Zutphen Roadshow

The Boss
Craig Martin

Carbon Pacman
Riccardo Pulselli

Energy nerds
Andy van den Dobbelsteen
Siebe Broersma
Leo Gommans
Michiel Fremouw

Designer of all
Greg Keeffe → **Craig Martin**

Student Operation Support
Nikoletta Dimitriou
Franziska Mack

Carbon challenge

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Riccardo M. Pulselli
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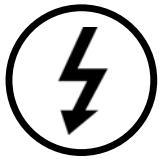
UNIVERSITÀ DEGLI STUDI FIRENZE
DIDA DIPARTIMENTO DI ARCHITETTURA
TU Delft



Electricity: 2400 kWh /yr

appliances & light

space cooling

Fuel: 11000 kWh /yr

space heating

water heating

cooking

Mobility: 14000 km /yr

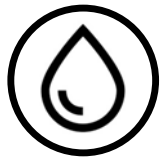
private car use

n.1.4 cars per house

Waste: 1200 kg /house yr

77% recycled and composted

23% waste to energy



Water: 100 m3 /house yr

Food consumption

Meat plus

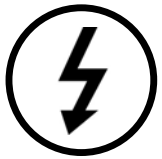
Food industry

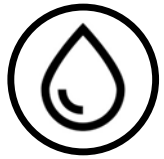
Food supply

HOUSEHOLD
CARBON SOURCES

2.17 PEOPLE/HOUSE

MISSING DATA





Electricity: 1100 kg CO_2eq — 10%

Fuel: 2700 kg CO_2eq — 25%

Mobility: 2400 kg CO_2eq — 22%

Waste: 200 kg CO_2eq — 2%

Water: 60 kg CO_2eq — 1%

4200 kg CO_2eq — 39%

HOUSEHOLD CARBON FOOTPRINT

10.6

t CO_2eq

HOUSEHOLD
CARBON FOOTPRINT

10.6 t CO_2eq

1.56 hectares

2.3 football fields

Pulselli et al."Carbon accounting framework for decarbonisation of European city neighbourhoods". Journal of Cleaner Production 208 (2018) 850-868.

Municipality of Zutphen

47934 inhabitants 2019

22045 households (2.17 people/house)

52,500 MWh households electricity

236,000 MWh households natural gas

154,800 MWh other electricity

111,000 MWh other natural gas

164,000 MWh private car use

45,600 MWh other transport

26,172 t waste

2779320 m3 water

Municipality of Zutphen

24,150 t CO_2eq households electricity (7%)

59,500 t CO_2eq households natural gas (17%)

71,200 t CO_2eq other electricity (21%)

27,900 t CO_2eq other natural gas (8%)

46,200 t CO_2eq car use (14%)

12,800 t CO_2eq other transport (4%)

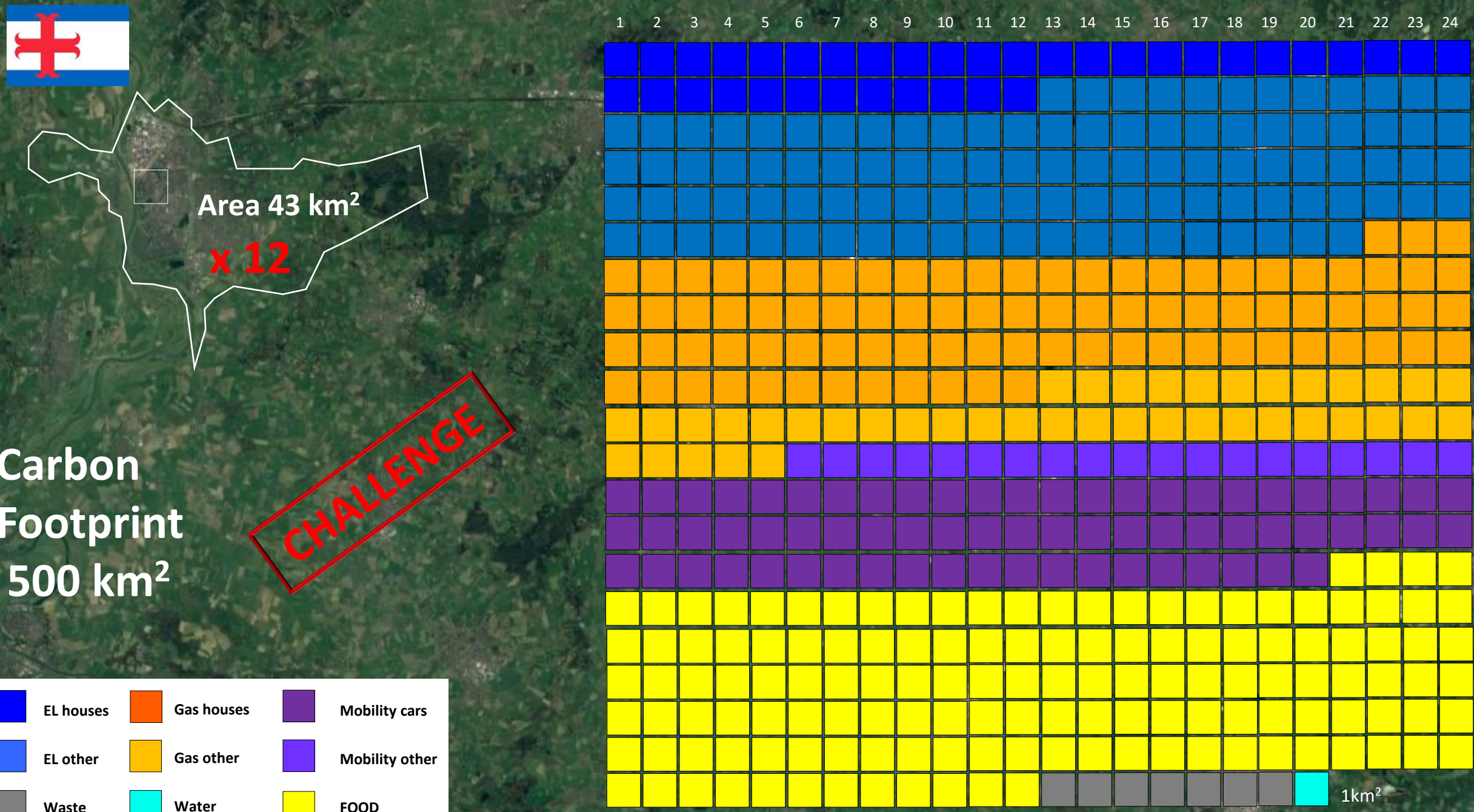
4700 t CO_2eq waste (1%)

1626 t CO_2eq m3 water (0%)

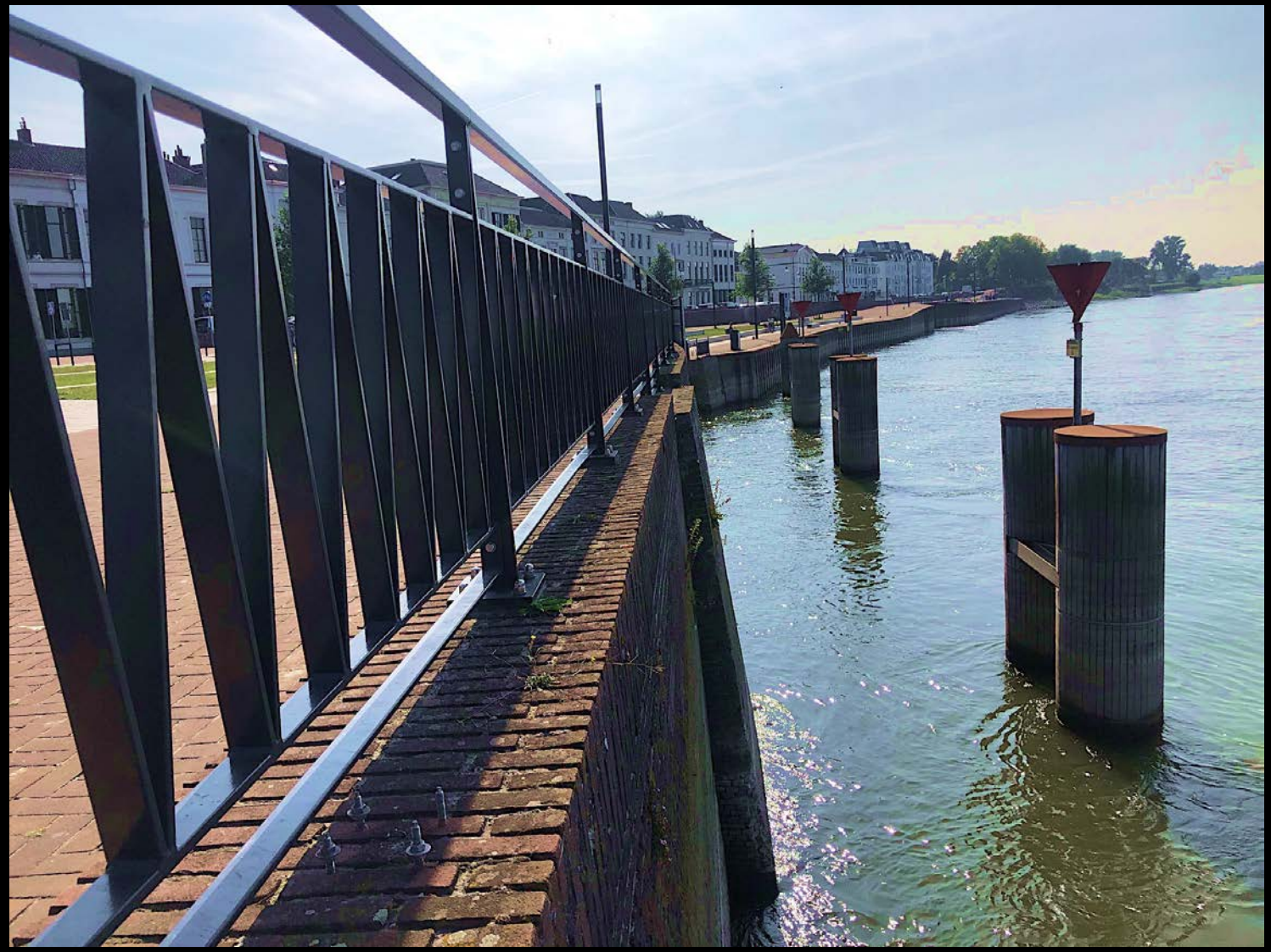
92,200 t CO_2eq FOOD (27%)

Municipality of Zutphen

340,000 t CO_2eq


Area 43 km²
x 12
CHALLENGE
Carbon Footprint 500 km²
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
1km²
EL houses
Gas houses
Mobility cars
EL other
Gas other
Mobility other
Waste
Water
FOOD

Energy strategy



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Own energy first ☺

- **Use your potential!**

NIEUWS DORPSRADEN EN BELANGENVERENIGINGEN VORMEN FRONT TEGEN GROOTSCHEEPSE PLANNEN

Lochemse kernen maken hun eigen energiestrategie

De dorpsraden en belangenverenigingen van Gorssel, Eefde, Barchem, Laren, Harfsen en Exel hebben één front gevormd tegen het onwerp van de Regionale Energie Strategie. Het gemeentebestuur van Lochem legt dit plan vanavond aan de raad voor. Het nieuwe collectief stelt echter dat ze vanuit de dorpskernen zelf plannen wil maken om op lokaal niveau energieneutraal worden.

Sander Zurhake
Lochem

Jan Koolschijn, namens de Belangenvereniging Exel en Omstreken de initiatiefnemer van het samenwerkingsverband, stelt dat mensen 'zonder dictaten vanuit Den Haag of de gemeenteraad van Lochem' invloed willen hebben op de energietransitie.

De wens voor deze vorm van controle is een reactie op de door de gemeente georganiseerde digitale inspreekavonden over de Regionale Energie Strategie. Die gaven menig Lochemer een ontevreden gevoel. Kritiek en zorgen 'zouden worden meegenomen' in de plannen, aldus de gemeente. Maar hoe dat zou gebeuren bleef voor inwoners onduidelijk.

Daarom hebben de besturen van negen dorpsraden en belangengroepen van bewoners van de Lochemse kernen besloten om intensief samen te gaan werken. Wanneer het gaat om de energietransitie willen ze eensgezind hun geluid laten horen richting de Lochemse politiek. Op deze manier willen ze de stem van Lochemse inwoners meer gewicht geven.

„Met de huidige handelswijze doet de politiek, het bestuur zichzelf en haar betrokken inwoners tekort", vindt Koolschijn. „Gemotiveerde inwoners zijn professioneel en innovatief en hebben belang bij een goede verduurzaming van hun leefomgeving. Beknot dat niet als gemeente maar maak er gebruik van."

Dus bepleit niet bij voorbaat om torenhoge windturbines of uitgestrekte zonneparken in het buitengebied van Lochem te plaatsen. „Onderzoek nou eens goed wat de energiebehoefte is per dorpskern", zegt Koolschijn. „Maak vervolgens een plan om die energie lokaal klimaatneutraal op te wekken. Dus goed huizen isoleren, zon op dak en met kleine windmolens. Wij zijn niet tegen de energietransitie, integendeel, het moet alleen anders worden georganiseerd."

Rundermest

Daarnaast pleiten de samenwerkende bewonersgroepen ervoor om naar andere energiebronnen te kijken. Bijvoorbeeld via vergisting van rundermest. Koolschijn: „Tijdens onze eerste bijeenkomst werd mij geleerd dat één koe via vergisting 5600 kilowatt kan opwekken per jaar. We hebben behoorlijk wat koeien in de Achterhoek staan. Betrek de boeren erbij."

In Larense Broek is de stichting Buurtbelangen Larensebroek al een eind op weg met onderzoek voor een zogeheten Buurt Energie Strategie (BES). Dit is een plan dat in overleg en door inwoners zelf wordt gemaakt om groene energie op te wekken zonder dat het natuurlijk schoon van Lochem geweld wordt aangedaan.

„Eigenlijk zou elk dorp in Lochem dit moeten doen. Er zit zoveel innovatieve kracht in elke kern met dat echte noaberschap en een mentaliteit van zelf schouders eronder zetten", zegt Koolschijn. „Maar dan moet je dat als gemeente wel de ruimte durven geven."

Eigen gebruik

Vandaag is de eerste informatieavond over het ontwerp van de RES in de Lochemse gemeenteraad. Burgers mogen hun visie geven. De vertegenwoordigers van dorpsraden en belangenorganisaties zullen dan ook het woord voeren. „Geen van ons is voor grootschalige opwek van wind en zon, we willen slechts lokaal opwekken voor eigen gebruik", aldus Koolschijn. „Dus op een warm onthaal hoeft deze RES niet te rekenen."

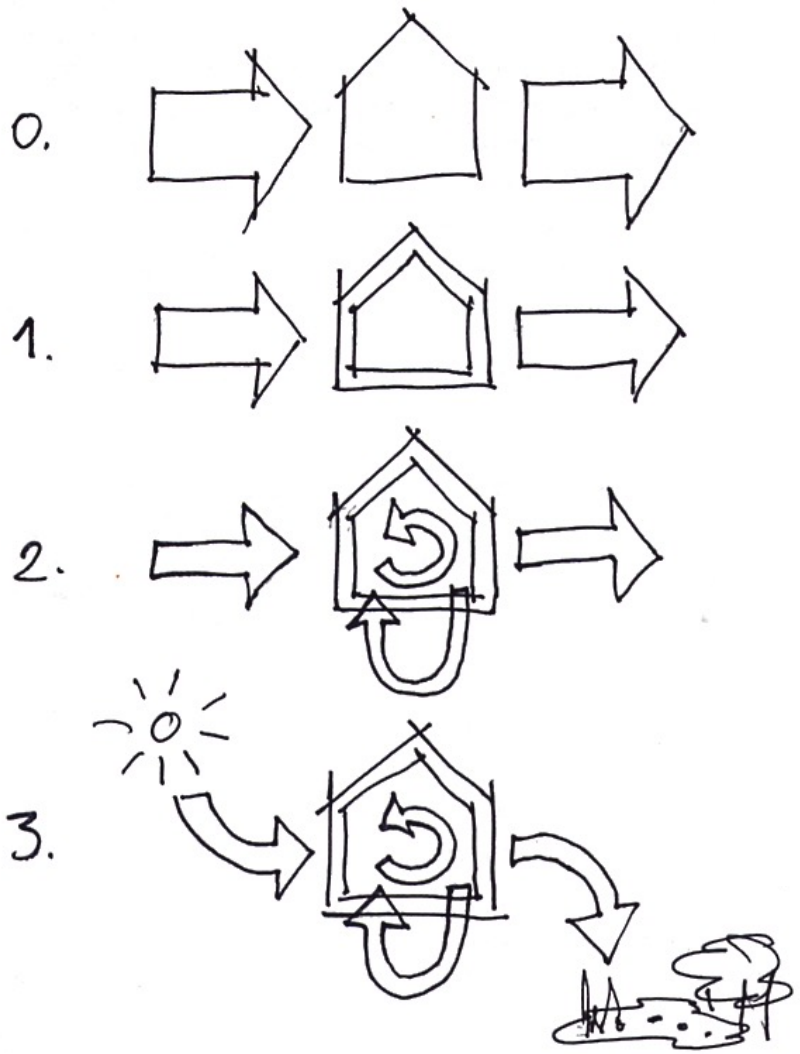
▲ **Jan Koolschijn staat bij de boerderij van Herbert Kupper. Hoe deze boer in Lochem vele zonnepanelen op zijn schuur heeft geplaatst vindt Koolschijn een goed voorbeeld van hoe je groene stroom kunt opwekken zonder het landschap te verpesten.** FOTO JEROEN JAZET

'Grootschalige opwek is noodzakelijk'

„Het college ondersteunt Buurtenergiestrategieën (BES) van harte", reageert wethouder Henk van Zeijts. „Zo betalen we mee aan de BES in het Larense Broek. We zijn ook bereid dat in andere buurten te doen. Maar die buurten zouden ook serieus moeten kijken naar grootschalige opwek. Anders gaat het te langzaam met de aanpak van het klimaatprobleem. We hebben te maken met een klimaatcrisis. Om die op te lossen is grootschalige opwek van elektriciteit uit wind en zon noodzakelijk, ook op land."

Van Zeijts vindt 'het begrijpelijk en nodig' dat het ontwerp van de RES reacties van inwoners oplevert. „Overigens is deze collectieve reactie van bewonersgroepen nog niet bij de gemeente bekend. Ik ben altijd bereid het gesprek aan te gaan."

Our energy approach: the New Stepped Strategy



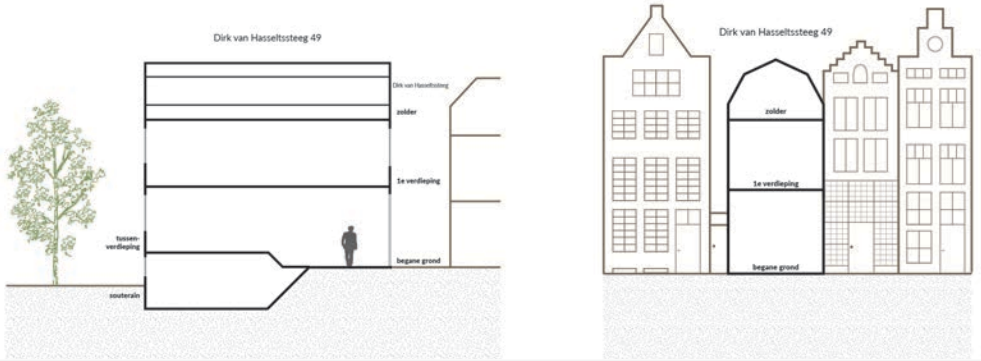
0 research: **study the local characteristics**

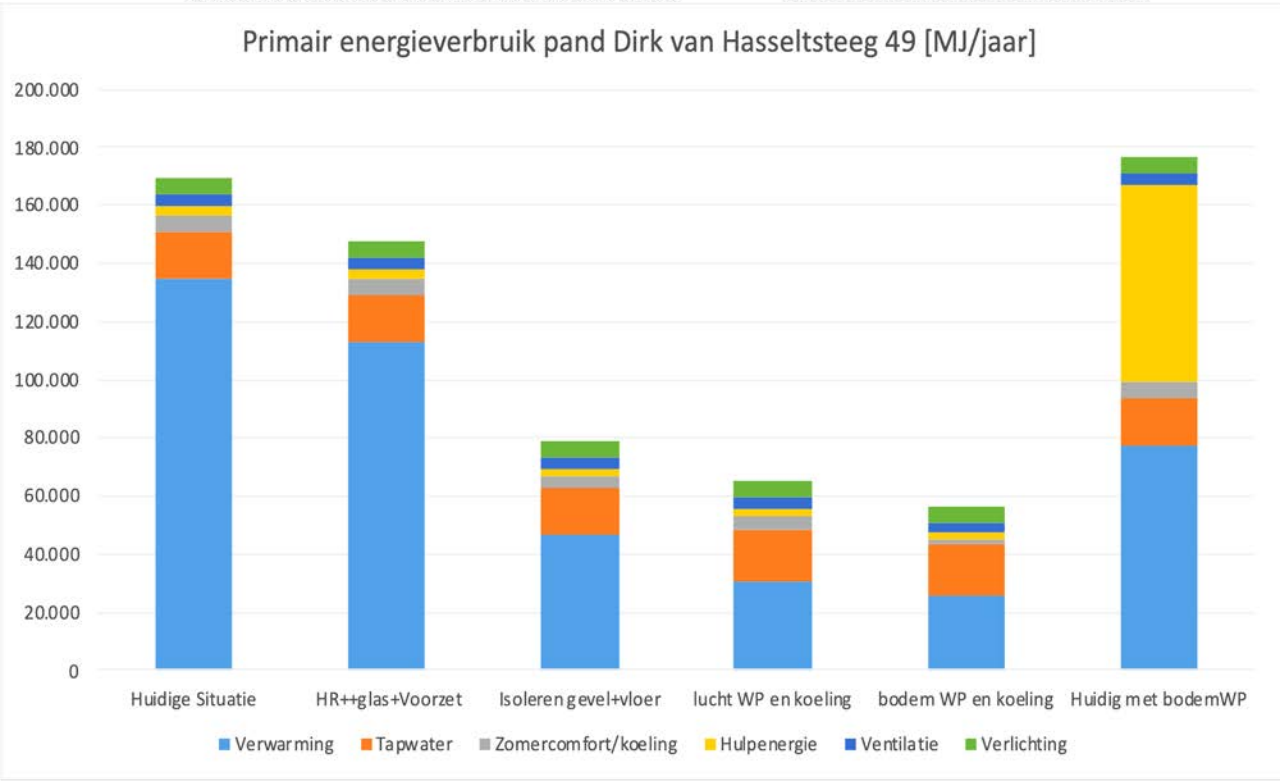
1 reduce: **reduce the demand**
- passive, smart bioclimatic design

2 reuse: **use residual flows**
- waste water, waste material, waste heat
- in closed or connected cycles

3 produce: **generate renewable energy**

Renovating monuments





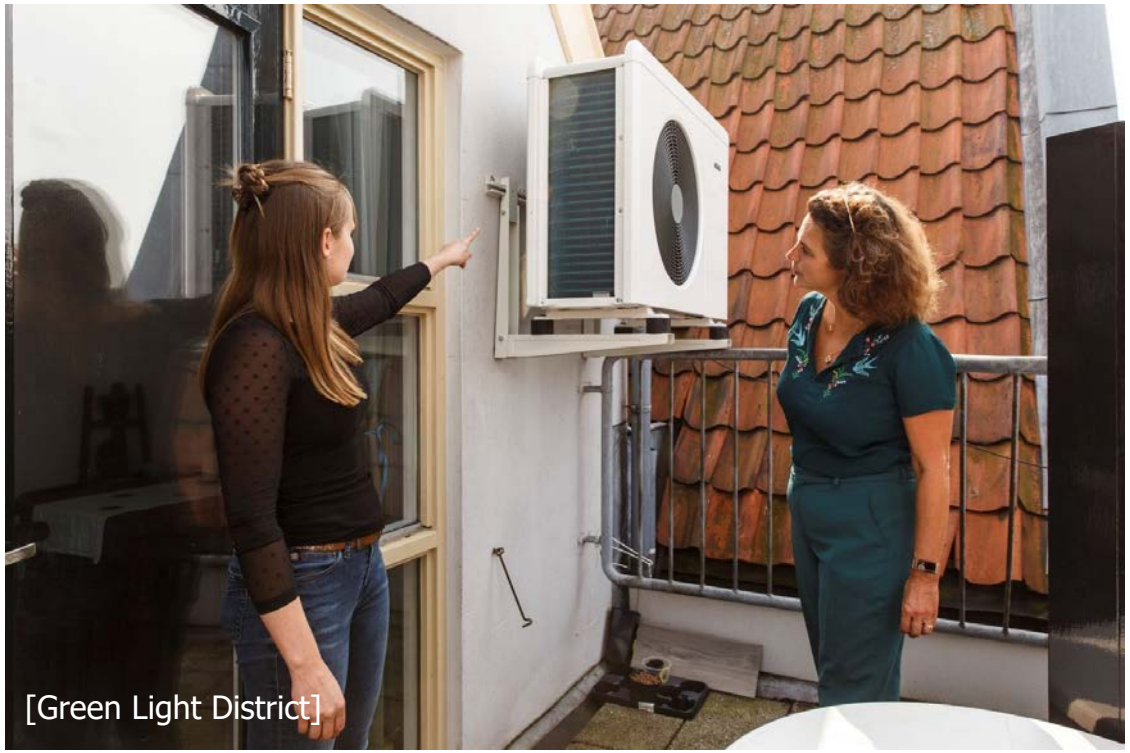
GREEN LIGHT DISTRICT AMSTERDAM

eit Climate-KIC

Climate-KIC is supported by the EIT, a body of the European Union

Individual solutions for monumental buildings

Air heat pump or infrared panels (+ thermal insulation)



[Green Light District]

[OneWorld]

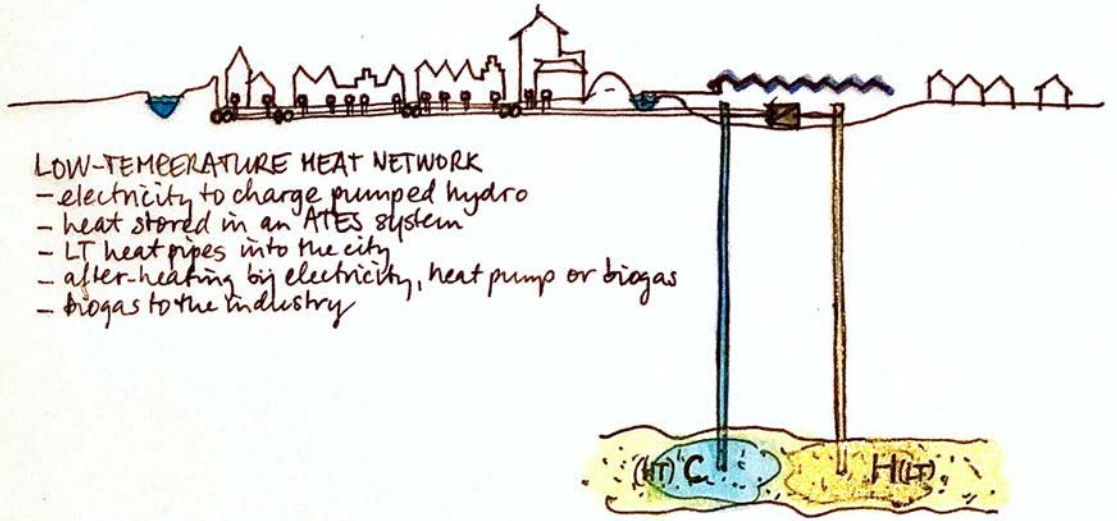
Climate-KIC is supported by the EIT, a body of the European Union

Beautiful heritage of Zutphen

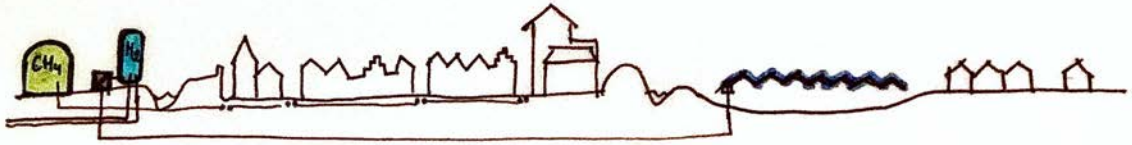
Not all heritage buildings are monumental

3 main solutions for the old town of Zutphen

HIGH-TEMPERATURE HEAT NETWORK
- electricity to charge the HT heat
- heat stored in a BTES system
- HT heat pipes into the city, no after-heating
- biogas to the industry

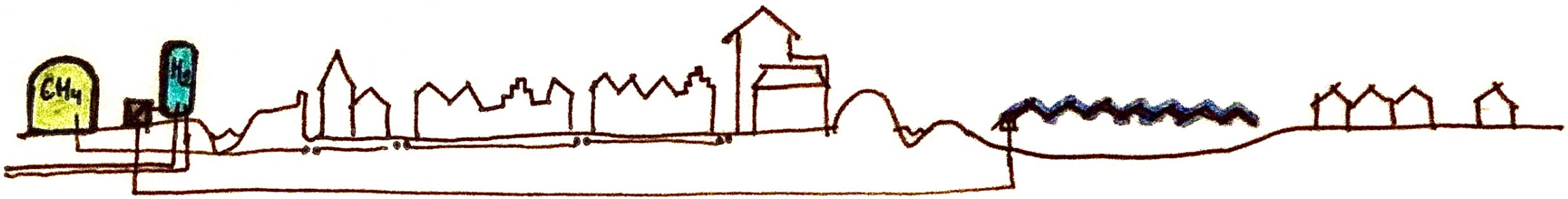


LOW-TEMPERATURE HEAT NETWORK
- electricity to charge pumped hydro
- heat stored in an ATES system
- LT heat pipes into the city
- after-heating by electricity, heat pump or biogas
- biogas to the industry



BIOGAS SYSTEM + HYDROGEN
- electricity to generate hydrogen
- hydrogen to the industry
- biogas to the city
- gas stored in tanks

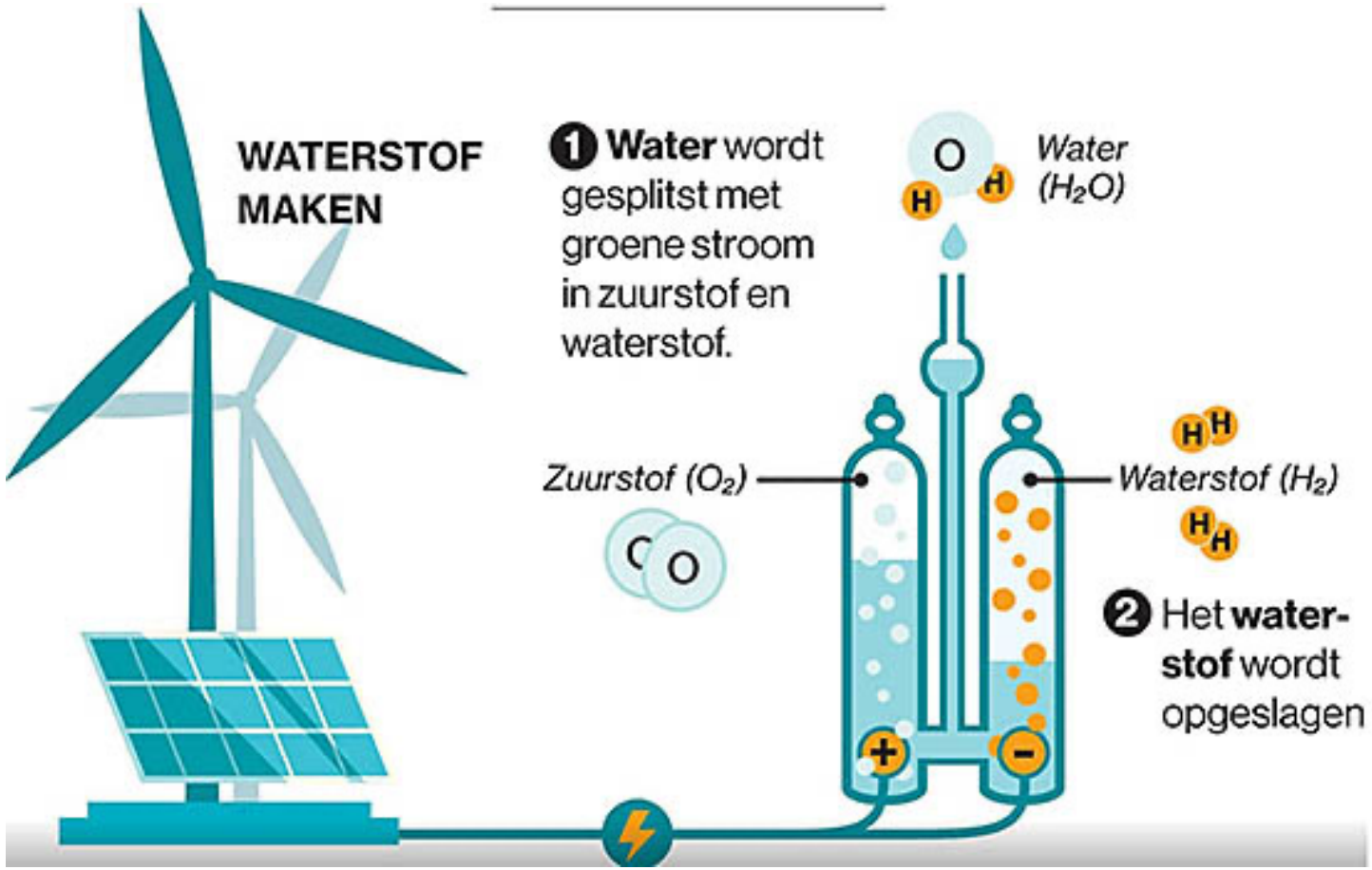
Inner city solution: **biogas + hydrogen**

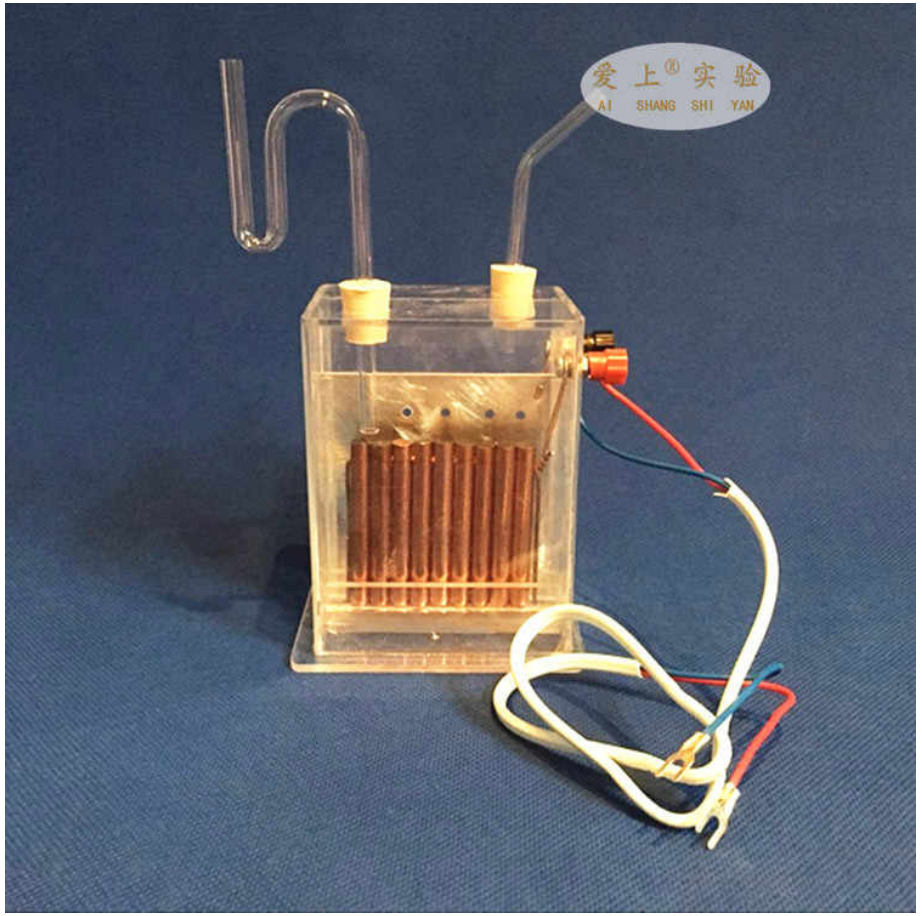


- BIOGAS SYSTEM + HYDROGEN
  - electricity to generate hydrogen
  - hydrogen to the industry
  - biogas to the city
  - gas stored in tanks

H_2: from electricity to hydrogen

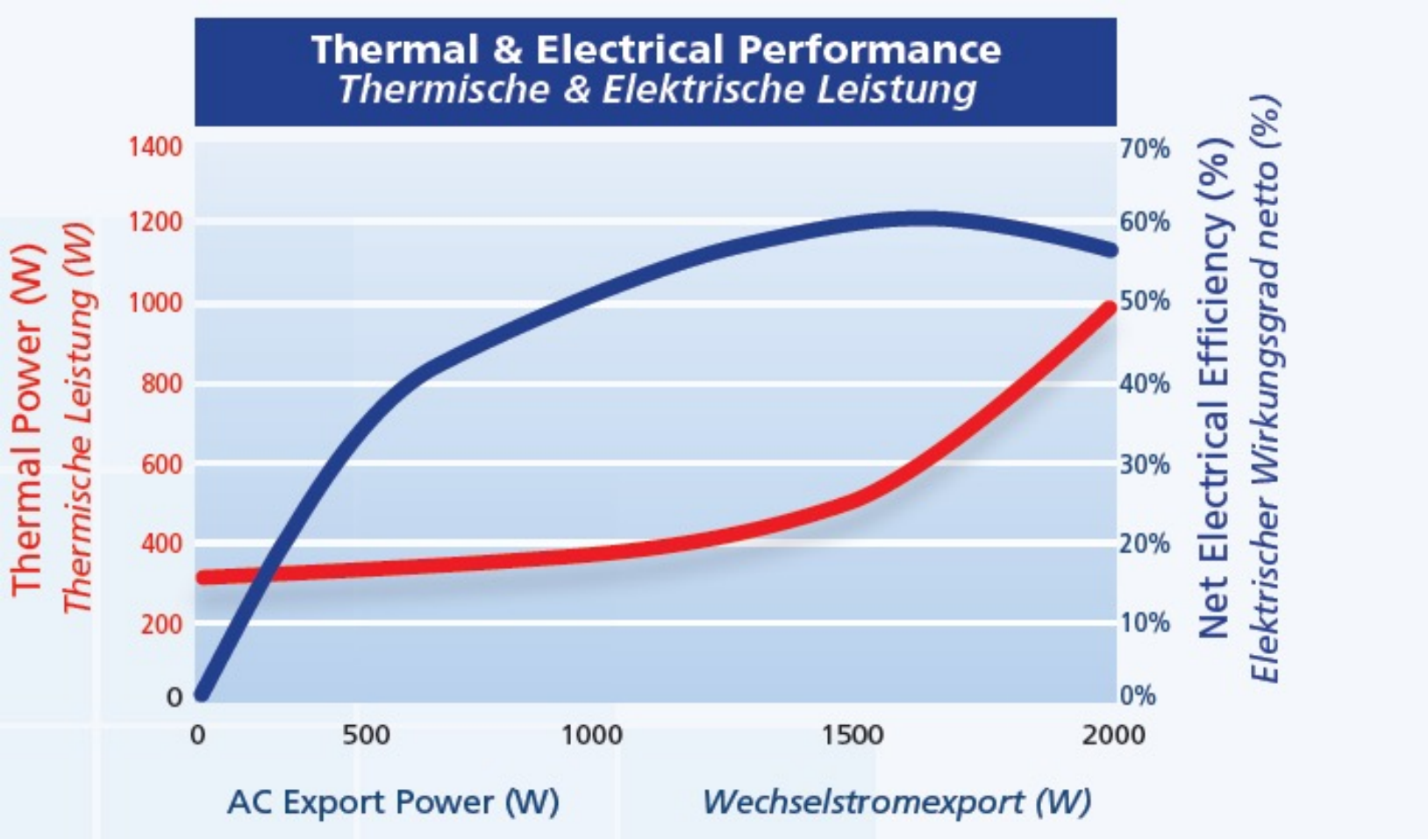
Electrolysis: electricity → 70% hydrogen + 20% heat of ?°C





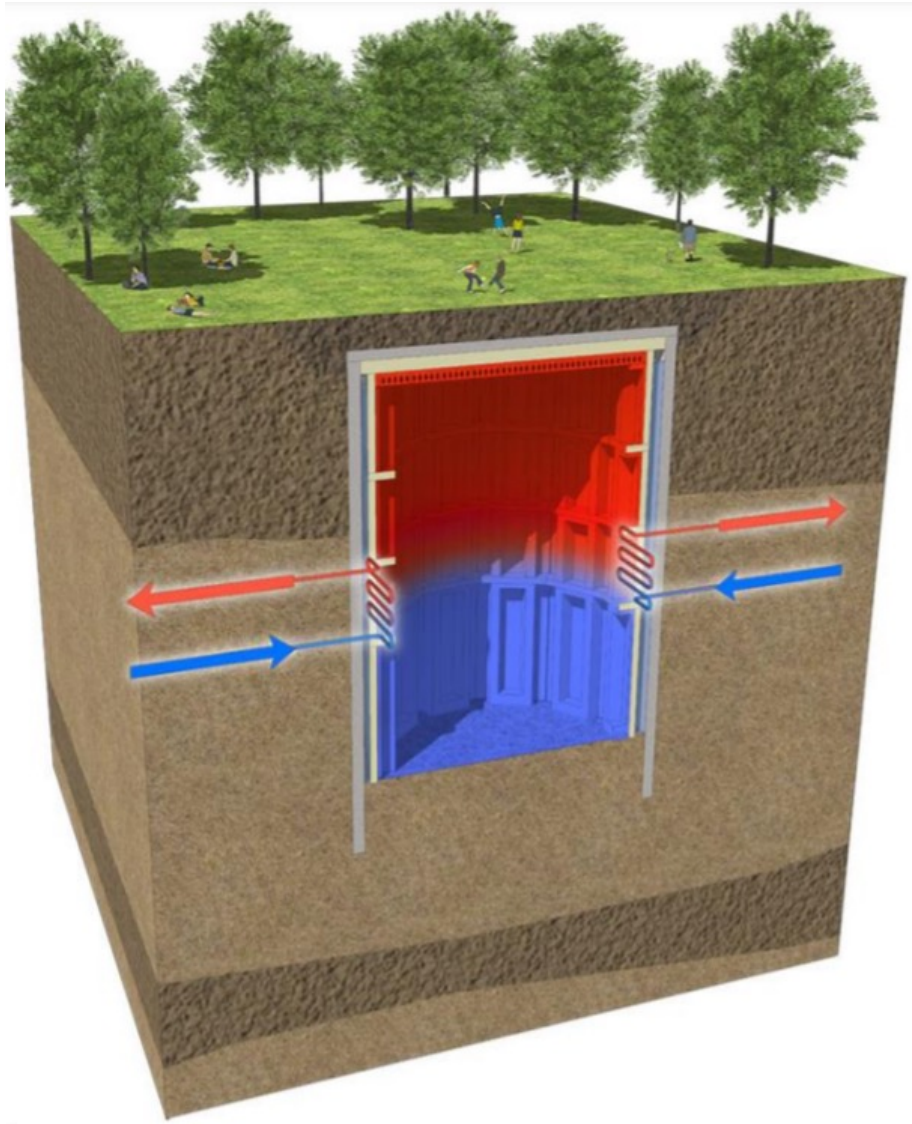
H_2: from hydrogen to electricity

Fuel cell (brandstofcel): hydrogen → 70% electricity + 30% heat of 90°C



H_2: Seasonal storage

Storage of hydrogen or heat of 90°C



Efficiency of hydrogen

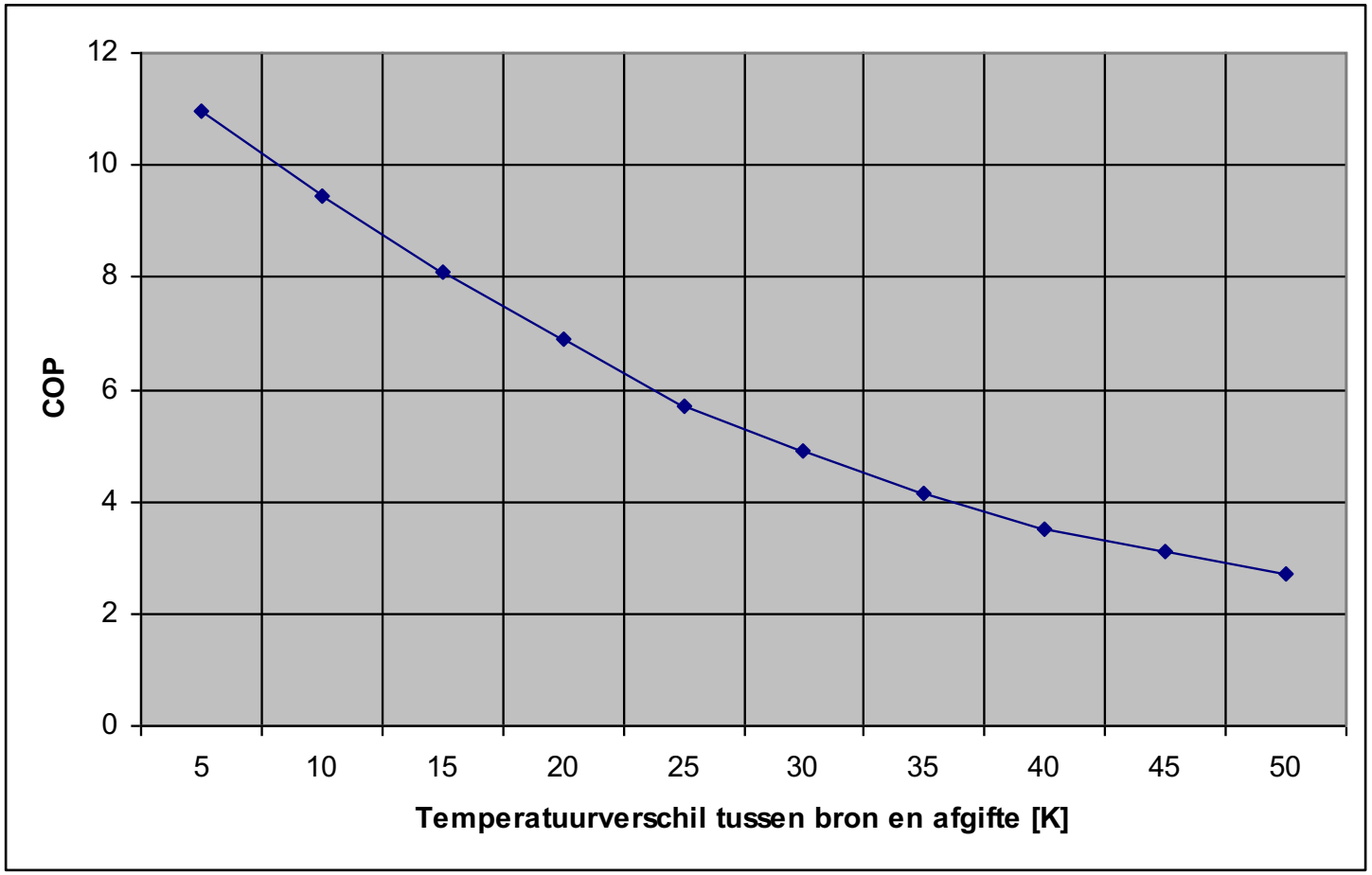
From sustainable electricity to hydrogen gas for heating houses efficiency = **47%**

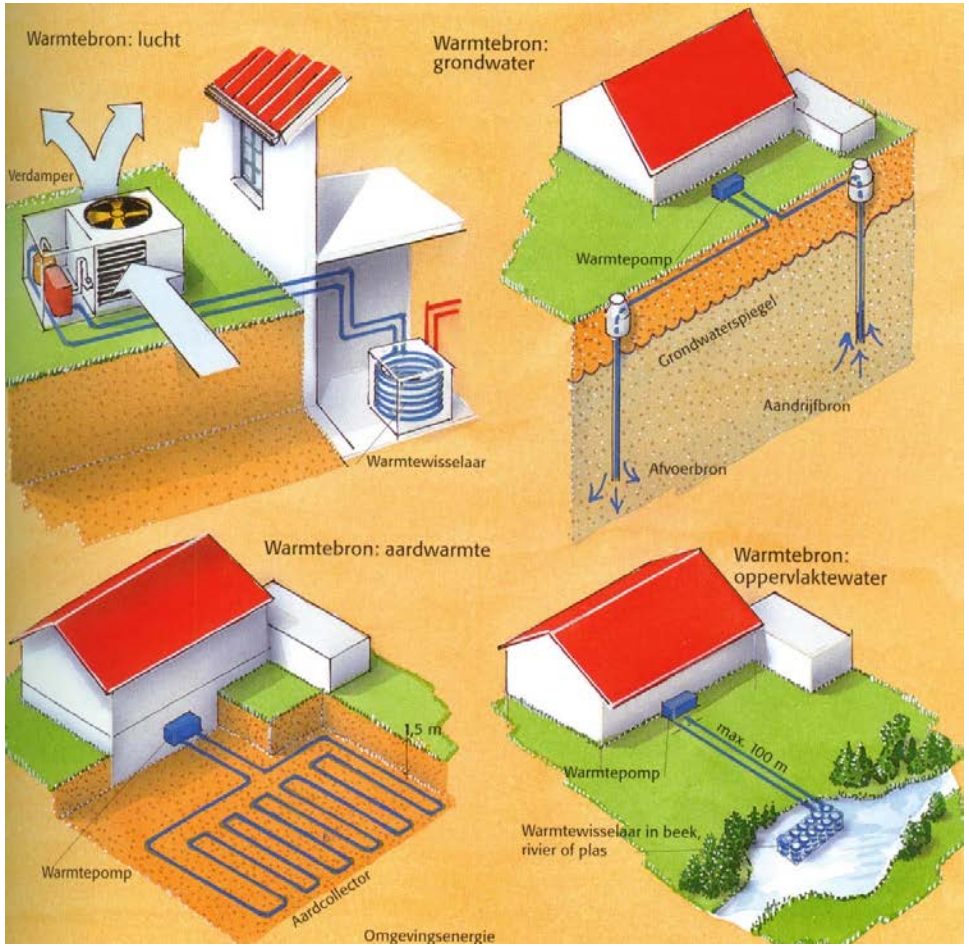
WATERSTOF IN HR-WATERSTOFKETEL (OPTIMISTISCH IN 2020)

Energieketen Van opwek naar gebruik	**Opwek** Duurzame elektriciteit	**Transport elektronen** Per kabel naar land	**Waterstof productie** Centraal, grootschalig middels water-elektrolyse aan land	**Comprimeren** Naar xx bar	**Transport H2 moleculen** Via bestaand hoge en middel druk gasnet	**Gebruik in woning** Met waterstof cv-ketel
Kenmerken/ aannames	• Wind park offshore met 4.700 vollasturen (54% van de tijd) en afstand <80 km van de kust • 1 turbine is 8 MW • Aanname geen curtailment (afschakeling turbine)	AC kabel Alternatieven: HV DC (3% verlies per 1.000 km) of H2-leiding	PEM-elektrolyse in 2020 bij 100% belasting	• Huidige gasnet van gasunie is 65 bar om zelfde hoeveelheid waterstof te transporteren is 3x hogere druk nodig dus circa 200 bar • Energie benodigd voor compressie is 2,5 kWh per kg waterstof.		Nieuw te ontwikkelen hr-ketel met waterstofbranders
Efficiency (verlies)	100% (0%)	98% (-2%)	73% (-27%)	93% (-7%)	95% (-2%)	85% (-15%)
Cumulatief	**100%**	**98%**	**71%**	**64%**	**62%**	**47%**

Heat pumps: using environmental heat

Heat pump: electricity → 400% heat of 60°C and cold of 12°C





Efficiency of heat pumps

From sustainable electricity to heat with an air based heat pump efficiency = 263%. That is 263 / 47 = 5.6 times better. With other sources even better (ground/PVT).

ELEKTRICITEIT IN LUCHTWARMTEPOMP (NU)

Energieketen van opwek naar gebruik	**Opwek** Duurzame elektriciteit	**Transport elektronen** Per kabel naar land			**Transport elektronen**	**Gebruik in woning** met warmtepomp
Kenmerken	Idem	Idem				Uitgaand van een Seasonal performance factor van 2,7. Warmte wordt uit de buitenlucht gehaald
Efficiency (verlies)	100% (0%)	98% (-2%)			95% (-5%)	270% (+170%)
Cumulatief	**100%**	**98%**			**93%**	**263%**

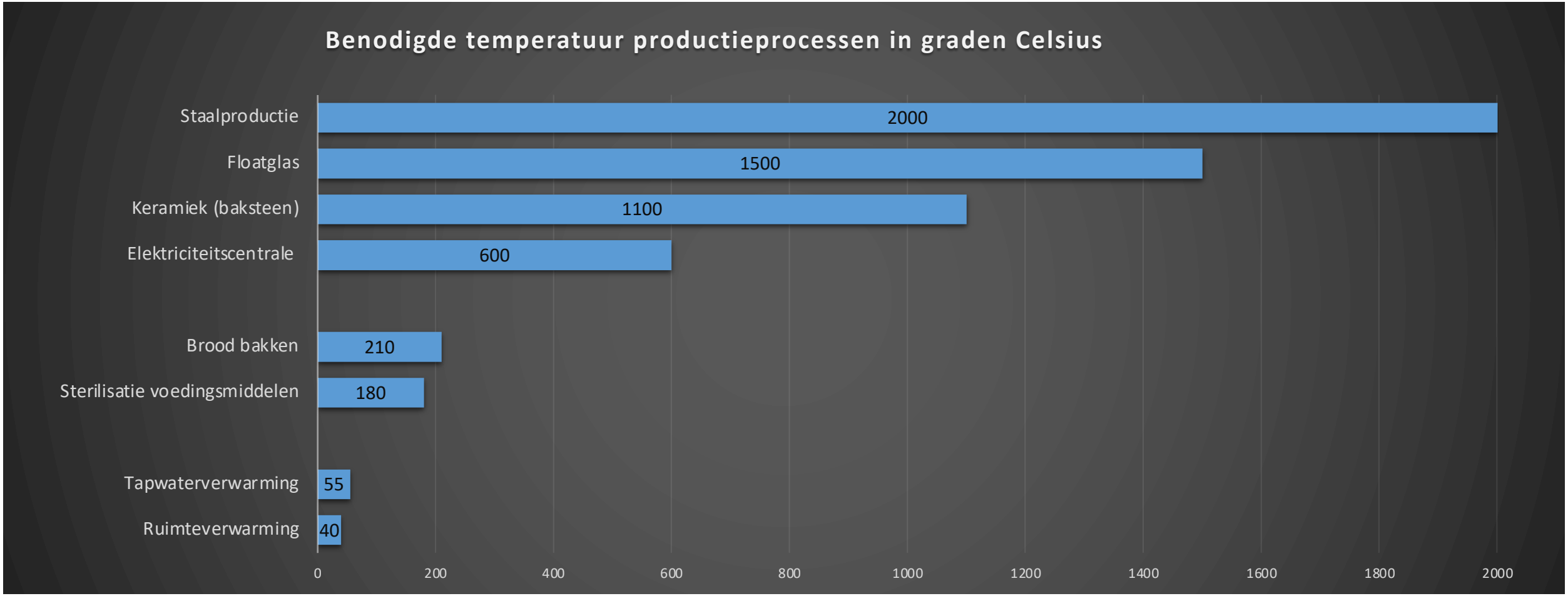
Met dank aan Lennart van der Burg van TNO. Copyright Vakblad Warmtepompen.

VAKBLAD WARMTE POMPEN

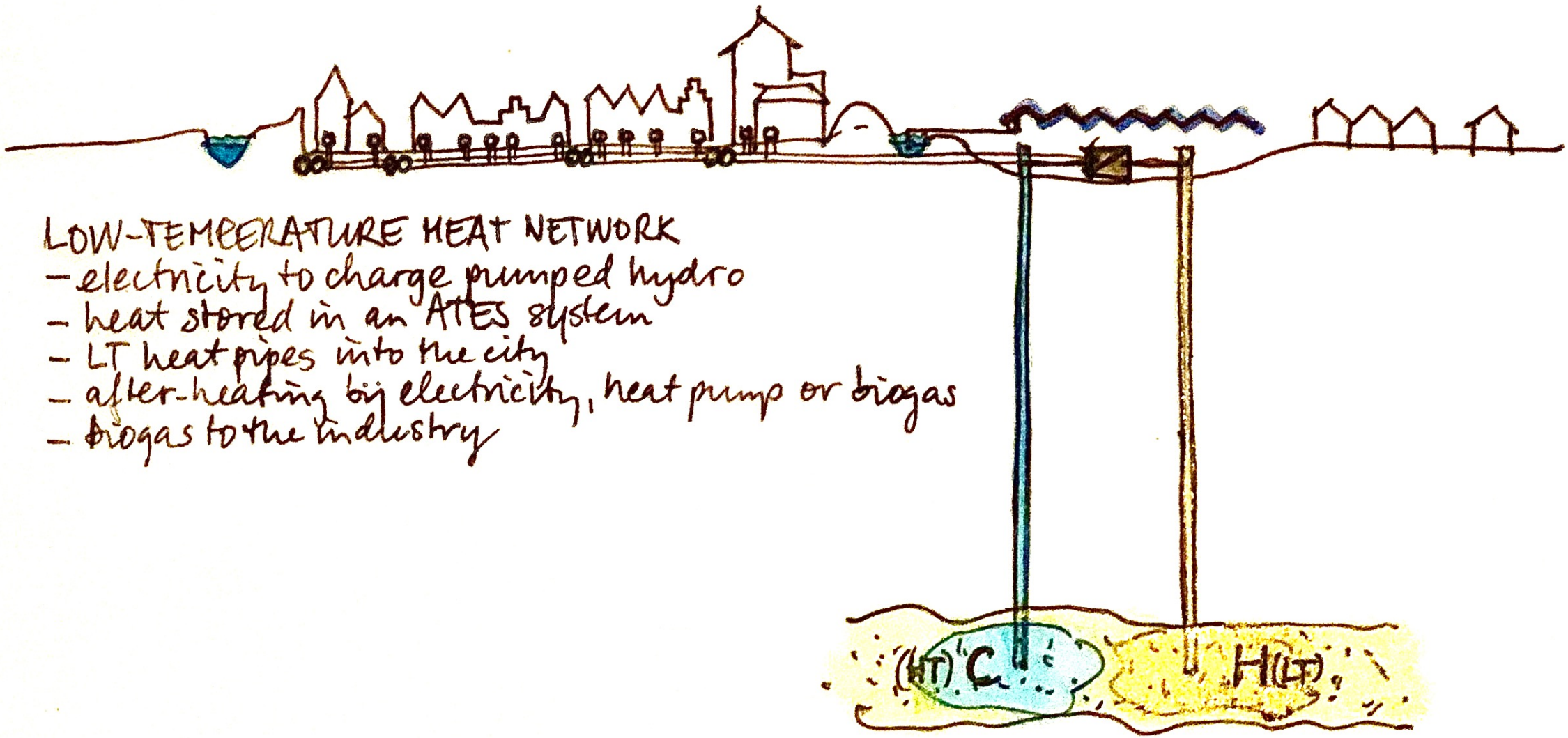
Alternatives for heat for local industries

Biogas for the built environment or for industrial processes?

Temperatures demanded by industries (in degrees Celsius):

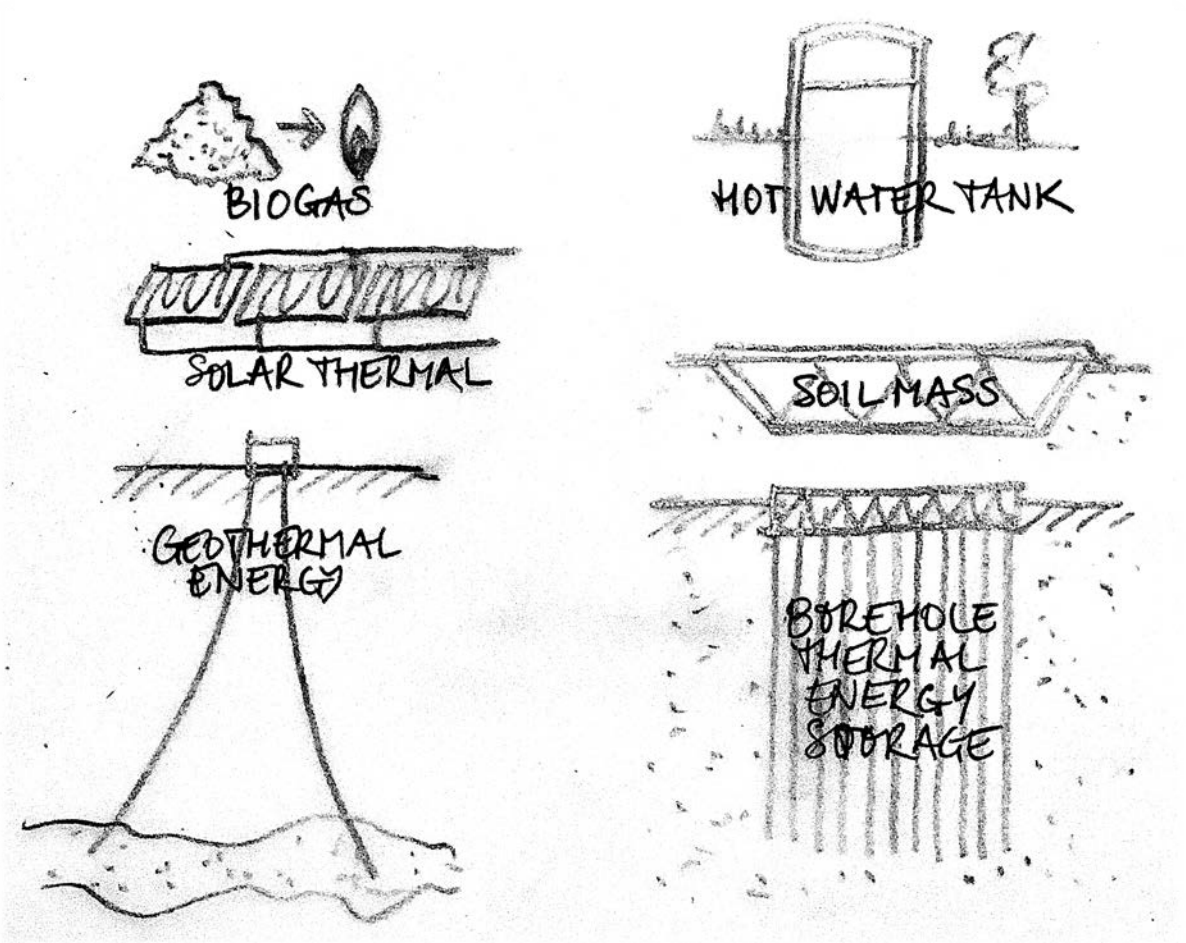


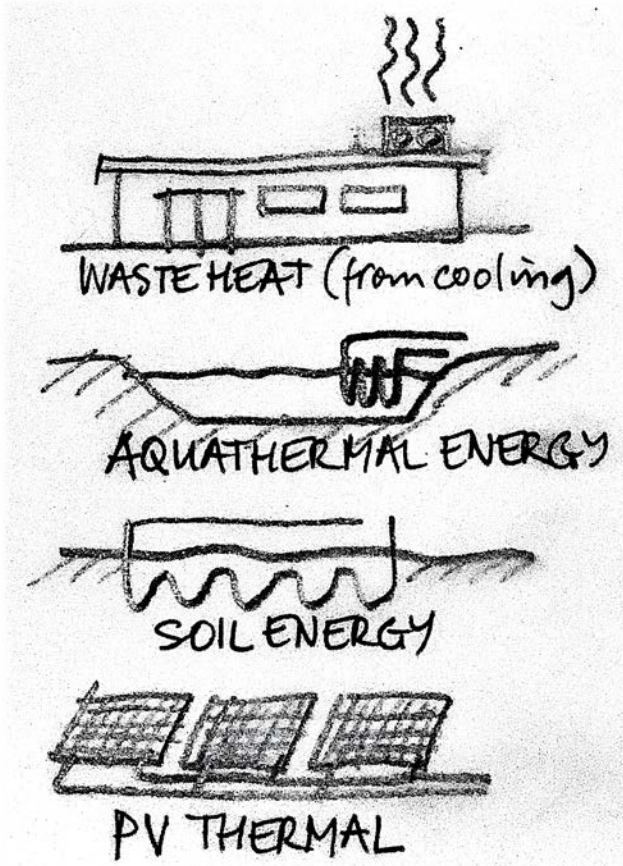
Inner city solution: **low-temperature heat network**

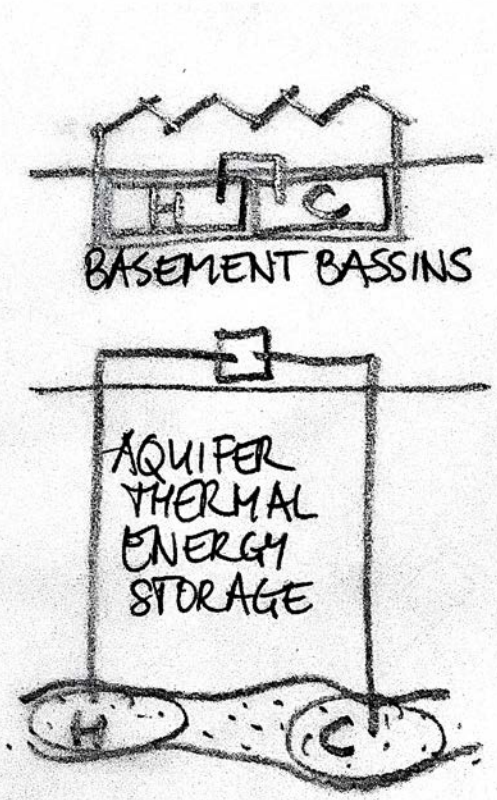


High- and low-temperature sources & storage

HT source | **HT storage** | **LT source** | **LT storage**

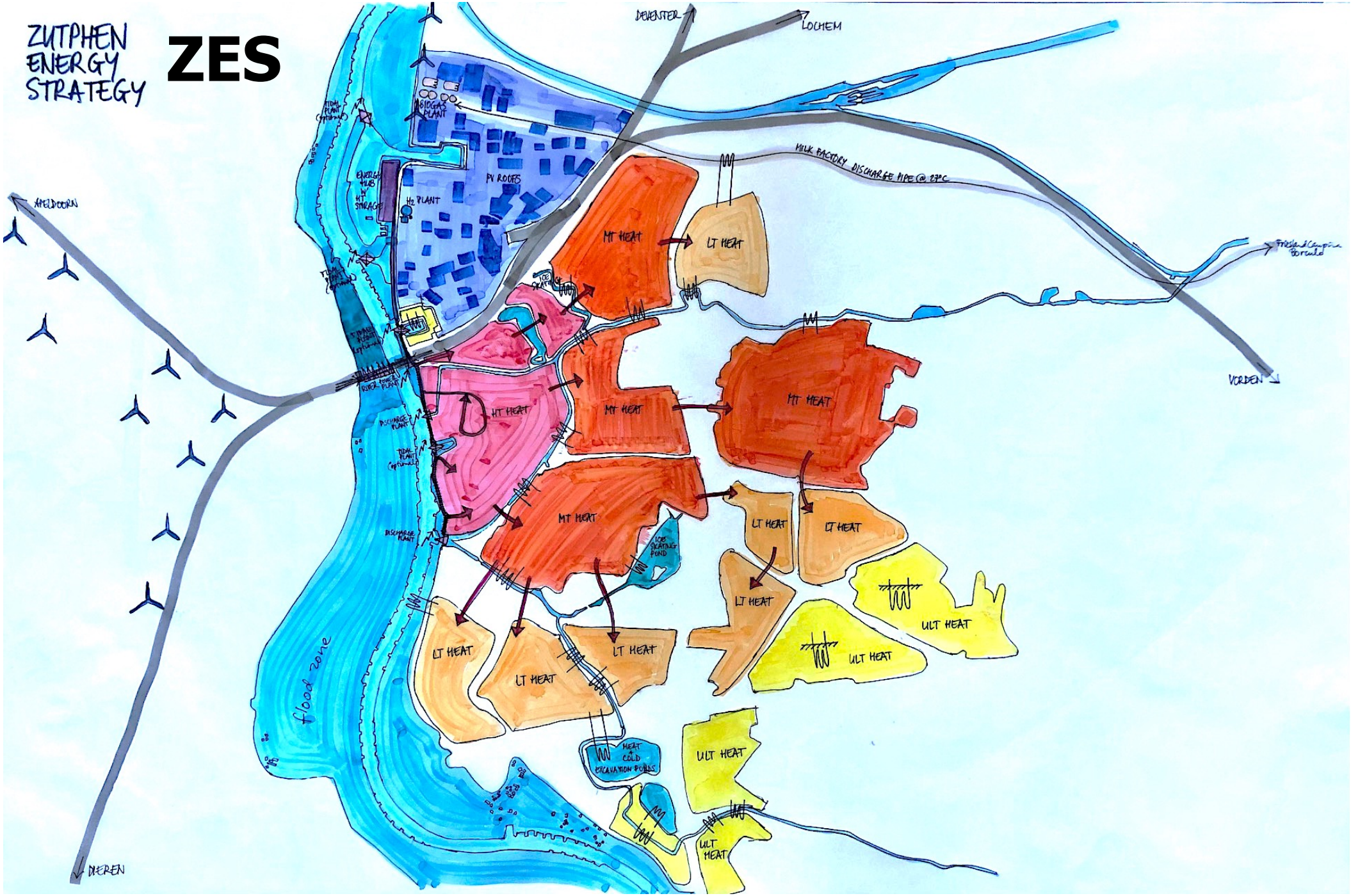






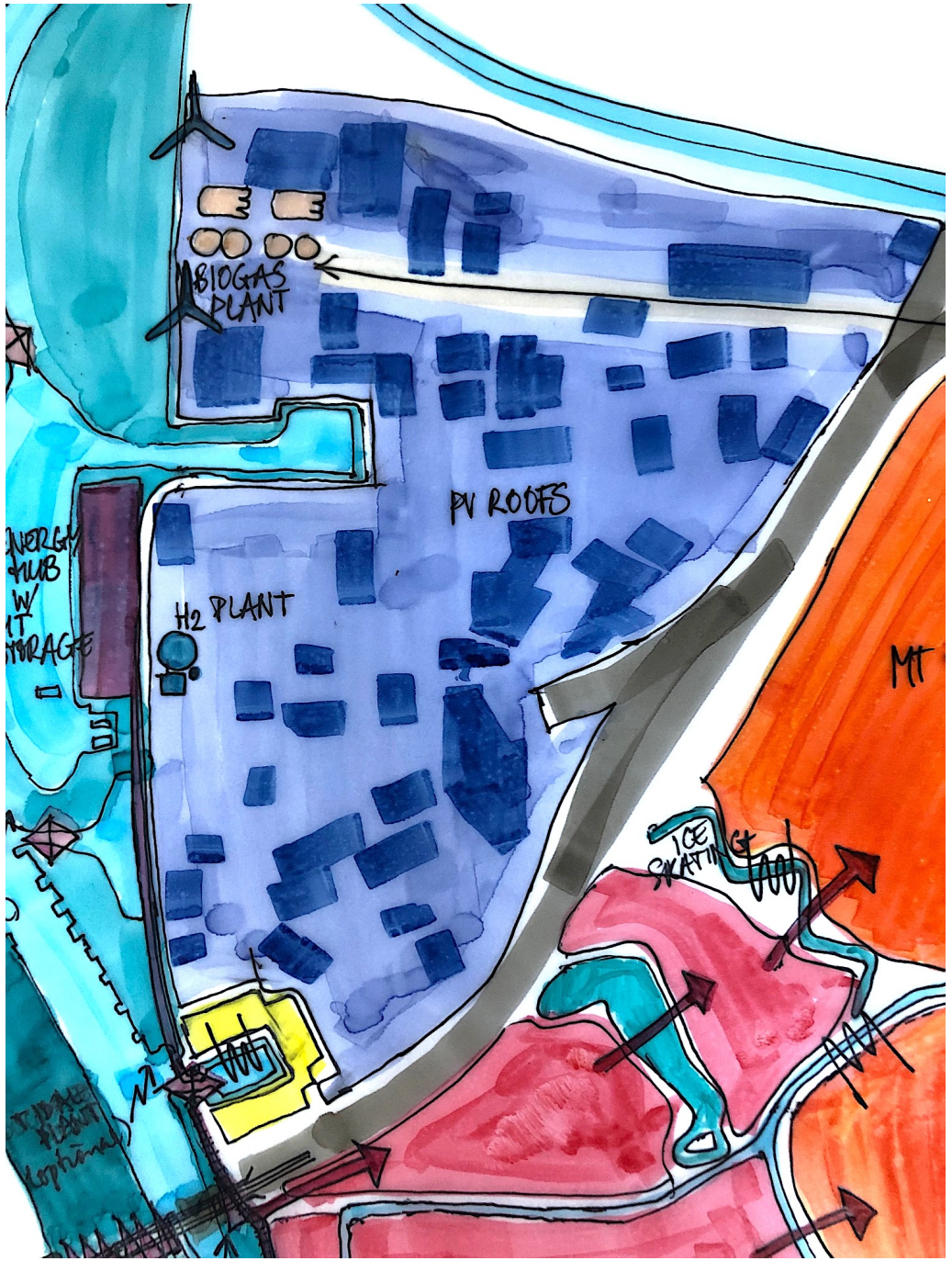
Inner city solution: **high-temperature heat network**

ZUTPHEN ENERGY STRATEGY ZES

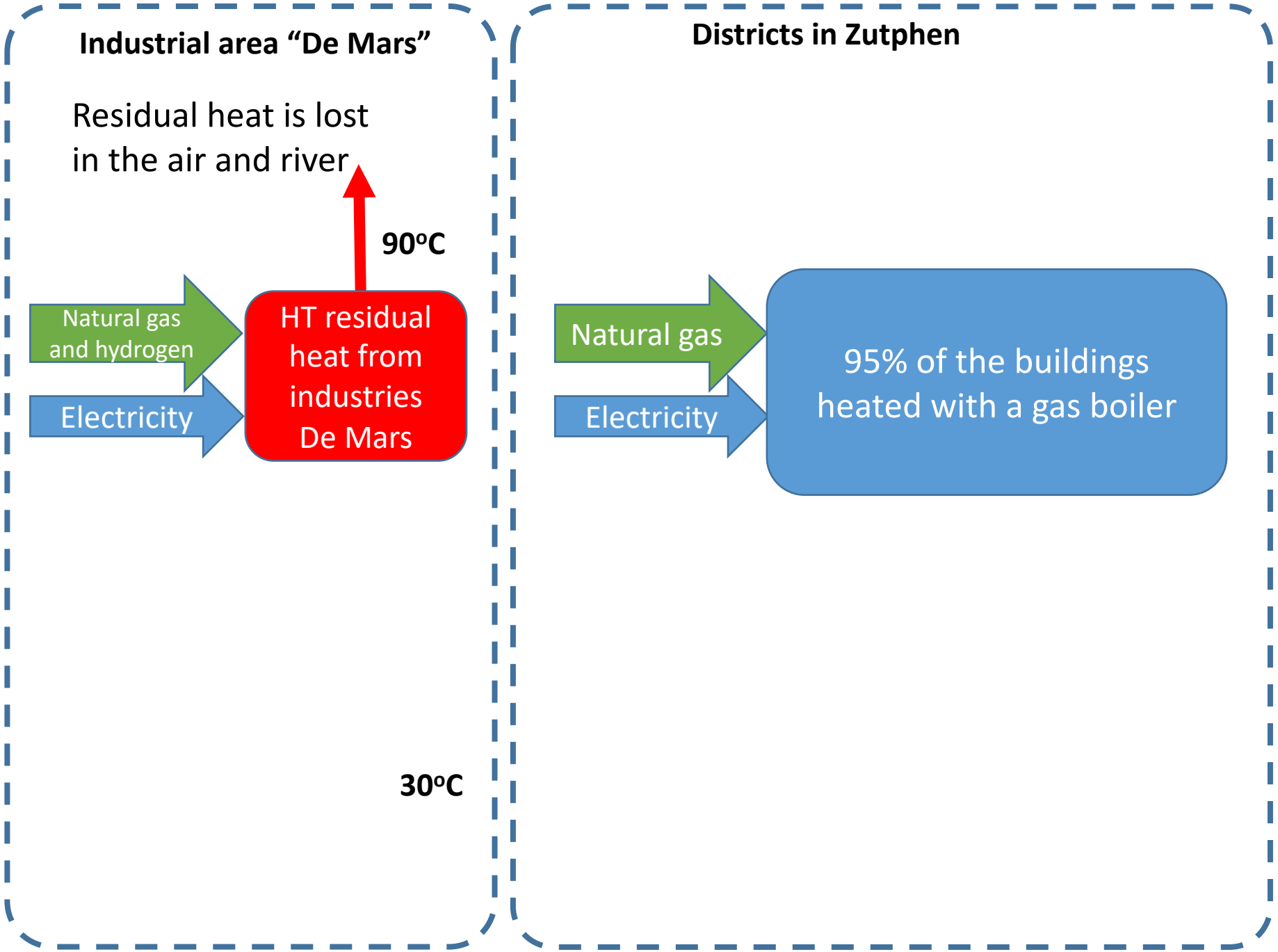


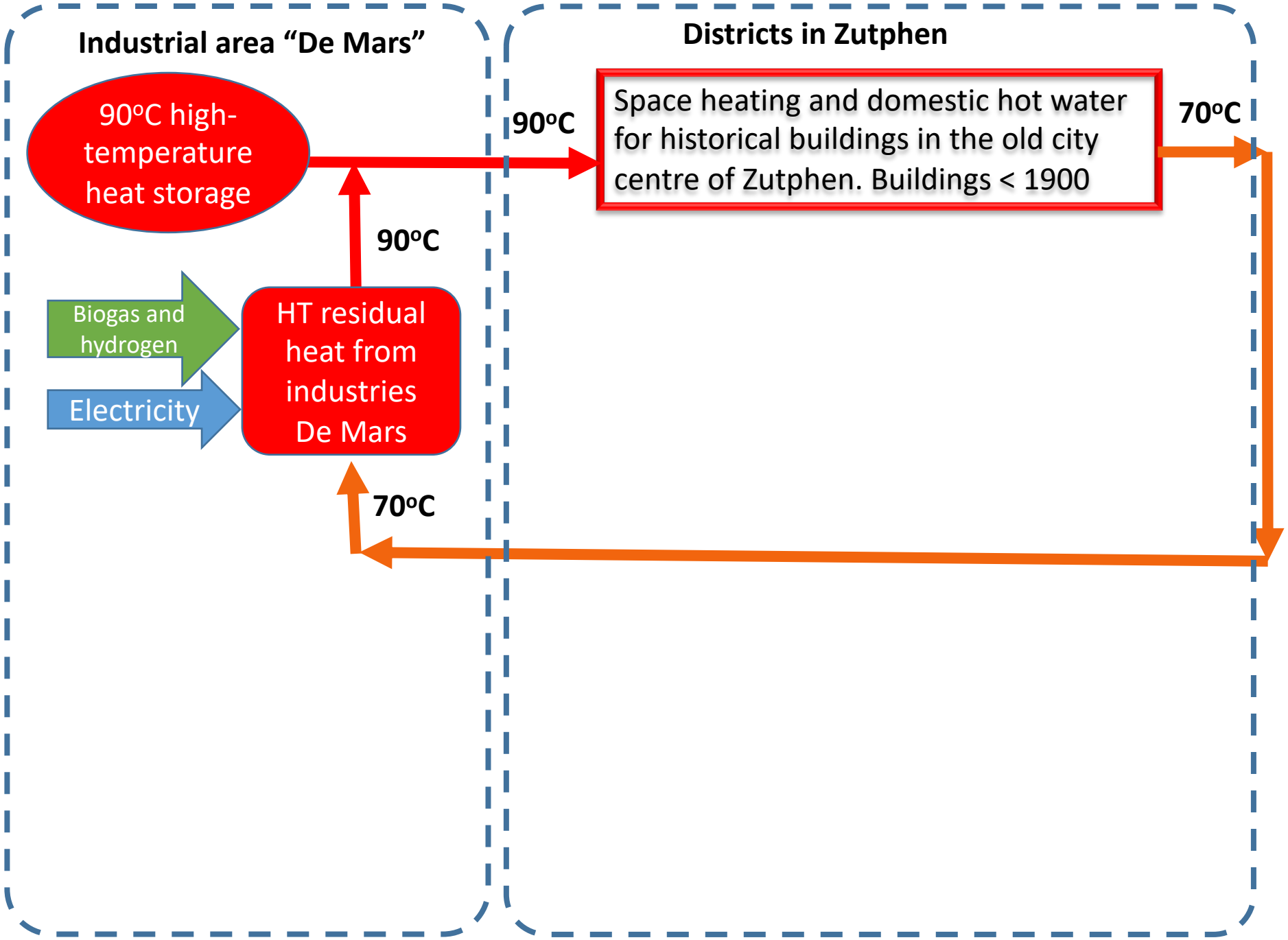
A large energy plant

- **Great use of electricity and gas**
- **Many roofs for photovoltaic power**
  - Potential to produce green hydrogen (H_2)
- **High-temperature waste heat (90°C)**
  - Copper melting
  - Plastic recycling
- **Low-temperature waste heat (25°C)**
  - Waste water treatment
  - Milk factory effluent
- **Biogas**
  - Biofermentation



The situation now




Industrial area “De Mars”
Districts in Zutphen
90°C high-temperature heat storage
90°C
Space heating and domestic hot water for historical buildings in the old city centre of Zutphen. Buildings < 1900
70°C
90°C
Biogas and hydrogen
Electricity
HT residual heat from industries De Mars
70°C

Industrial area “De Mars”

Districts in Zutphen

90°C high-temperature heat storage

90°C

Space heating and domestic hot water for historical buildings in the old city centre of Zutphen. Buildings < 1900

70°C

90°C

Biogas and hydrogen

Electricity

HT residual heat from industries De Mars

50°C

Space heating and domestic hot water for renovated buildings of Zutphen 1900 – 1975 (NOM)

70°C

50°C

50°C

Space heating (renovated) buildings of Zutphen 1975 – 2020. Domestic hot water with heatpump boiler or booster

30°C

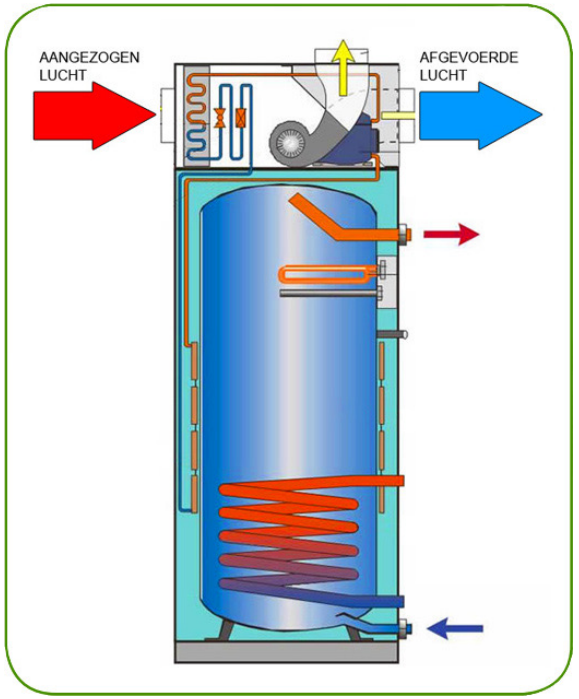
LT residual heat from De Mars (RWZI)

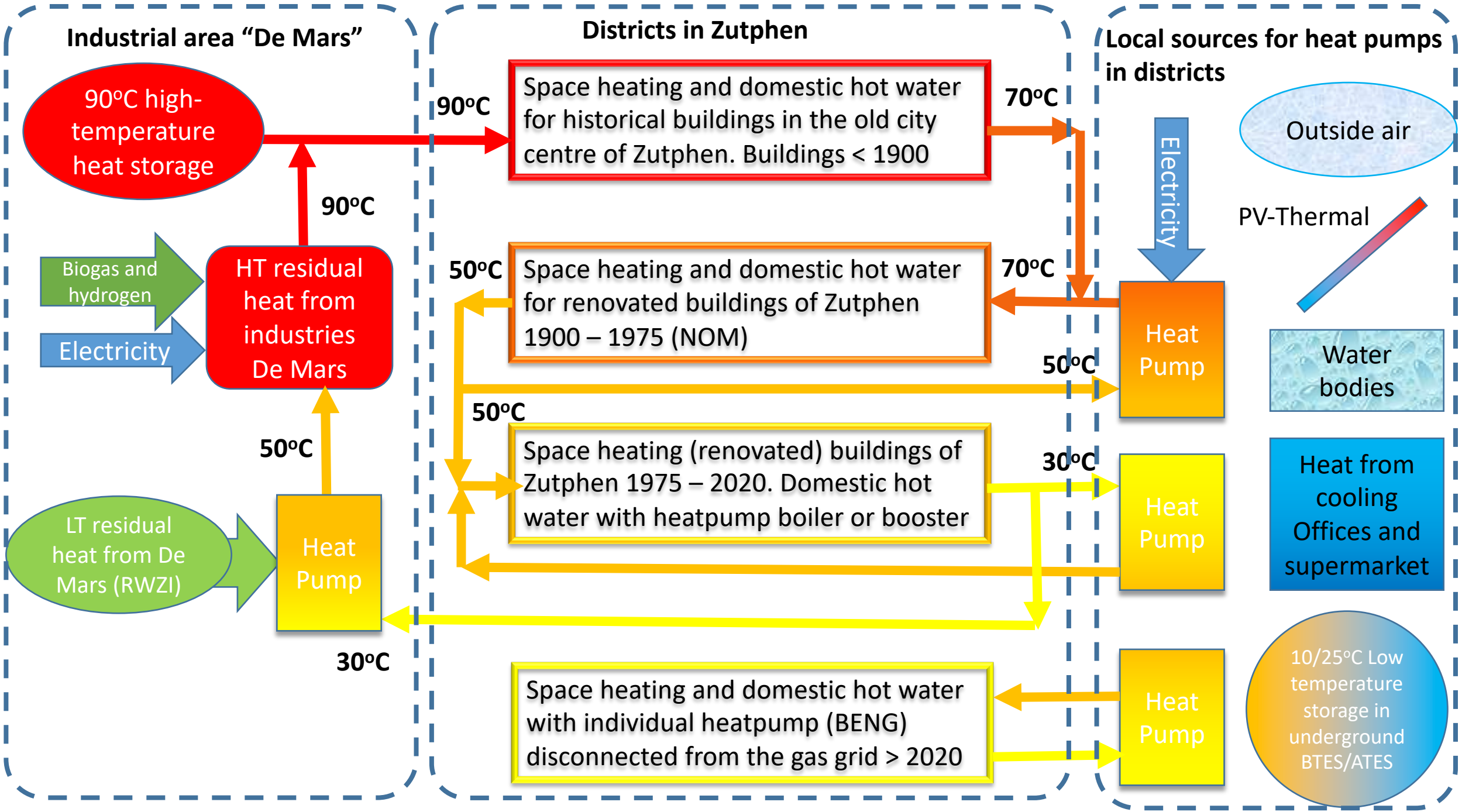
Heat Pump

30°C

Space heating and domestic hot water with individual heatpump (BENG) disconnected from the gas grid > 2020

Heat Pump




Industrial area "De Mars"
Districts in Zutphen
Local sources for heat pumps in districts
90°C high-temperature heat storage
90°C
90°C
Space heating and domestic hot water for historical buildings in the old city centre of Zutphen. Buildings < 1900
70°C
Biogas and hydrogen
Electricity
HT residual heat from industries De Mars
50°C
Space heating and domestic hot water for renovated buildings of Zutphen 1900 – 1975 (NOM)
70°C
Electricity
Heat Pump
50°C
50°C
50°C
Space heating (renovated) buildings of Zutphen 1975 – 2020. Domestic hot water with heatpump boiler or booster
30°C
Heat Pump
LT residual heat from De Mars (RWZI)
Heat Pump
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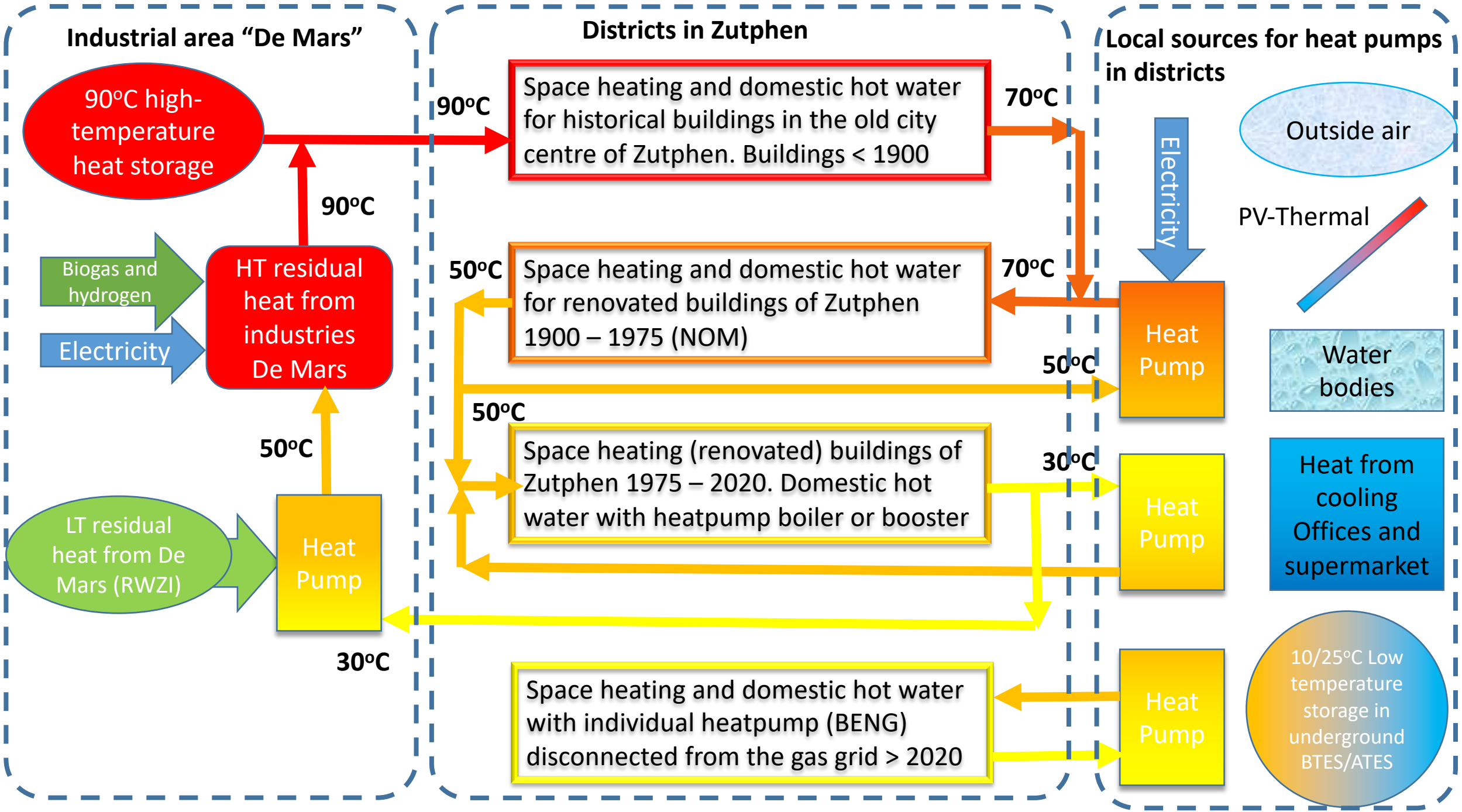
Space heating and domestic hot water with individual heatpump (BENG) disconnected from the gas grid > 2020
Heat Pump
Outside air
PV-Thermal
Water bodies
Heat from cooling Offices and supermarket
10/25°C Low temperature storage in underground BTES/ATES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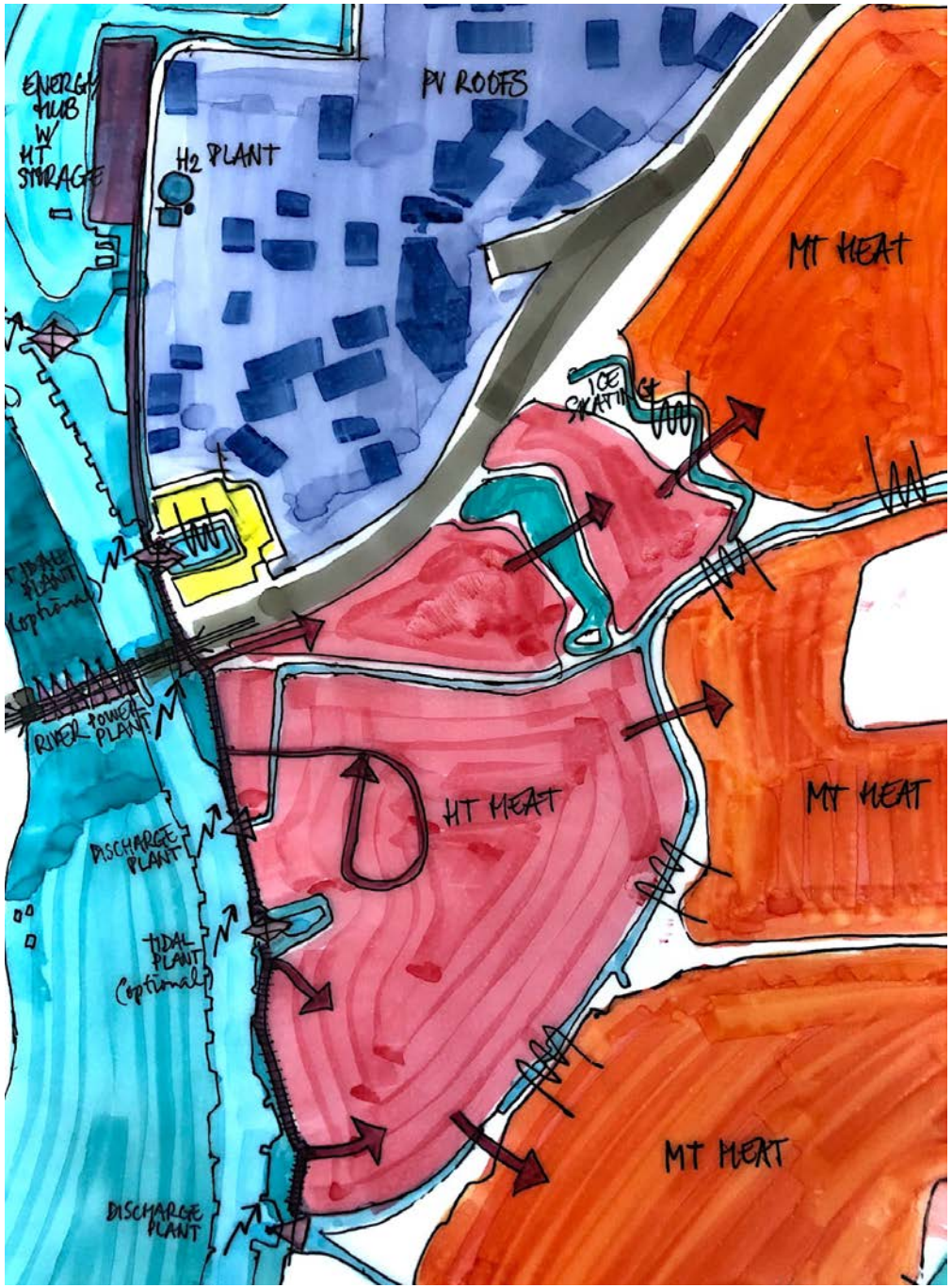
HT heat supply to the city

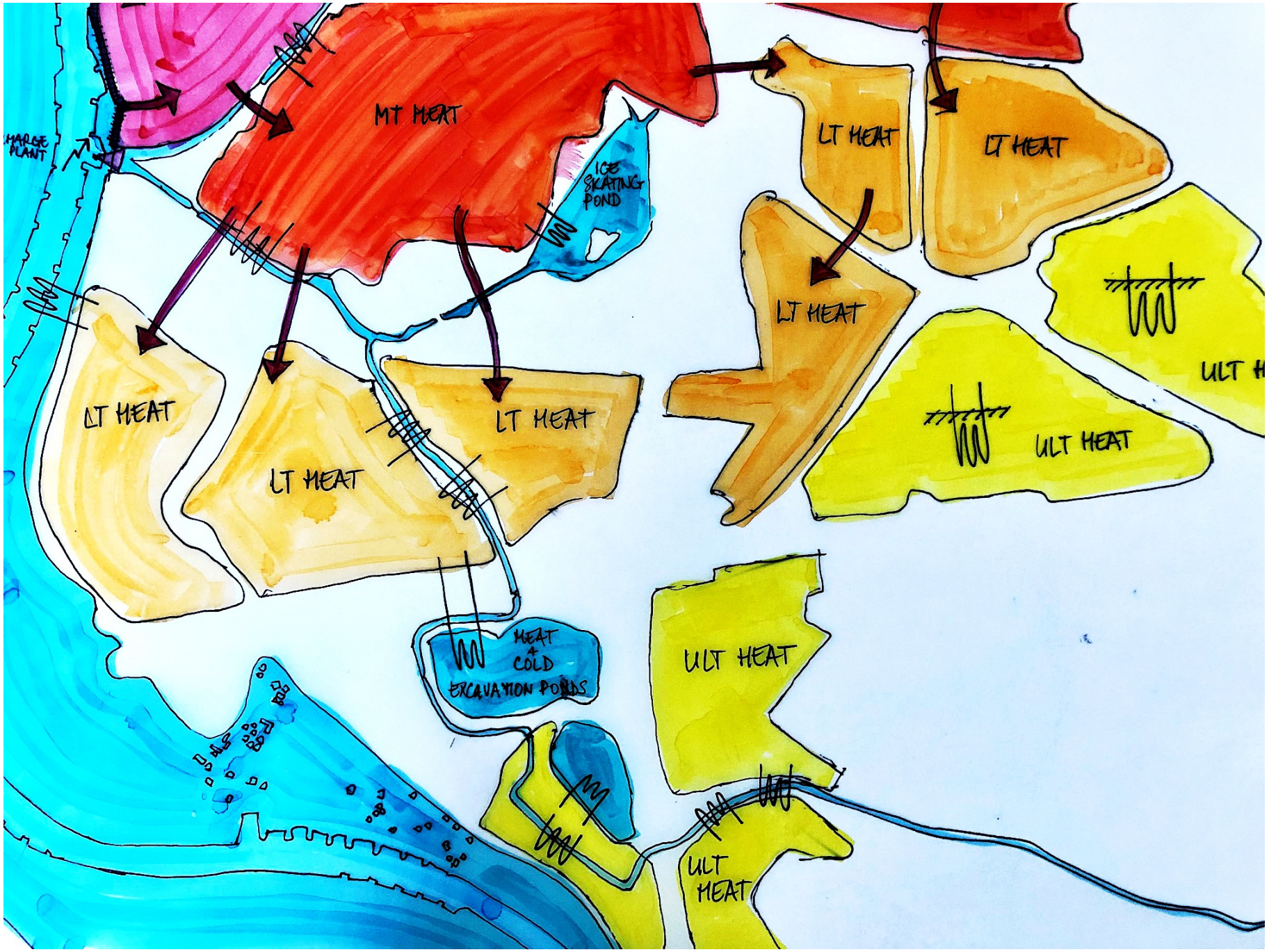
- **Old town first**
- **Along the main streets and alleys**



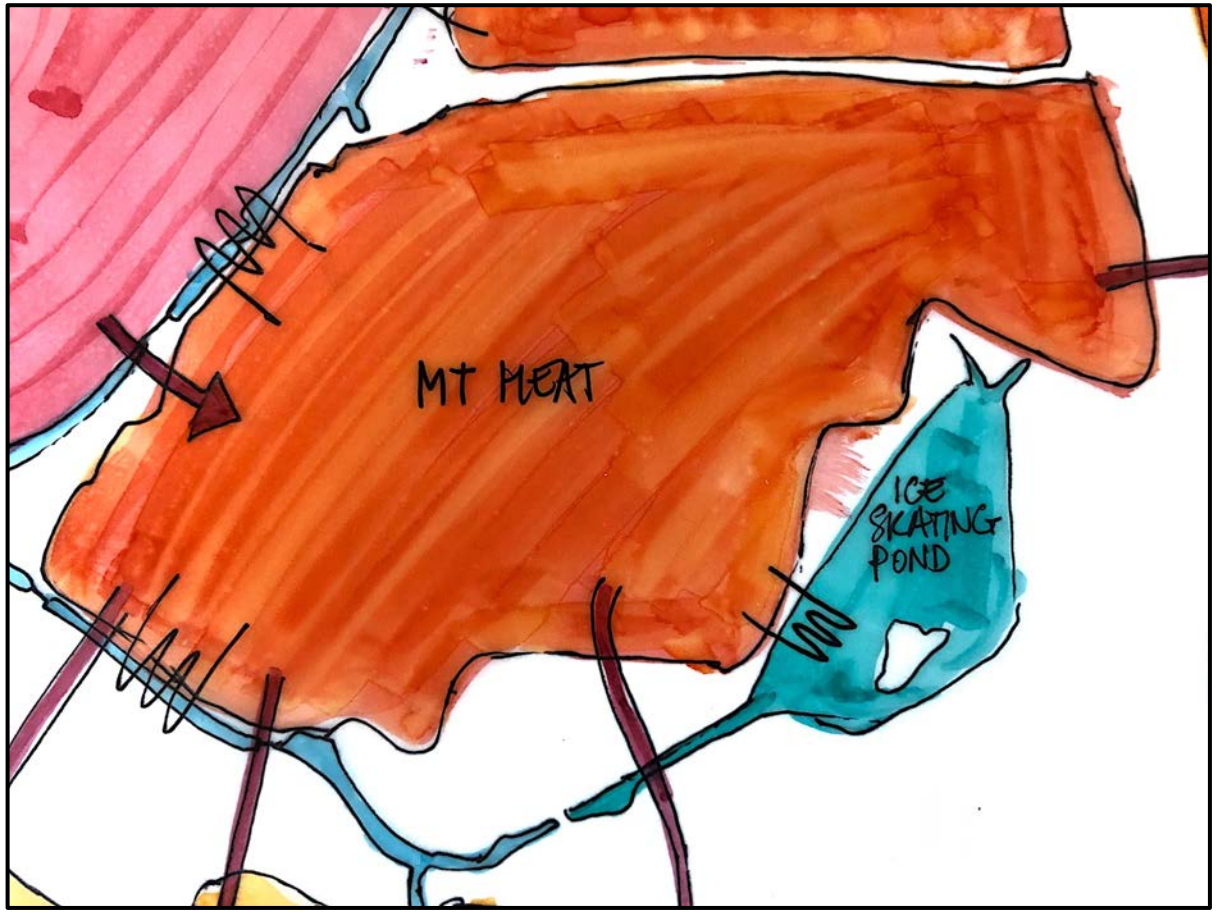
Living archaeology

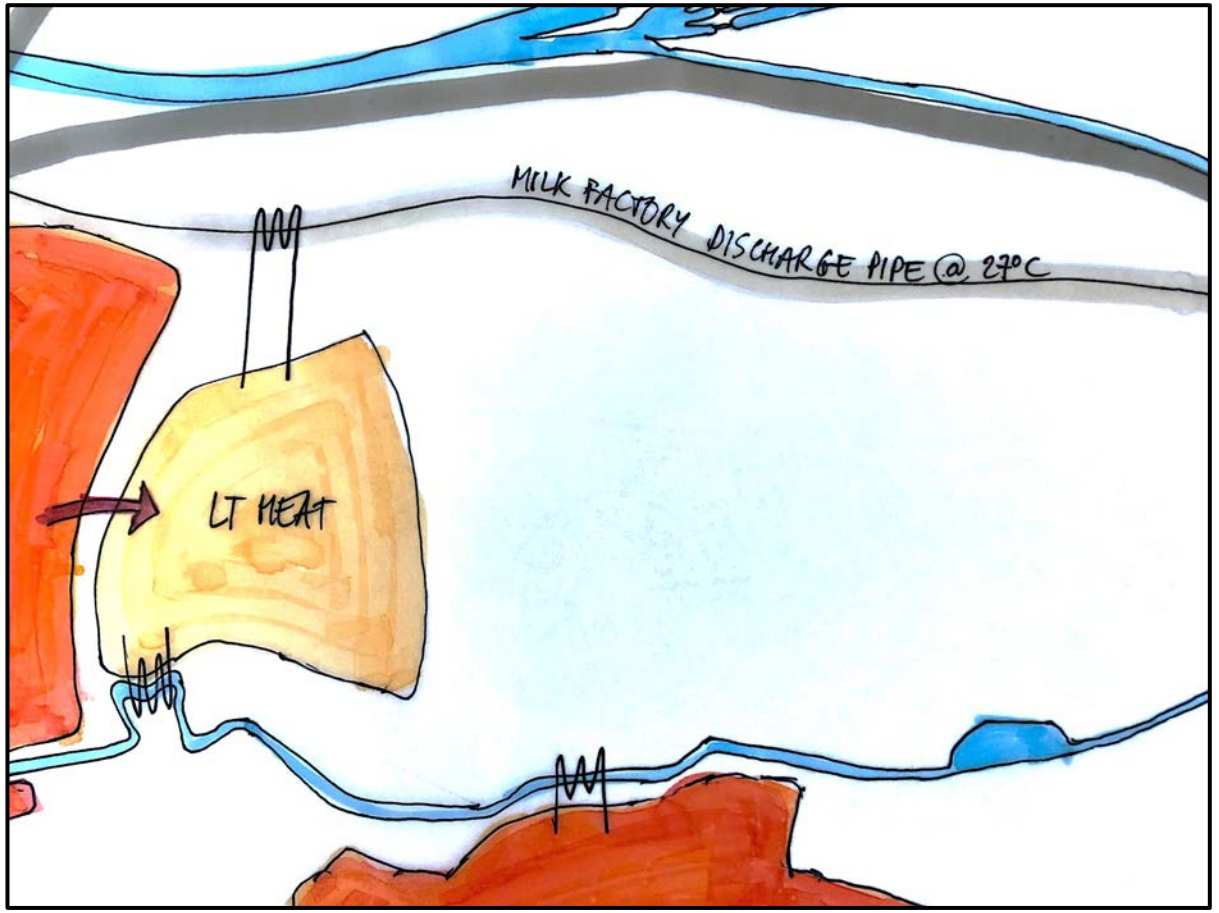
Imagine how interesting streets would become...

Cascading


MT HEAT
ICE SKATING POND
LT HEAT
LT HEAT
LT HEAT
LT HEAT
LT HEAT
LT HEAT
ULT HEAT
ULT HEAT
HEAT & COLD EXCAVATION PONDS
ULT HEAT
ULT HEAT

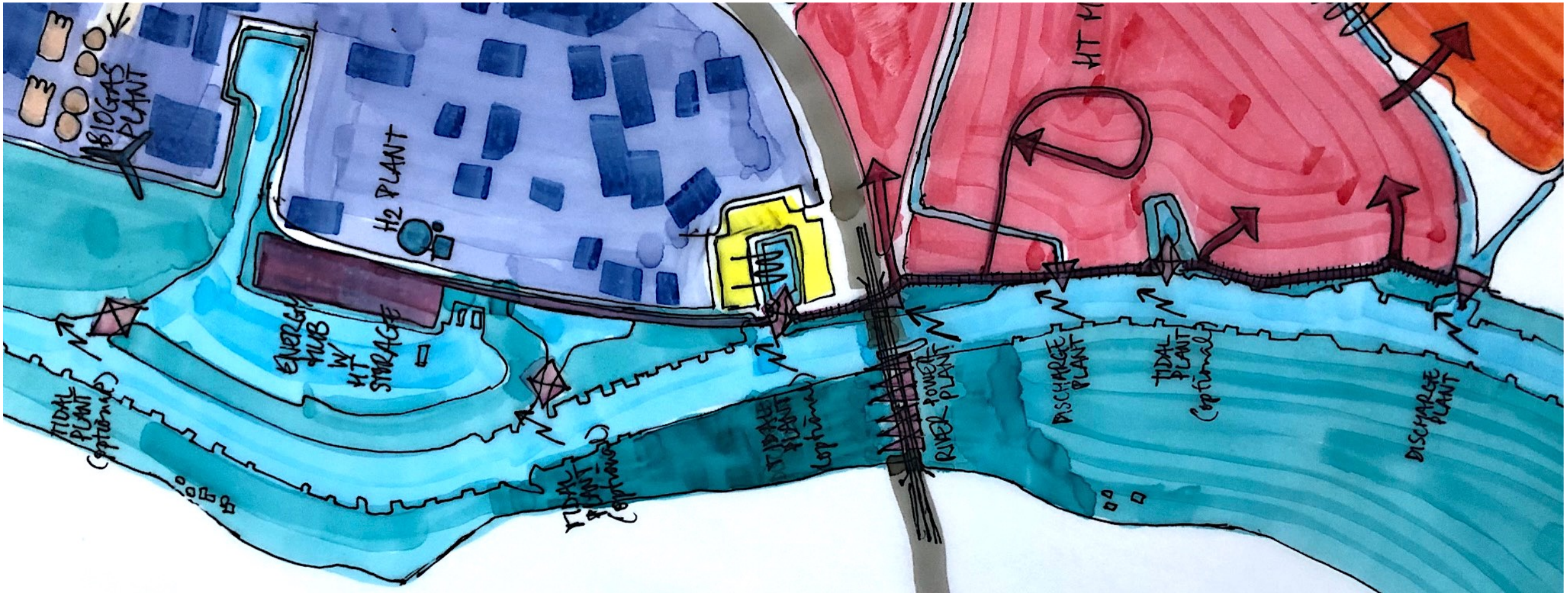
Using ponds and the milky way





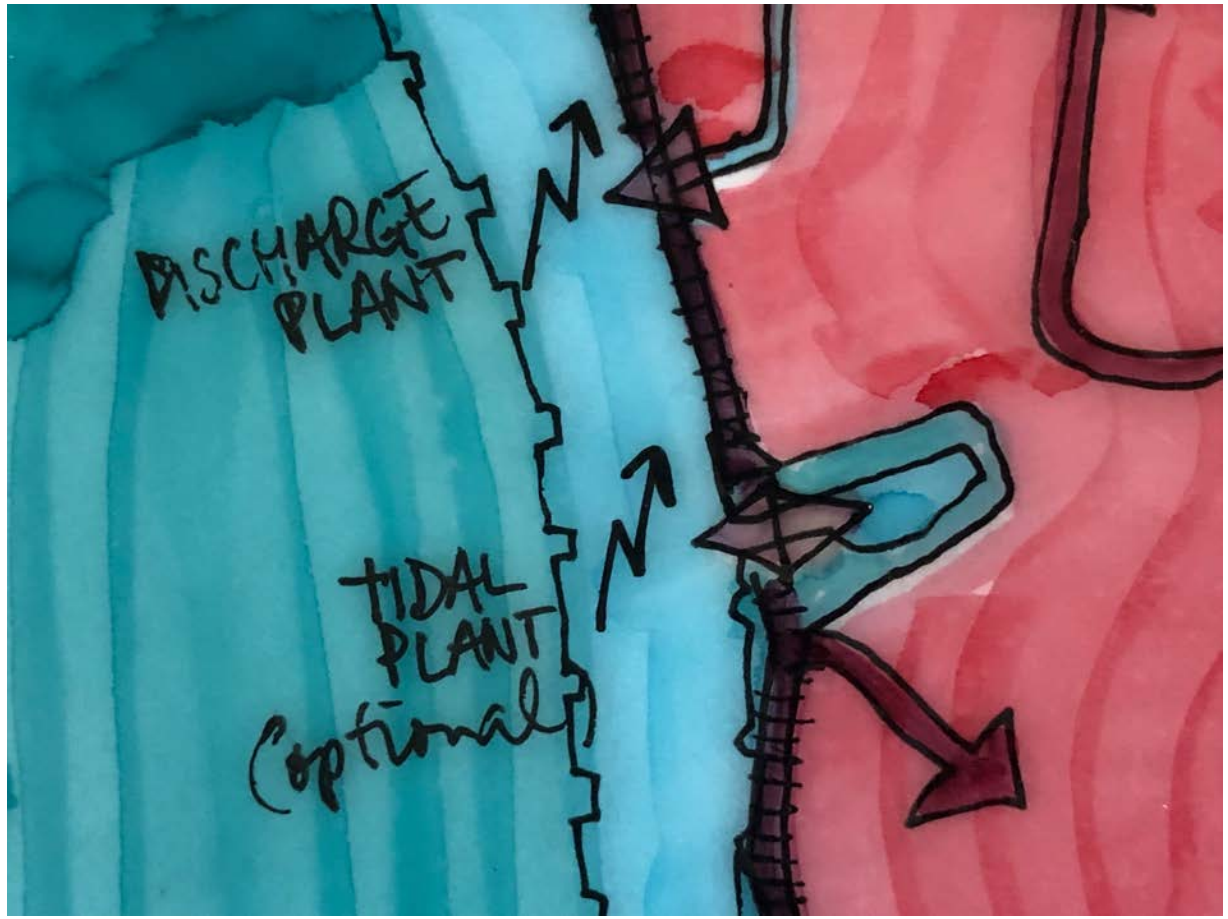
The power of water

Zutphen has a lot of hydro power!



Hydro power from discharge points

- **Berkel** (2x)
- **Vierakkerse Laak**



Berkel power potential

E = M x **g** x **Δh** x **η** (energy = mass x gravity x height difference x turbine efficiency)

- River speed: 2 m/s → 7,200 m^3/h or 172,200 m^3/day or $63*10^6$ m^3/year per m^2 width and height
- $63*10^6$ m^3 x 1000 kg/m^3 = $63*10^9$ kg of water mass per m^2 width and height
- River cross section (2 discharge points): 8 m x 1 m → $512*10^9$ kg
- 40% turbine efficiency (fish friendly, no detour possible)

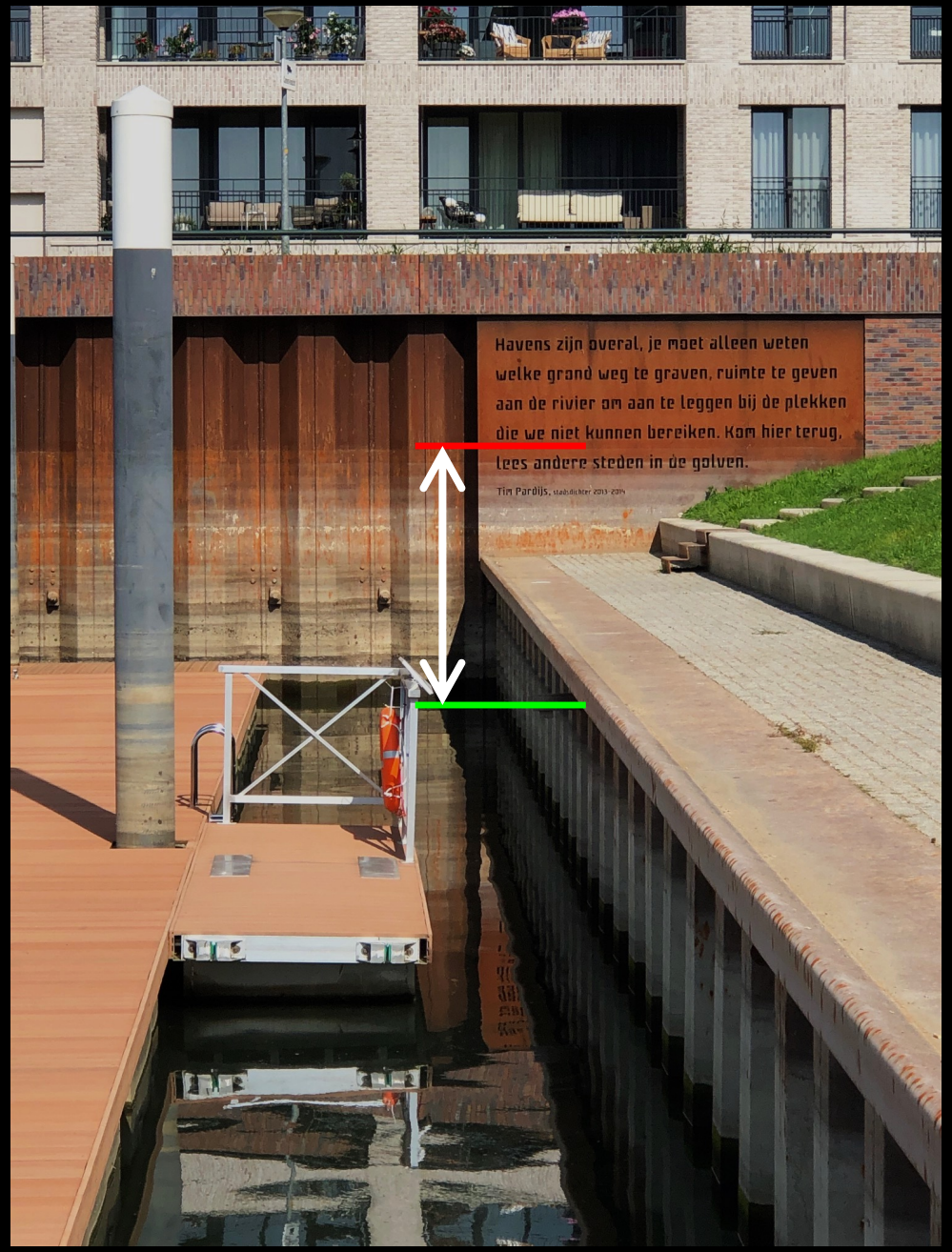
Total energy potential: E = $512*10^9$ x 9.82 x 0.4 = $2.0*10^{12}$ J = 2.0 TJ/year =

7.2 GWh per year

Flood safety

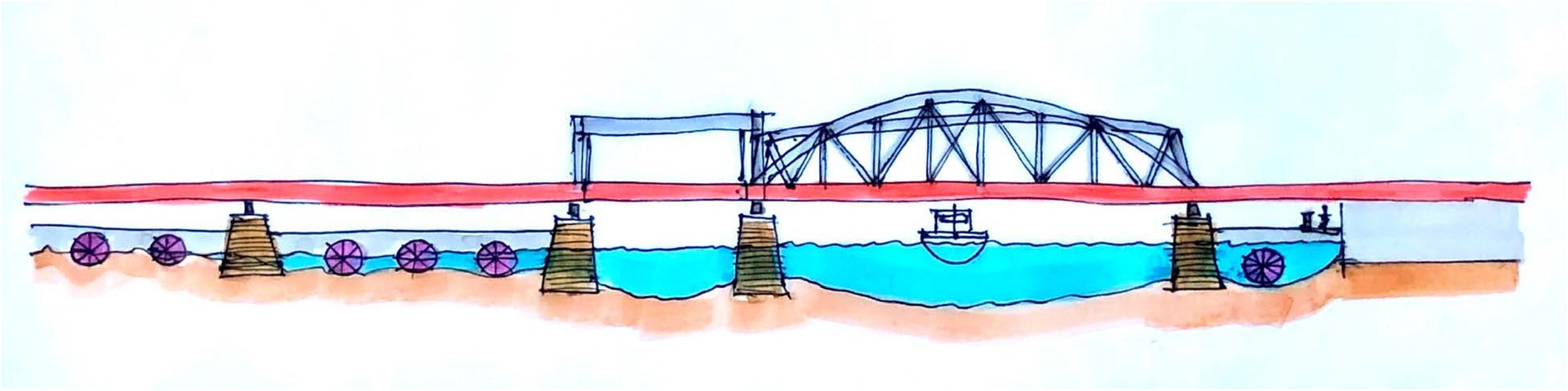
The tides

Markers


Havens zijn overal, je moet alleen weten
welke grond weg te graven, ruimte te geven
aan de rivier om aan te leggen bij de plekken
die we niet kunnen bereiken. Kom hier terug,
lees andere steden in de golven.
Tim Pardijs, stadsdichter 2013-2014

IJssel power

IJssel power plant



By-pass

IJssel power potential

E = M x **g** x **Δh** x **η** (energy = mass x gravity x height difference x turbine efficiency)

- River speed: 5 m/s → 18,000 m^3/h or 432,000 m^3/day or $158*10^6$ m^3/year per m^2 width and height
- $158*10^6$ m^3 x 1000 kg/m^3 = $158*10^9$ kg of water mass per m^2 width and height

- River cross section permanent: 10 m x 3 m → $4.74*10^{12}$ kg
- River cross section at high tides (average, 4 weeks/yr): 50 m x 2 m → $1.22*10^{12}$ kg
- Total water mass pushed through turbines: $5.96*10^{12}$ kg

- 60% turbine efficiency, 50% reduction due to resistance (water taking a detour)

Total potential: E = $5.96*10^{12}$ x 9.82 x 0.3 = $17.6*10^{12}$ J = 17.6 TJ/year =

63 GWh per year

Energy performance

Energy demand municipality of Zutphen

HEAT

non-residential
118 GWh

residential
251 GWh

HEAT DEMAND: 369 GWh_{th}

ELECTRICITY

residential
52 GWh

non-residential
155 GWh

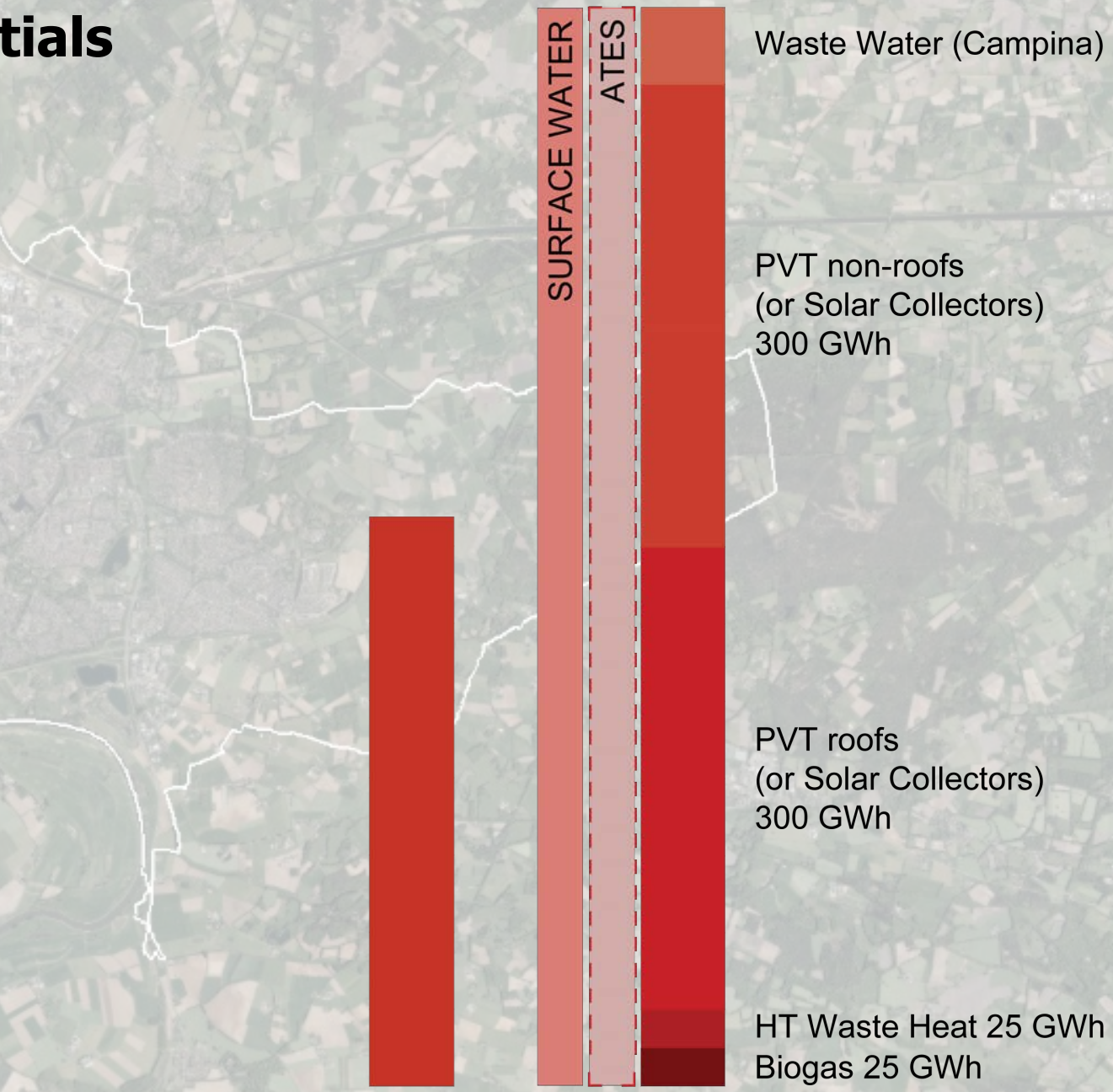
ELECTRICITY DEMAND: 207 GWh_e

MOBILITY

210 GWh

Fuel: 210 GWh_{pr}

Heat potentials



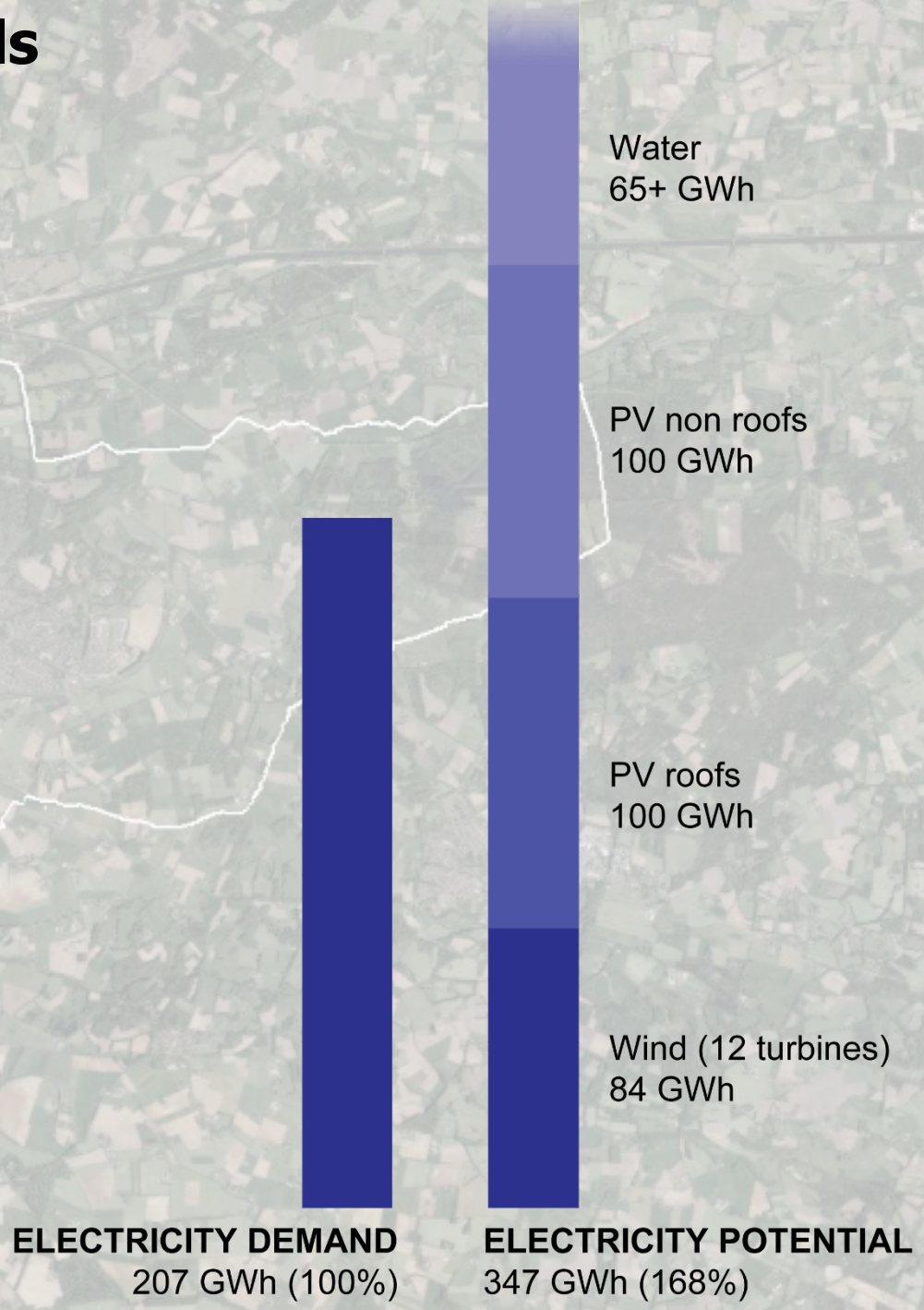
Space for production

1 sewage treatment plant (RWZI)

Solar thermal on roofs (50ha) **OR**
PVT on roofs (50ha)

PVT non-roofs (50ha)

Electricity potentials



Space for production

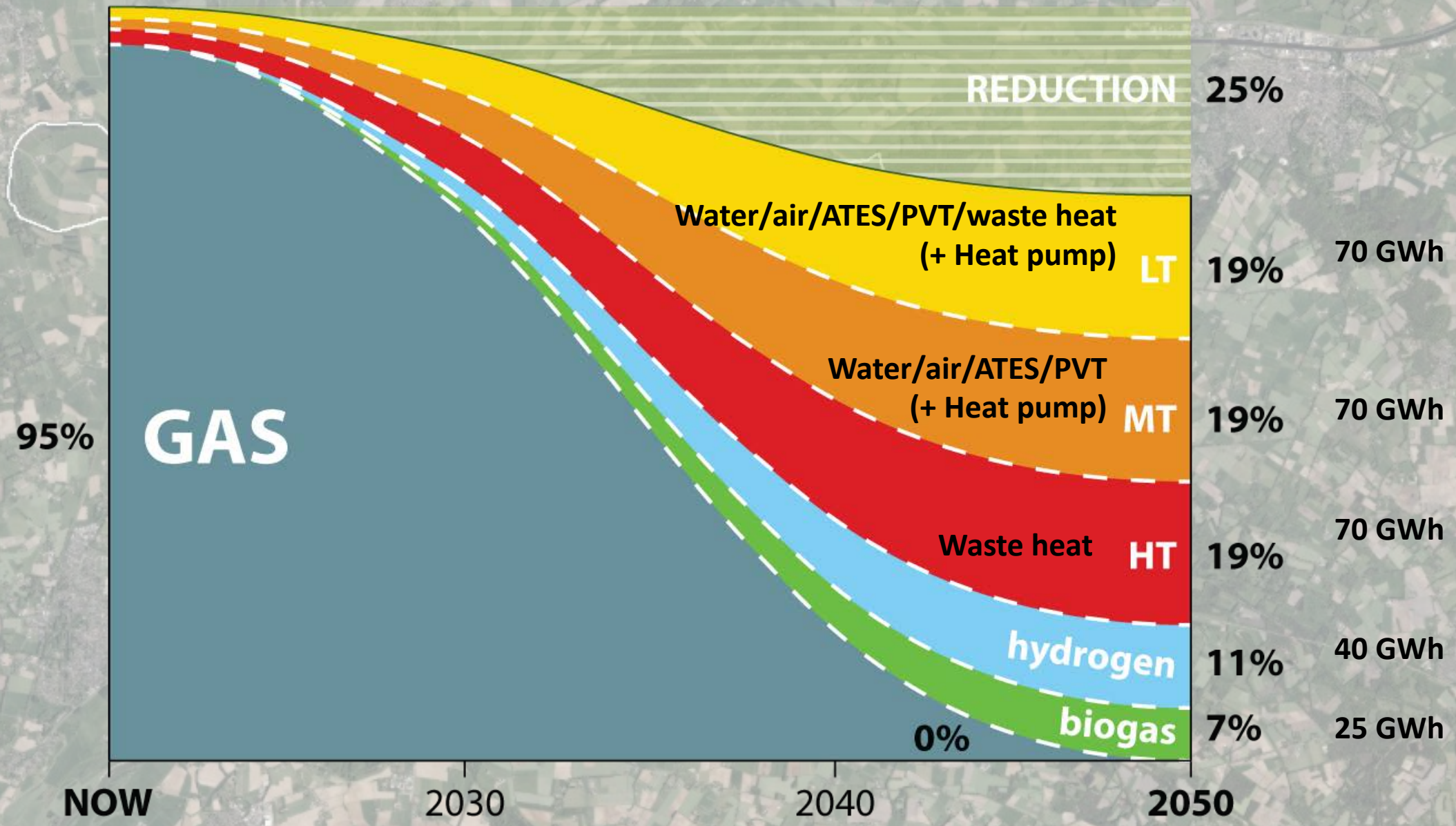
12 Wind turbines

20% of all roofs

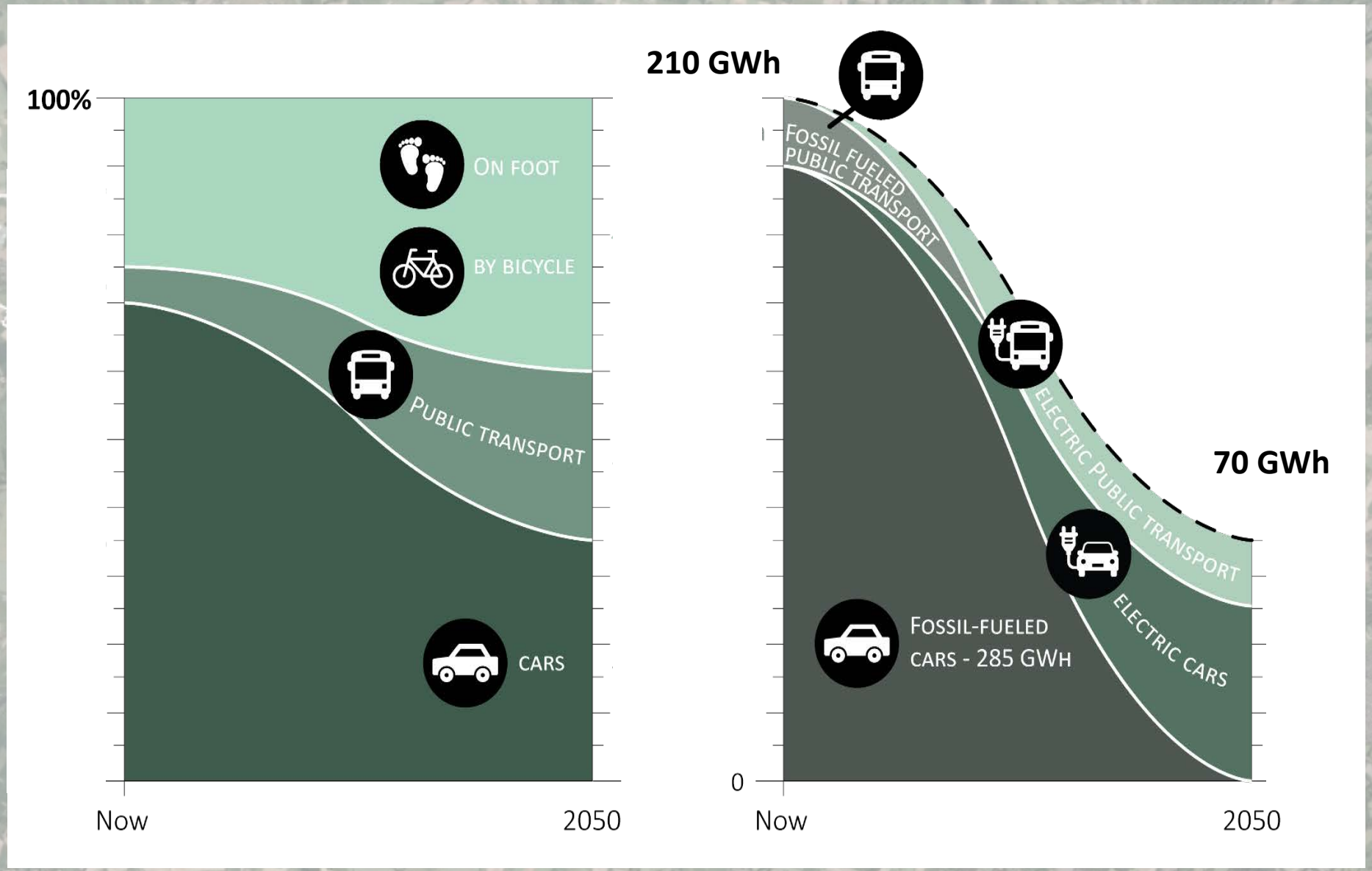
50 ha non-roof

Water turbines

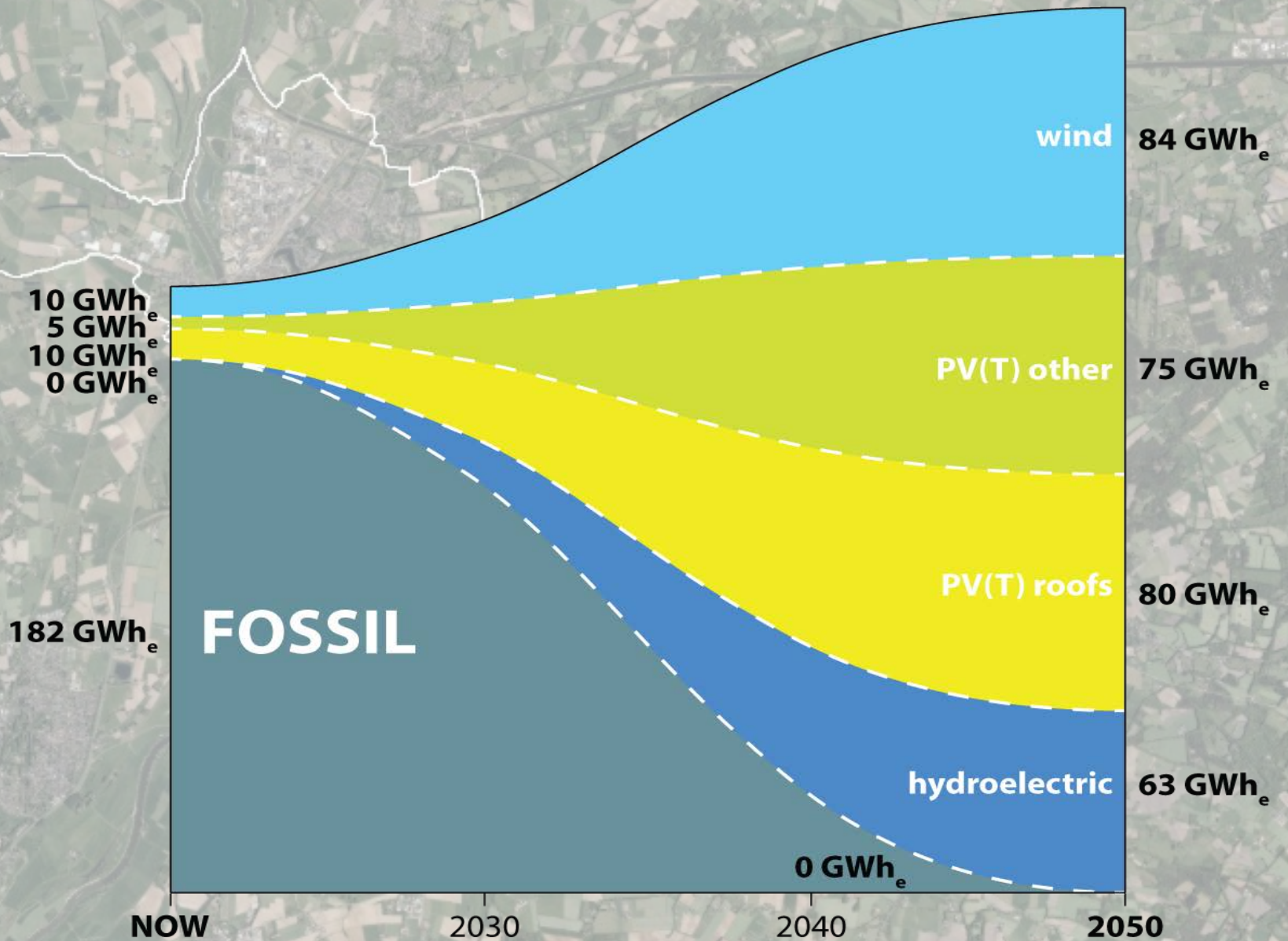
Heat Balance



Mobility: Modal Split & Electrification



Electricity Balance



Production from

12 Wind turbines

60 ha non-roof

40 ha roof (25% of all roofs)

x Water turbines

Zutphen Power Hub

Biogas and **hydrogen** (50GWh) is produced to power the industrial processes

HT waste heat (65GWh) from these ind. processes

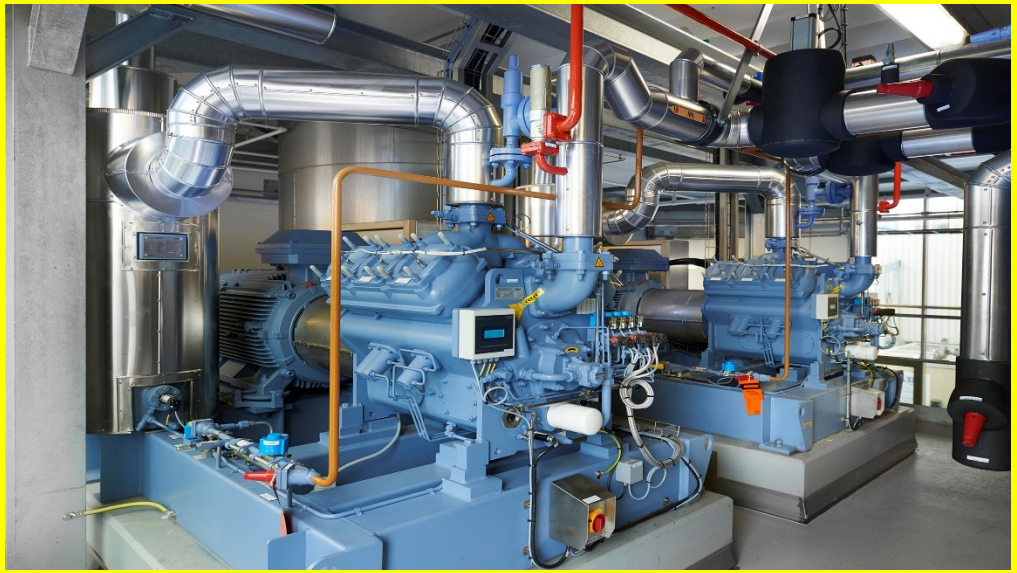
Robust HT heat grid

A collective **high temperature heat grid** starts at the business district

It distributes **waste heat** and **different sustainable heat sources** to the nearby neighbourhoods

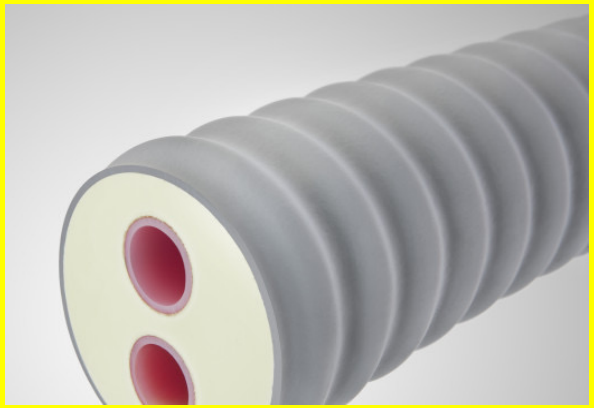
New heat sources

- **PV-thermal** on roofs+ **ATES + industrial heat pump**
- Floating **PV-T**
- **Water + ATES + industrial heat pump**
- **Waste heat** from hydrogen production/storage



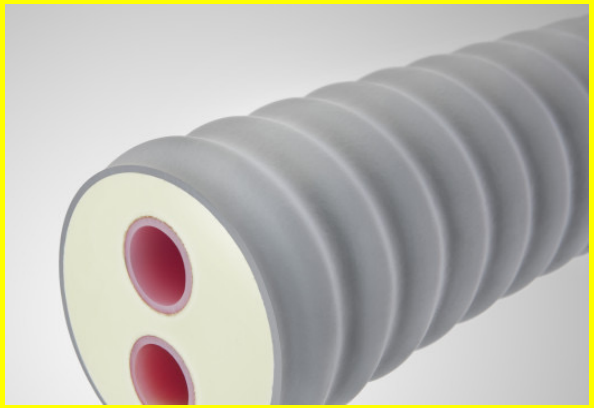
HT waste heat for the inner city

- **High temperature heat** from the business park to the historic city
- Individual heat projects also possible (e.g. Klein Vaticaan)



HT heat grid cascade to MT heat grid

- Old neighbourhoods (> 1900) around the historic city can get a **cascaded** heat grid at **medium temperature**



New MT heat sources

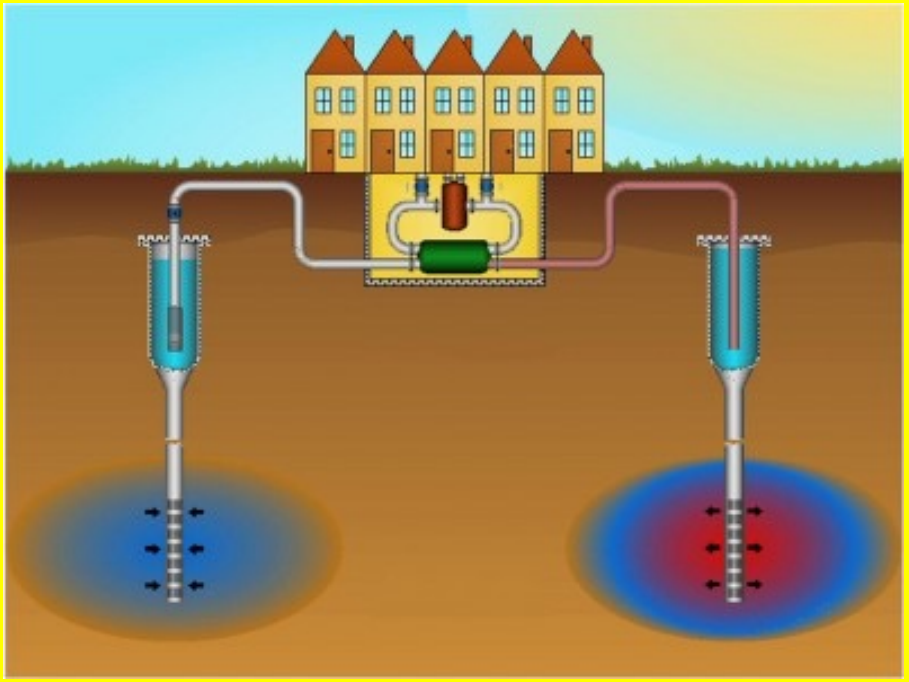
Connect different sustainable sources to the grid like:

- Heat from **water bodies**
- **Waste heat** from cooling processes
- **PV-thermal panels**

Seasonal storage and heat pumps

The heat produced in summer can be stored underground in ATES

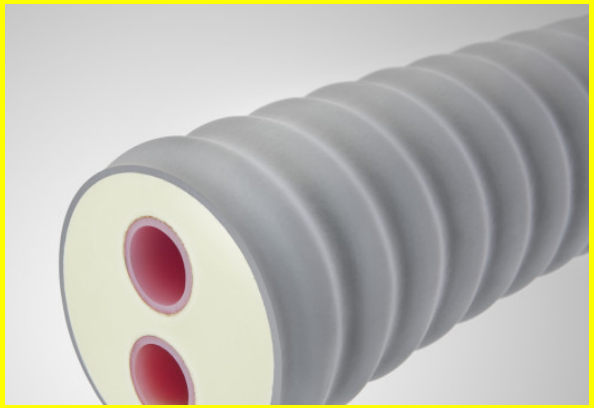
central heat pumps can upgrade this heat to medium temperature



LT heat grids for neighbourhoods > 1975

Collective heat grids on Low Temperature for relative young neighbourhoods.

Individual grids or cascaded form the MT grid



New LT heat sources

Connect different sustainable sources to the grid like:

- Heat from **water bodies**
- **Waste heat** from cooling processes
- **PV-thermal panels**

(+ seasonal storage & Heat pumps)

PV - thermal

Waste heat

Heat pump
Water

Individual all-electric buildings

Buildings outside the denser neighbourhoods with the heat grids become individually **all-electric**

Central electricity production

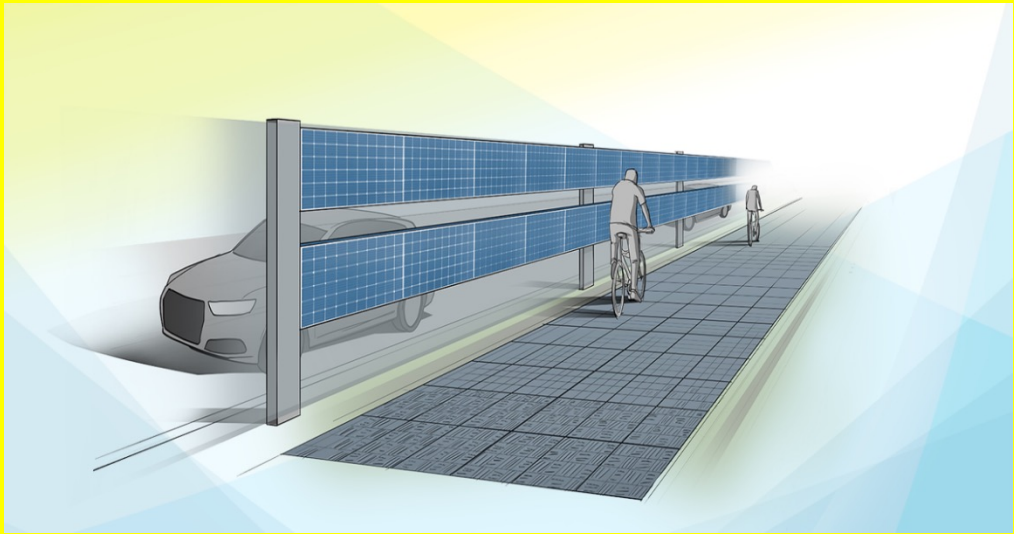
40 ha of PV(T) panels on roofs

60 ha of PV(T)-panels along roads or on green lands

12 wind turbines

1 large water turbine

800 panels/yr (4/working day) until 2050



Urban plan

The Boss
Craig Martin

Carbon Pacman
Riccardo Pulselli

Energy nerds
Andy van den Dobbelsteen
Siebe Broersma
Leo Gommans
Michiel Fremouw

Designer of all
Greg Keeffe → **Craig Martin**

Student Operation Support
Nikoletta Dimitriou
Franziska Mack

Zutphen Urban design strategy

Urban design is effective not efficient!!

How do we use the heritage infrastructure to our advantage?

How do we better connect the city to its landscape

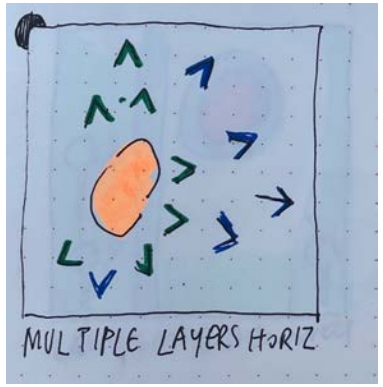
How do we better connect the city to itself

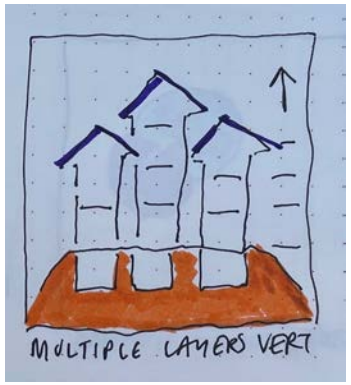
And be more resilient - less carbon, better equipped to deal with climate change

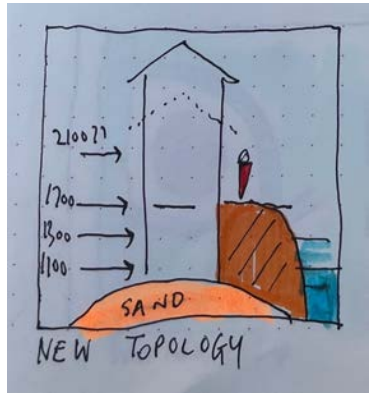
Oh – and reduce the average distance to a café! (at present 2km – Dutch average 1.2km)

Zutphen. And and AND

- **Serious Heritage**
- Continual adaptation
- Multiple layers – 2 directions
  City growth horizontally
  City growth vertically
- New topology
- Denial of the river







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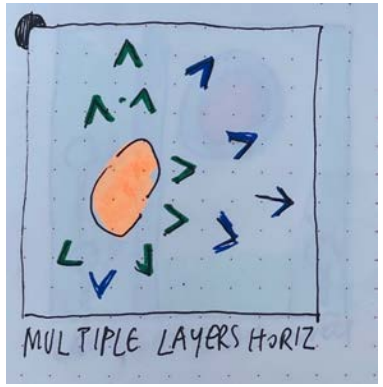

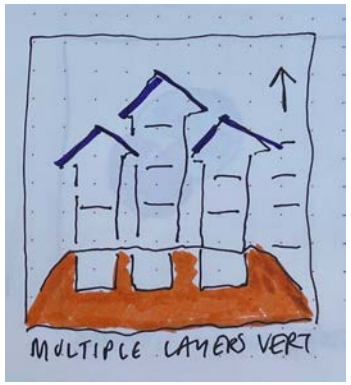

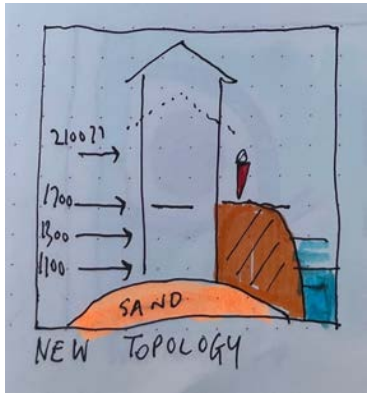

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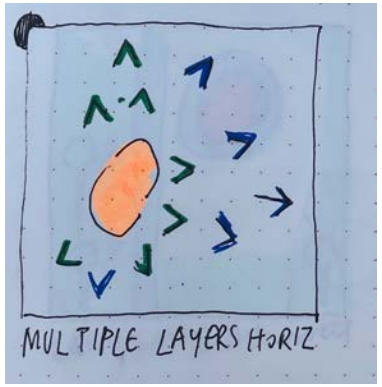

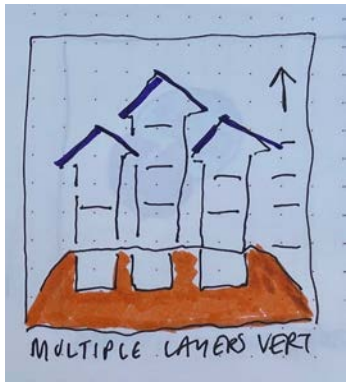

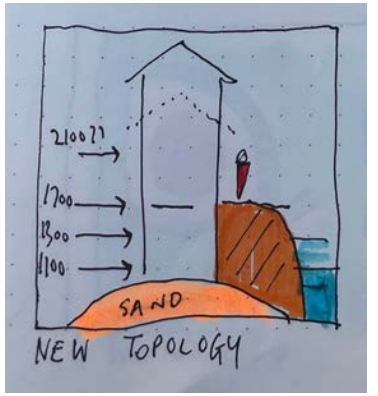

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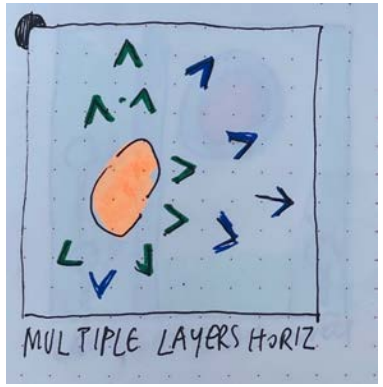

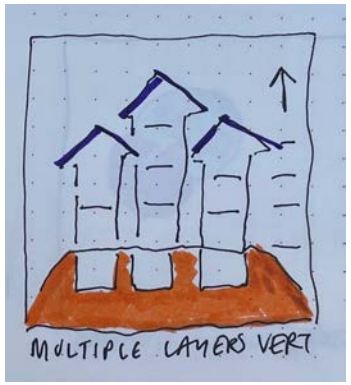

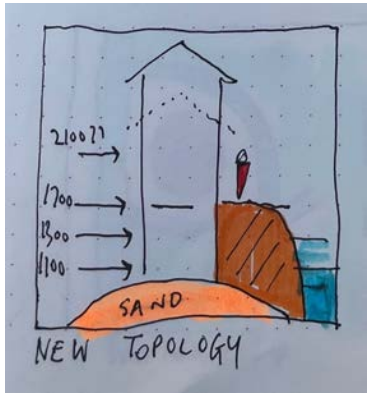

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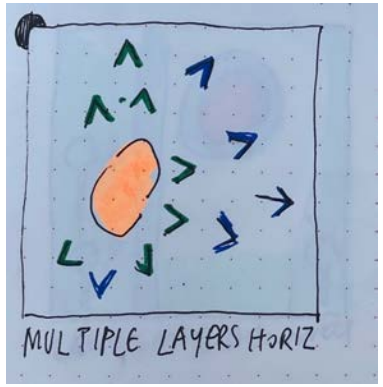

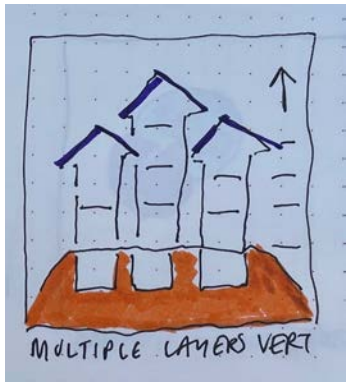

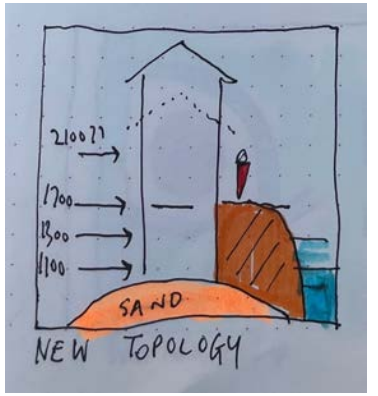

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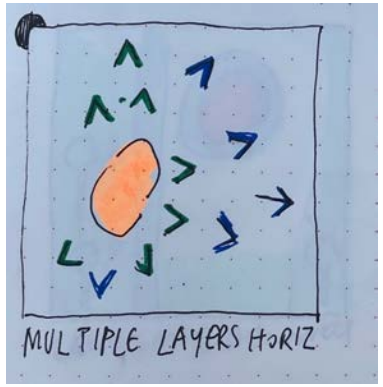
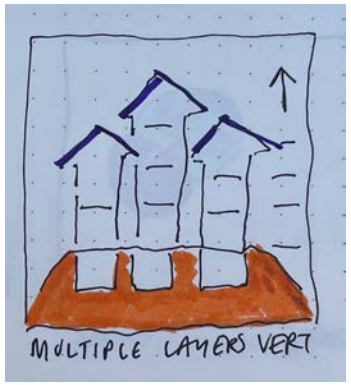
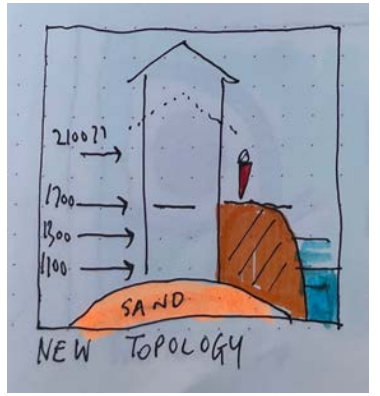
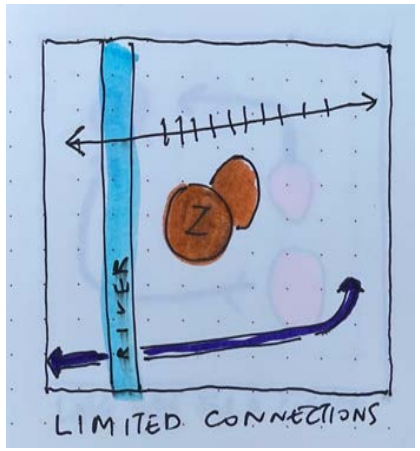


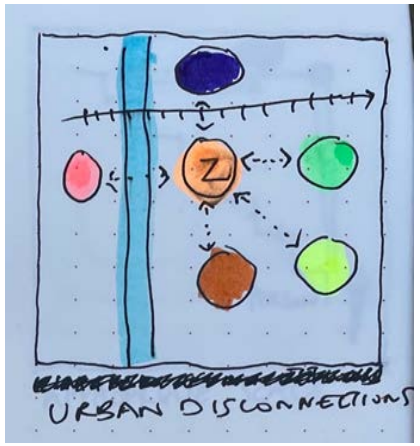


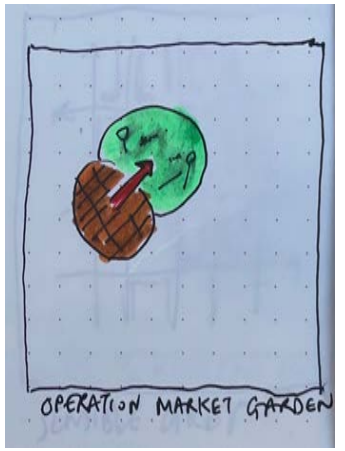


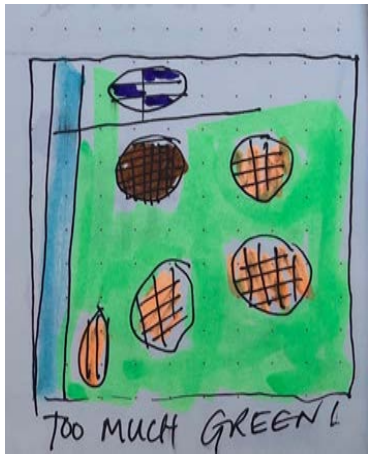
Zutphen. And and AND

- **Limited connections**
- Water city
- Landscape disconnection
- Urban disconnection
- Operation market garden
- Too much green!









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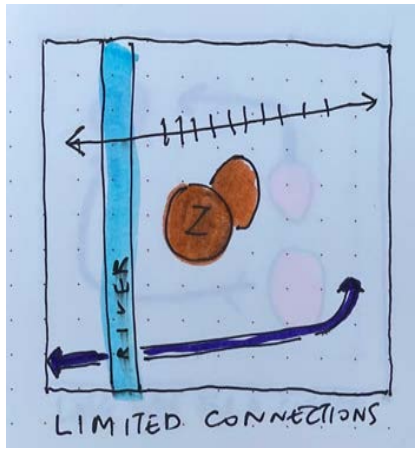

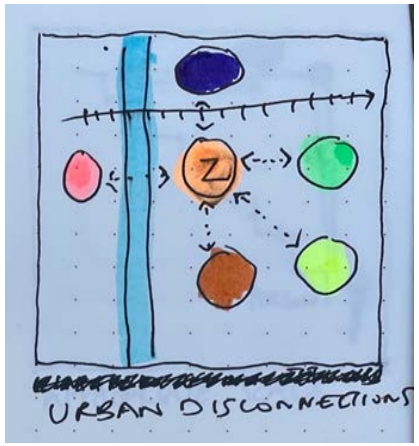

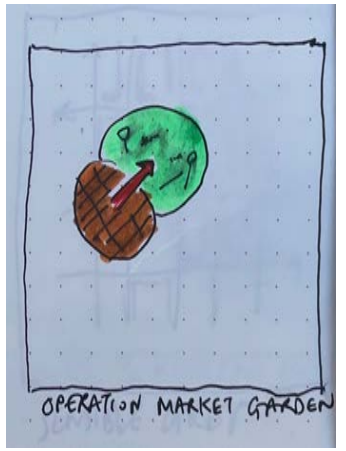

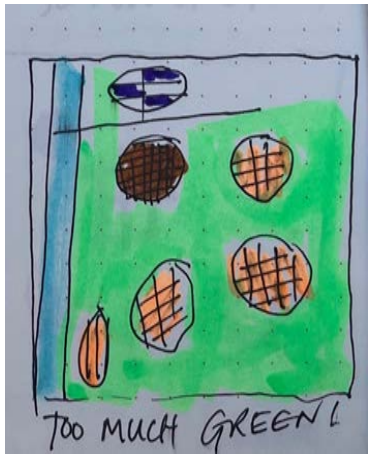

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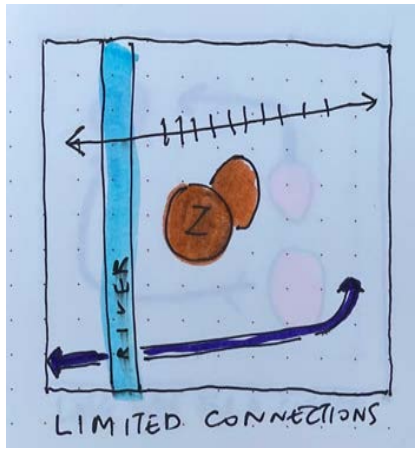

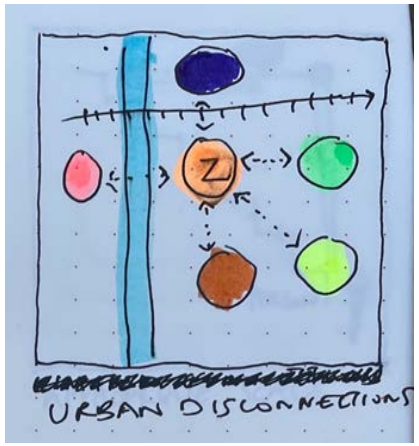

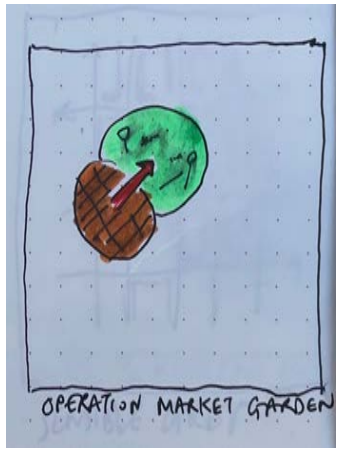

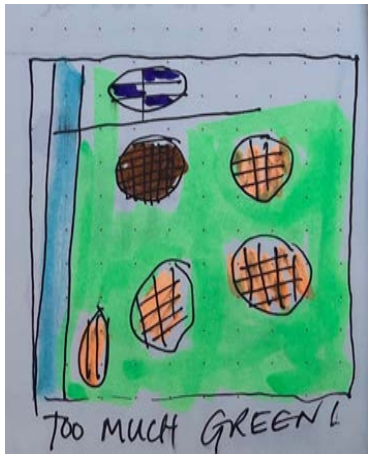

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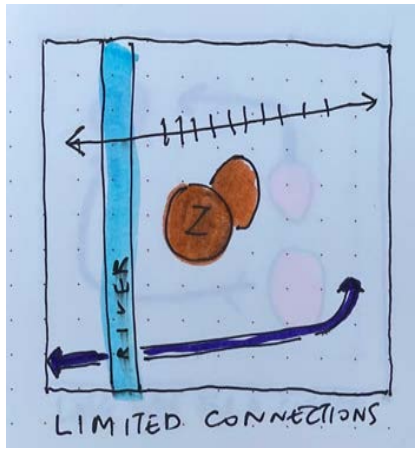

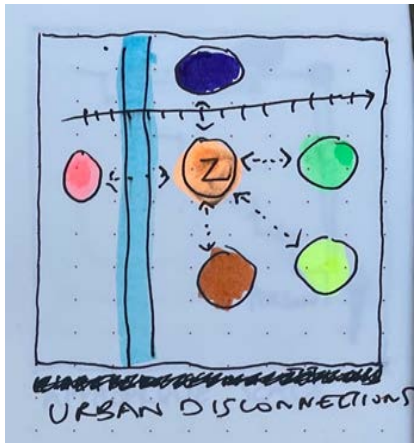

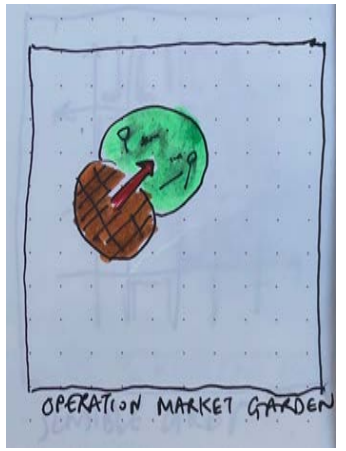

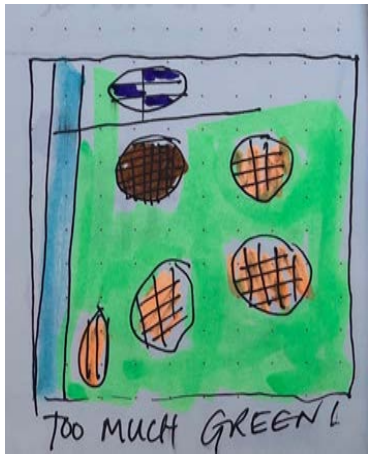

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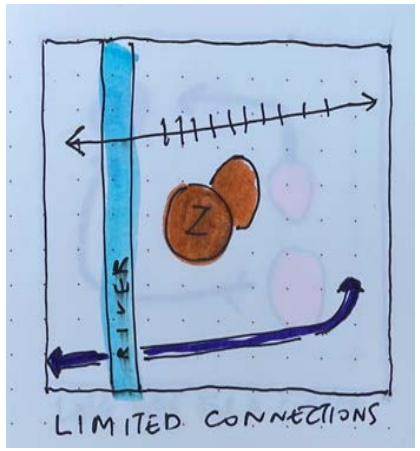

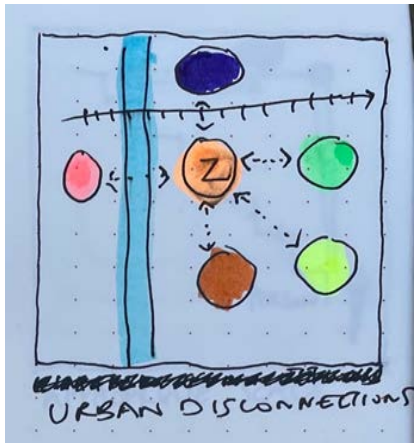

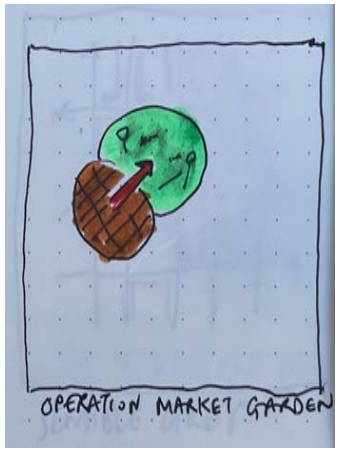

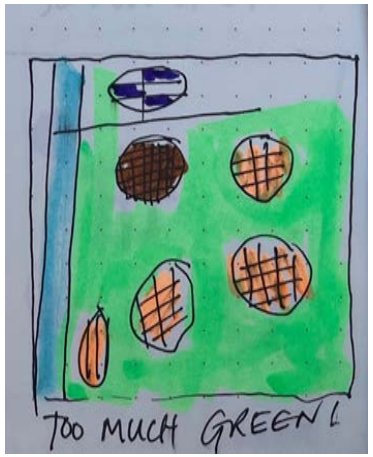

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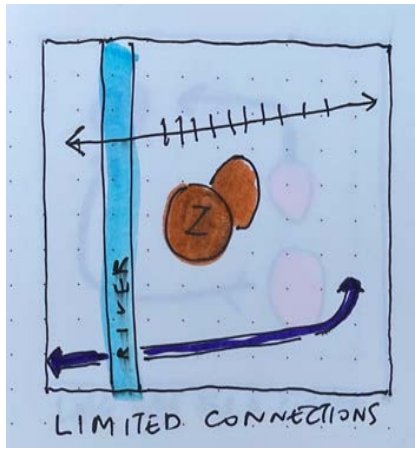
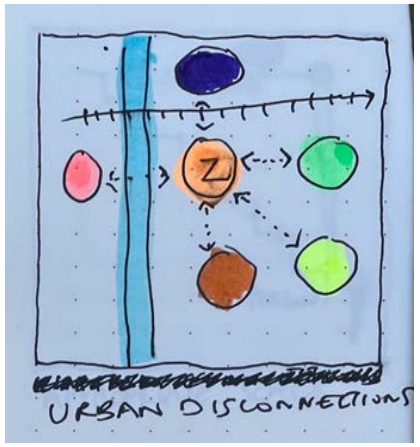
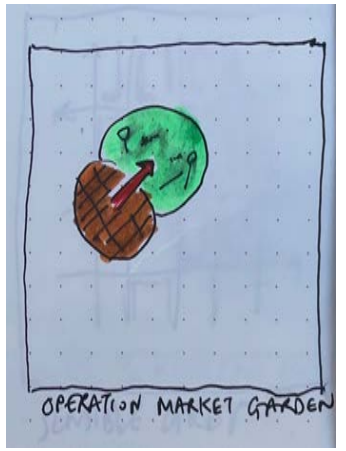
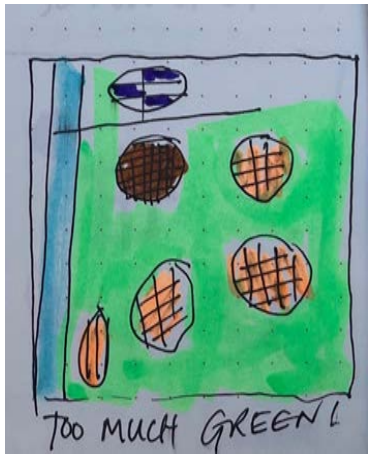


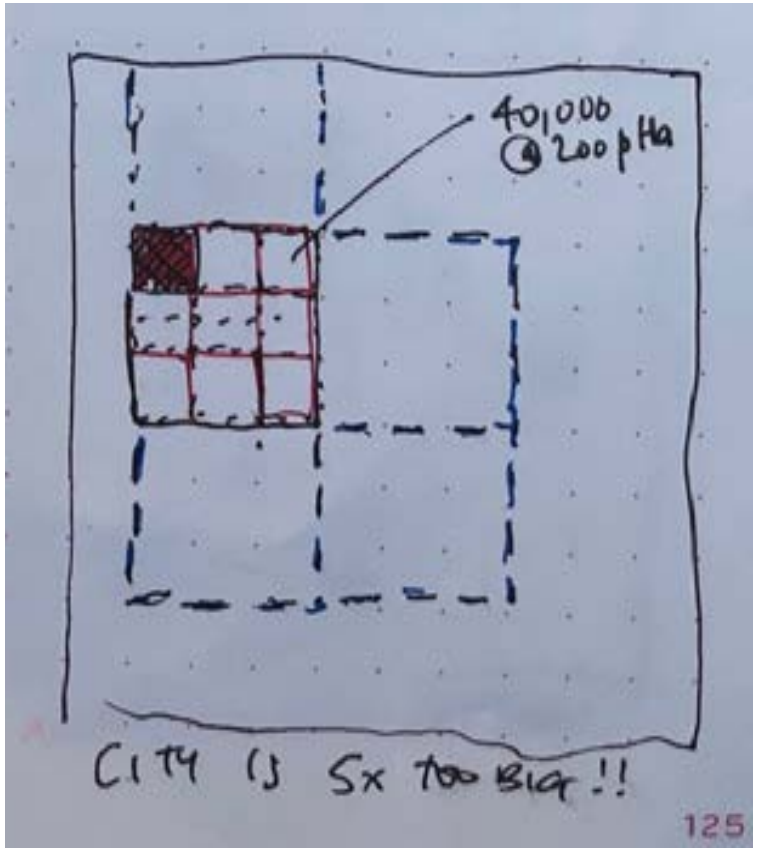


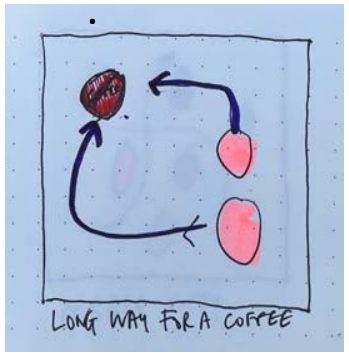


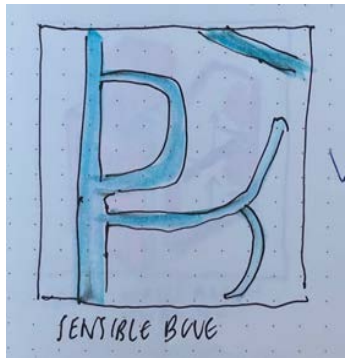


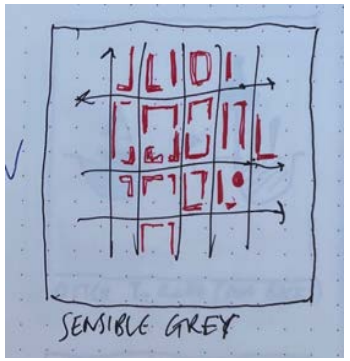
The city is 5 times too big (at least)

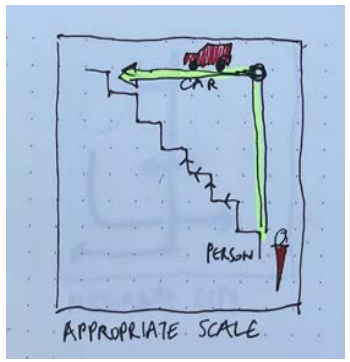
- Long way for a coffee
- Sensible blue
- Sensible grey but not commensurate with grey
- Appropriate scale
- Additive history (vertical)
  Different paradigms
- Layered history (horizontal)
  Different paradigms

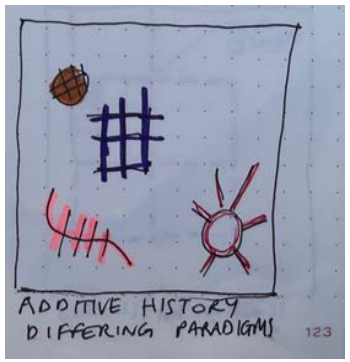








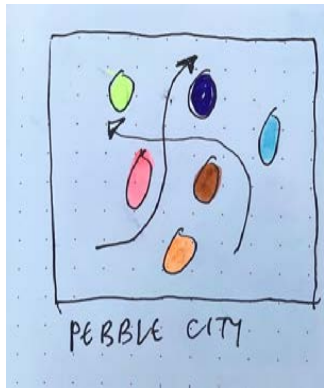


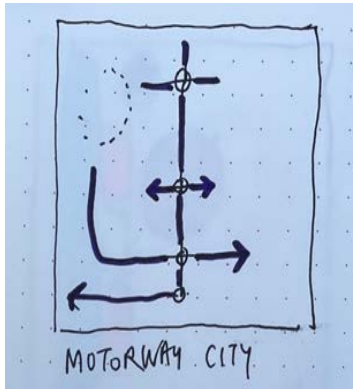


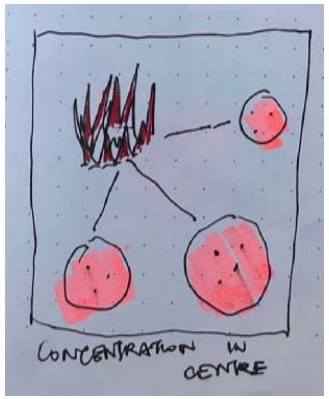
- Pebble city
- Motorway city
- Concentration of function in centre
  but poor connection.

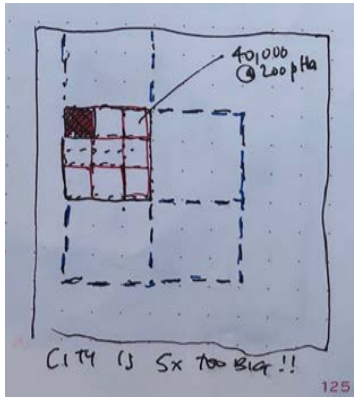
Good adaptations

- Cross walls allow change
- Ditch to road.
  And back again



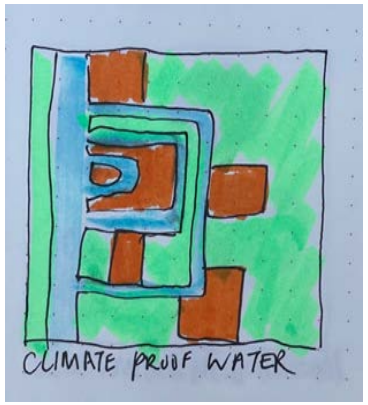


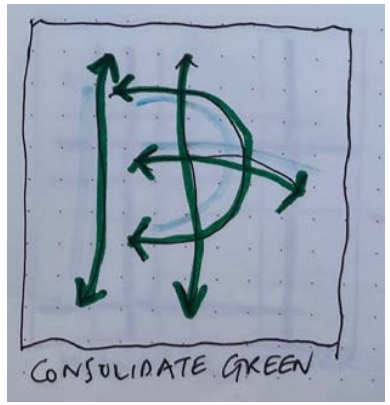




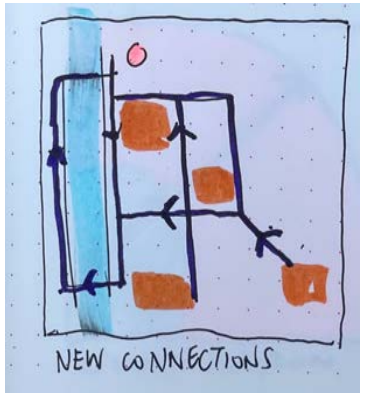
Morphology

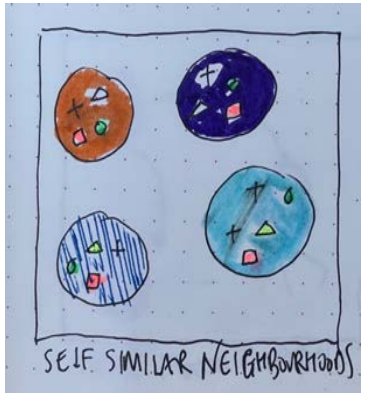
- Streets not roads
- Climate proof water (flow/storage/drain)
- New waterfront
- Grand unifying theory
  (make the city be one)
- Through not round
- Consolidate green network (disappears)

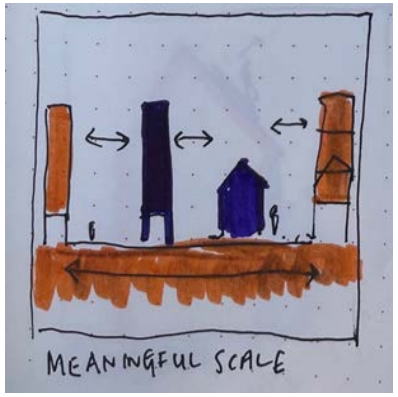


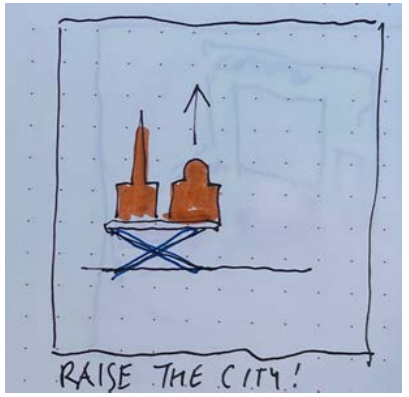


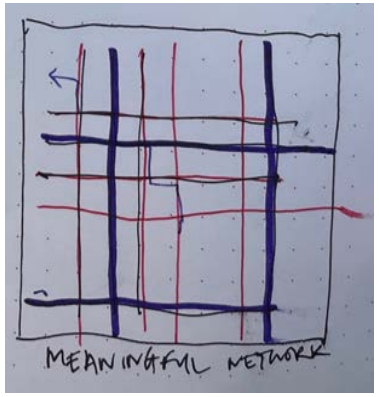
- New connections
- Self similar neighbourhoods
- Meaningful scale of network
- Densify and reconfigure
- Raise the city!!
- Meaningful network





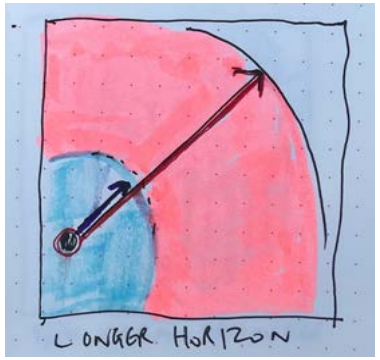


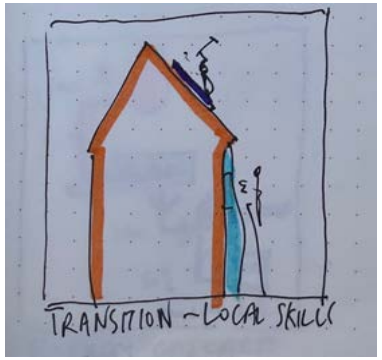


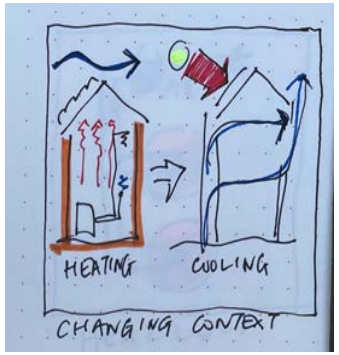


Content

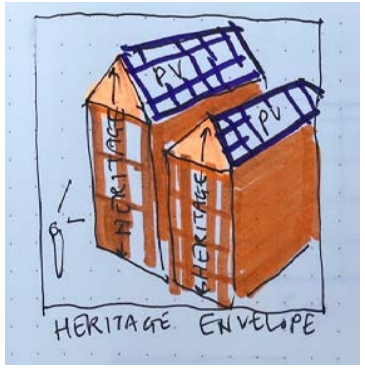
- Longer horizon vision
- Transition – local skills
- Take food to the people (unpack food locally)
- Changing context
- Café society
- Locally based skills
- New high streets – with energy centres (offering advice)

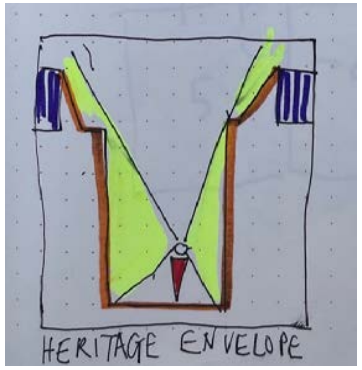


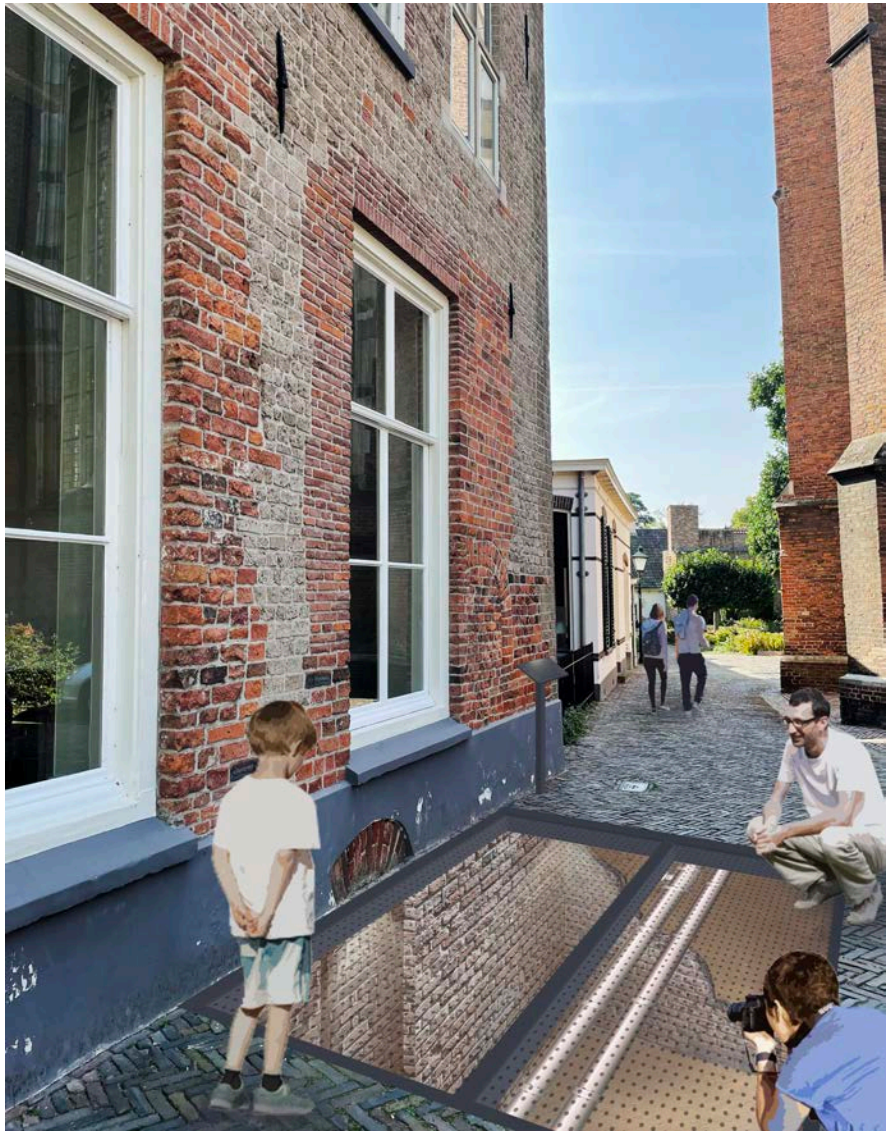




- **Heritage envelope**
- Demountable Climate Protection
- Rewild the city
- Can you change without changing???







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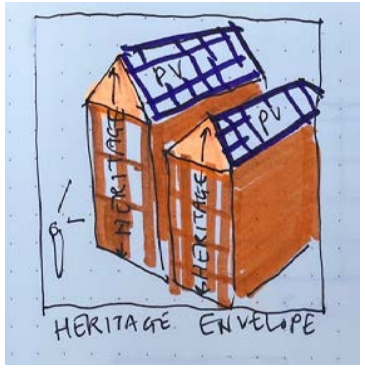

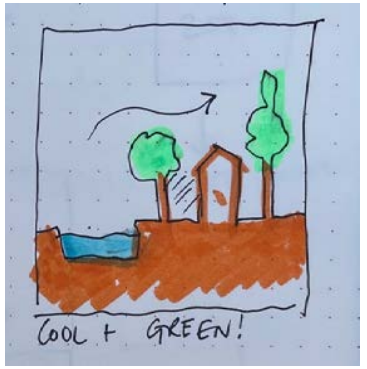

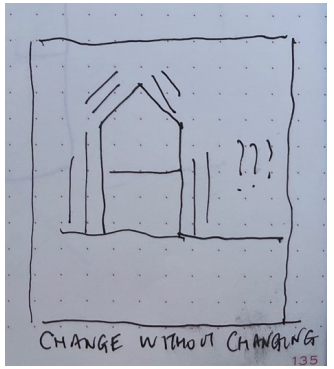

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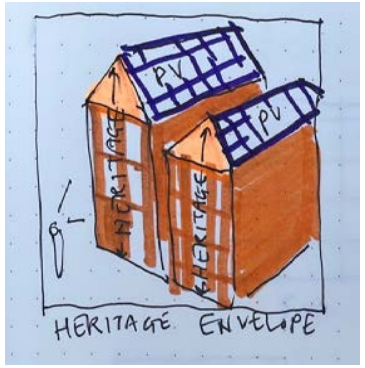

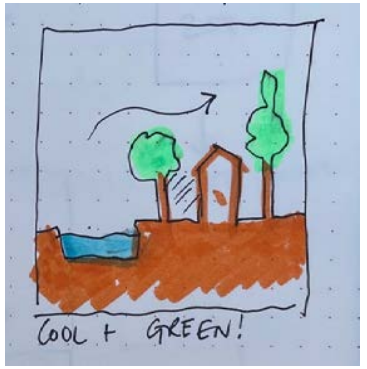

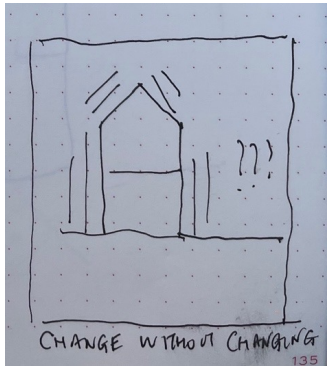

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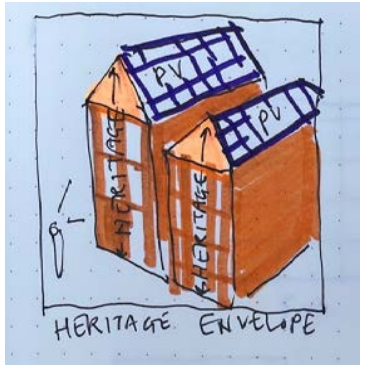
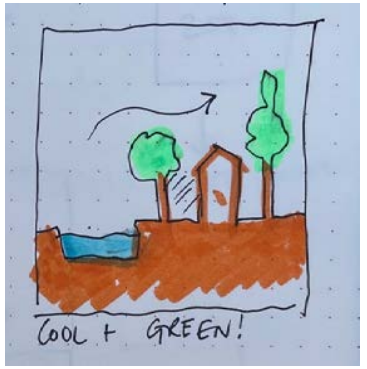
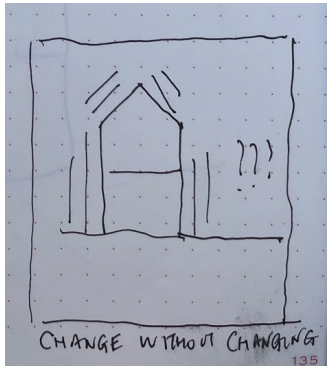


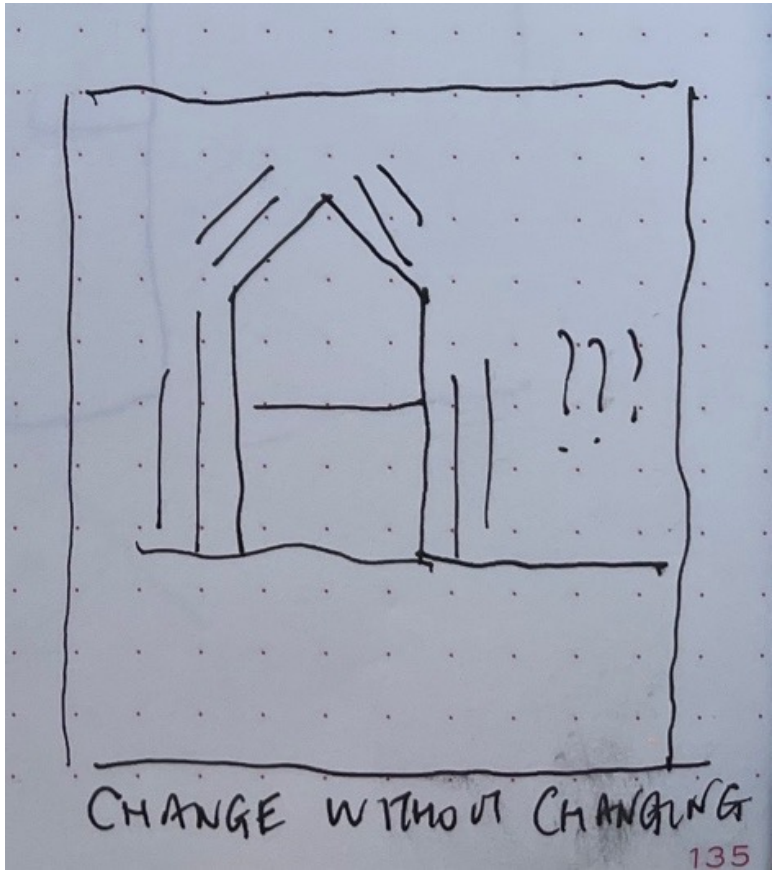


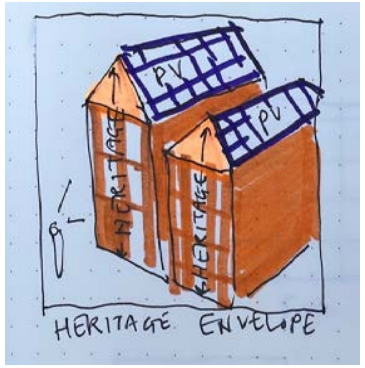


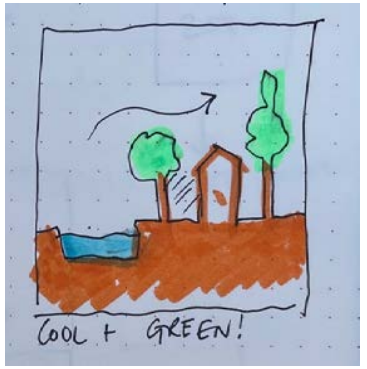

REWILD THE CITY


REWILD THE CITY

- Heritage envelope
- Demountable Climate Protection
- New urban agriculture
- Rewild the city
- **Can you change without changing???**

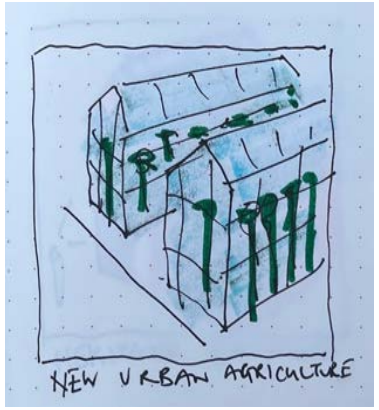


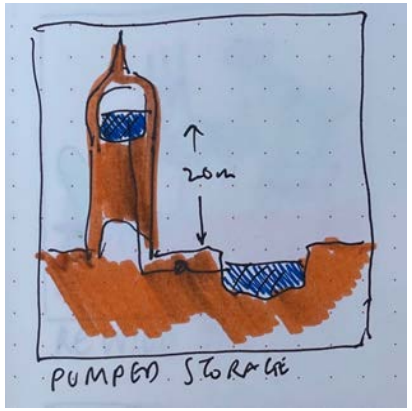


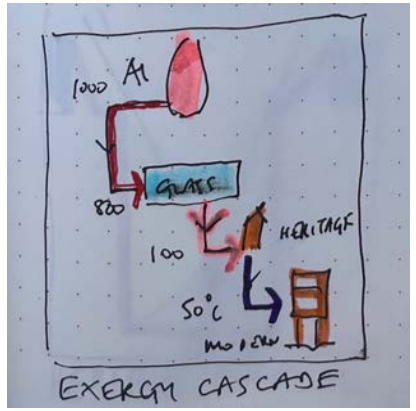


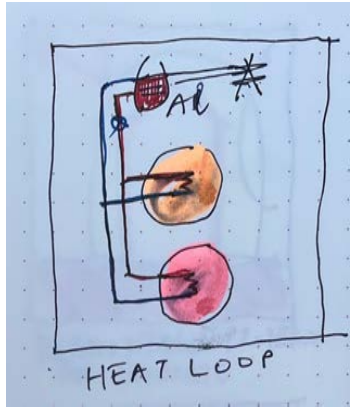
Energy

- New urban agriculture
- Pumped storage
- Exergy cascade
- Heat loop
- Cellar storage heat
- Nested system









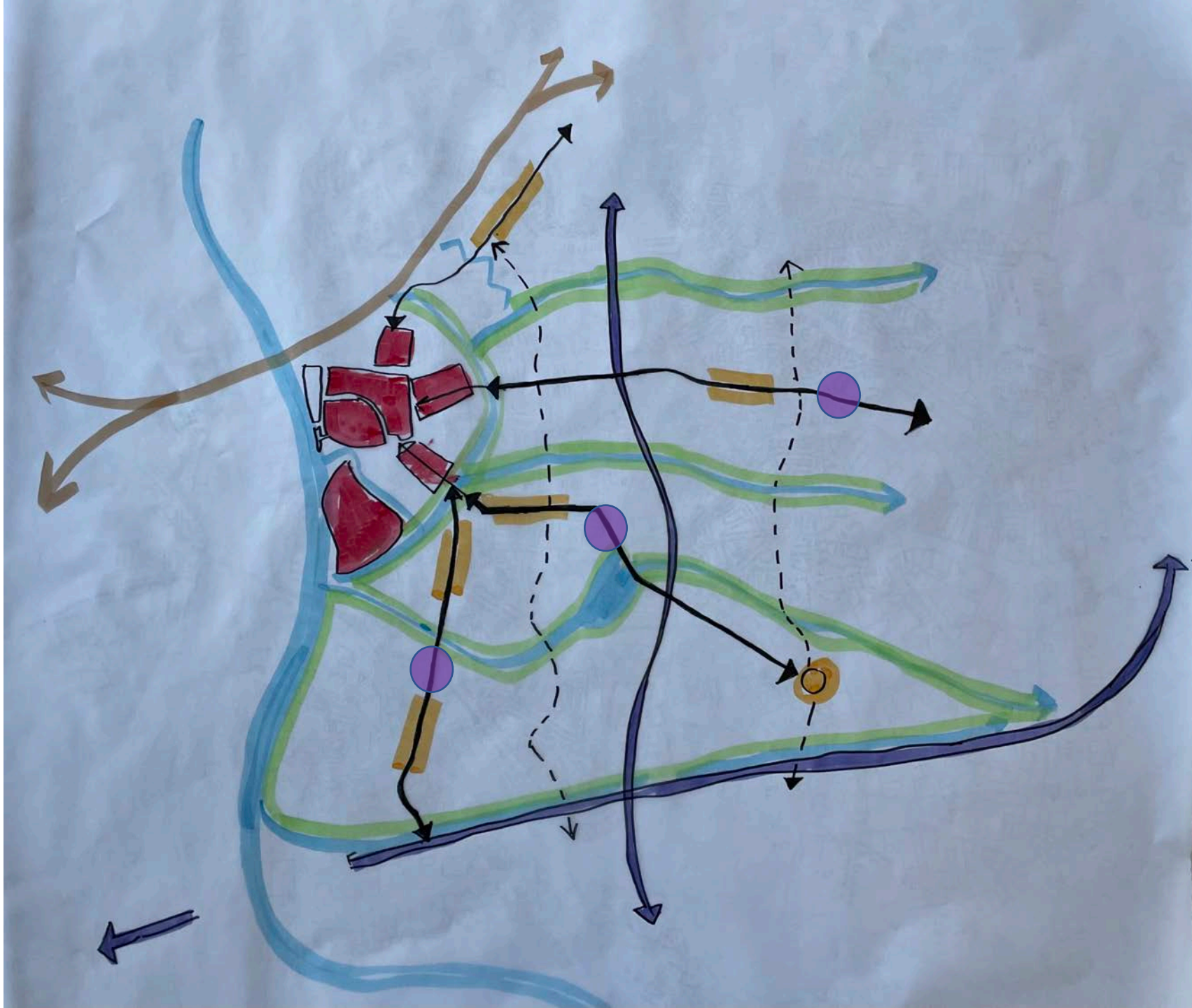
The city

Plan

Greening

new connections

Education / Schools



The waterfront

The waterfront

The waterfront
(New surface)

The waterfront

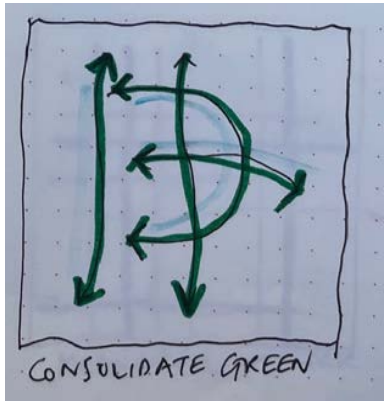
The waterfront

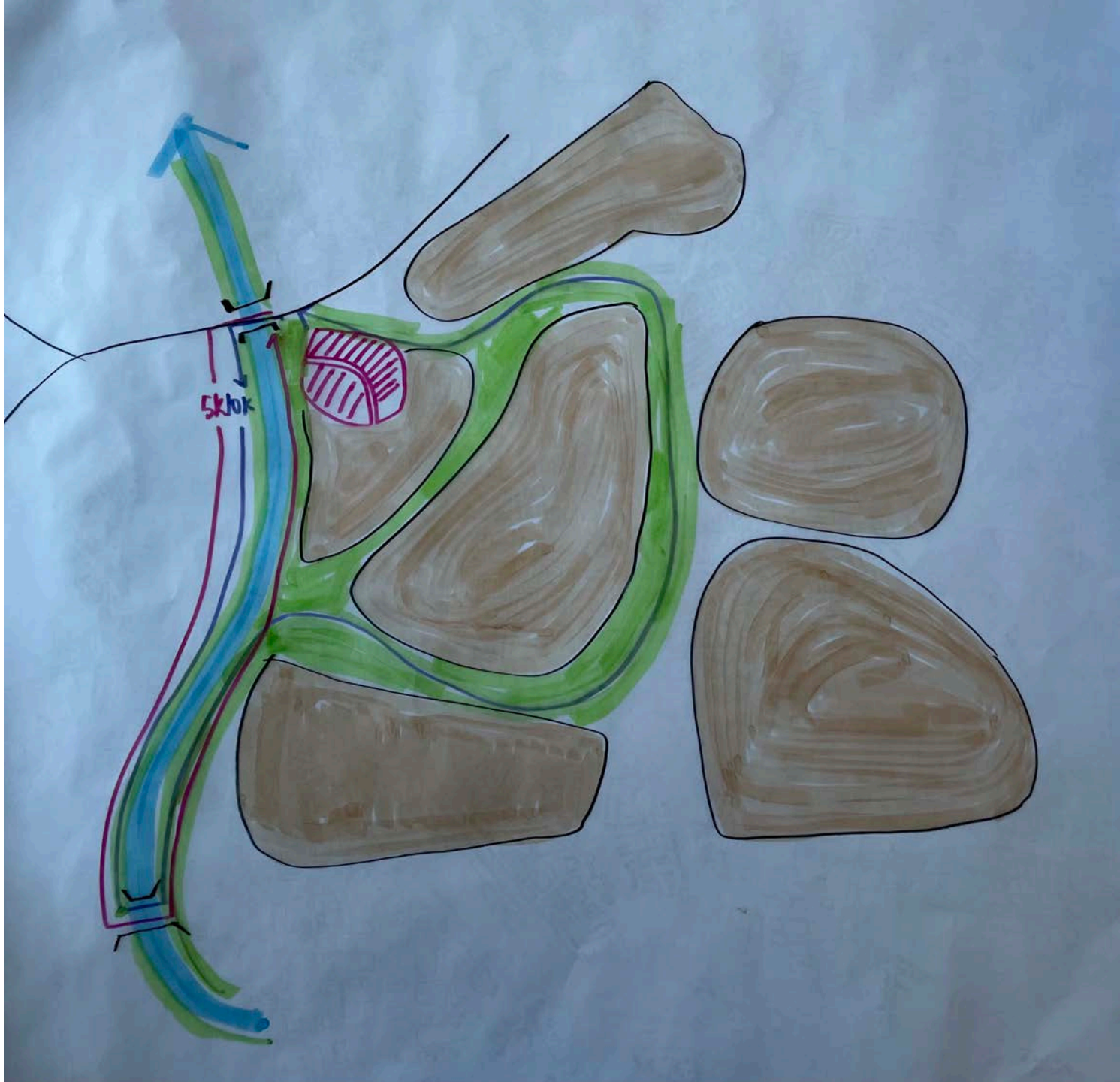
The waterfront

The waterfront

The waterfront

Running track





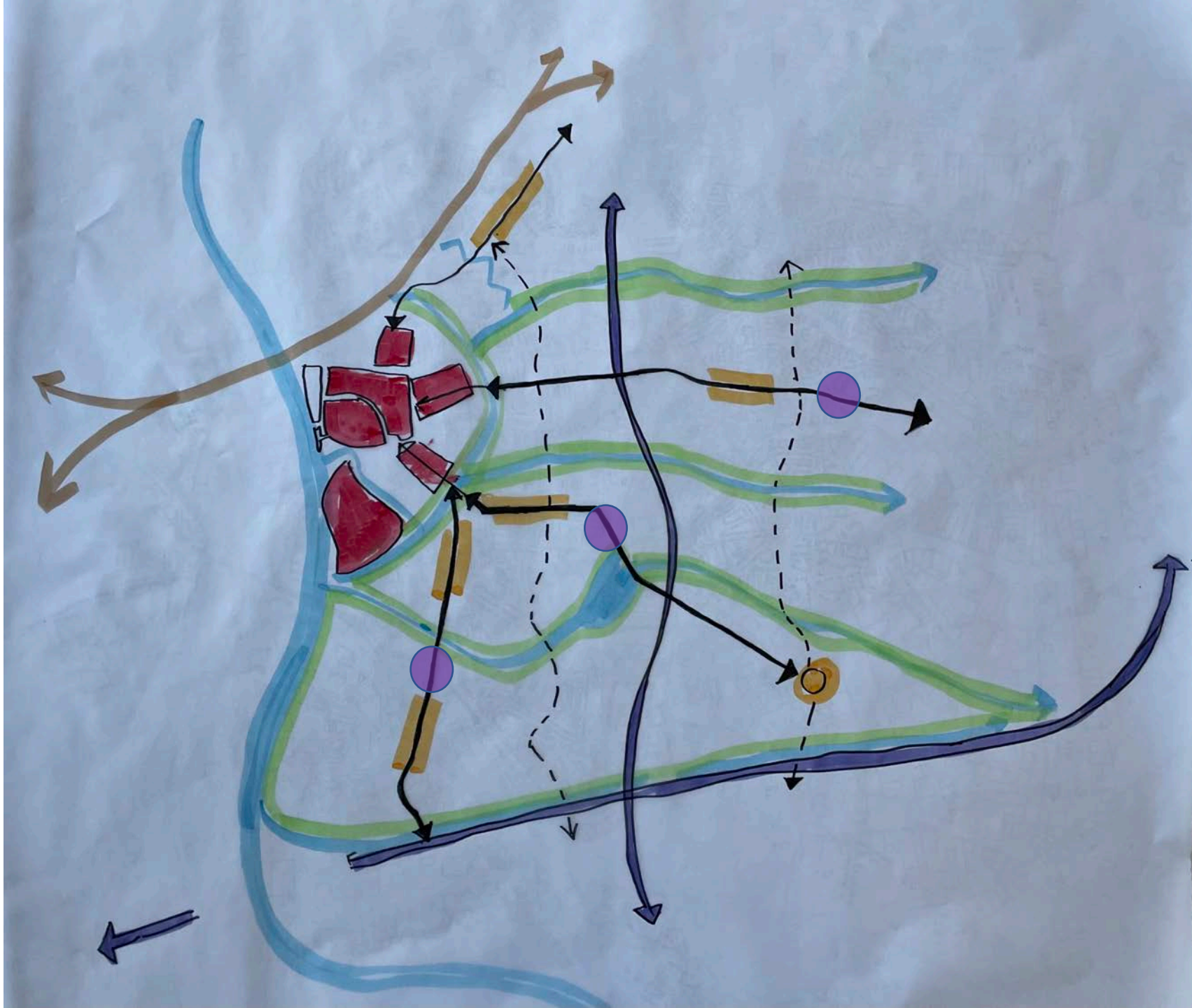
The city

Plan

Greening

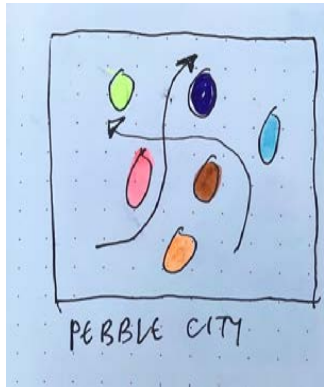
new connections

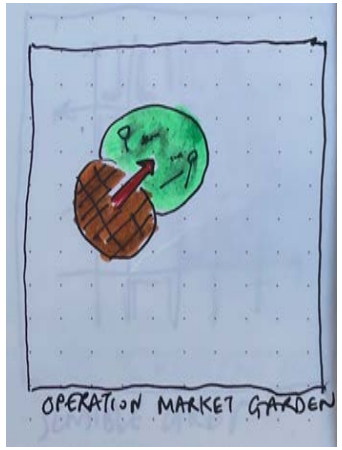
Education / Schools



The neighbourhood

Leesten
(one of the pebbles)




OPERATION MARKET GARDEN


Maria Kloosterstraat
MED Zutp


Bonmarché

Hi I’m Annelies. I live in the historic part. It used to be a bit of a themepark – completely disconnected from the rest of Zutphen, but the new grey infrastructure has changed all that. People from the whole city are coming into the centre now and its got a much more cosmopolitan feel.

You really notice it at the weekend when the 5 and 10k jogging routes along the river and round the town are alive with people. The safe e-routes for the kids are brilliant for getting around and my kids can visit their friends all over the city.

We also have heritage photovoltaics on our apartment which means we get power for free. History and the future mixed up is cool!

Hi, I’m Omar and I’m one of the new farmers in the city. I live in the burbs and I was always wondering why we never did anything with all the green space around the town except mow it!!

Now we have two sorts of green – greenhouses and wilderness! The combination of these is brilliant. I get to work on local food production, and it’s great to see all the wildlife coming back into the city…

Hi, I'm Ric, I'm 15 and still at School. I live in Leesten. We used to not feel part of the city at all, but the recent changes have made the whole place feel different. We now have a shopping centre that stays open into the evening so we can hang out, and the free electric scooters and the safe route to the city mean that my mum let me go into the centre in the evening. Its great, even in winter, we can play 5-a-side by the river as the pitches are heated by the energy store.

Carbon performance

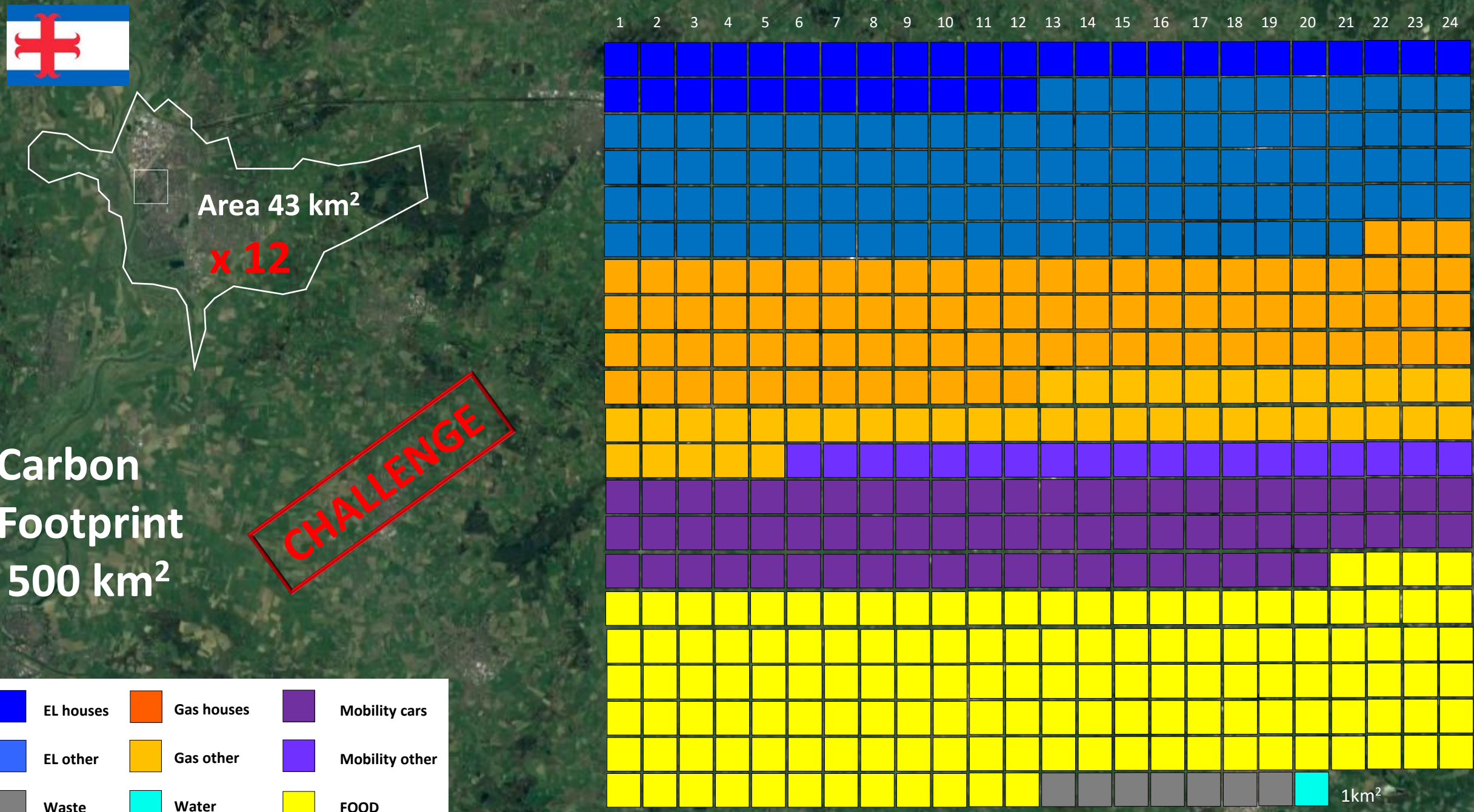
The Boss
Craig Martin

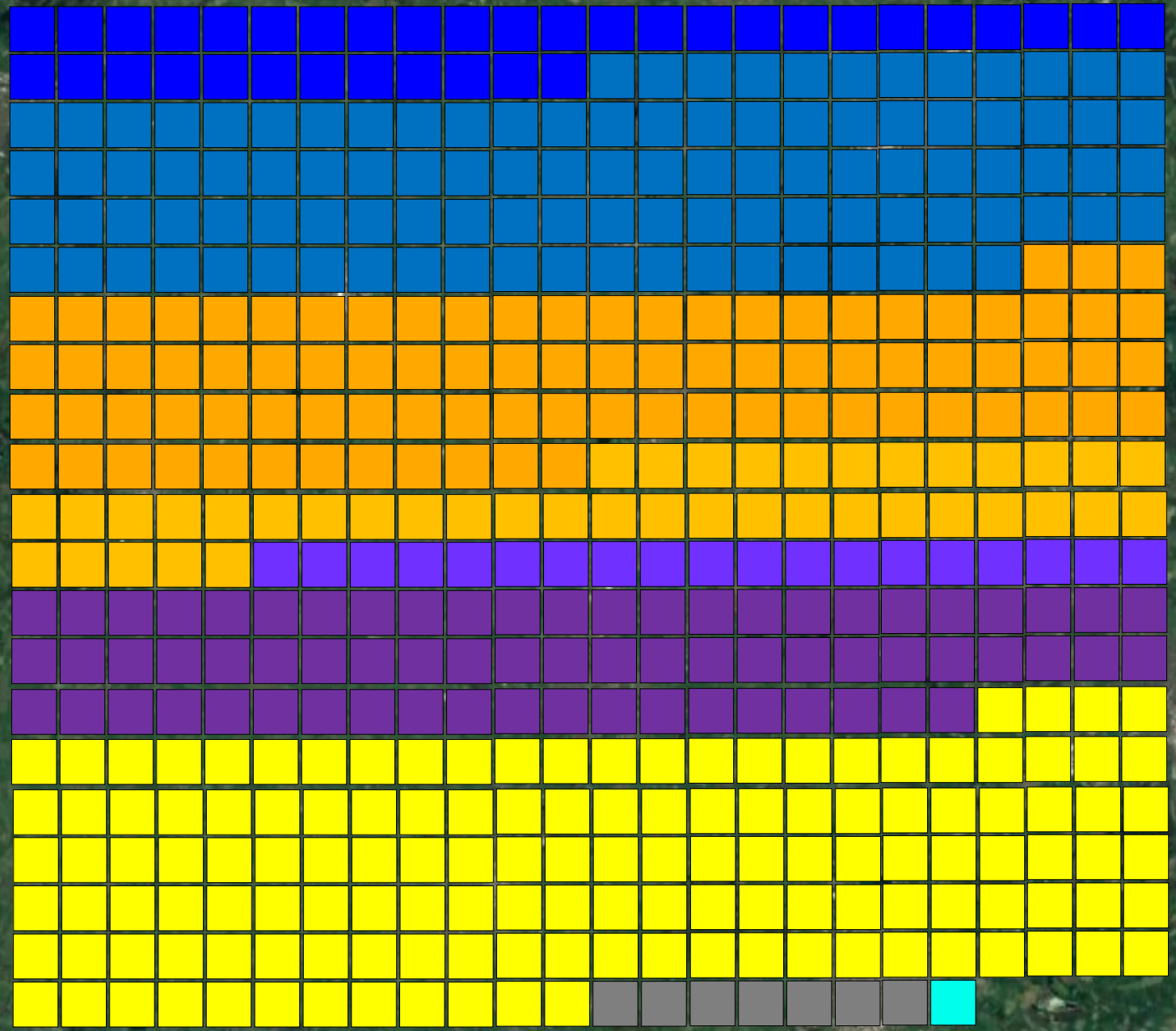
Carbon Pacman
Riccardo Pulselli

Energy nerds
Andy van den Dobbelsteen
Siebe Broersma
Leo Gommans
Michiel Fremouw

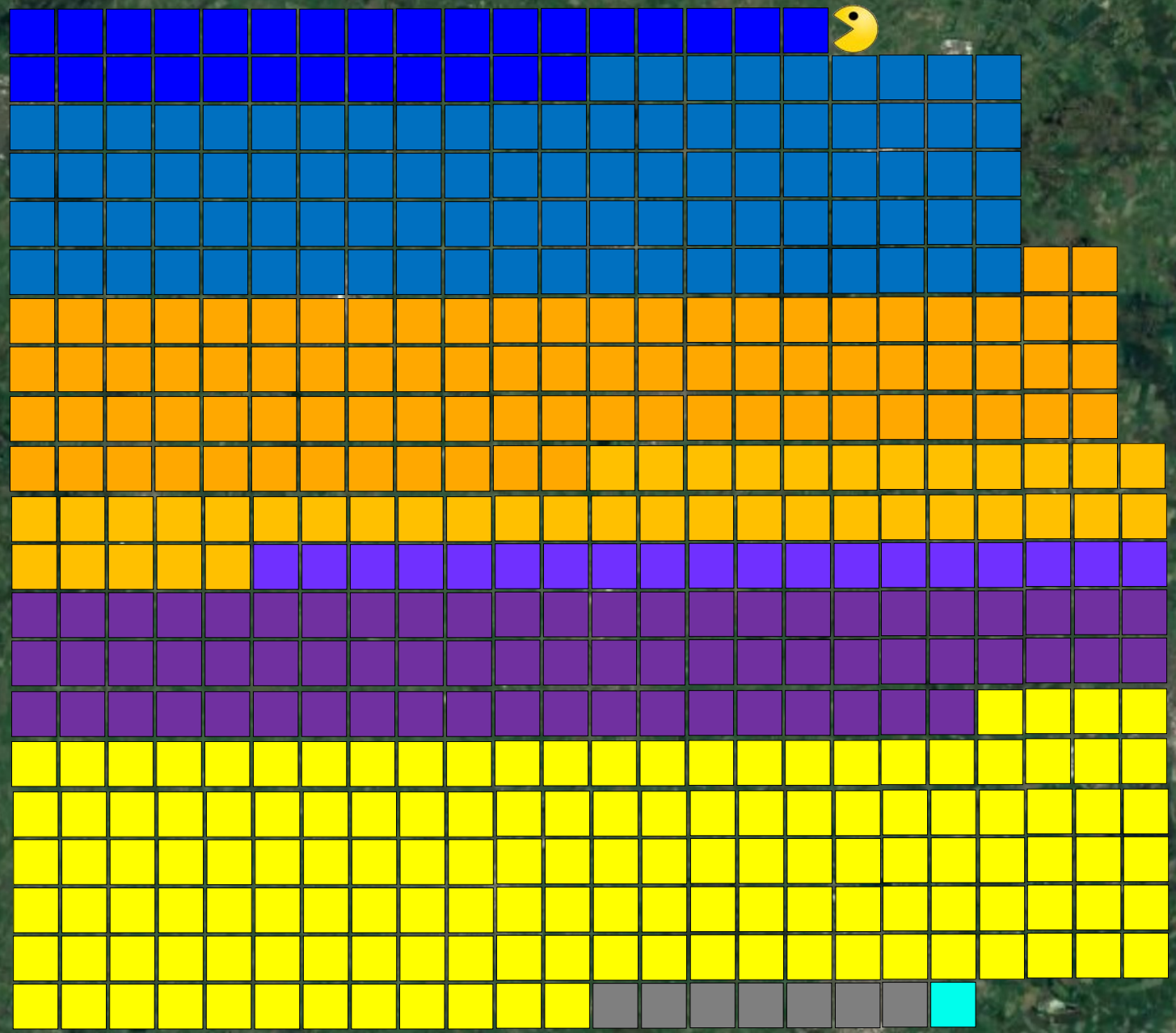
Designer of all
Greg Keeffe → **Craig Martin**

Student Operation Support
Nikoletta Dimitriou
Franziska Mack


Area 43 km²
x 12
CHALLENGE
Carbon Footprint 500 km²
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
1km²
EL houses
Gas houses
Mobility cars
EL other
Gas other
Mobility other
Waste
Water
FOOD



Let’s start!



01

People behaviour

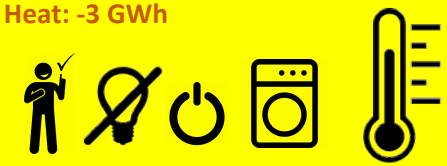
Energy saving in buildings

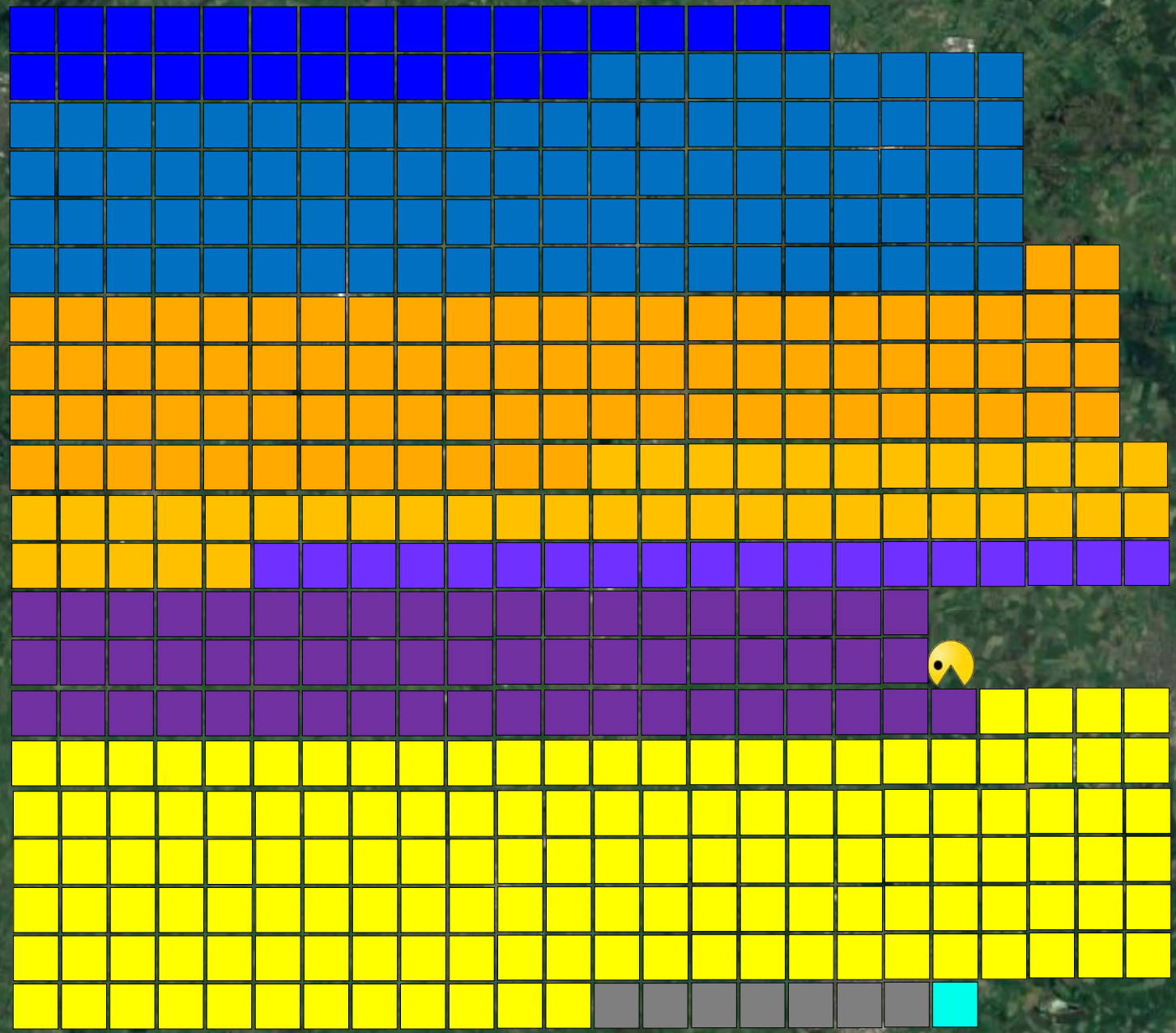
70% deployment;

-10% EL; -10% heat

EL: -10 GWh houses, - 17 GWh offices

Heat: -3 GWh





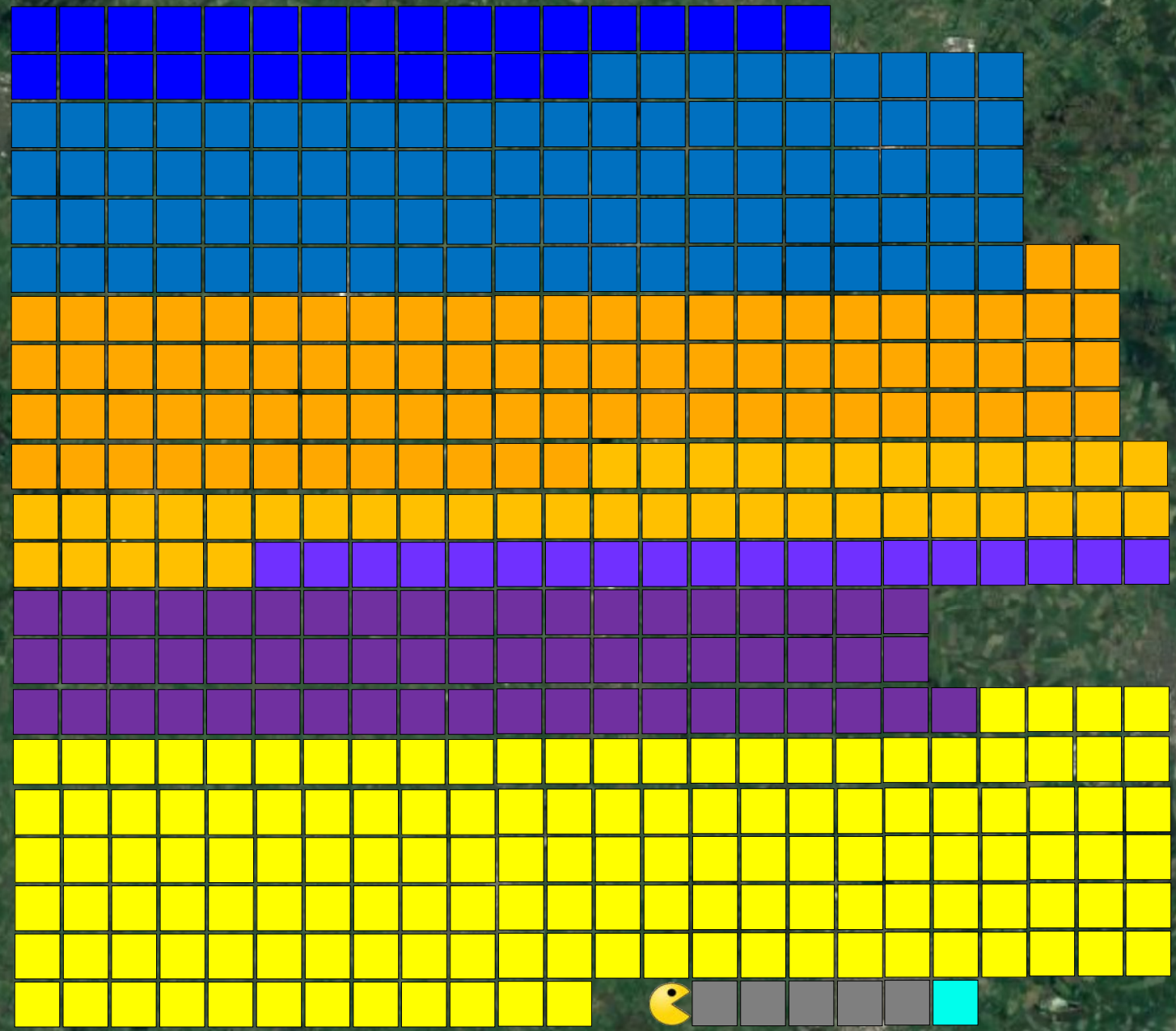
02

People behaviour

Energy saving in mobility

30% deployment;

-50% car use

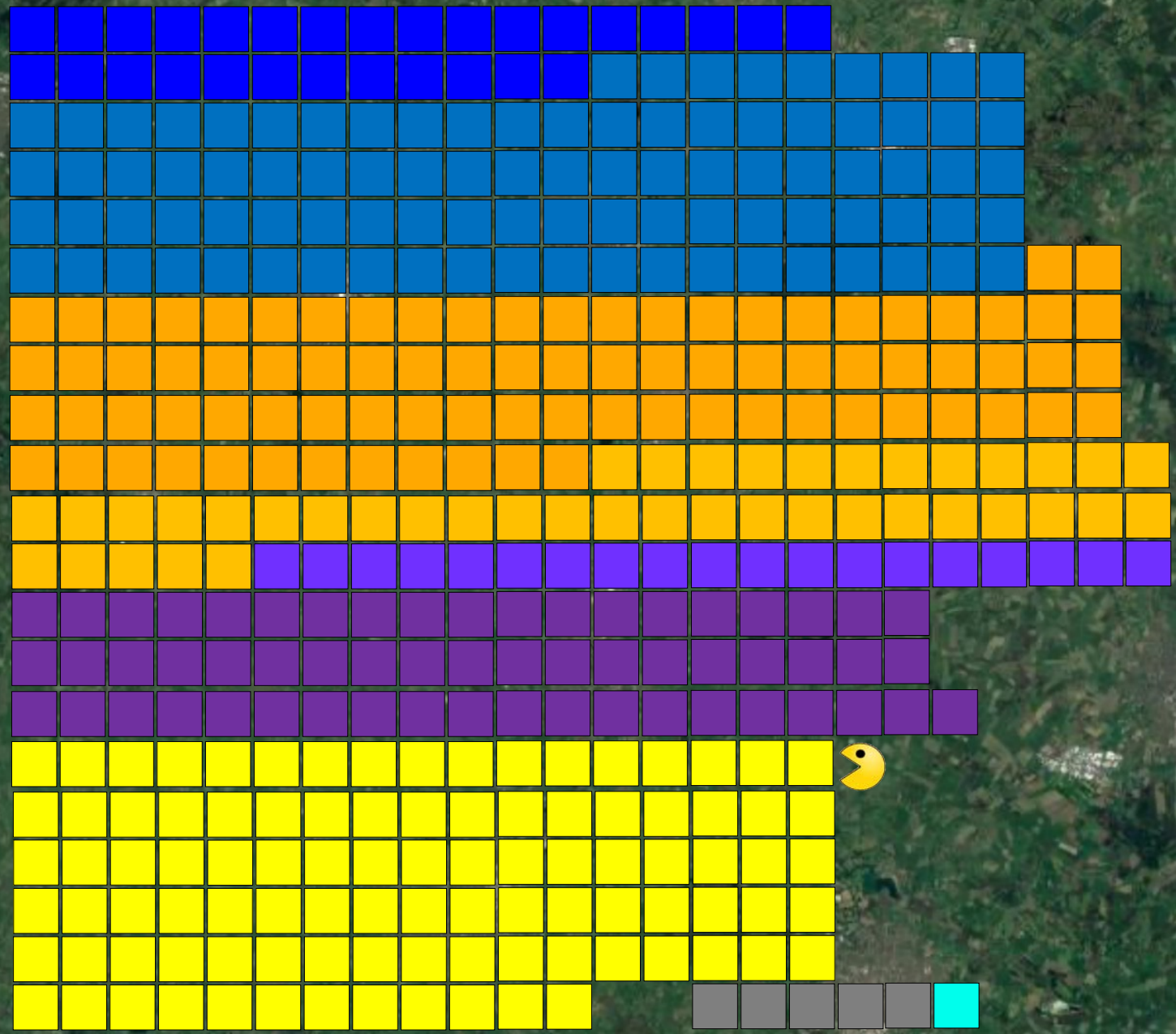


03

People behaviour

Waste production

50% deployment;
30% more efficient recycling and circular economy initiatives

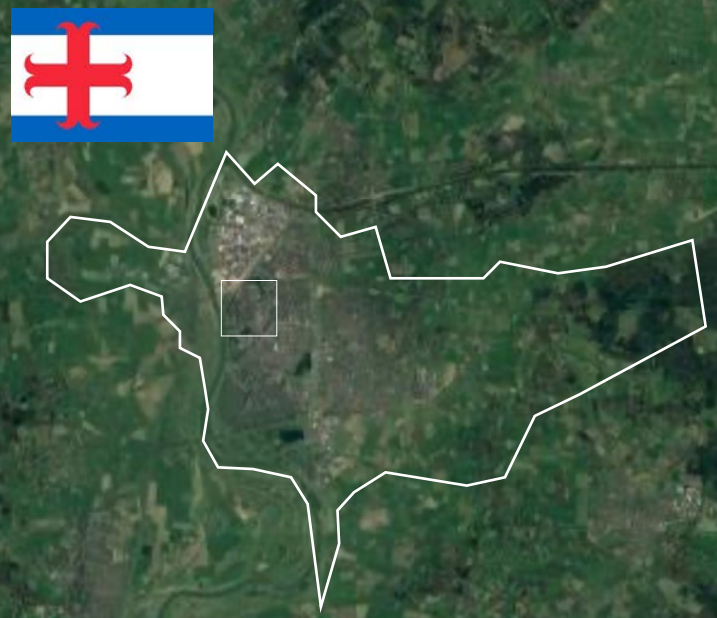


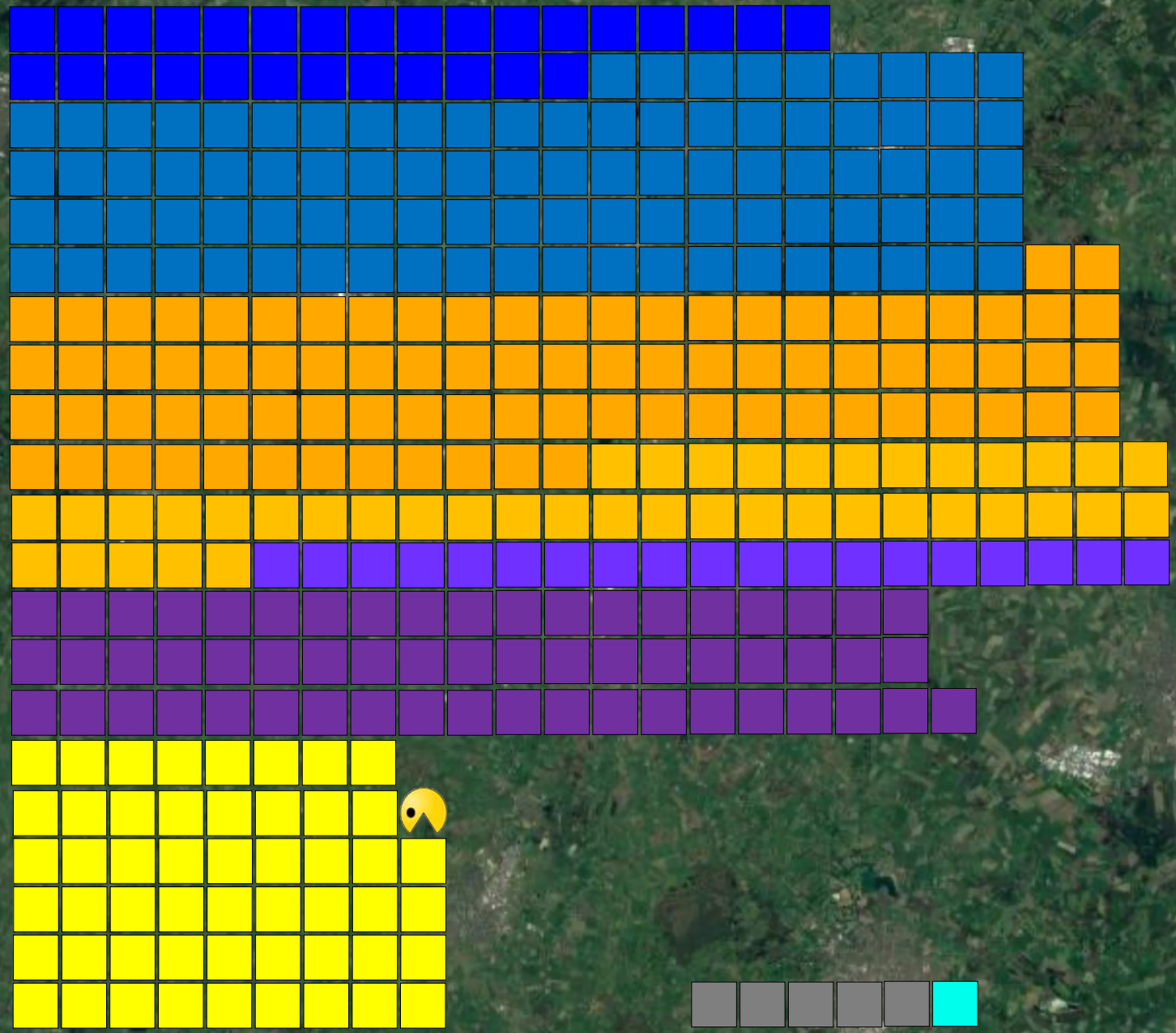
04

People behaviour

Balanced diet

80% deployment;
From plus meat to balanced





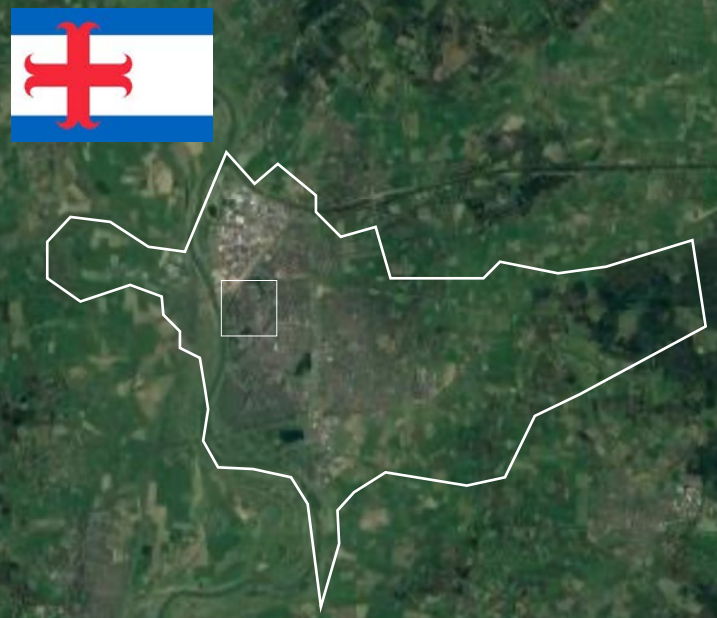
05

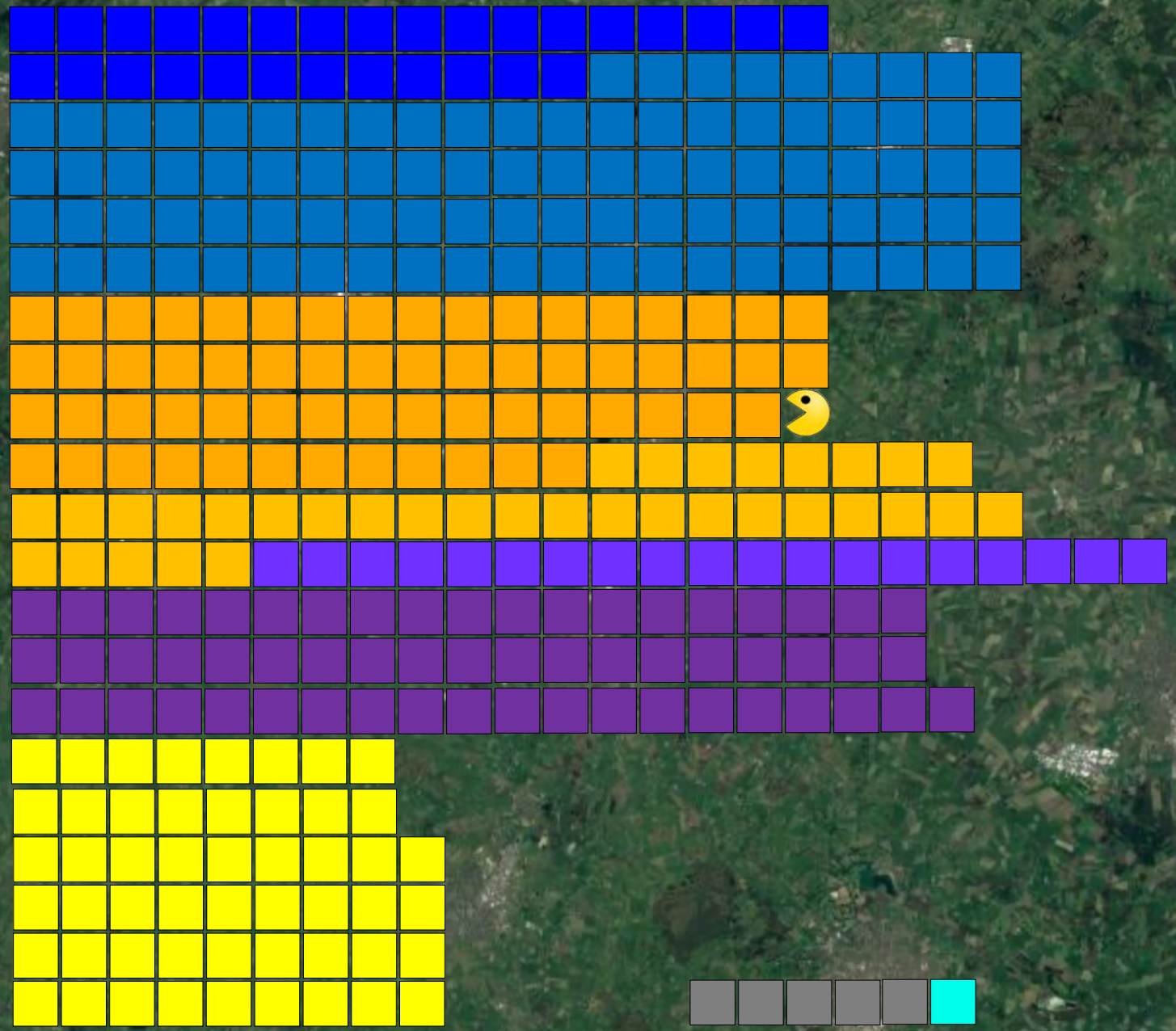
People behaviour/policy

Local food

100% deployment;

50% Local Food





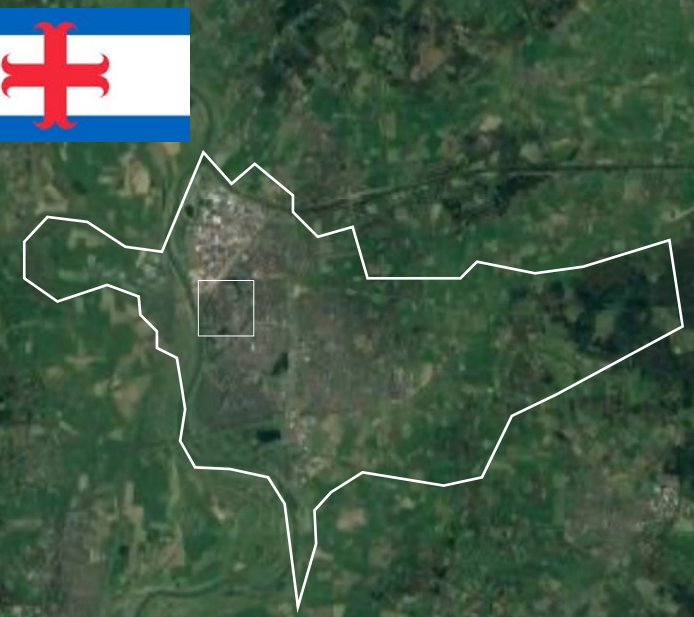
06

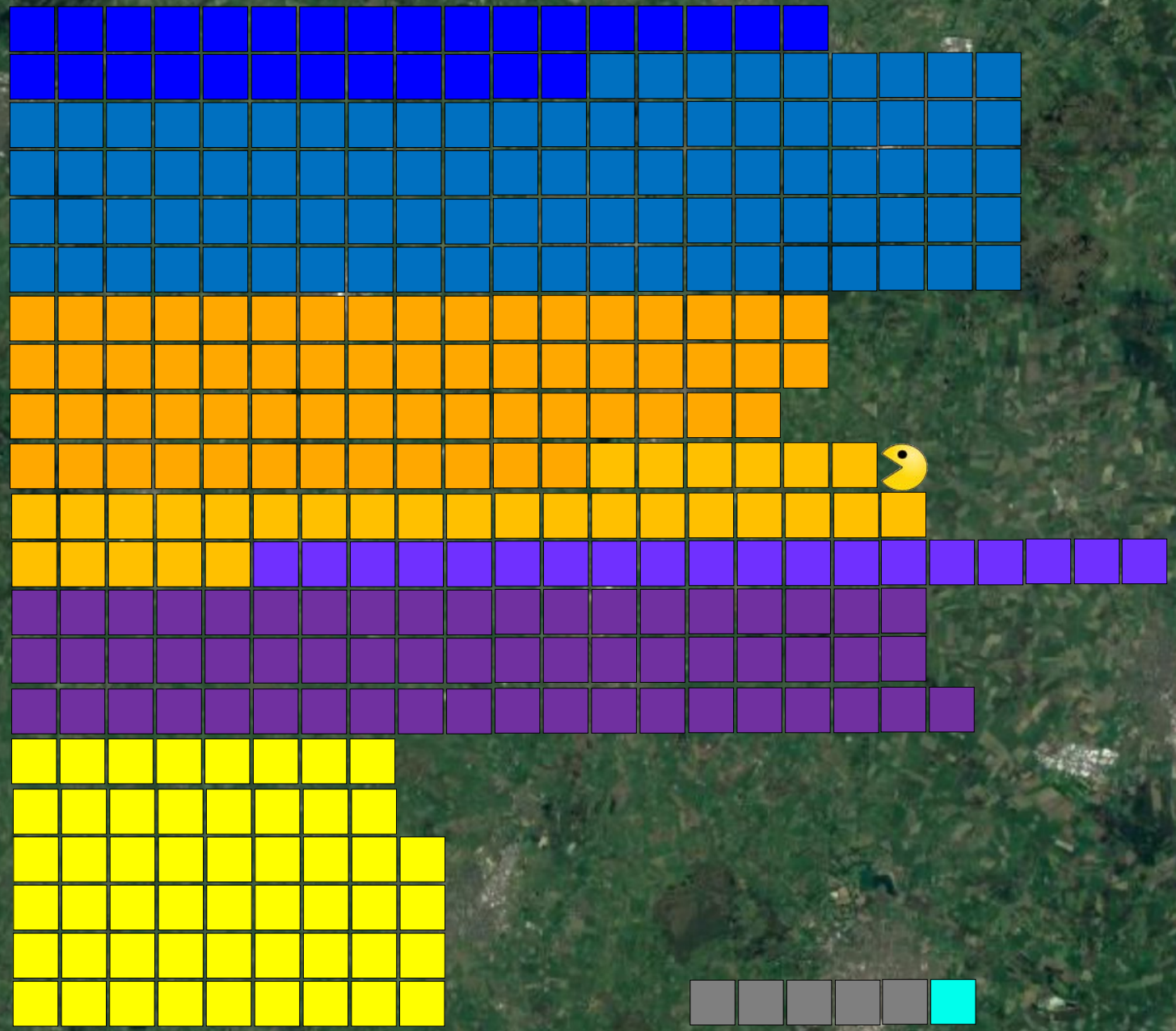
Technology/policy

Energy saving in buildings

-25% heat;

-50 GWh houses; -10 GWh other



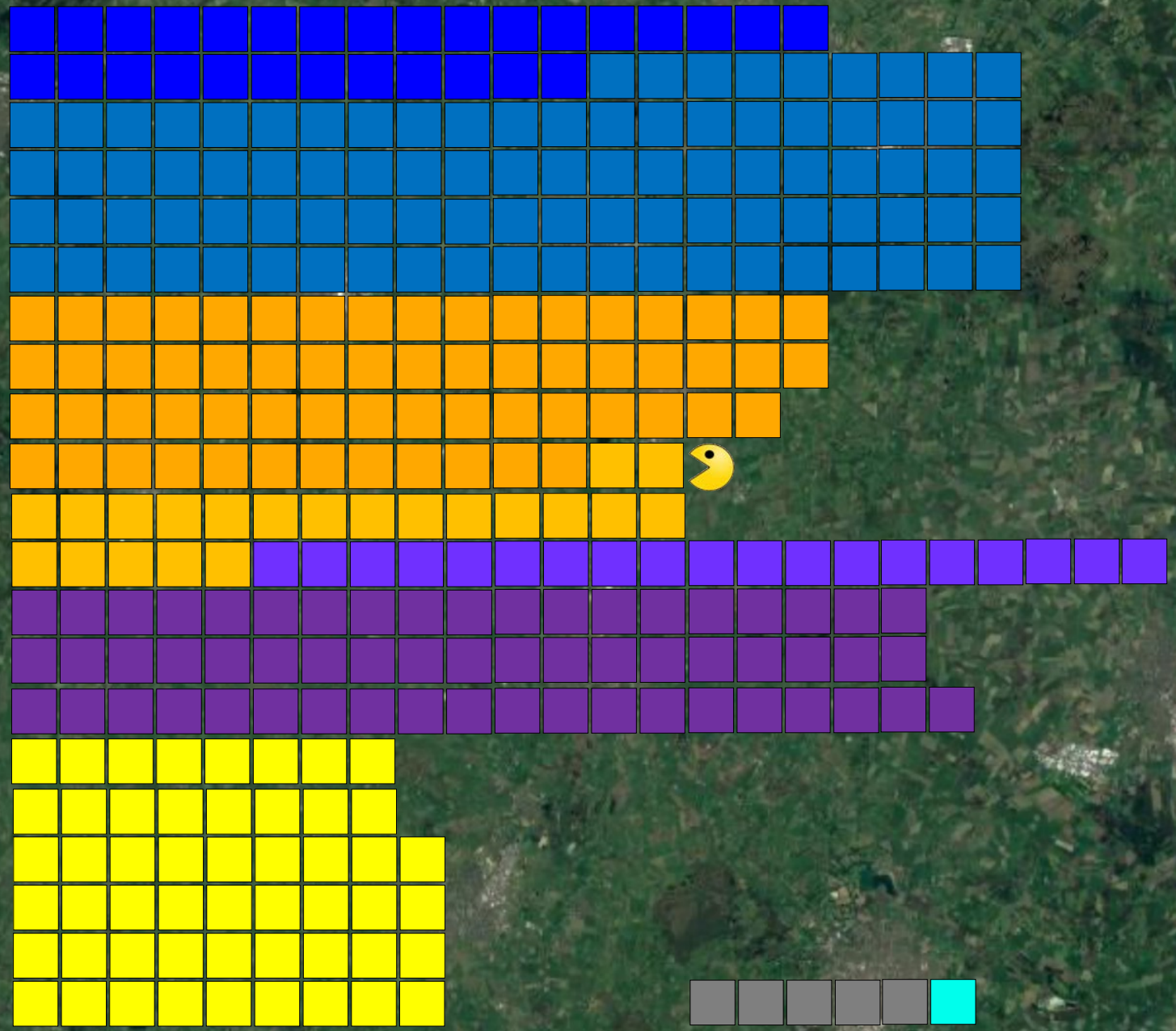


07

Technology/policy

Industrial processes

-20 GWh houses



08

Infrastructures/policy

Biogas from sewage

- 25 GWh in companies

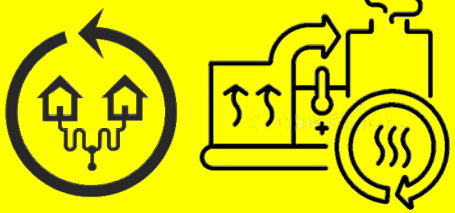
Avoided emissions from sewage plant

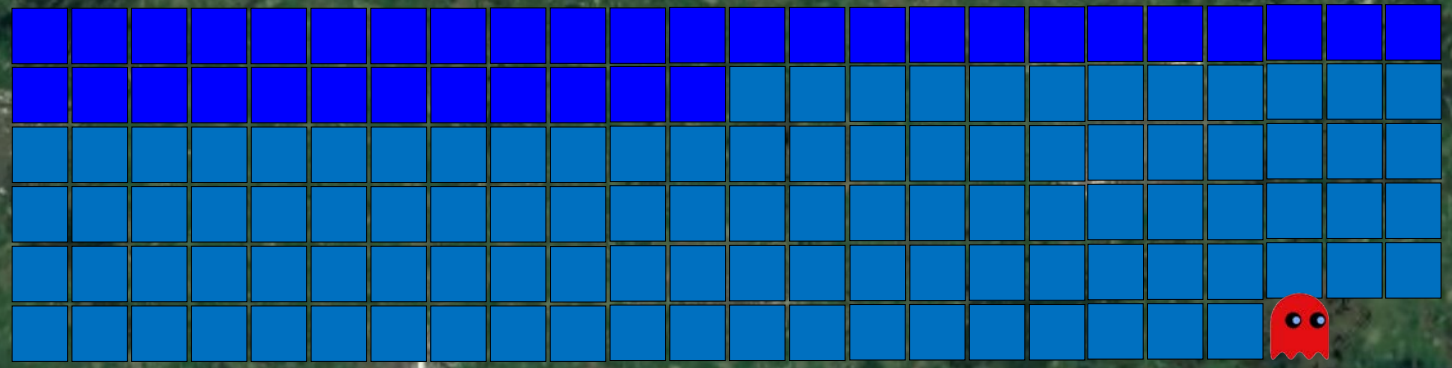
09

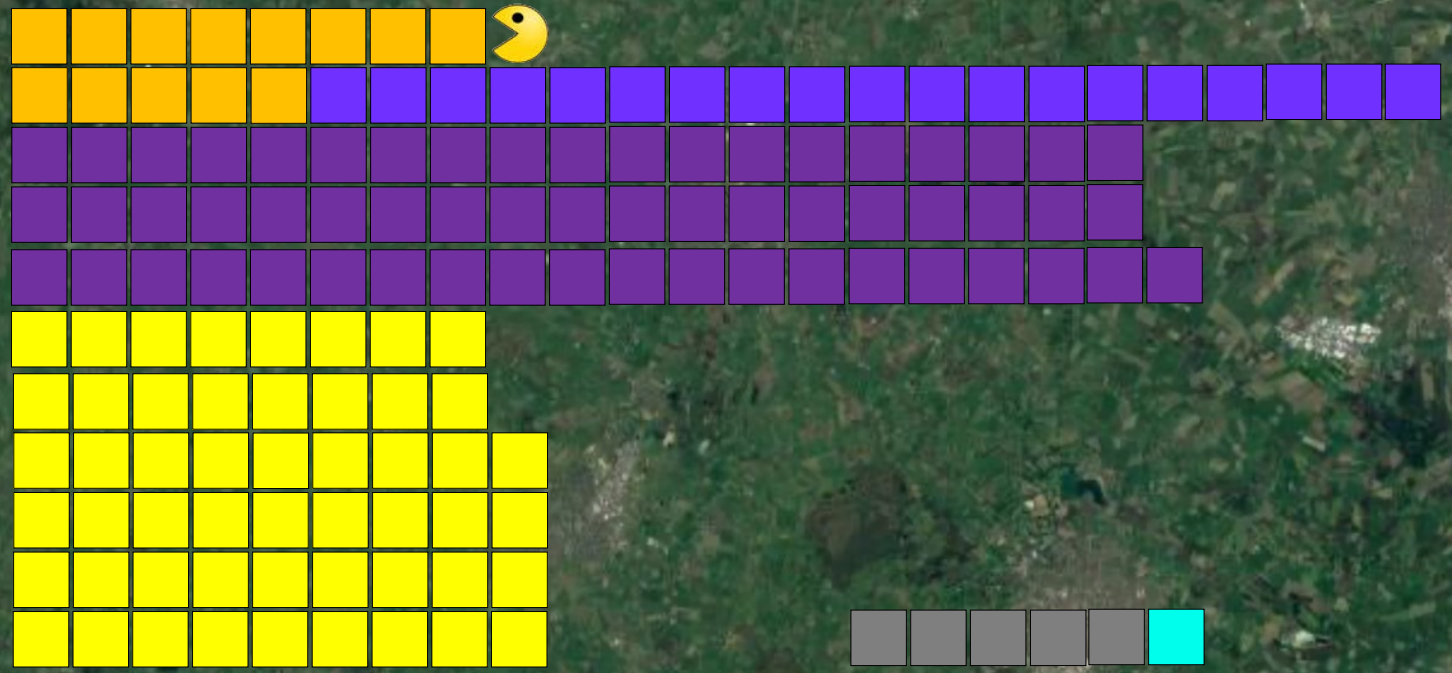
DHN

HT grid + waste heat

- 70 GWh heat





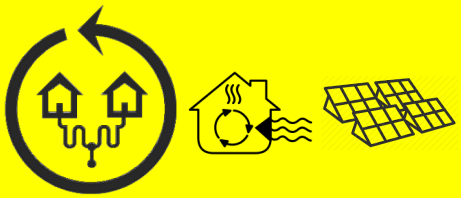


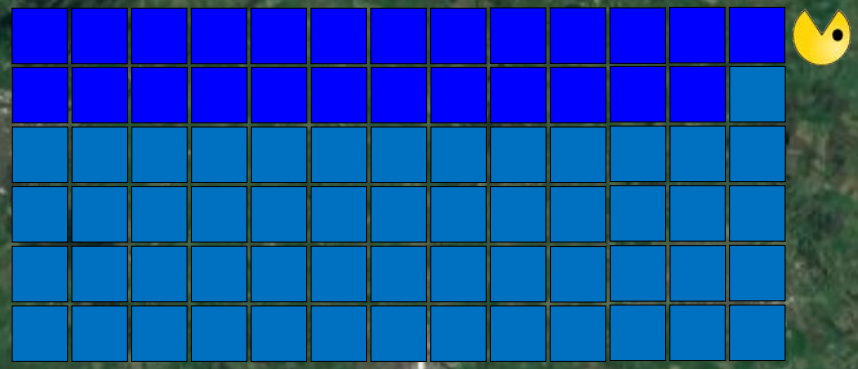
10

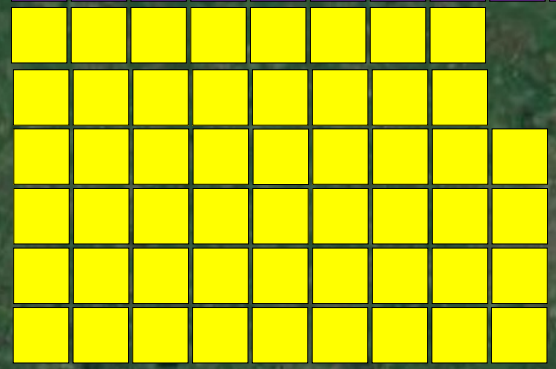
DHN & transition to electric

LT DHN + Solar Thermal

- 120 GWh heat; + 30 GWh EL





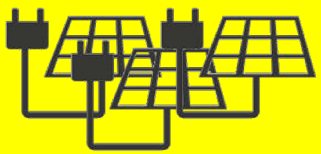


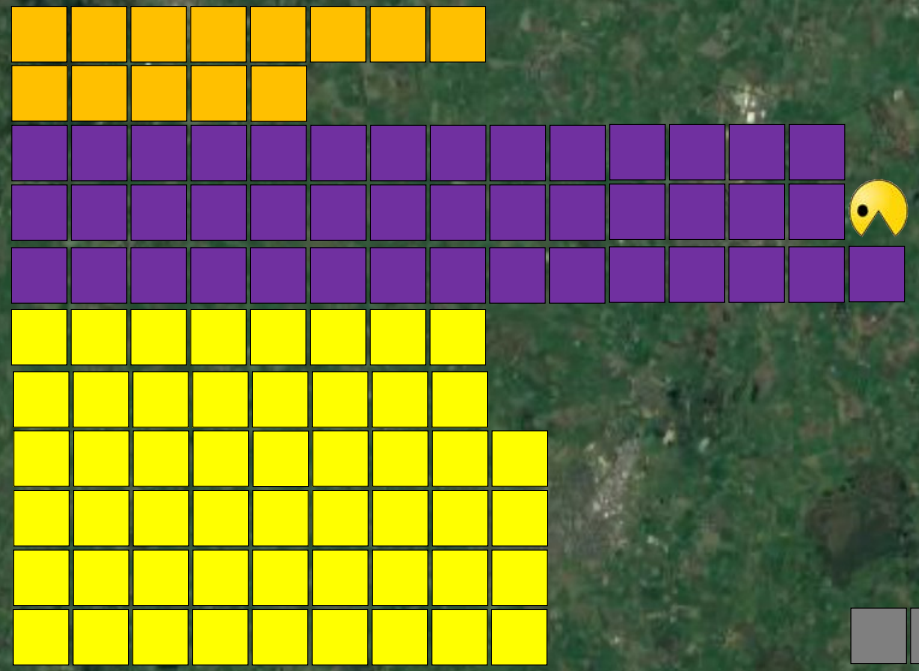
11

RES

PV on roofs

- 80 GWh



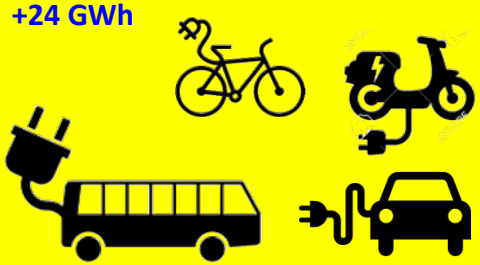


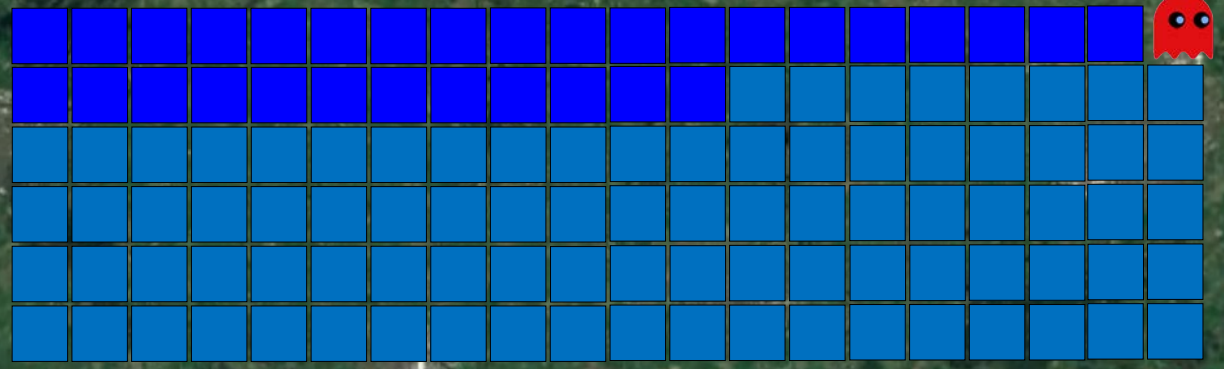
12

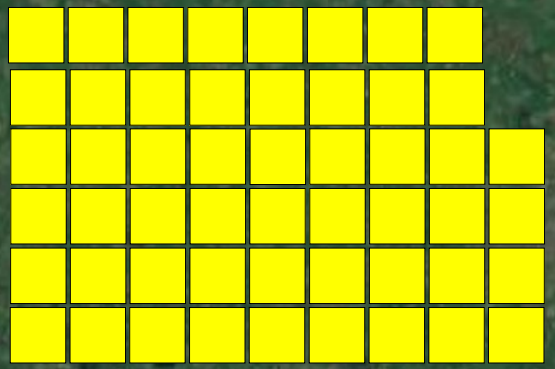
Infrastructures

El. vehicles sharing

+24 GWh





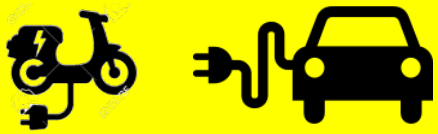


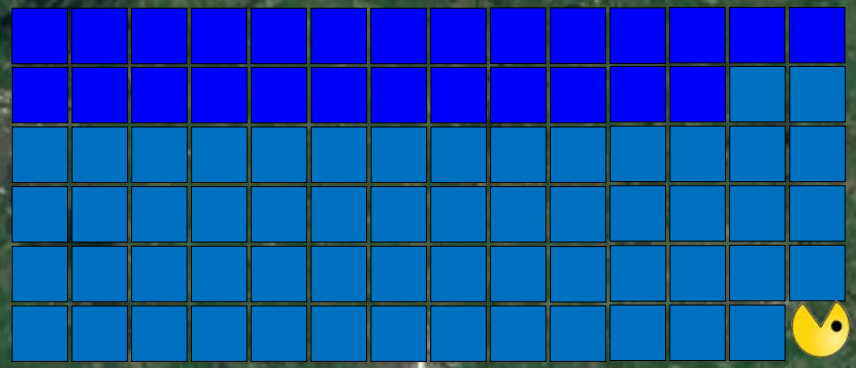
13

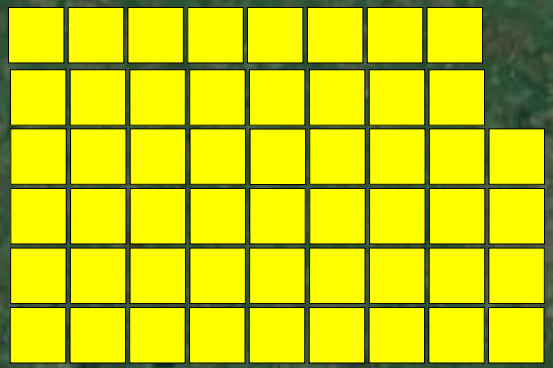
Transition to electric

Electric vehicles

+35 GWh





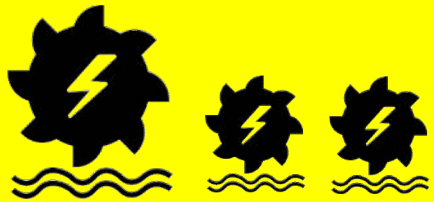


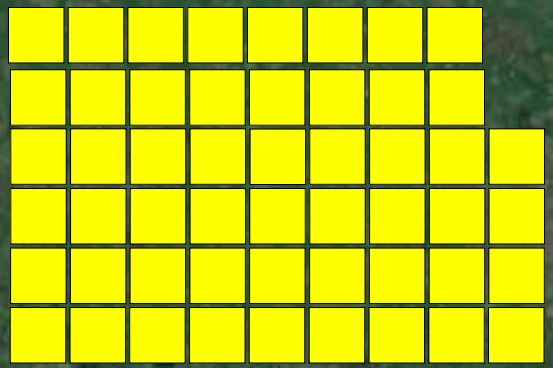
14

RES

Hydro

- 60 GWh





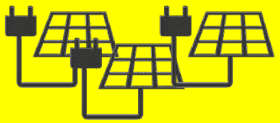
15

RES

Wind mills &

PV roads

- 120 GWh

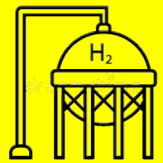


16

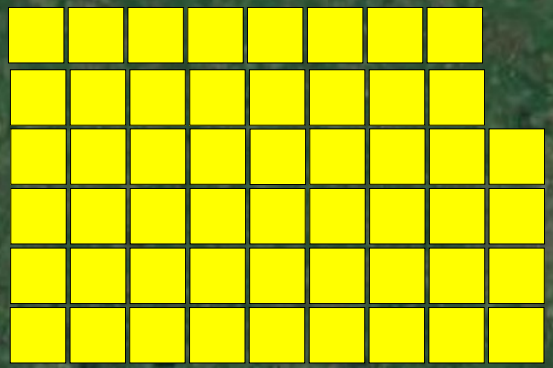
RES

Hydrogen

From surplus RES energy



H_2

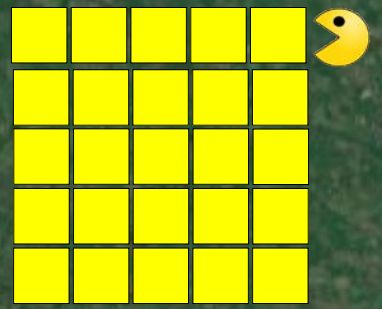


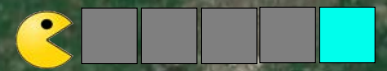
17

National policy 2050

Production chains

Electric delivery



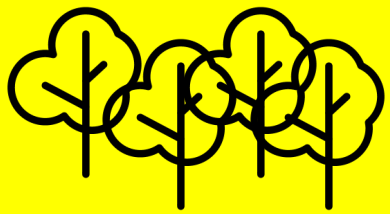


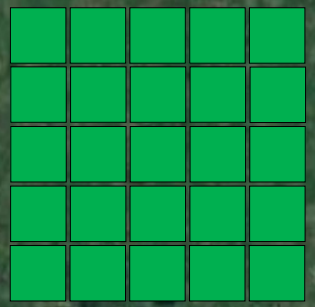
18

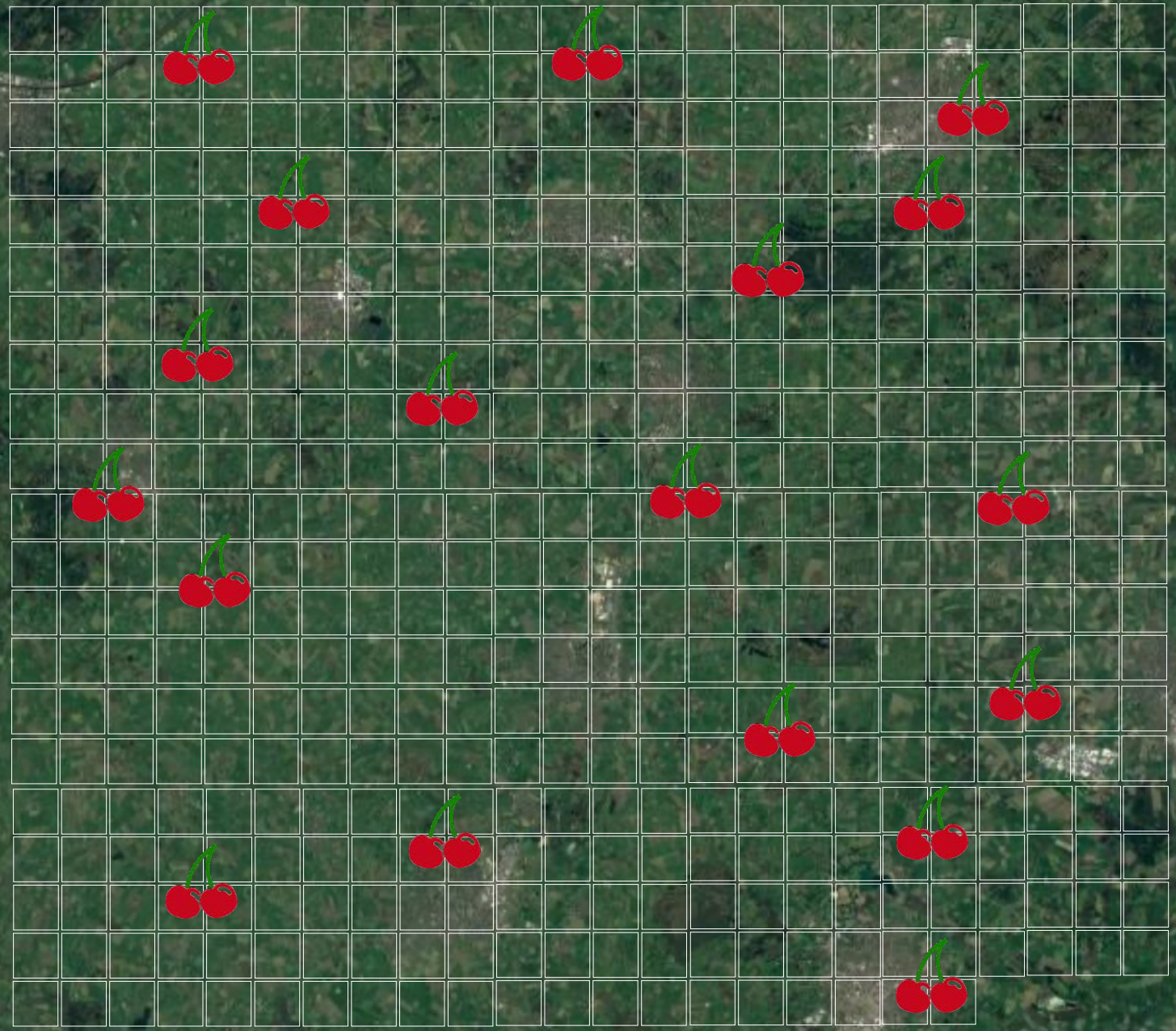
Carbon uptake

Forestry

25 km²








11 SUSTAINABLE CITIES AND COMMUNITIES
15 LIFE ON LAND
13 CLIMATE ACTION
10 REDUCED INEQUALITIES
17 PARTNERSHIPS FOR THE GOALS
7 AFFORDABLE AND CLEAN ENERGY
4 QUALITY EDUCATION
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
6 CLEAN WATER AND SANITATION
5 GENDER EQUALITY
2 ZERO HUNGER
1 NO POVERTY
8 DECENT WORK AND ECONOMIC GROWTH
14 LIFE BELOW WATER
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE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1 NO POVERTY
8 DECENT WORK AND ECONOMIC GROWTH
14 LIFE BELOW WATER
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
Citizens, let's go to zero!

Thank you!