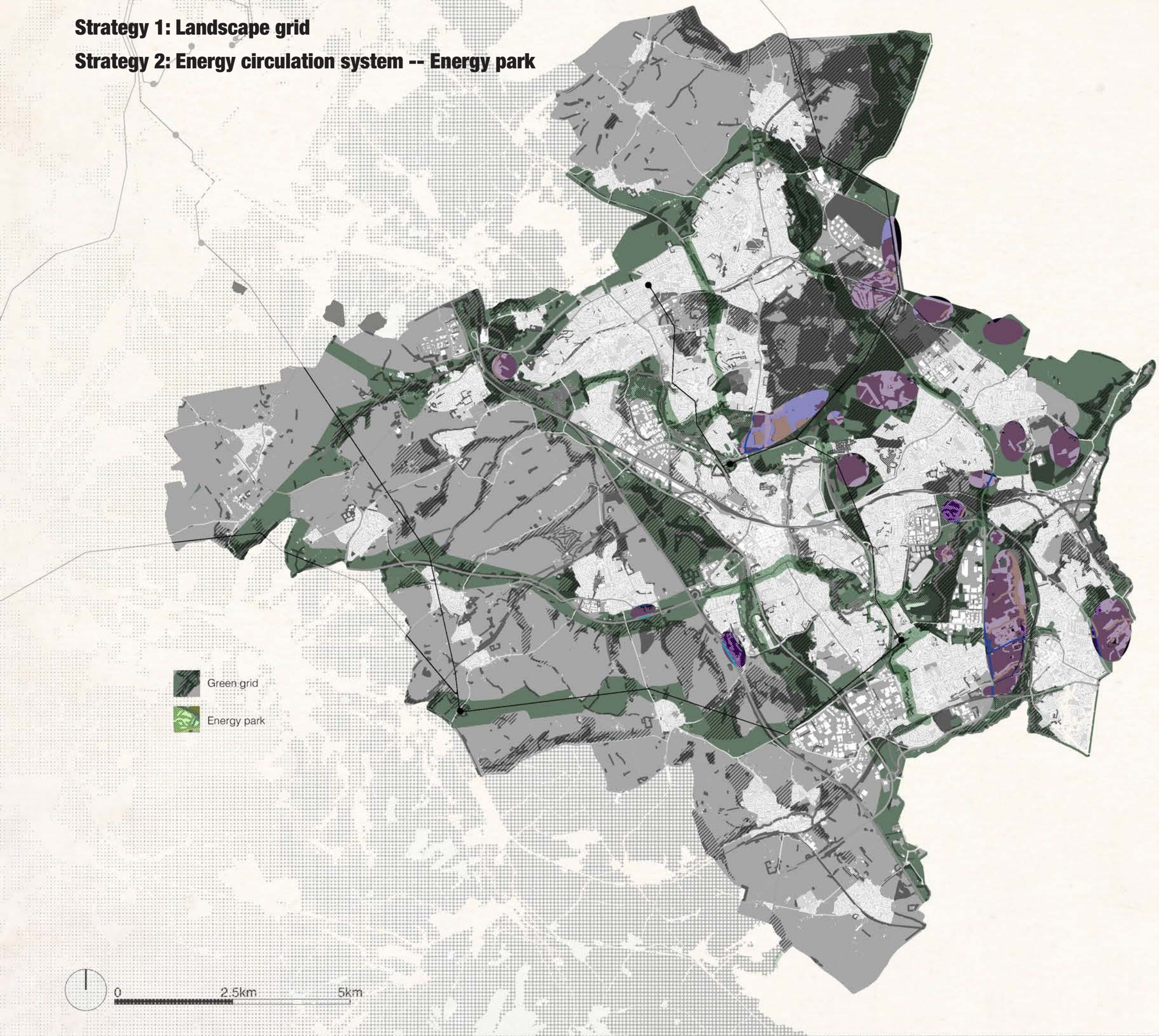
Strategy 3: Spatial composition

4. Three-dimensional

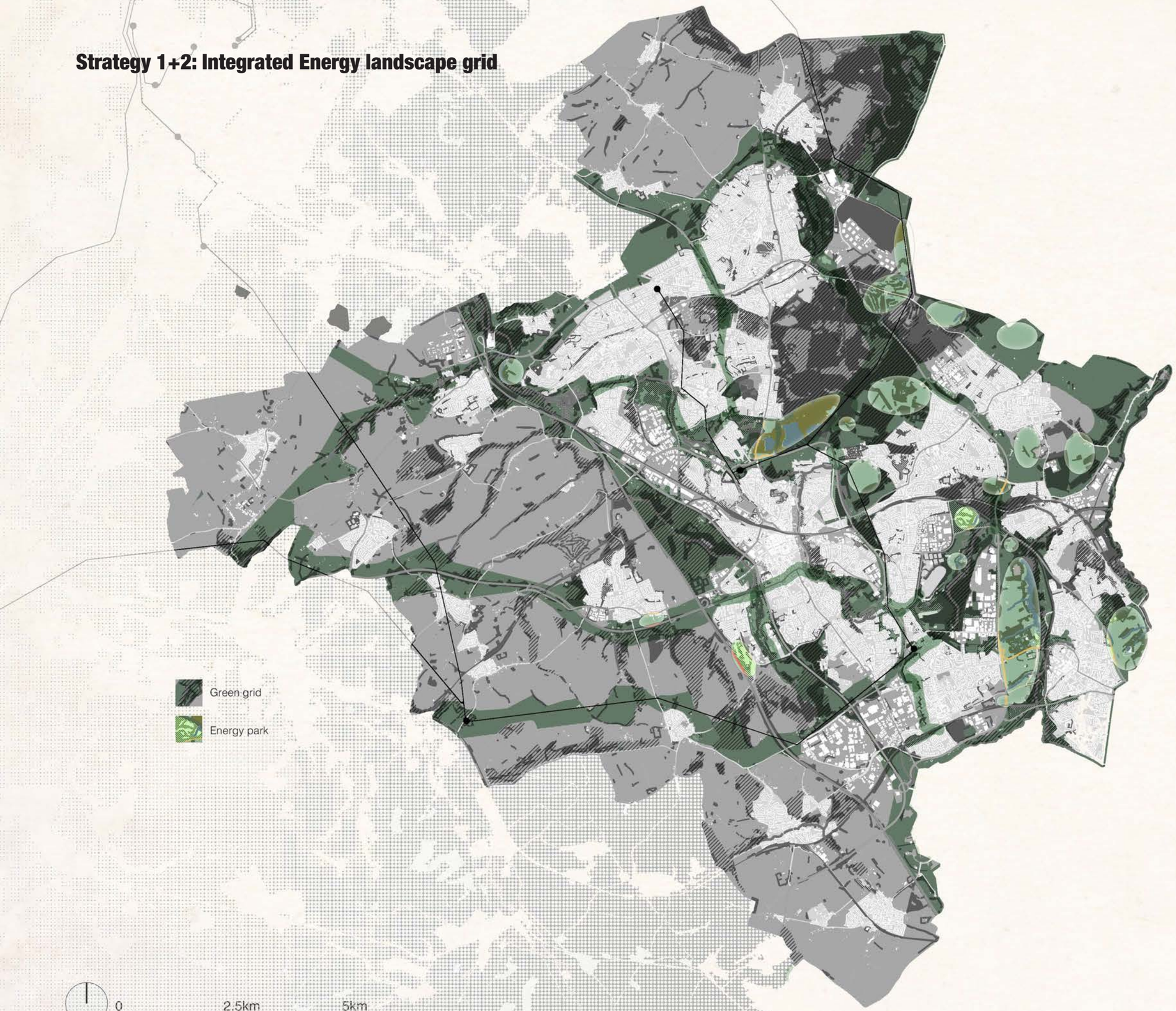


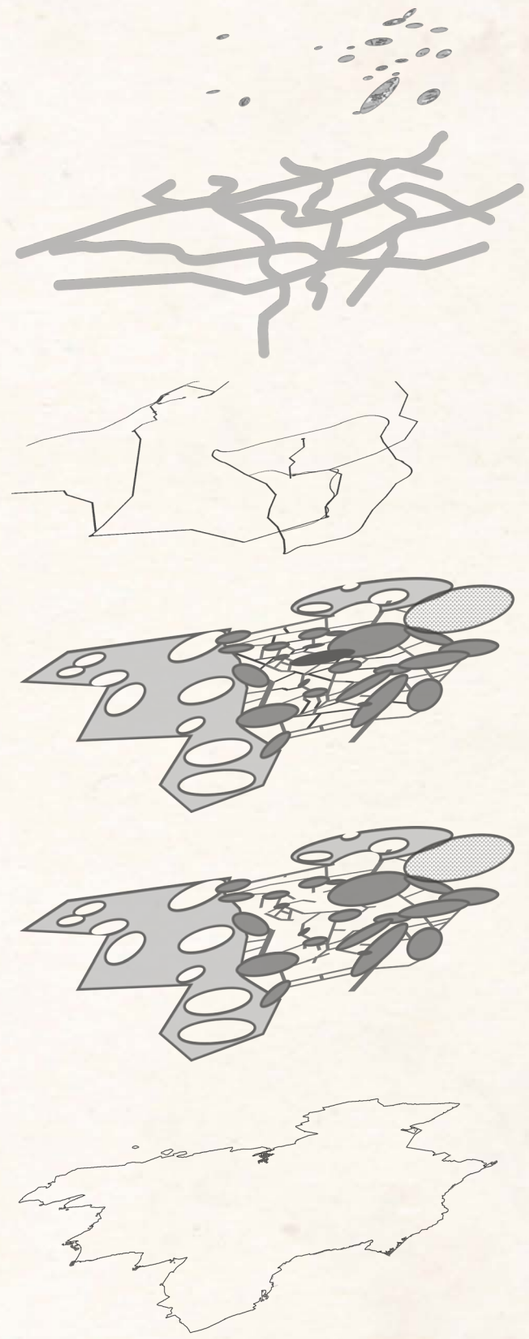
Strategy 1: Landscape grid

Strategy 2: Energy circulation system -- Energy park



Strategy 1+2: Integrated Energy landscape grid





Strategy 1+2+3: Integrated Energy landscape scenario

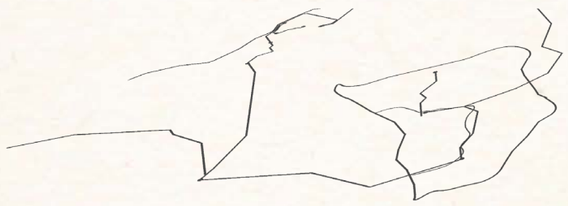
Energy park



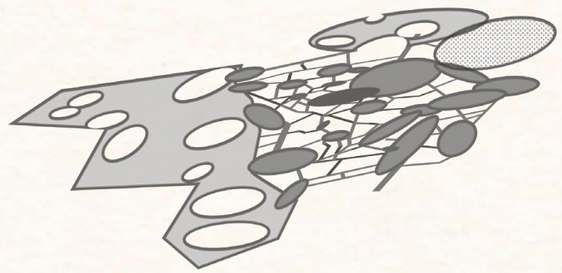
Grid



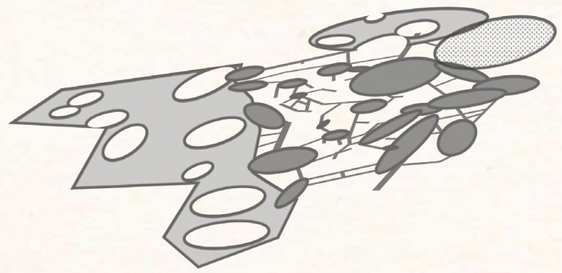
Voltage line & the loop

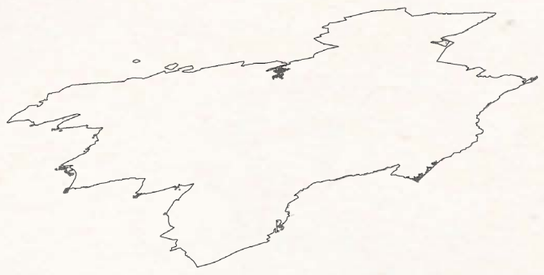


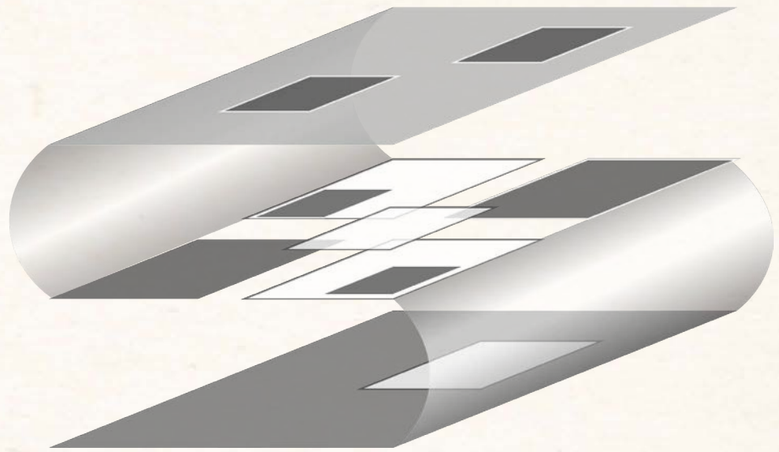
Green network



Initial green network

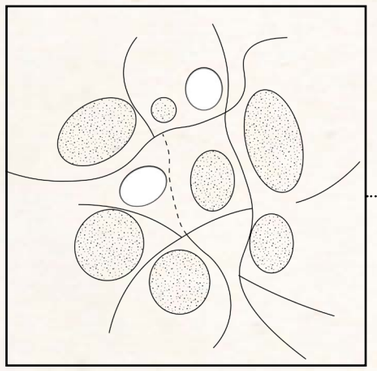






Strategies review

Strategy 1

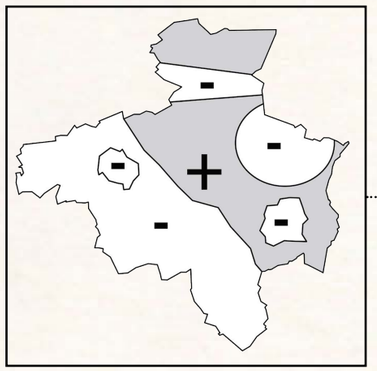




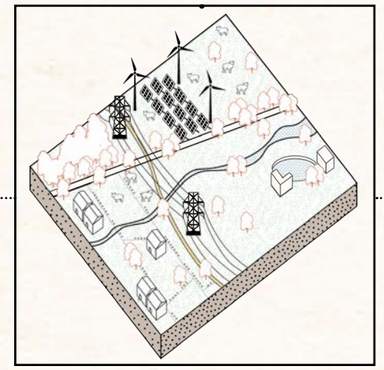


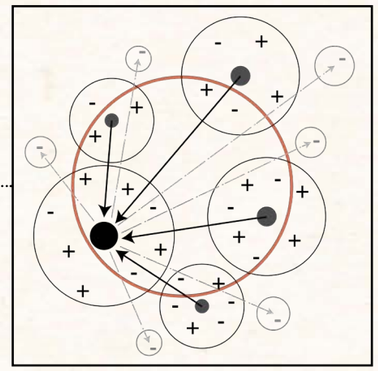


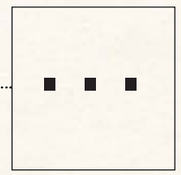
Strategy 2





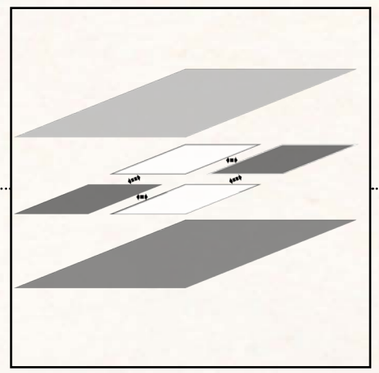


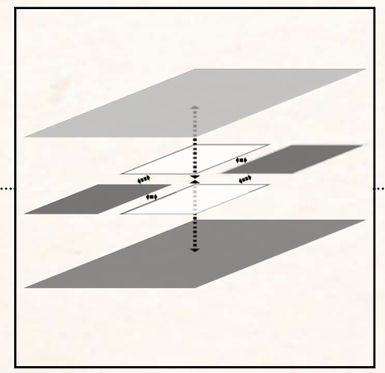


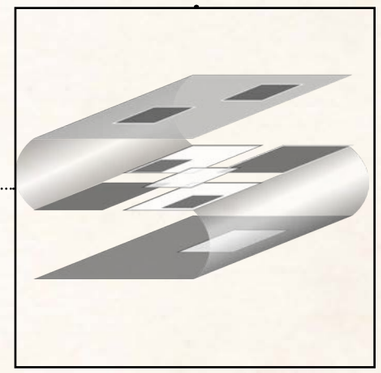


Strategy 3









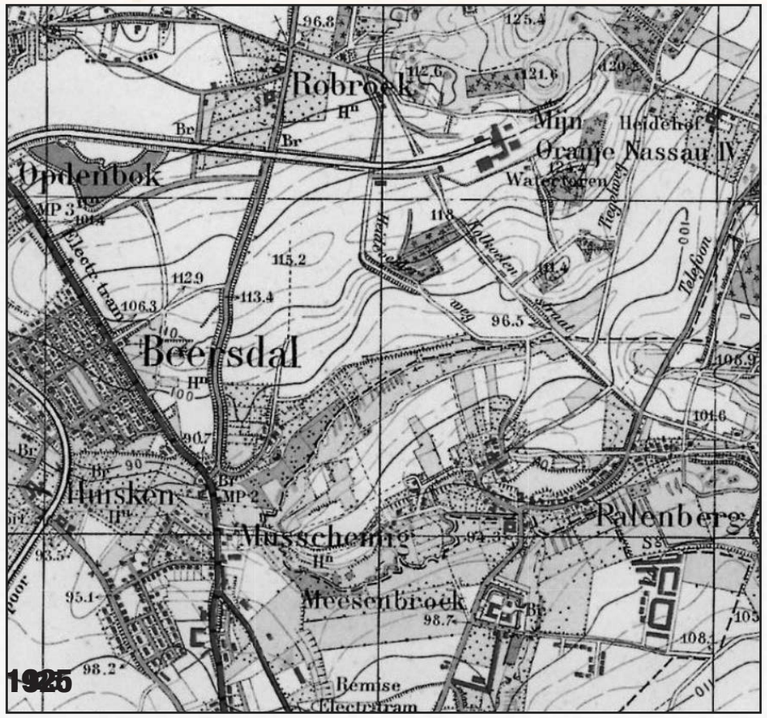
SITE

Design elaboration

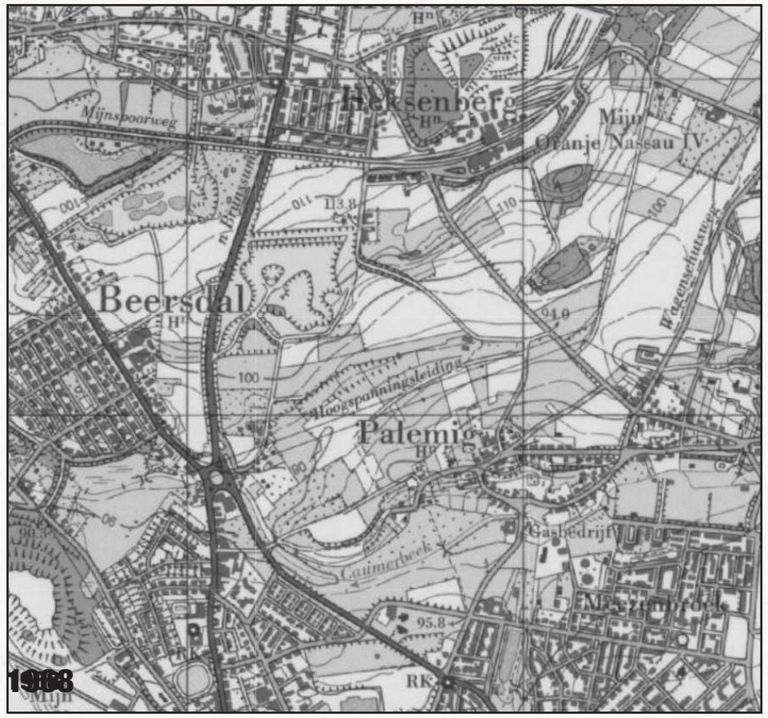
Location



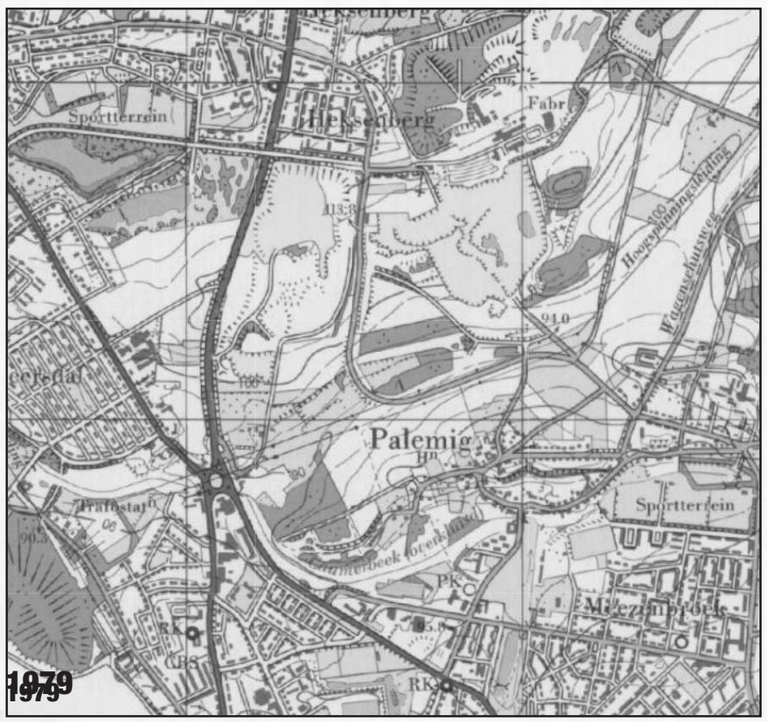
Location



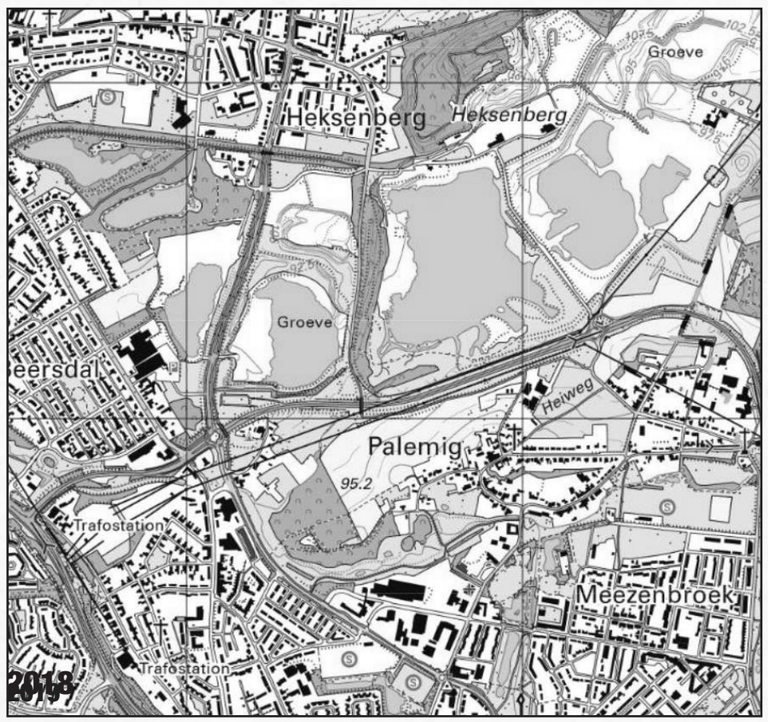
1925



1968



1979



2018

Oranje Nassau IV

Location: Heerlen
Start building: 1910
Product period: 1925-1966
Total production: 13,754,000 ton
Shaft: 740 meter deep

SIBELCO Sibelco Benelux B.V.

Masonry contractor
Date of establishment: 28-04-1970
Products and services: Sand, gravel and clay extraction

The current license from Sibelco will expire in 2020.

The proposal, the so-called provincial integration plan, provides that Sibelco may continue to extract silver sand until 2035.
It is an elaboration of an agreement

Zones

Nature Area

Close to Nature

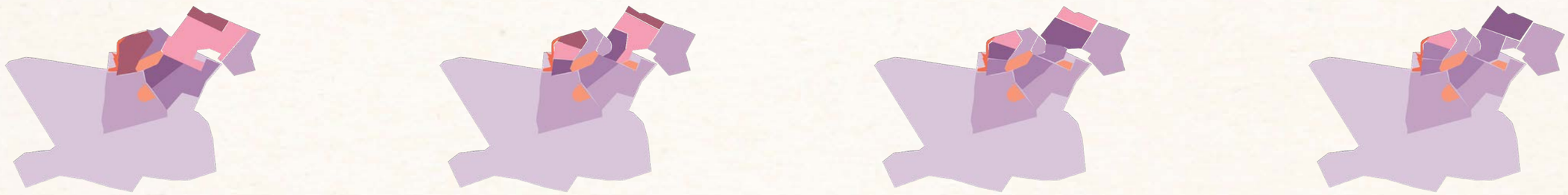
Integrate Energy Infrastructure with Landscape

Energy Generation

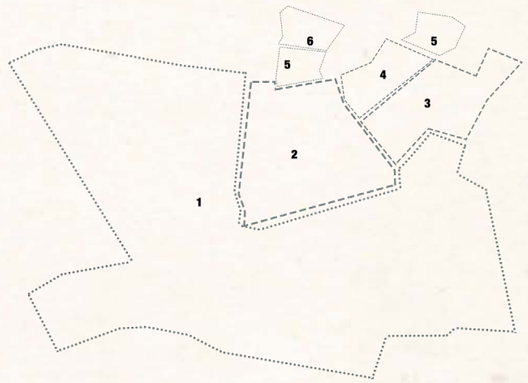
Terrain in between

Urban area

Existing planning



2020 2025 2030 2035



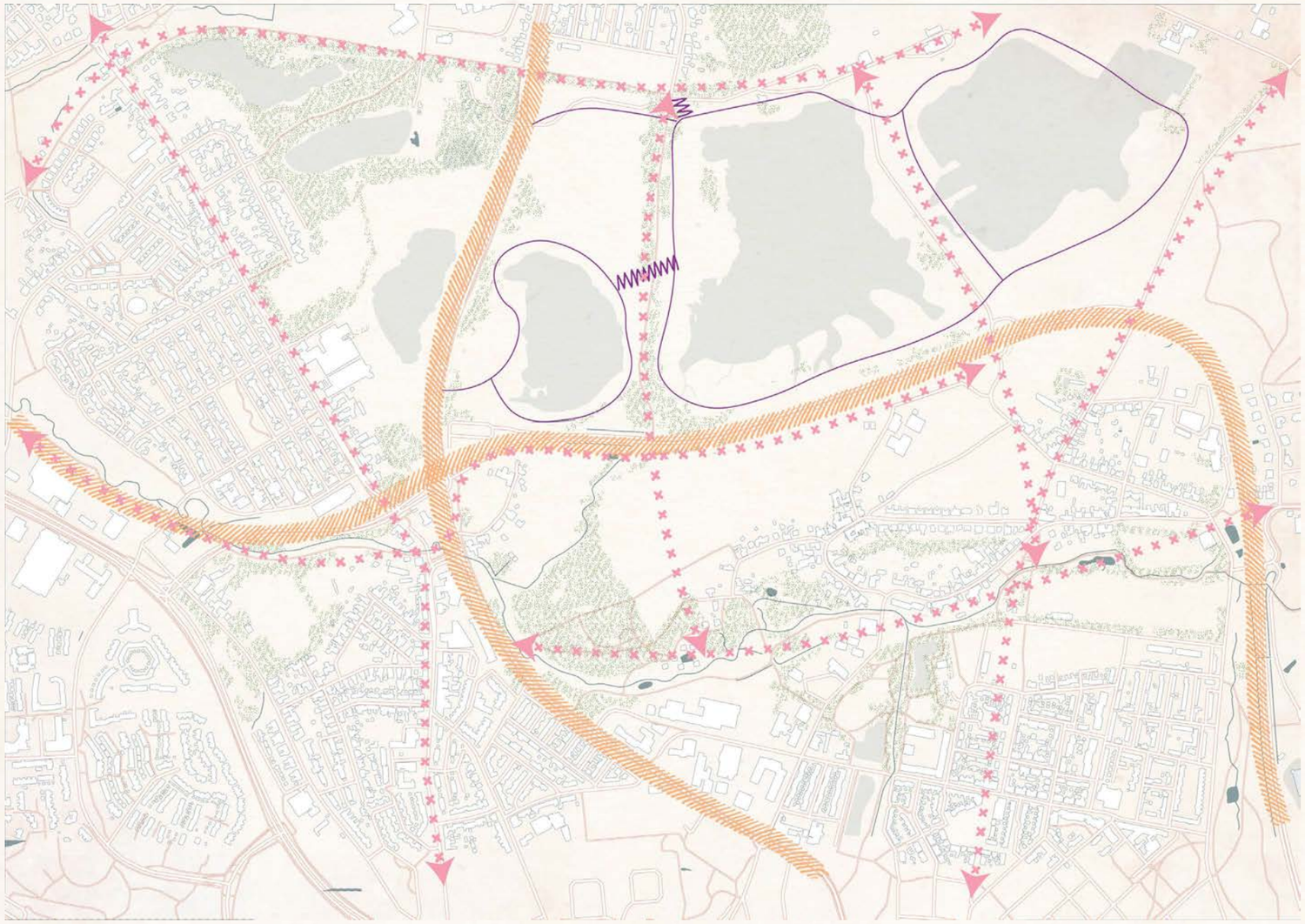
Phasing plans
delivered
furnished / ready for delivery
mining ended
wet extraction
dry extraction
mining has not yet begun
factory zone / process pond / sand storage
peel mine stone mountain; unstoppable zone

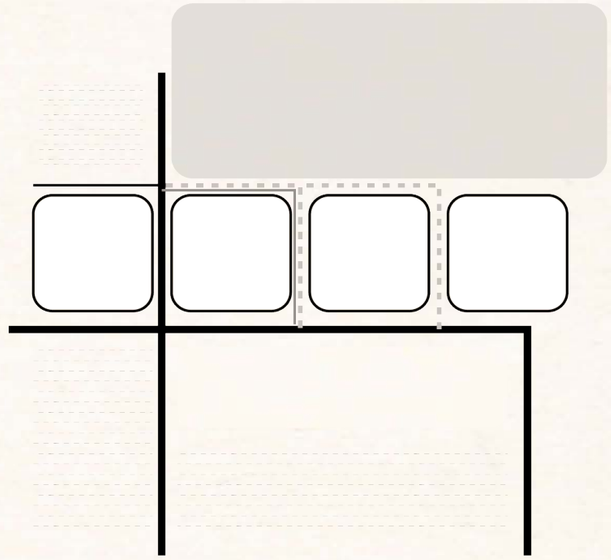
Approach 1: Accessibility dedign

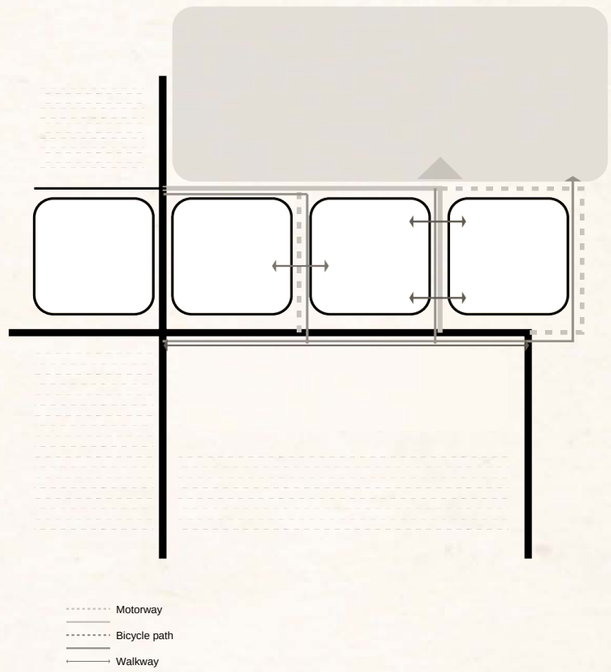
Approach 1: Accessibility dedign

Approach 1: Accessibility dedign

Approach 1: Accessibility dedign







Ecological bicycle bridge





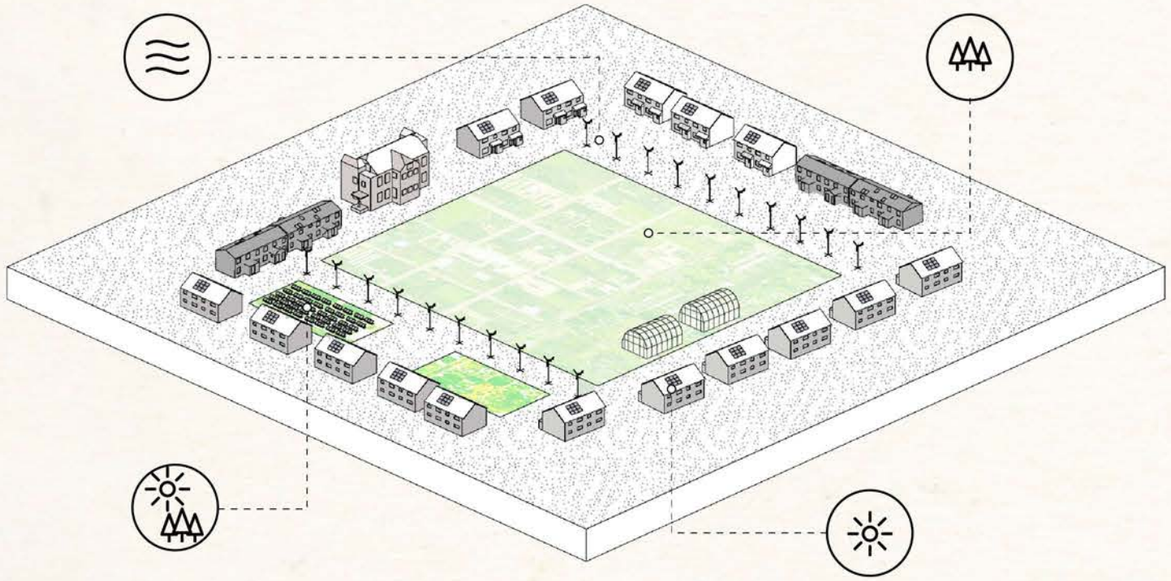
Approach 2: Axes

1. Social axis

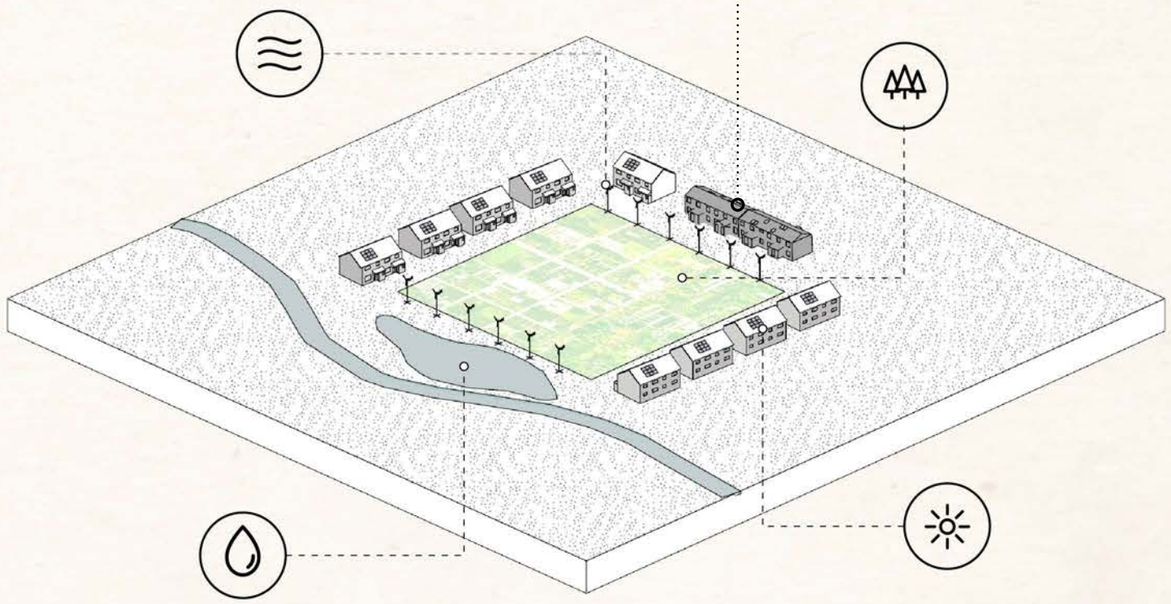
0 100 200 m

Approach 2: Axes

1. Social axis -- community garden



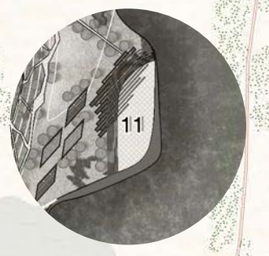






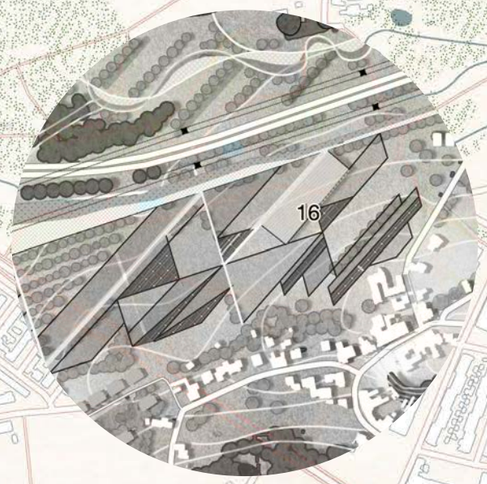
Approach 2: Axes

2. Integrated energy landscape axis









Approach 2: Axes

2. Integrated energy landscape axis --abstracting elements

SOLARB



IOMASS



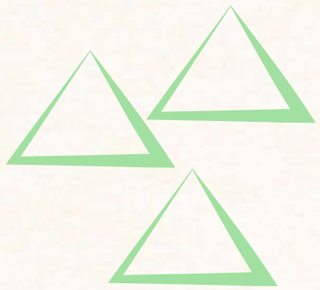
WIND

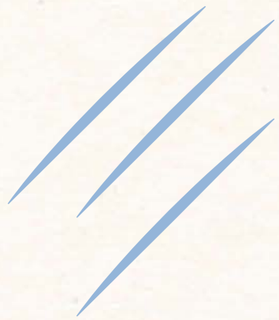


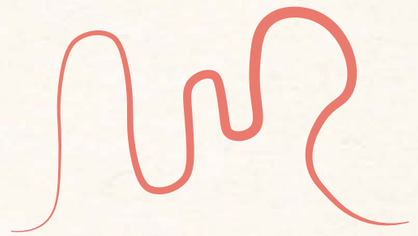
GEOTHERMAL

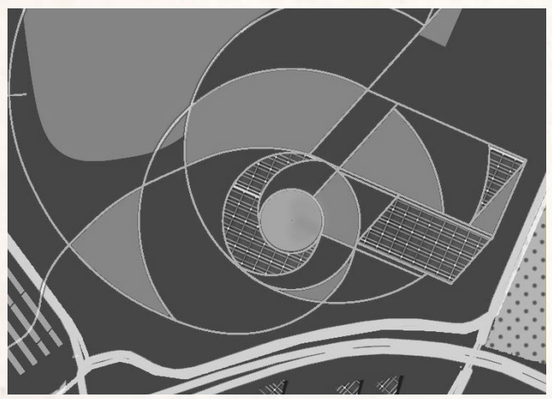




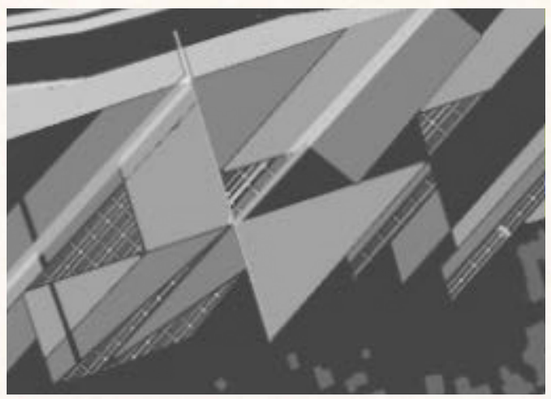


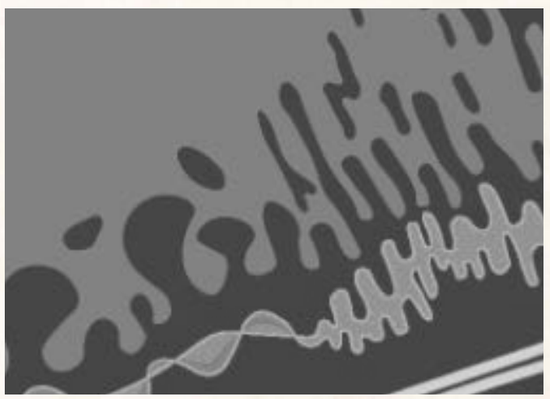








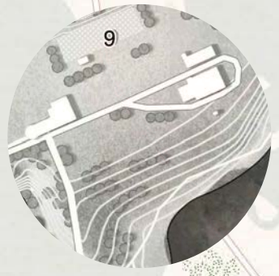


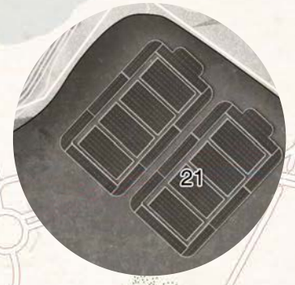


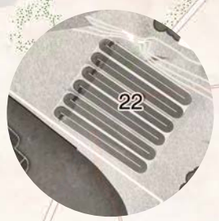
Approach 2: Axes

3. Energy generation axis







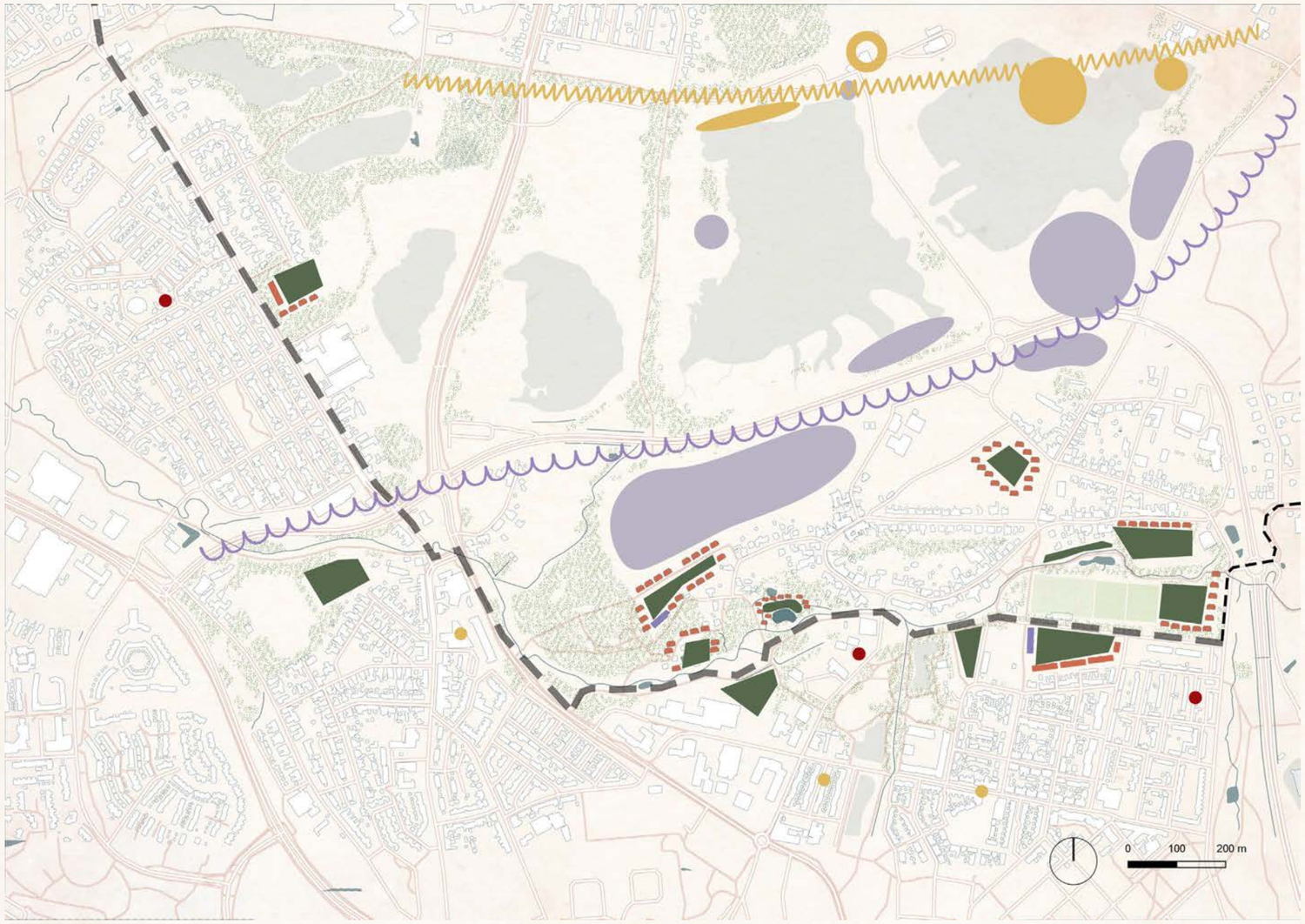


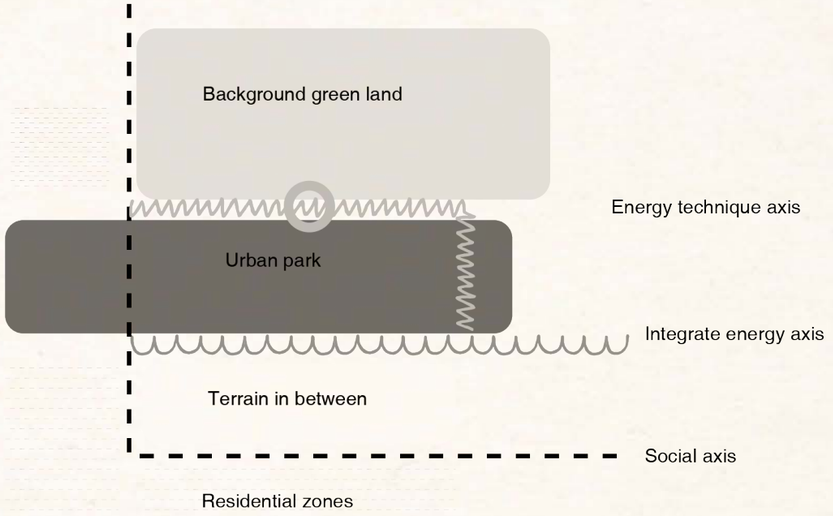
Approach 2: Axes

3. Energy generation axis

Approach 2: Axes

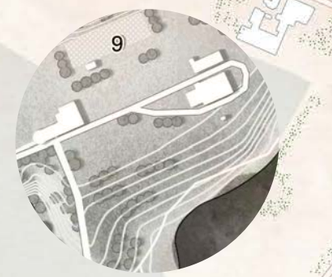
Three axes scheme





Approach 3: Landscape elements

Landmarks





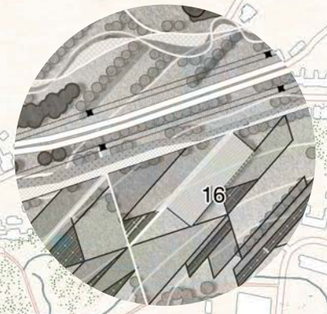


Approach 3: Landscape elements

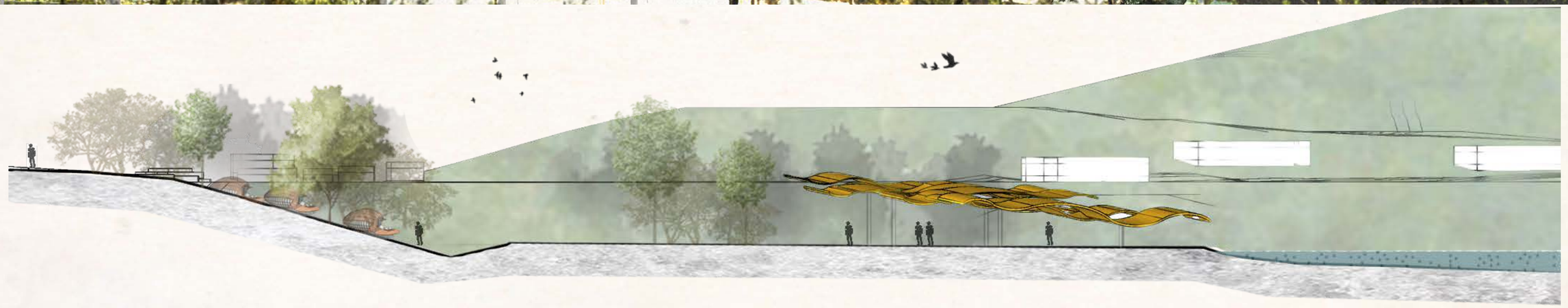
Night acctractions













Energy crops and solar panel
Bike lane

Master plan



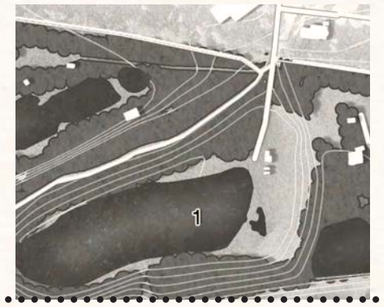
Legend

1. Protected natural area
2. Agricultural area
3. Energy crops
4. Geothermal hot spring pool & sauna
5. Camping area
6. New ecological residences (nursing house)
7. New holiday houses
8. Expanded camper areas
9. Eco parking lots
10. Lane in forest and forest cabin
11. Open air theather and solar panel pavilion
12. The pier
13. Orchard
14. Bird island and fishpond
15. Energy museum
16. Green house
17. Community garden
18. Curvy footpath &wetland & micro wind turbine
19. Solar panel-- the earth art
20. The Slopes
21. Floating solar panel
22. Algae farming

0 100 200 m

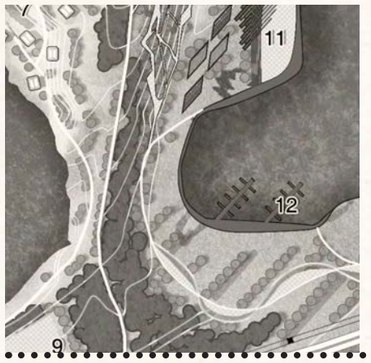
Plant configuration

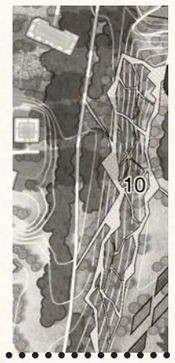


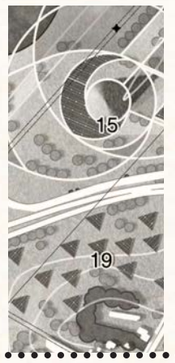


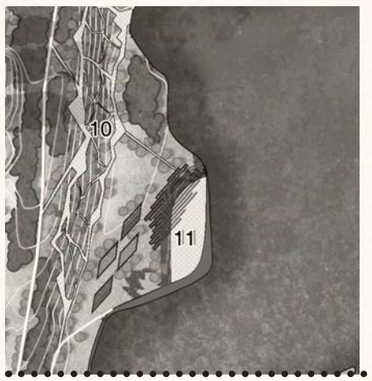






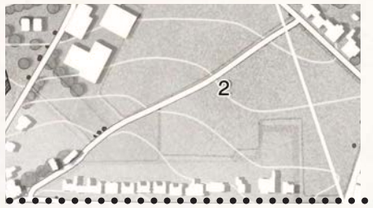


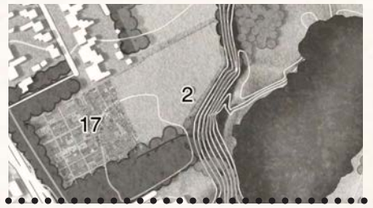




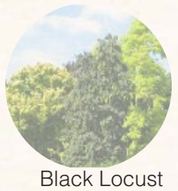








Trees



Black Locust



Common Alder



Common Ash



Common Linden



Common maple



European beech



Lombardy Poplar



White Birch

Shrubs



Common Barberry



European Mountainash



Bird Cherry

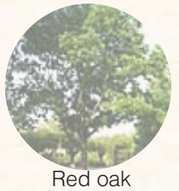
Threes in parks or along roads



Dutch Elm



European Filbert



Red oak



White Willow

Herbage



Arabis



chrysanthemum



dandelion



Wetland plants



Pennisetum alopecuraides



Vetiveria zizanioide



Agrostis capillaris



Typha latifolia

Agricultural plants



Carrot



Tomato



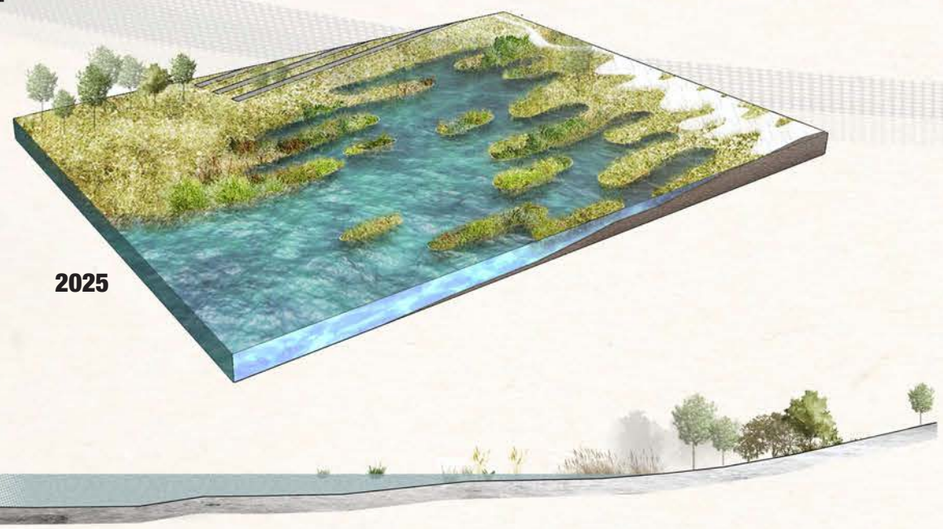
Maize



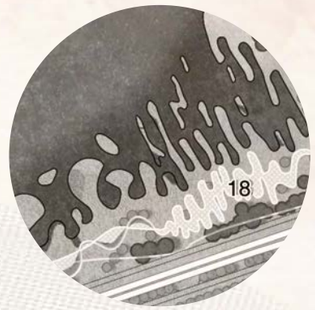
Raspberry

Time plan

Example: wetland

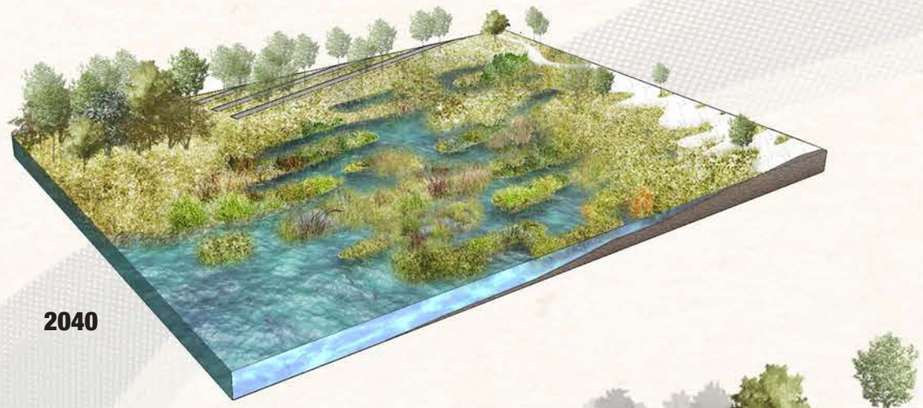


2025





2030



2040



Energy capacity analysis

Statistics

Type	Quntity	comsumption
House	378	470,548 kwh/yr
Company	53	149,059 kwh/yr
Total	610,607 kwh/yr	



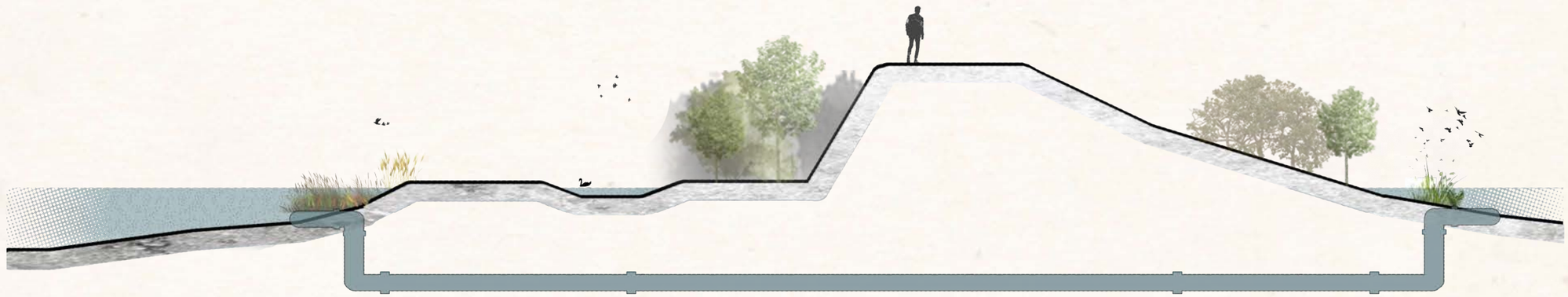
Energy capacity analysis

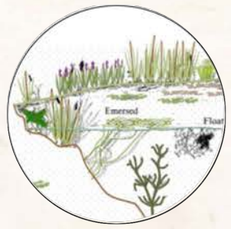
Statistics

Energy type	category	Quantity/unit		value	Quantity PJ/year（in 5 years）	Quantity PJ/yearh（in 10 years)	Quantity PJ/yearh (in 20 years) 100%
Solar	floating	26,300 m²		0.0054 PJ/ha/yr	0%	0%	0.014202
	roof	975 m²	15% heater	0.0126 PJ/ha/yr	50%	100%	0.00078975
			85% photovoltaic	0.0054 PJ/ha/yr			0.000447525
	land	27,760 m²		0.0054 PJ/ha/yr	30%	60%	0.0149904
Biomass	livestock manue (1000)	138000 m²		23 MJ/m³	20%	65%	0.003174
	forest	40,000 m²		37.05 GJ/ha	60%	85%	0.0001482
	energy crop	61230 m²		100 GJ/ha	15%	45%	0.0006123
	other arable land	57,700 m²		60 GJ/ha	80%	100%	0.0003462
	algae farming	280 m²	691.895kg	37 MJ/kg	0%	100%	0.0000256
Geothermal	cold heat storage	36,900 m²		1,3 TJ/ha/yr	50%	50%	0.0048
wind	wind turbine	-		-	-	-	-
Total	0.034735975 PJ/yr = 10,982,215 kWh/yr						

Site energy capacity:10,982,215 Kwh/yr
Surrounding building consumption: 619,607 kWh/yr
Heerlen demand: 8.35 PJ/yr
Parkstad demand: 20.37 PJ/yr

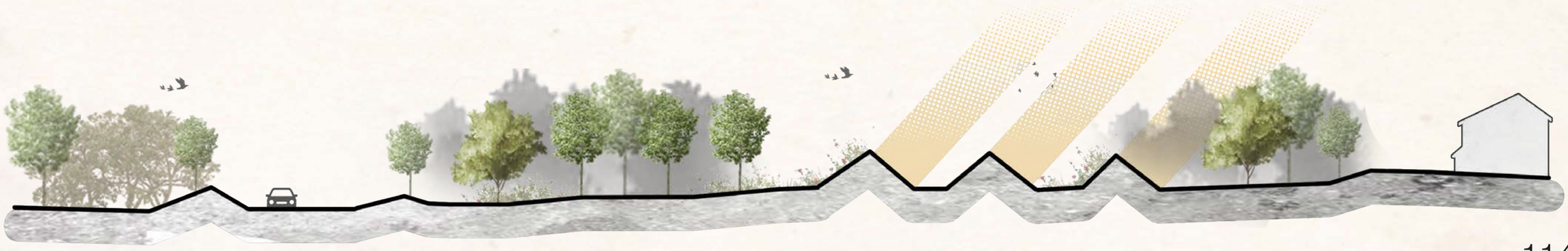

14°



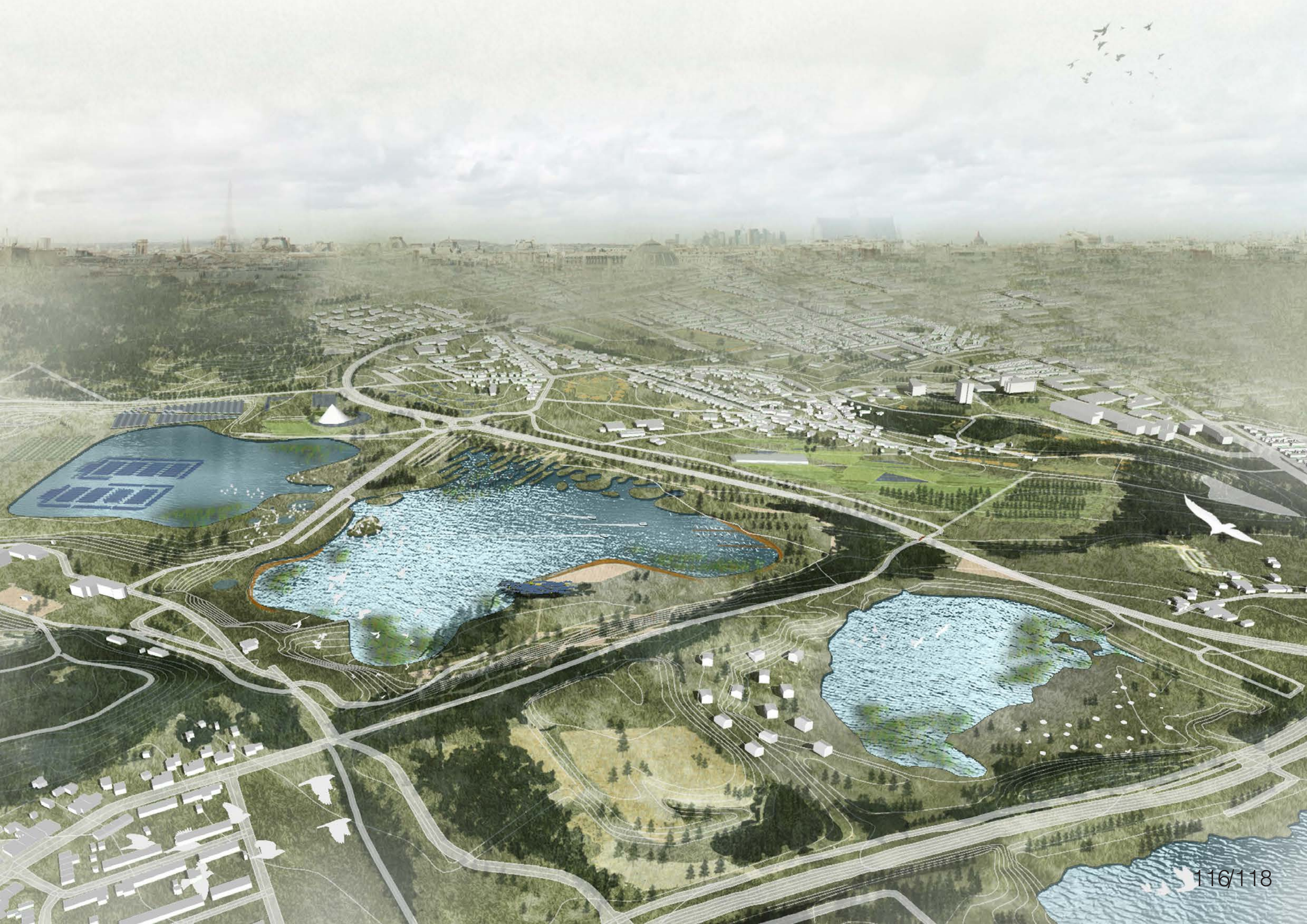

Emersed
Float




20




4




LANDSCAPE GRID
ENERGY POTENTIAL
ENERGY-CONSCIOUS
LANDSCAPE
COMMUNITY GARDEN
SOCIAL
ENERGY CIRCULATION FLOW
WIND
LANDSCAPE GRID
BIOMASS
ENERGY PARK
RECREATIONAL
SYNERGIES
ECOLOGICAL
SOLAR
TRADE-OFF
ENERGY
SPATIAL COMPOSITION
GEOTHERMAL
INTEGRATED ENERGY LANDSCAPE

Thank you!