Energy and Climate mitigation Synergetic Urban landscape planning in Rotterdam

Useful examples for your own city in in water, energy, densification, greening and using city data

TU Delft Delft University of Technology

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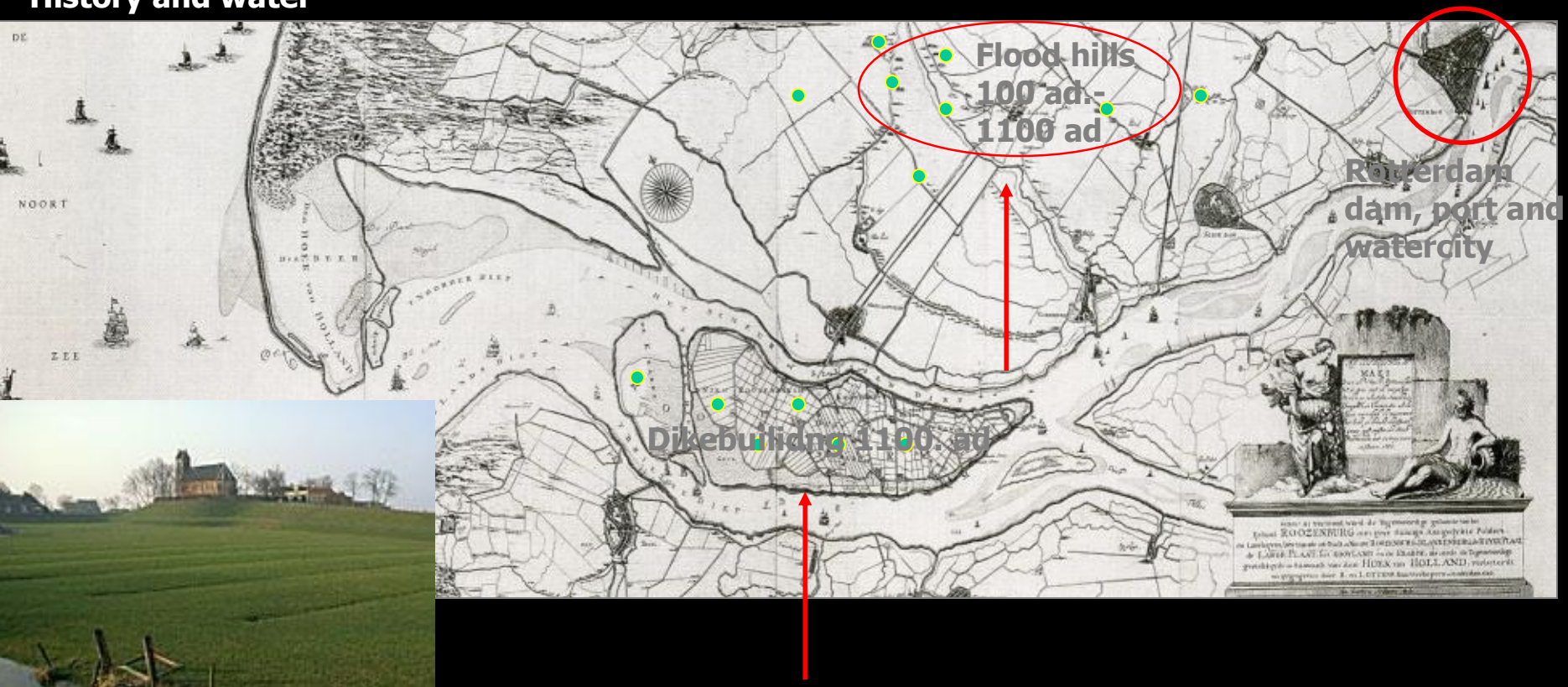
Landscape Architecture, Delft University of Technology,

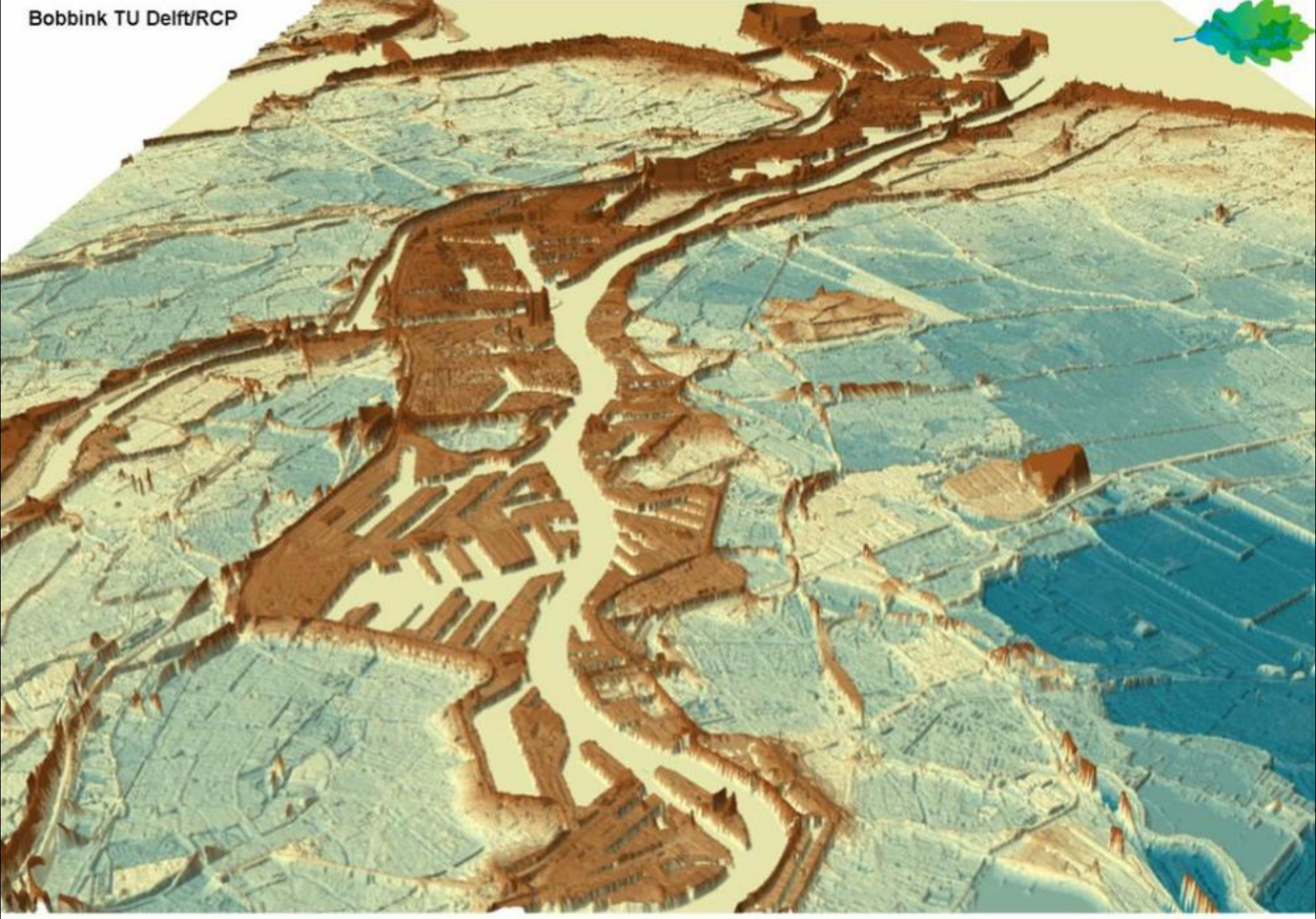
Director European office World Council on City Data

Part 1. Water

Innovative solutions start with understanding the system

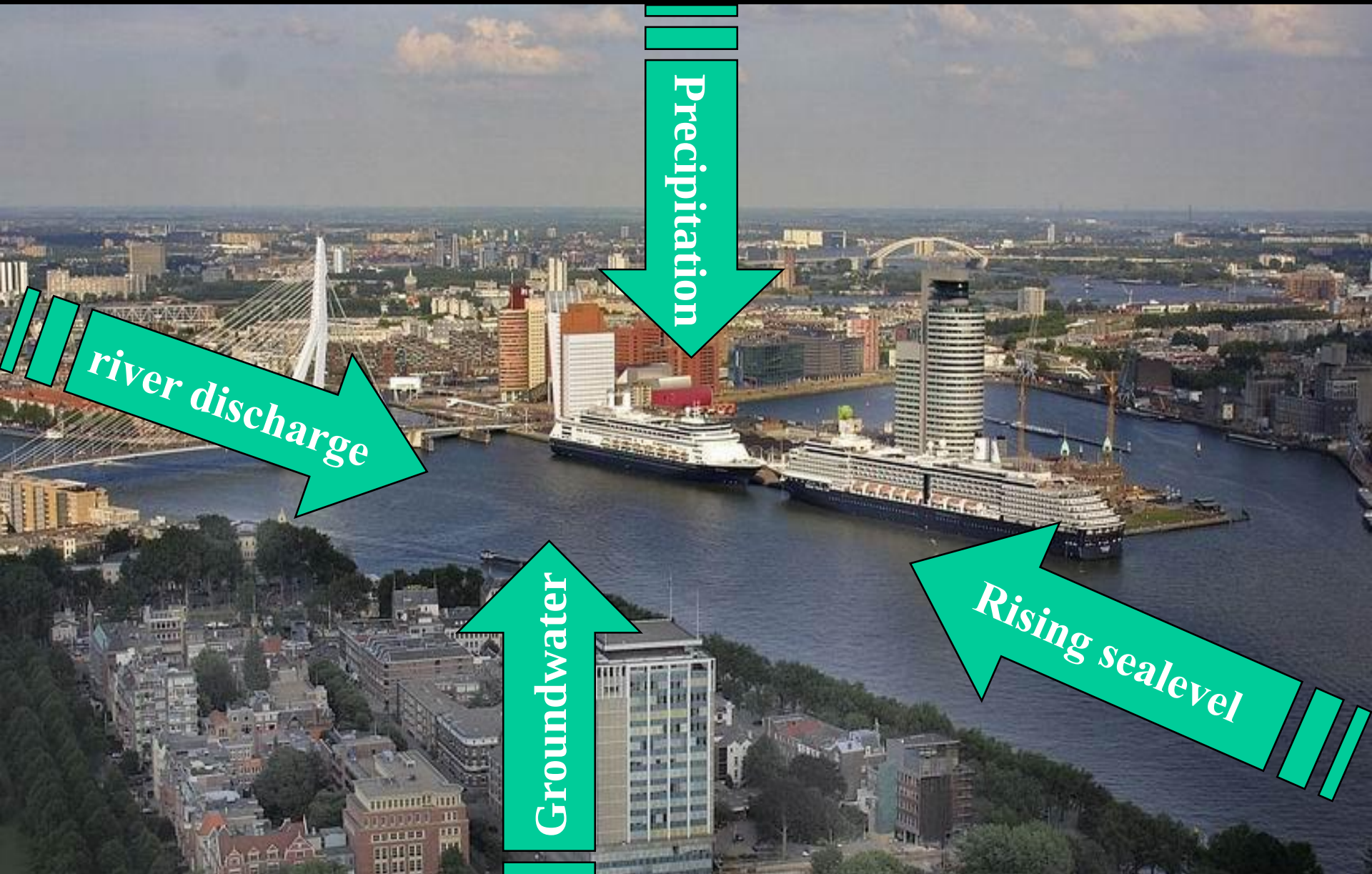
History and water



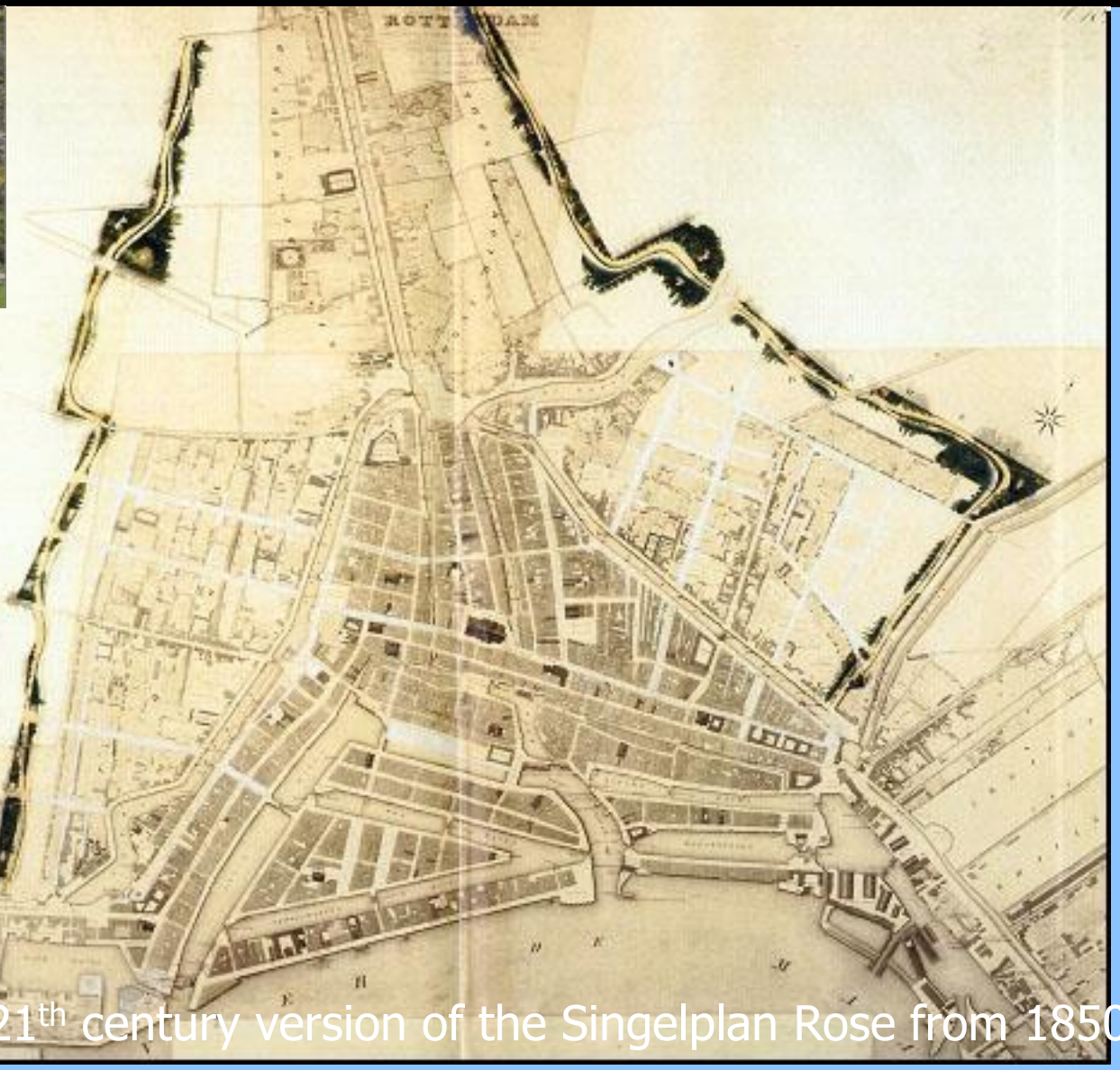


Topo map: above (brown) and below (blue) sea level

Water in Rotterdam



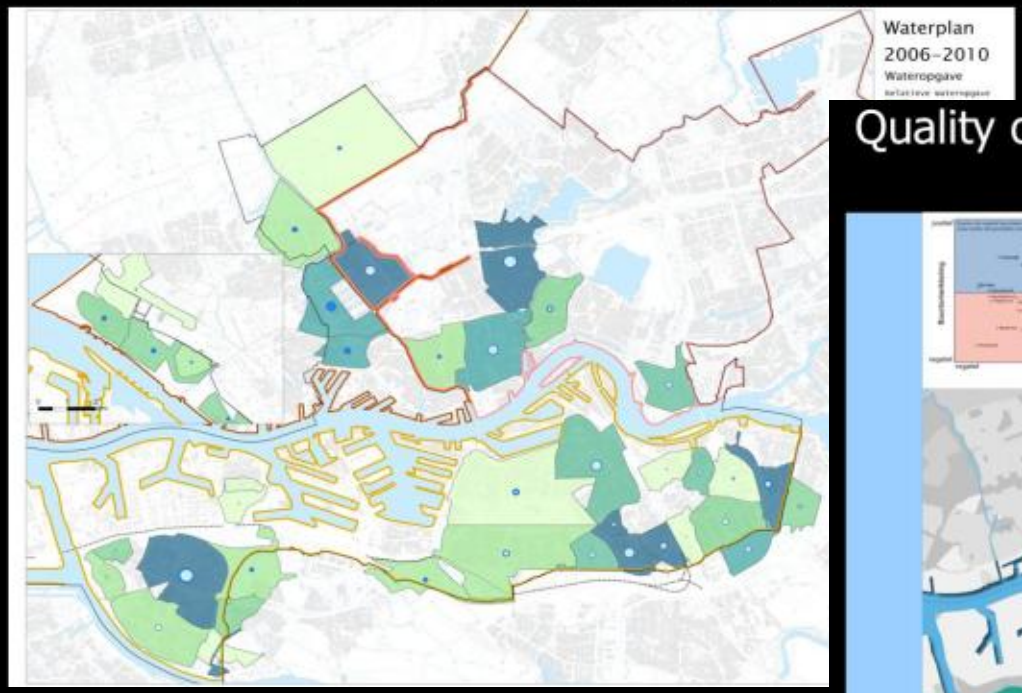
Singelplan as an example ?



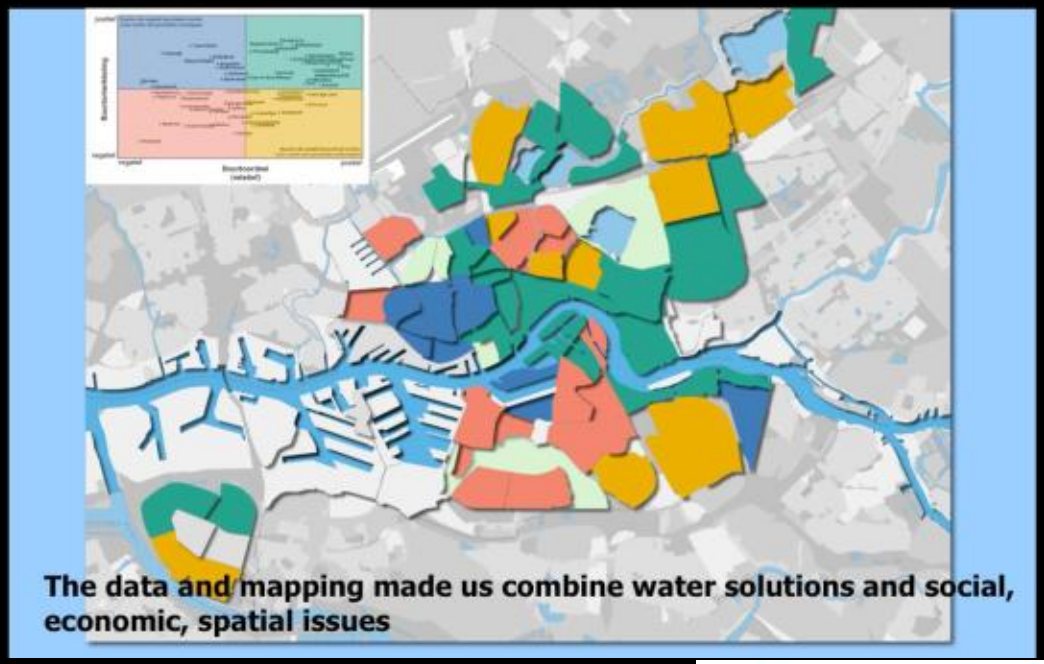
What is the 21th century version of the Singelplan Rose from 1850's ?

What about precipitation and water in the city

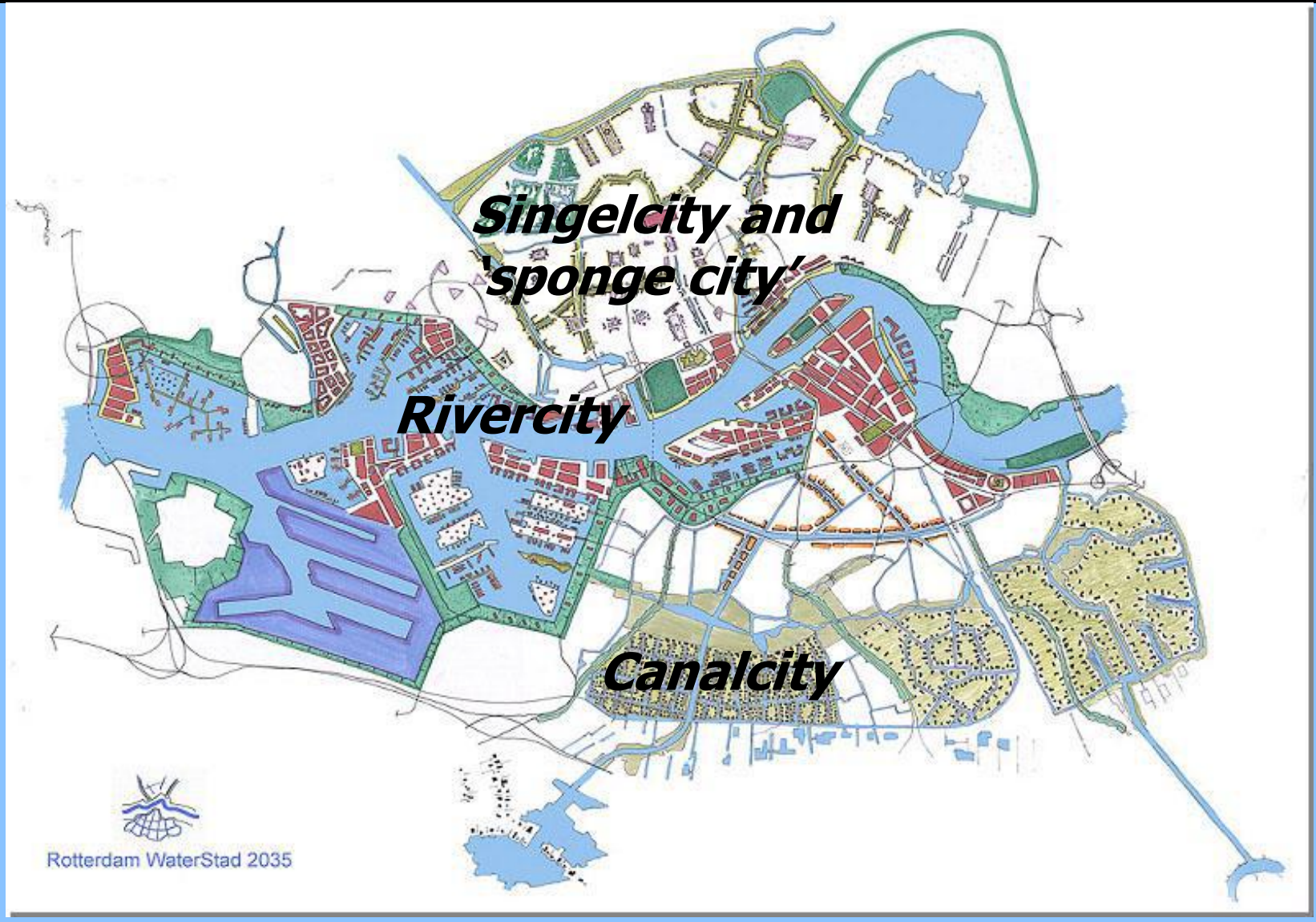
1.Water: Precipitation, storage capacity per district



Quality of life data per district



From stand alone solutions to overall strategy (2005)



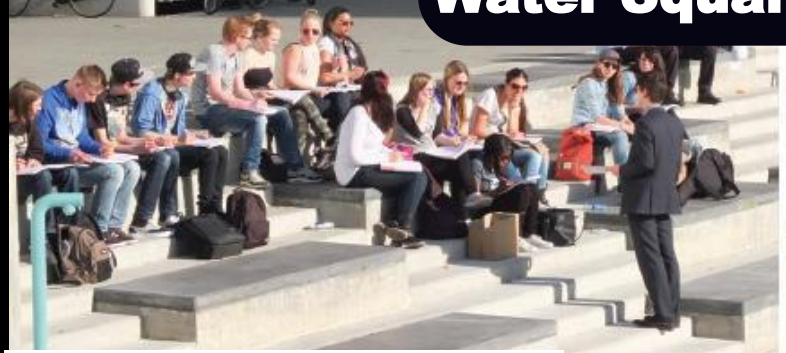
Water solutions good housing + public space + water transport

Watersquare finished in nov 2012

Watersquare finished in nov 2012

Watersquare finished in nov 2012

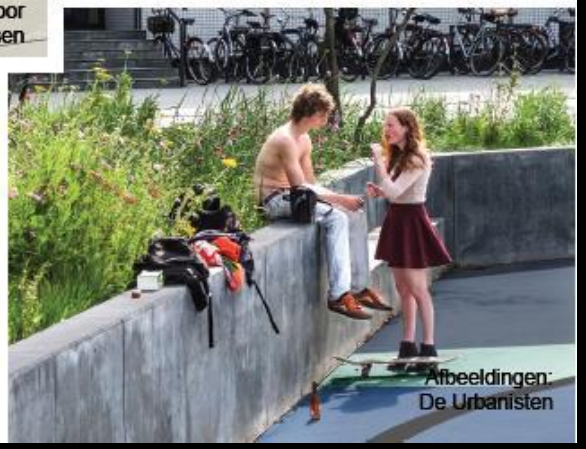
Water Square now


Trappen te gebruiken als tribune voor bijv. lessen Zadkine

Daily Use


Veelvuldig gebruik bassin #2 voor samenkomst van mensen


Grote bassin ingericht op actief gebruik door verschillende groepen

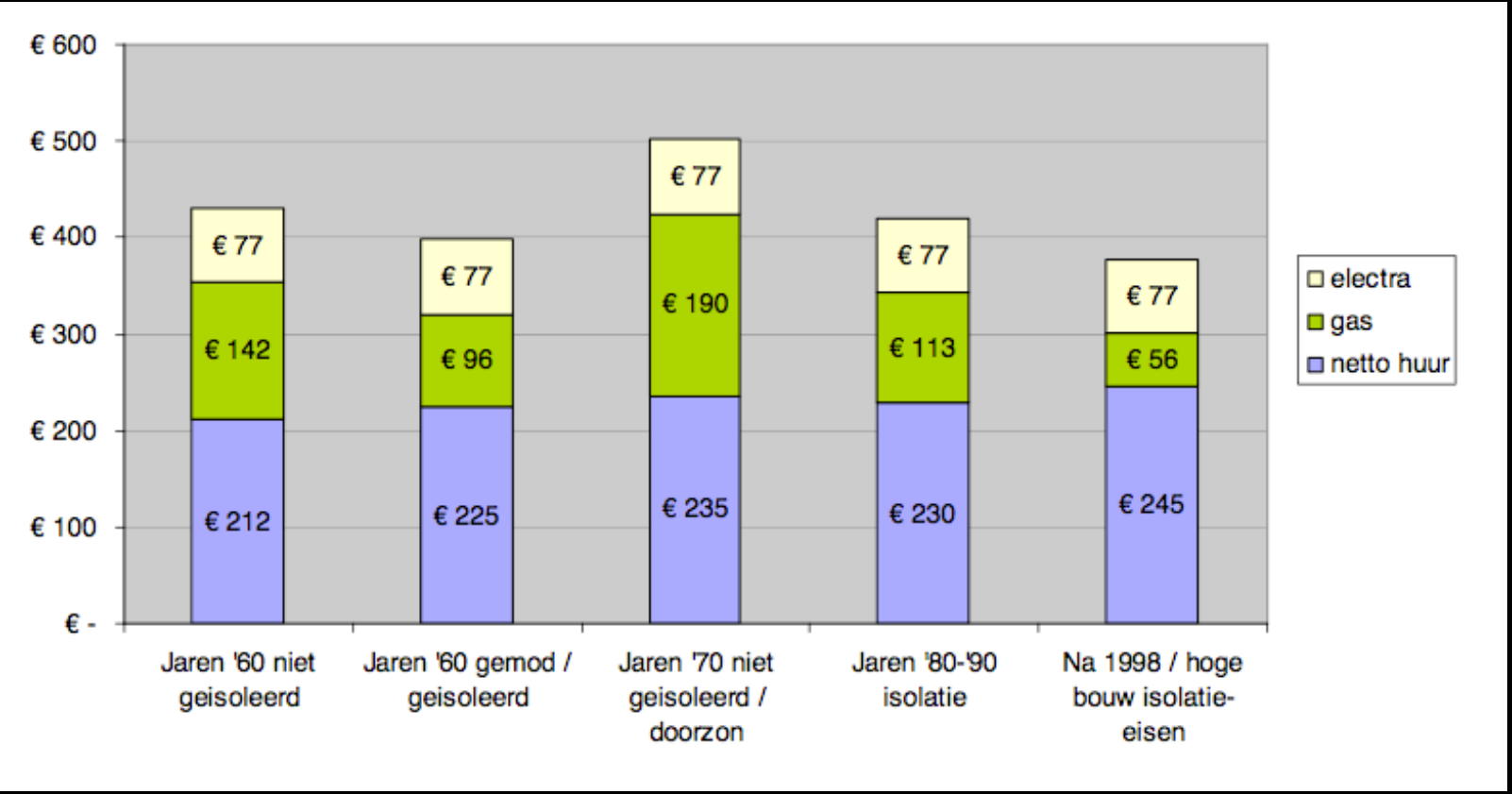

Afbeeldingen: De Urbanisten

Protection and moving in: A dike, with shops below and a roof garden to link the waterfront very active neighborhood involvement

Okra landscape architects

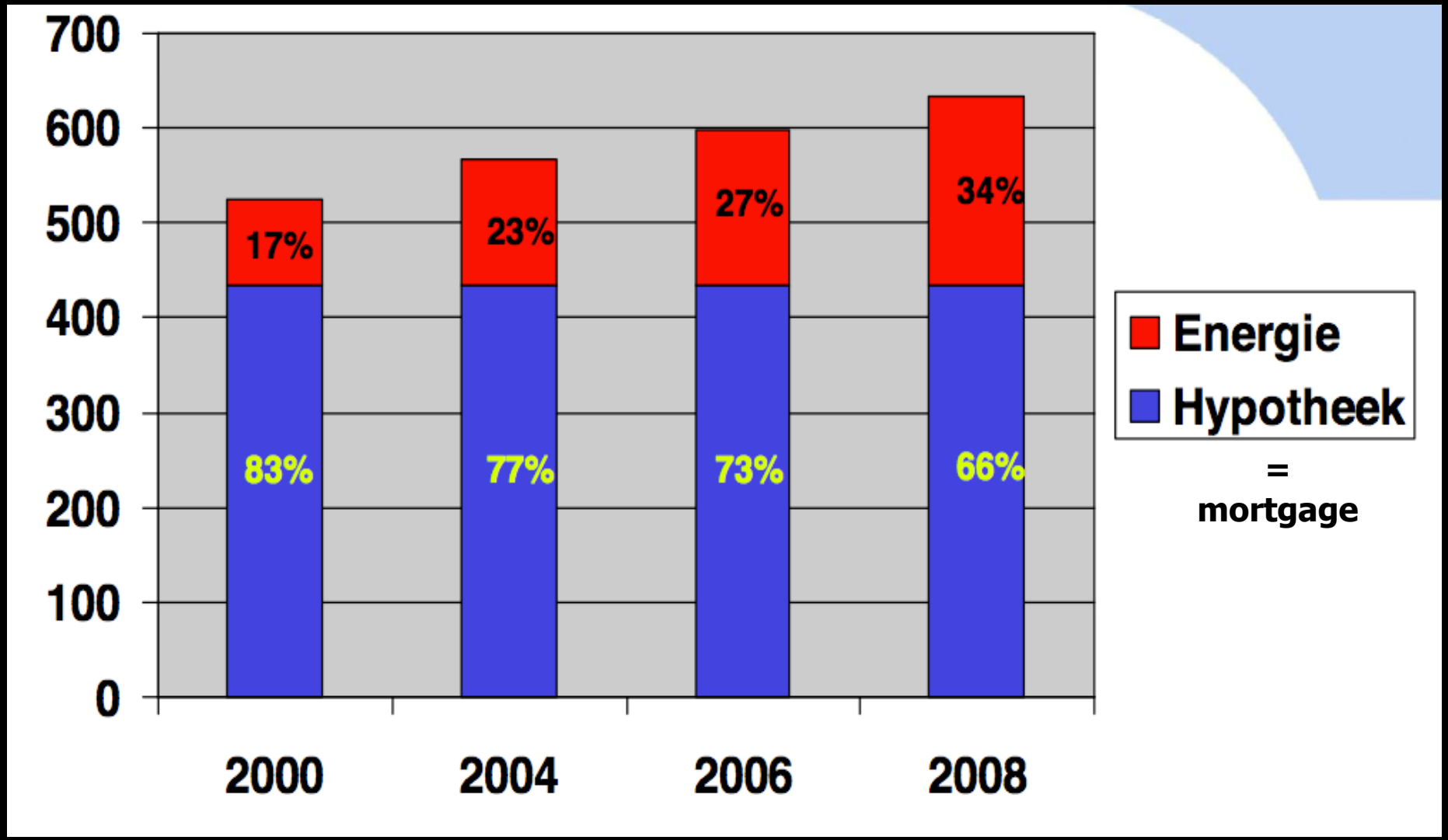
Why not have this approach for Energy?

Energy costs rental homes the Netherlands



i. Straathof senternovem, 2008

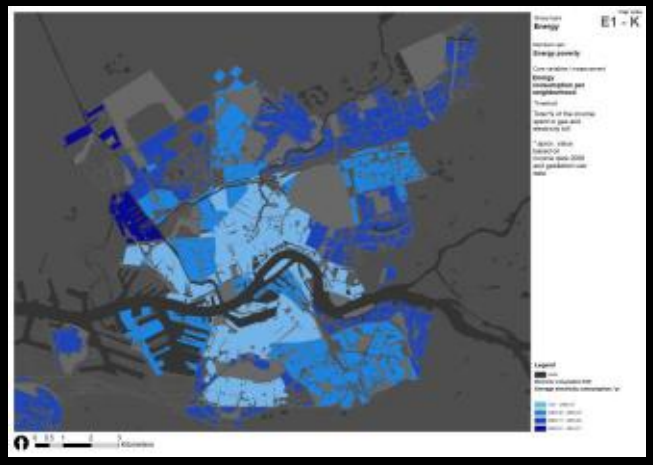
Energy costs home owners

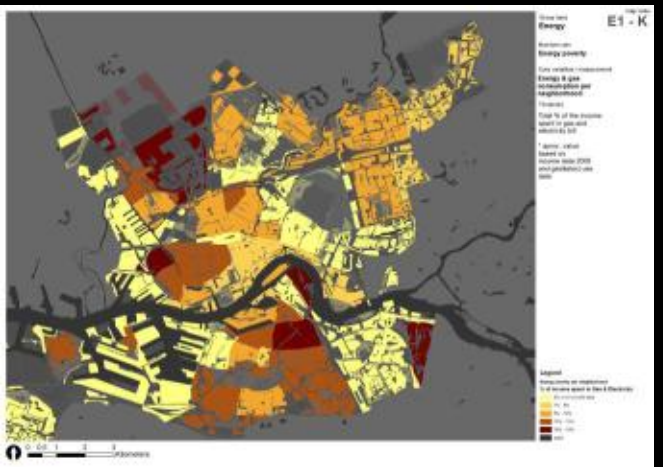


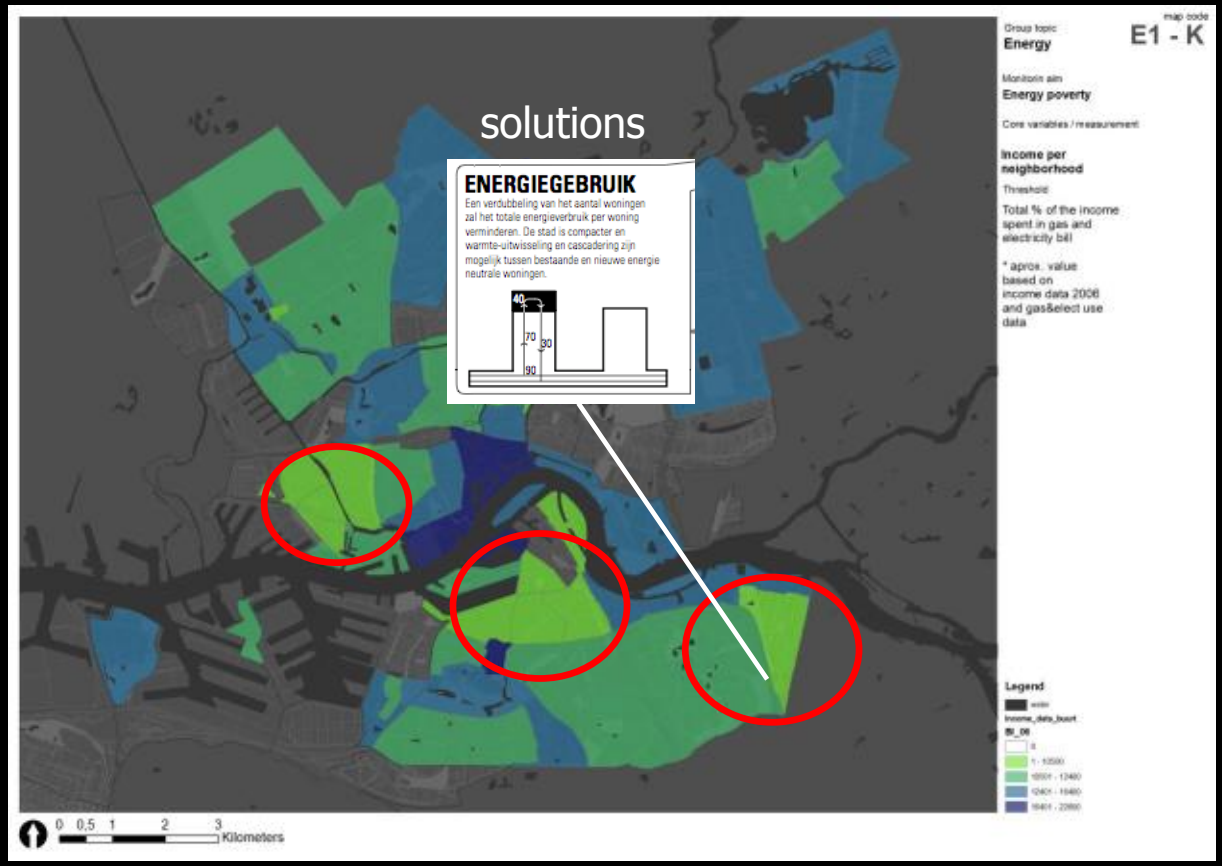
i. Straathof senternovem, 2008

High energy use, low income, energy too expensive

Possible solutions: smart meters, insulation,own production, lower rent, green loans







Since 2005-2007 Energy and Climate Initiatives Worldwide

CO2 reduction and renewable energy supply

From list of solutions to a spatial inclusive strategy for Energy transition and improving Quality of life

Residential & services	Transport ….	Behaviour …..	Innovation ….	Industry & food
•deals with corporations •Public lighting •Compulsory use of district heating •Fiscal incentives •Local laws	•public transport, cycling •Renewable energy •Parkingfees • vehicles and ships	•All public vehicles co2 free •All public buildings co2 free •Campagne •Incentives	•innovationfund •Knowledge cluster of new techniques •Research connections with universities to implement	•Carbon captivity storage •Deals with companies to filter •Biofuel •CO2 to greenhouses •Quai electricity

…. to a vision …from there, a tailormade plan for our specific situations, neigborhoods!

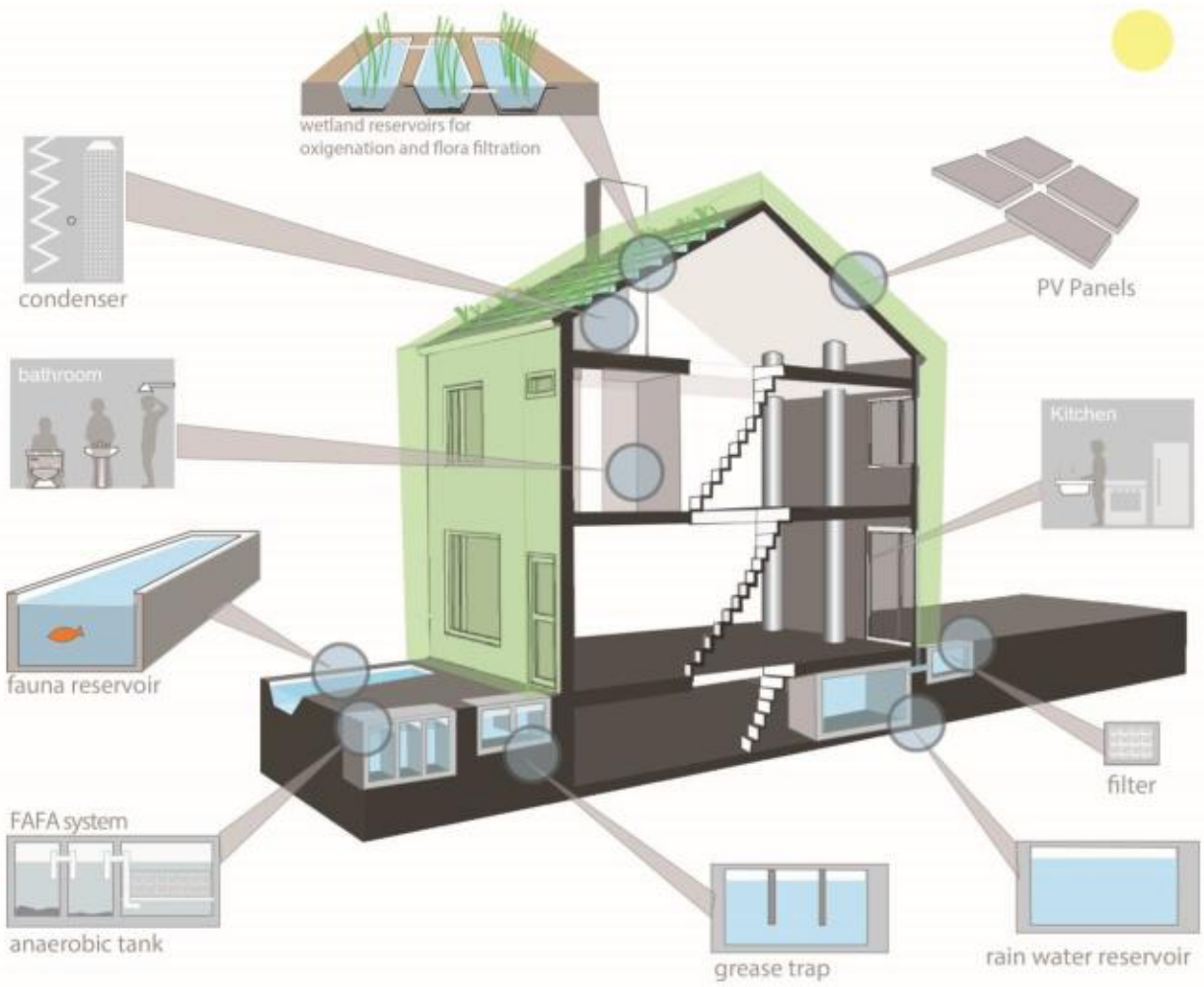
Challenge still about how to scale up

…to low carbon neighborhoods, districts, cities and regions

Solar Decathlon 2014:

Scaling up in number: decarbon existing housing stock: 1.5 million in NL alone much more all over Europe

Relevant theme: energetic refurbishment



Facts...

* Our job is to take our homes to a sustainable future...

* We will retrofit on different scales
  - -Urban scale
  - -Individual homes
  - -Building parts

* We will develop a set of tools to retrofit

* We will develop a platform for tools

* We are 1 of 20 competing teams across the globe

* Our house will be seen by 300.000 visitors

PRÊT-À-LOGER
SOLAR DECATHLON 2014

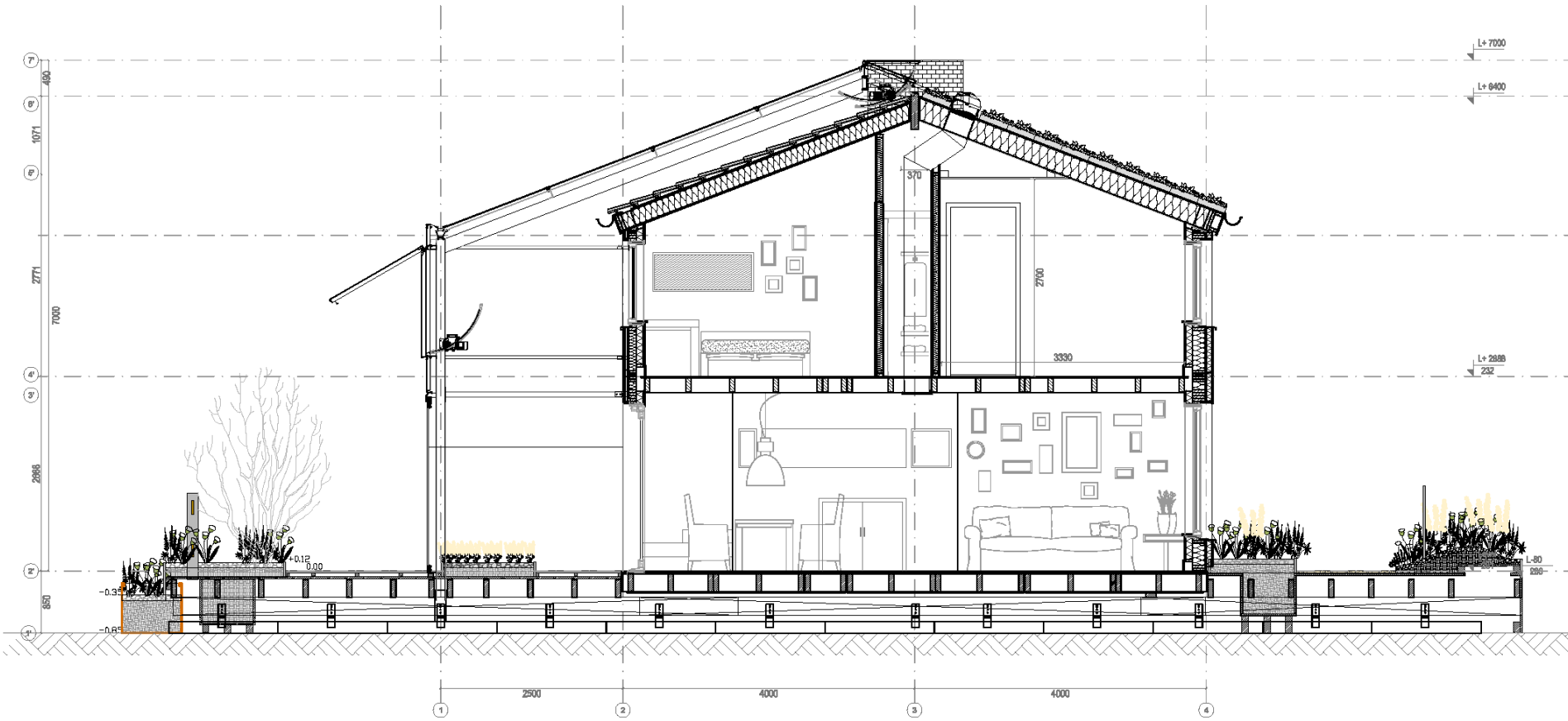
Solar Decathlon Europe 2014

TU Delft

Prêt-à-Loger

Nico Tillie – **Green Building Festival**, Toronto 2nd of October 2014

Cross-section

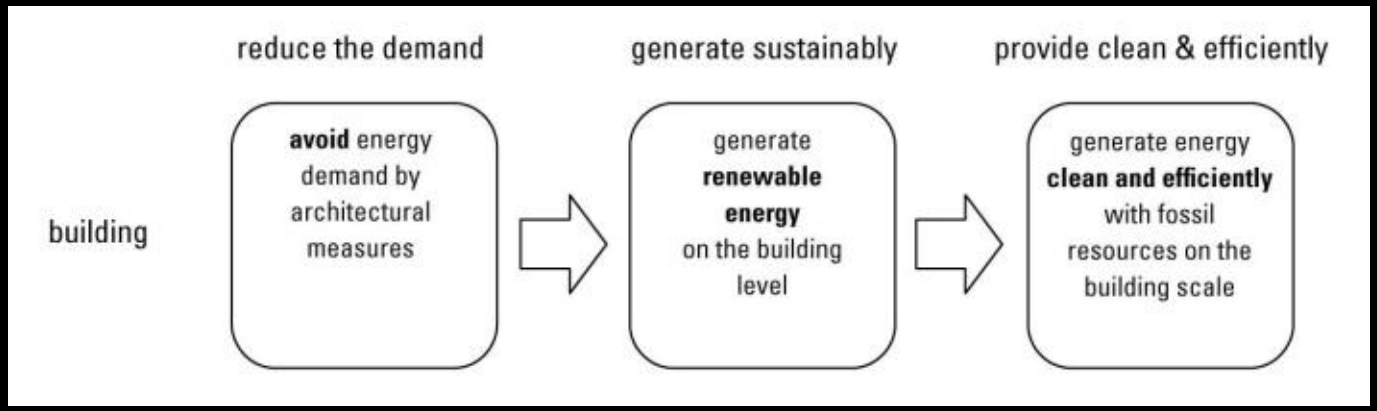


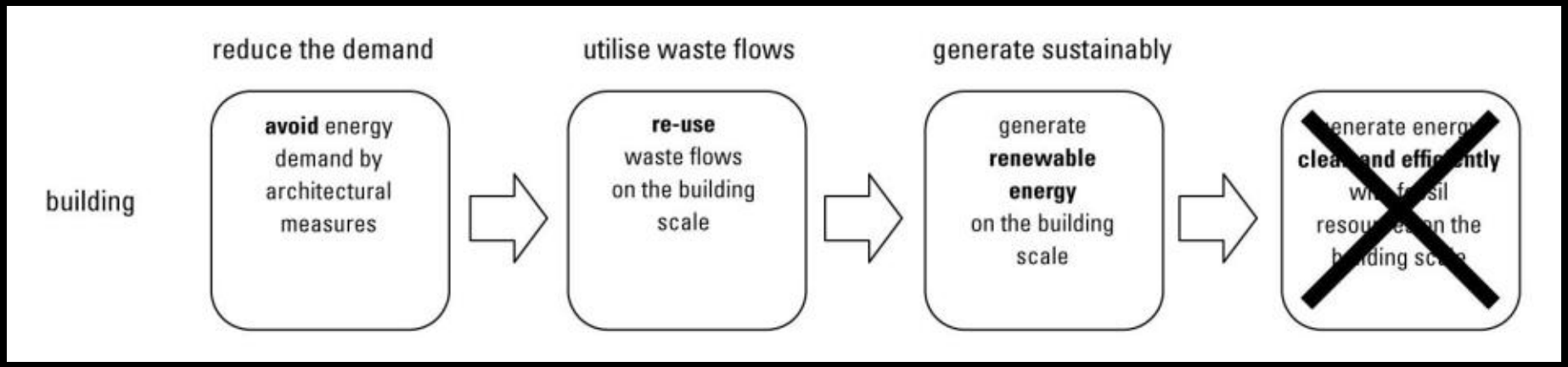
What it looks like

www.pretaloger.nl

Scaling up in Approach: energy as a 'layer' in urban planning!

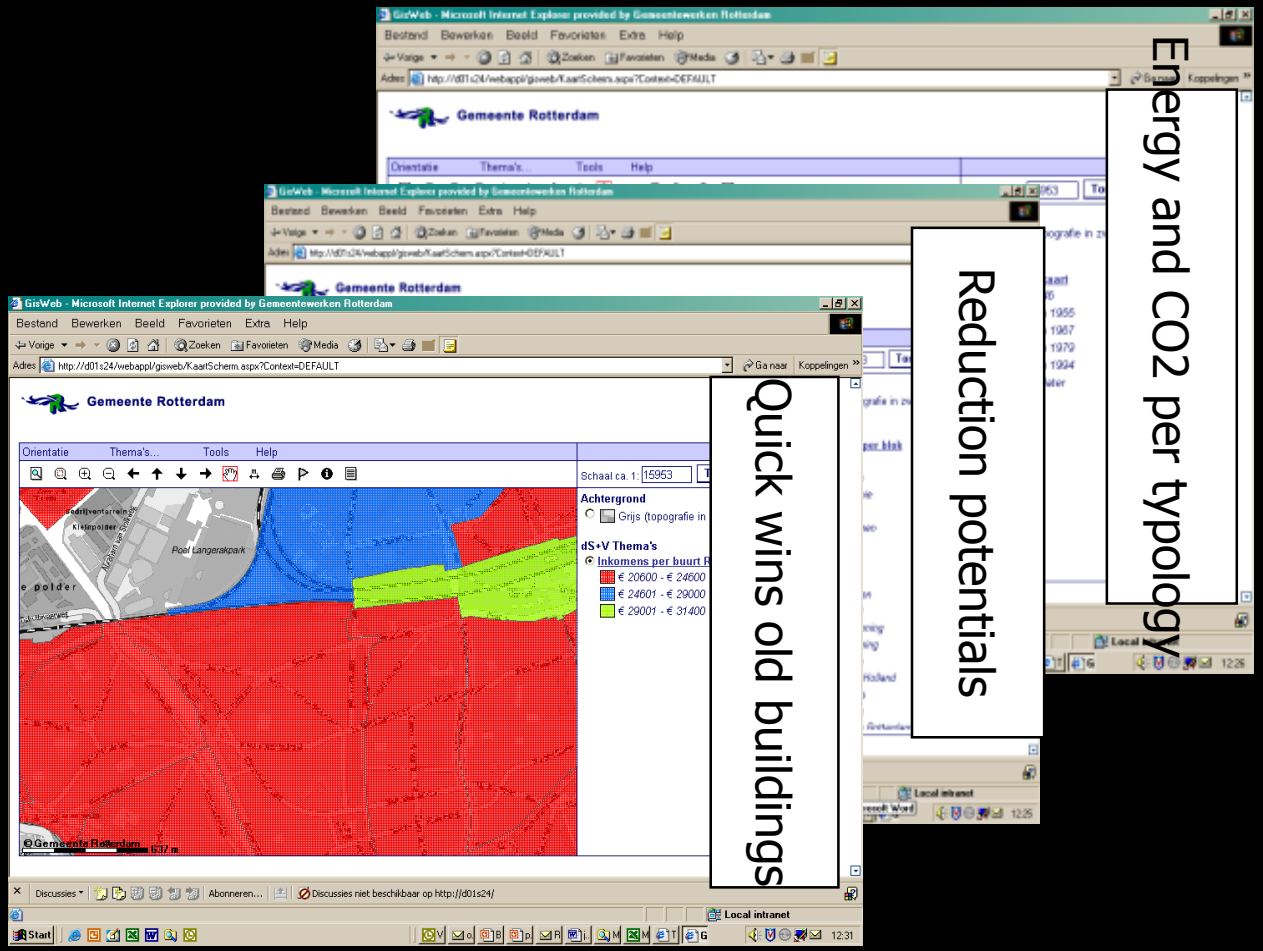
From 'Trias energetica' to new stepped strategy



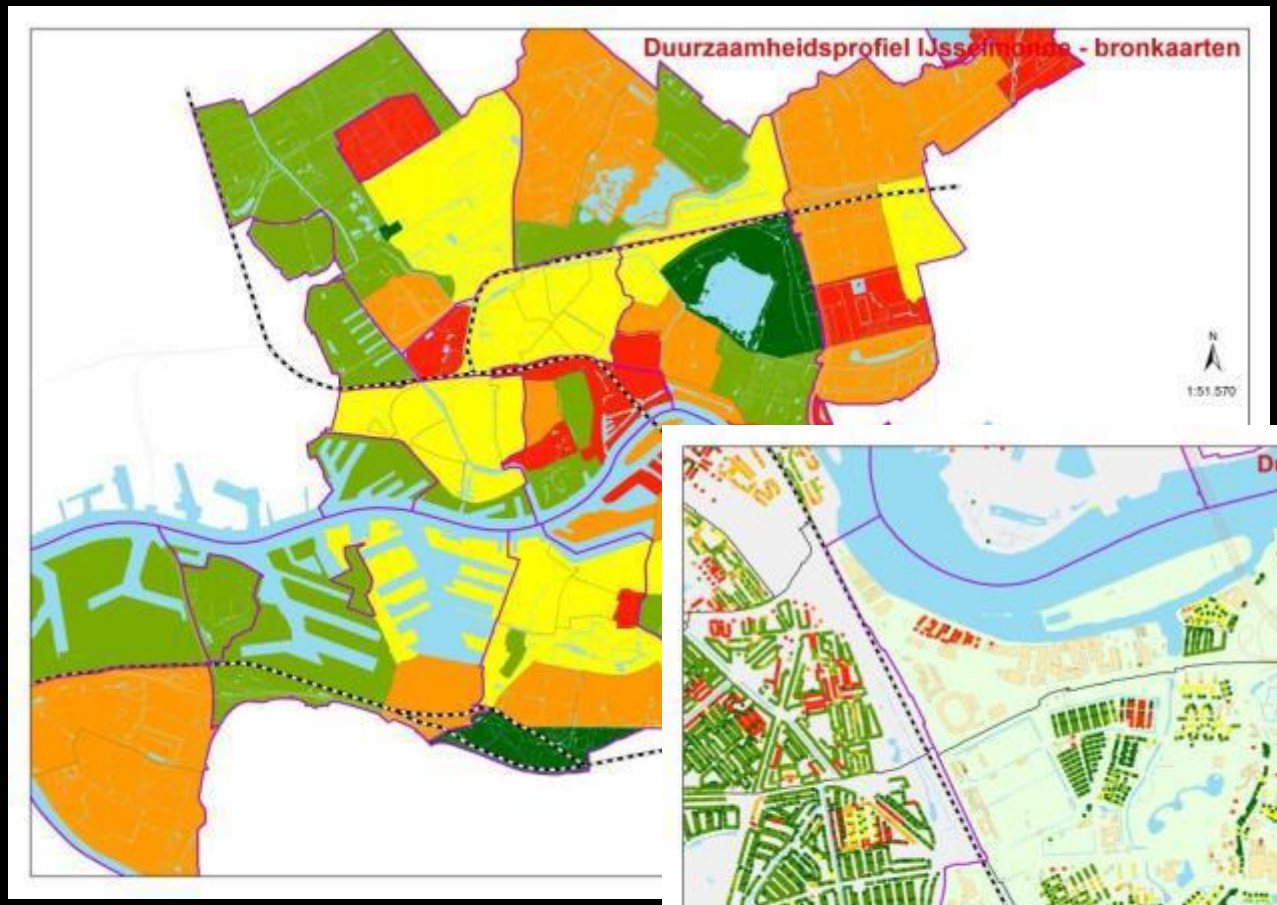


Prof. Andy Van den Dobbelsteen TU Delft

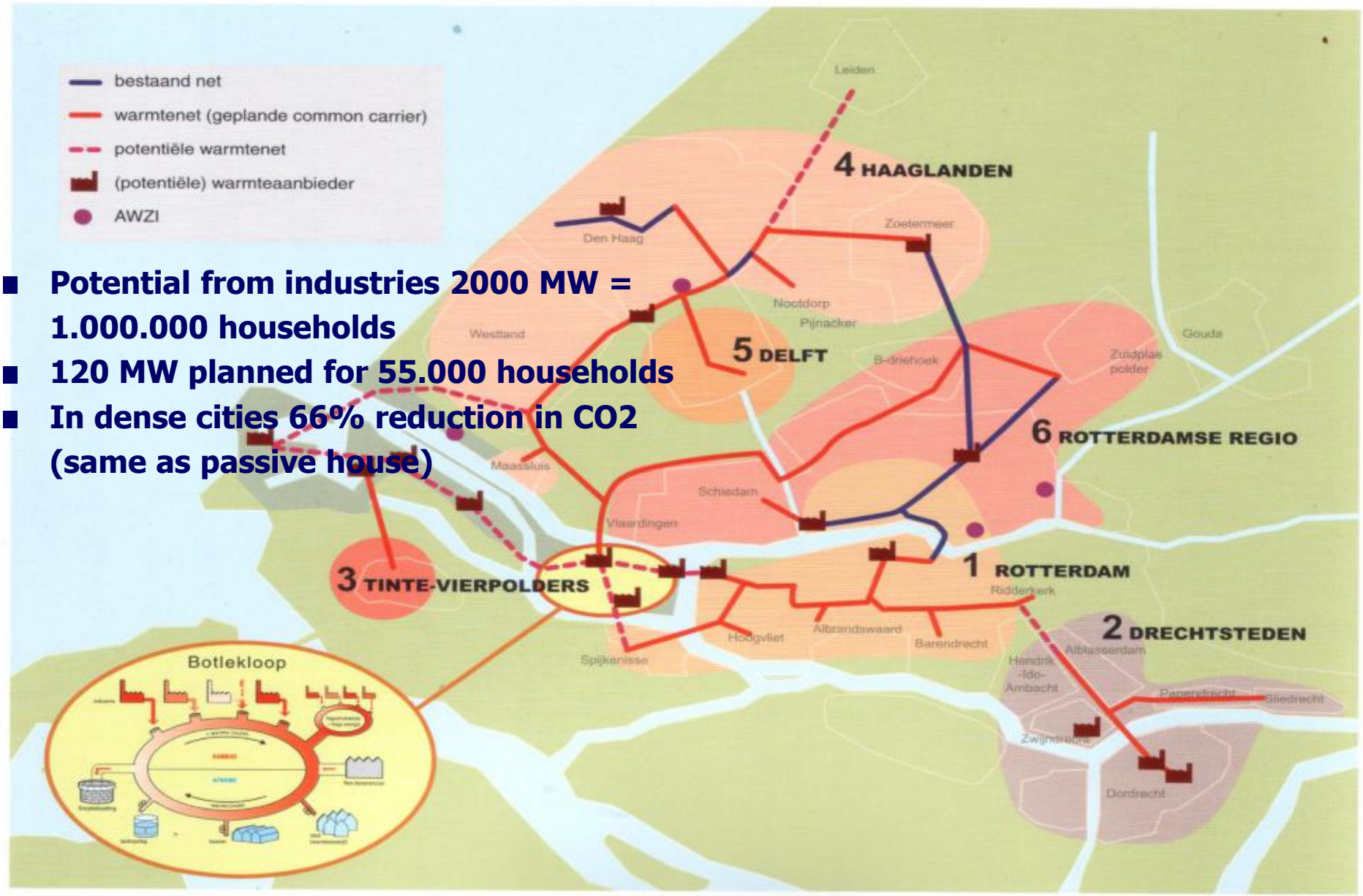
1. reduction of demand



Types of result – savings potential maps are easier to read than 10 excell sheets



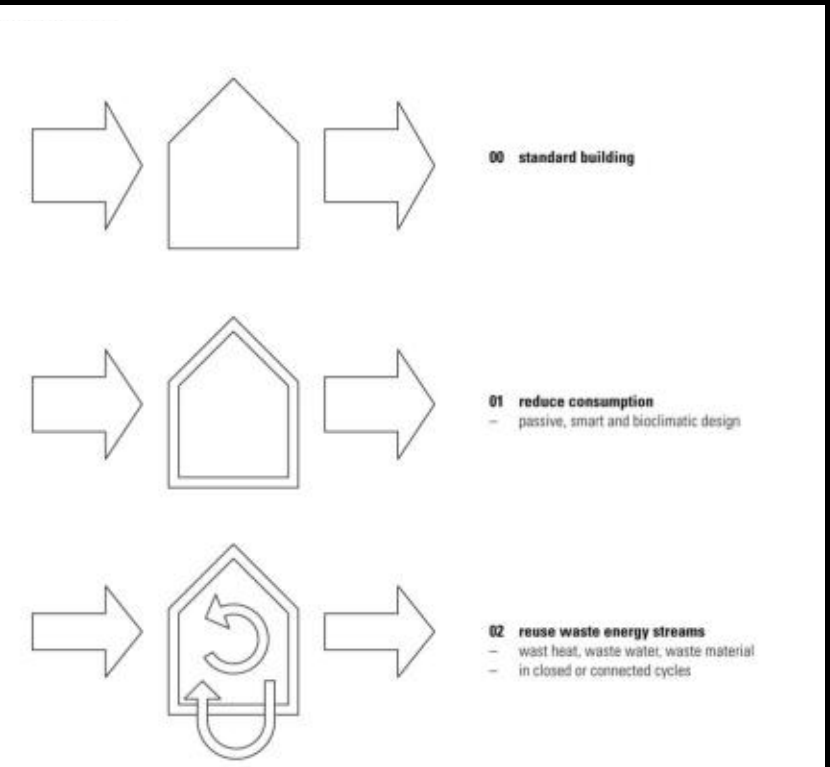
2. Exchange waste flows
District heating networks



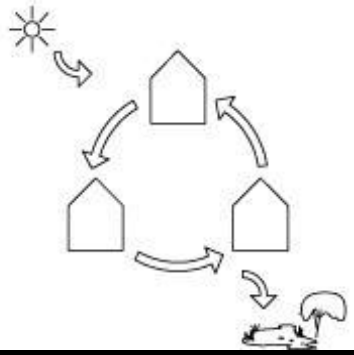
- **Potential from industries 2000 MW = 1.000.000 households**
- **120 MW planned for 55.000 households**
- **In dense cities 66% reduction in CO2 (same as passive house)**

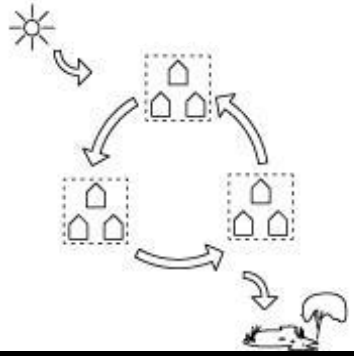
The New Stepped Strategy

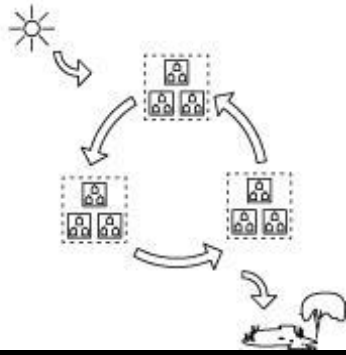
By: A. Van den Dobbelsteen



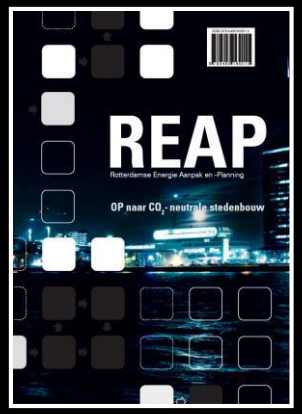
...and upscaling



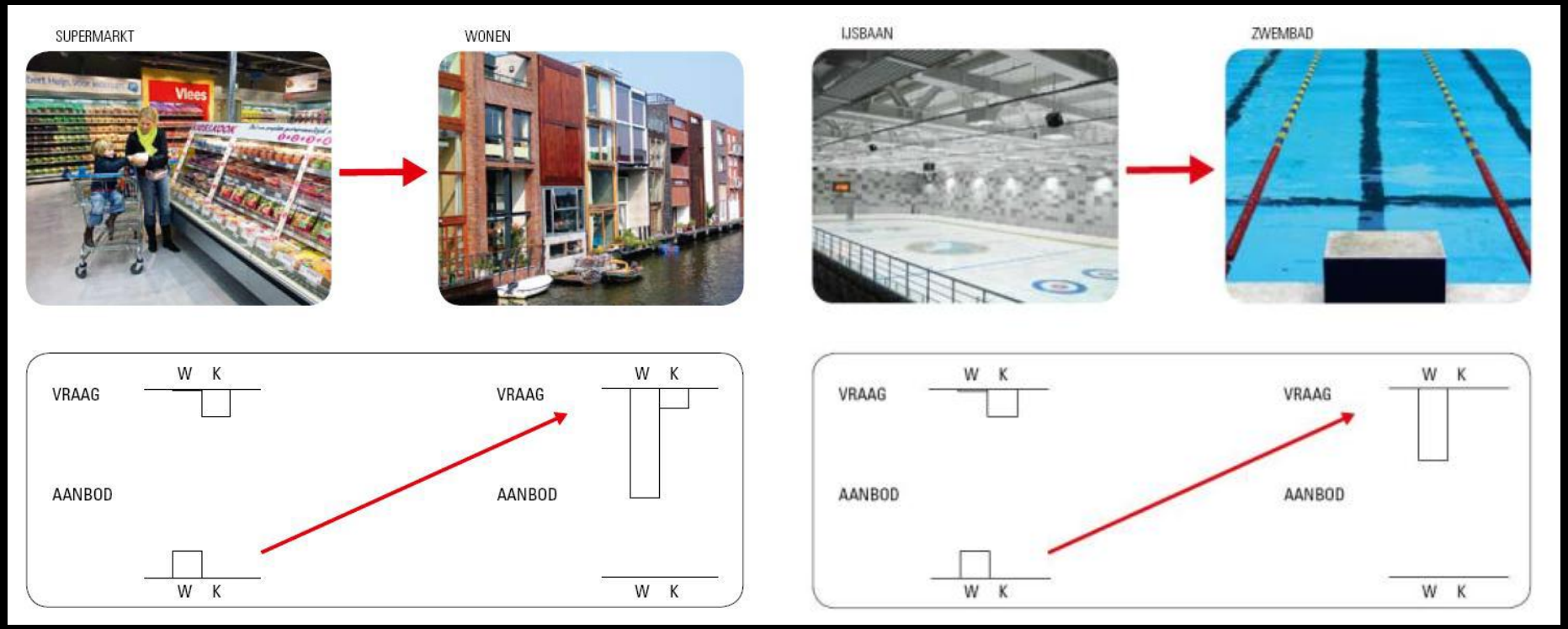




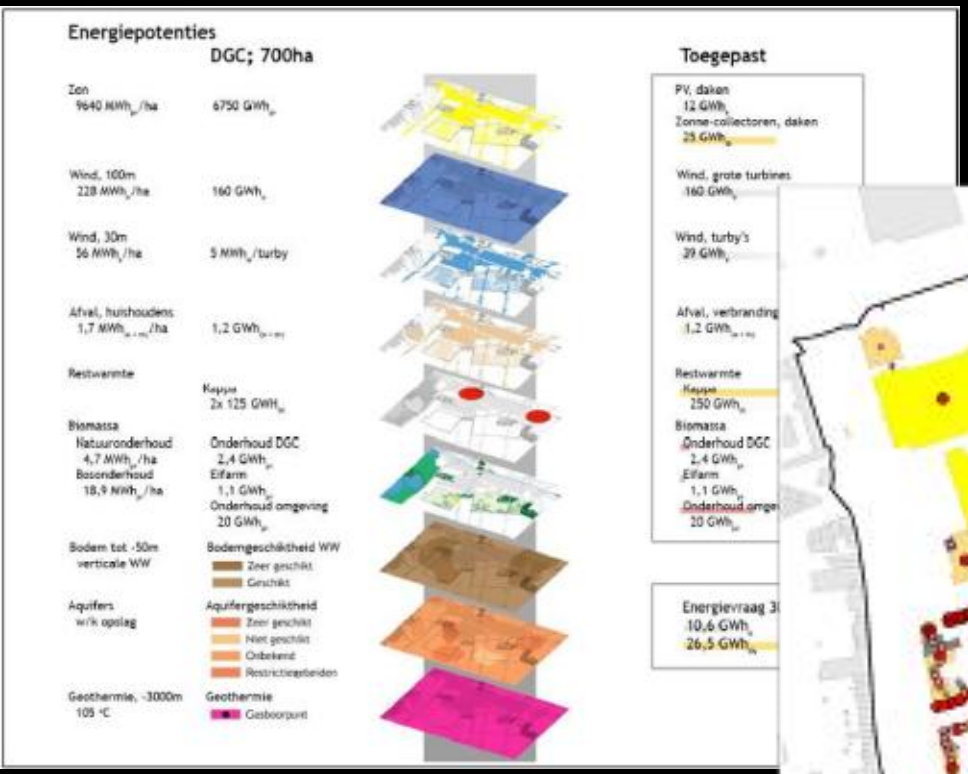
Exchange of Energy waste flows in REAP

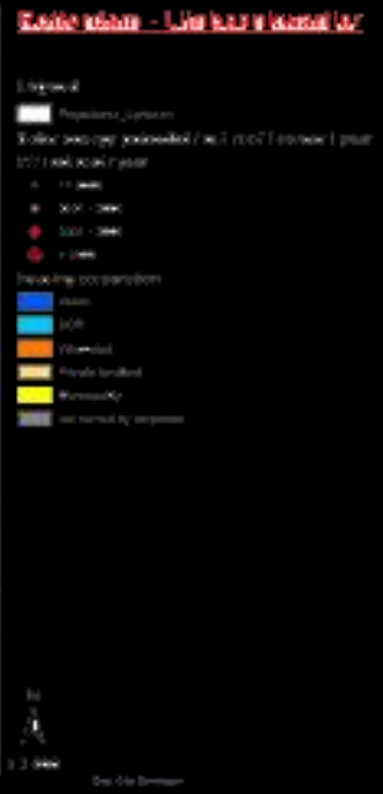


1 m2 of super market can heat 7 m2 of appartment
1 m2 of green house can heat 4 m2 of appartment and produce food!!



3. Renewable Production: Energy potential maps





By: A. Van den Dobbelsteen

Energy Atlas Rotterdam online
Amsterdam Energy atlas alos available.

Basic information

Future

3000 dwellings:

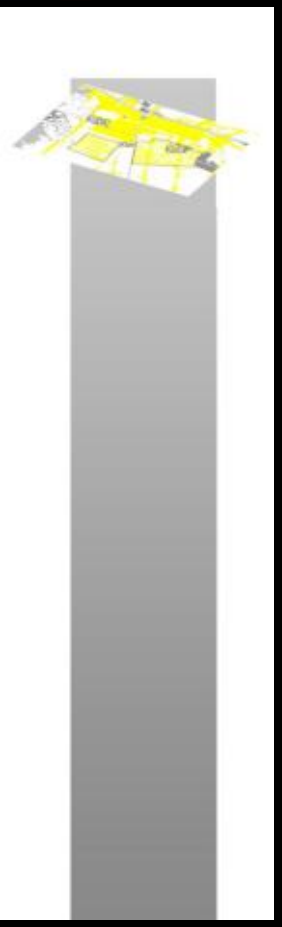
Elektricity: **10,5 GWh_e**
Heating: **26,5 GWh_{th} (aeq)**

From: Prof. Andy van den Dobbelsteen , Delft University of Technology

Energy potentials

10,5 GWh$_e$

26,5 GWh$_{th}$



6750 GWh$_{pr}$

12 GWh$_e$

sun

Per house 40 m^2 pv or solar collectors

DGC: PV on roofs: 12 GWh$_e$

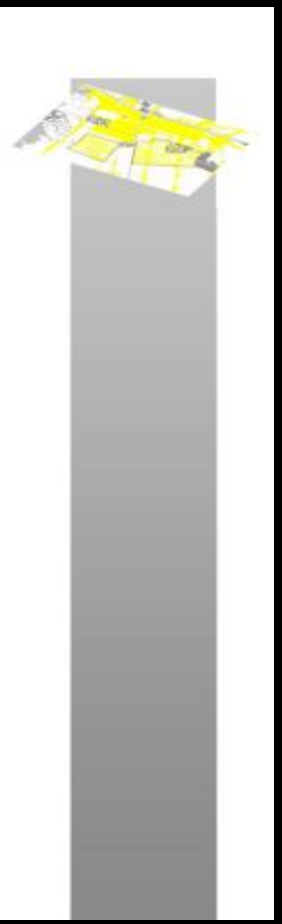
DGC: SC on roofs: 35 GWh$_{th}$

Energy potentials

Electricity from wind 100 m (8 m/s)

10,5 GWh_e

26,5 GWh_{th}



6750 GWh_{pr}

12 GWh_e

35 GWh_{th}

large turbines : 0.23 GWh_e/ha

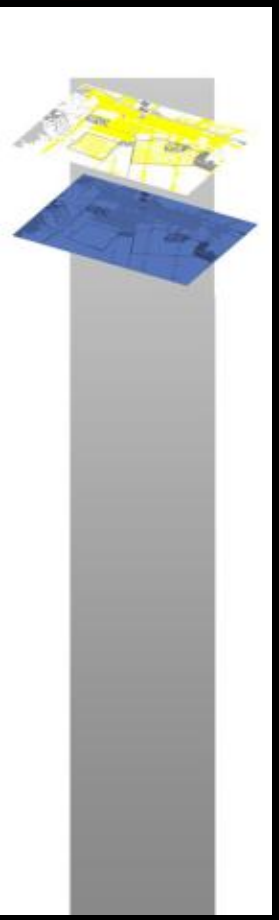
DGC: 0-160 GWh_e

Energy potentials

Electricity from wind at 30 m (5 m/s)

10,5 GWh_e

26,5 GWh_{th}



6750 GWh_{pr}

12 GWh_e
35 GWh_{th}

0 - 160 GWh_e

Wind at 30m:

Per Turby: **5 MWh_e**

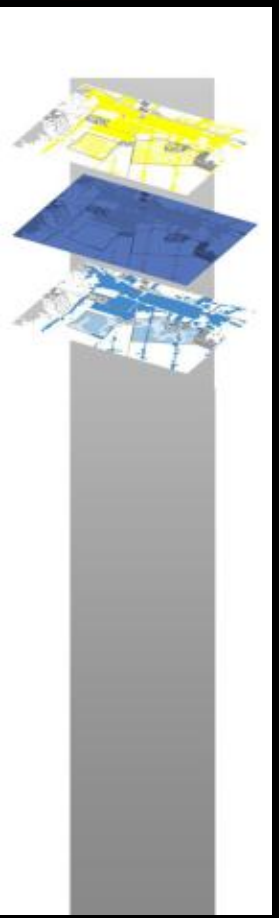
(DGC: **56 GWh_e)**

Energy potentials

Energy from waste

10,5 GWh_e

26,5 GWh_{th}



6750 GWh_{pr}

12 GWh_e
35 GWh_{th}

0 - 160 GWh_e

5 MWh_e/turby

Per household: 0,57 ton → 326 kWh_e+ 59 kWh_{th}

DGC: 1,2 $GWh_{(e+th)}$

Energy potentials

10,5 GWh_e

26,5 GWh_{th}

6750 GWh_{pr}

12 GWh_e
35 GWh_{th}

0 - 160 GWh_e

5 MWh_e/turby

1,2 $GWh_{(e+th)}$

waste heat

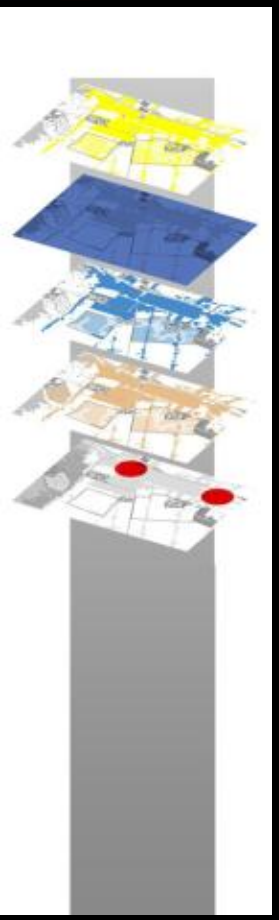
Cardboard factories: 2 x 125 GWh_{th}

Energy potentials

biomass

10,5 GWh_e

26,5 GWh_{th}



6750 GWh_{pr}

12 GWh_e
35 GWh_{th}

0 - 160 GWh_e

5 MWh_e/turby

1,2 $GWh_{(e+th)}$

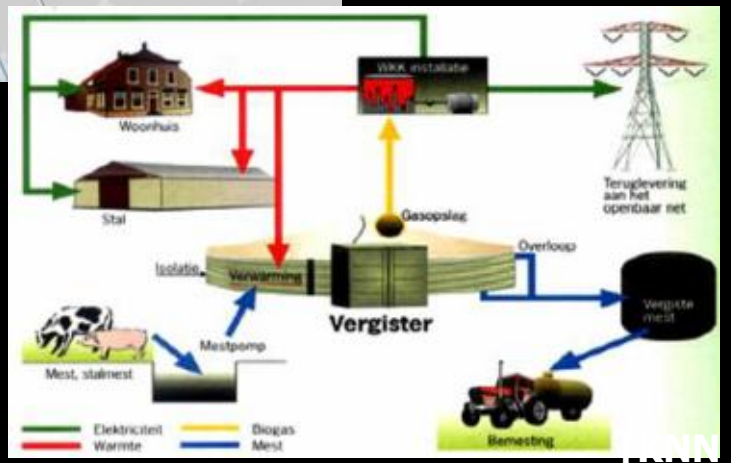
2 x 125 GWh_{th}

biogas

Chicken farms:

129.000 m^3 (Ae)

1.1 GWh_{Ae}

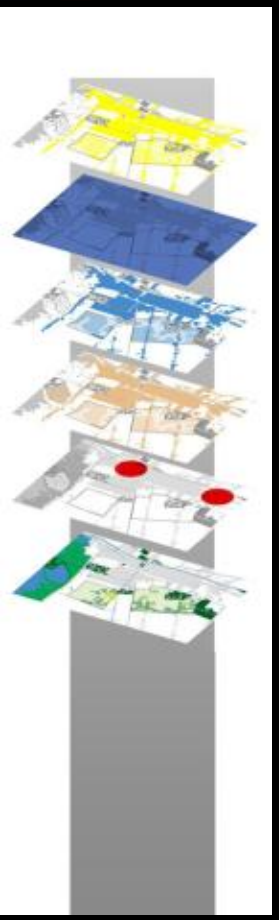


Energy potentials

Biomass

10,5 GWh_e

26,5 GWh_{th}



6750 GWh_{pr}

12 GWh_e
35 GWh_{th}

0 - 160 GWh_e

5 MWh_e/turby

1,2 $GWh_{(e+th)}$

2 x 125 GWh_{th}

1,1 GWh_{Ae}

Biomassa-incineration:

from maintenance of parks: 4.7 MWh_{pr}/ha

and gardens: 18,9 MWh_{pr}/ha

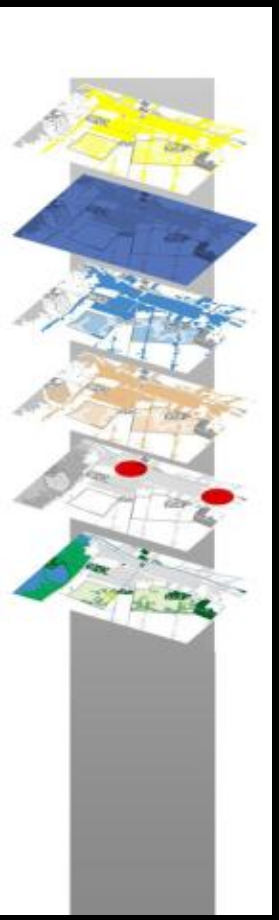
→ DGC: 2,4 GWh_{pr}

Energy potentials

biomass

10,5 GWh_e

26,5 GWh_{th}



6750 GWh_{pr}

12 GWh_e
35 GWh_{th}

0 - 160 GWh_e

5 MWh_e/turby

1,2 $GWh_{(e+th)}$

2 x 125 GWh_{th}

1,1 GWh_{Ae}
2,4 GWh_{pr}

Biomassa-verbrandingsinstallatie:

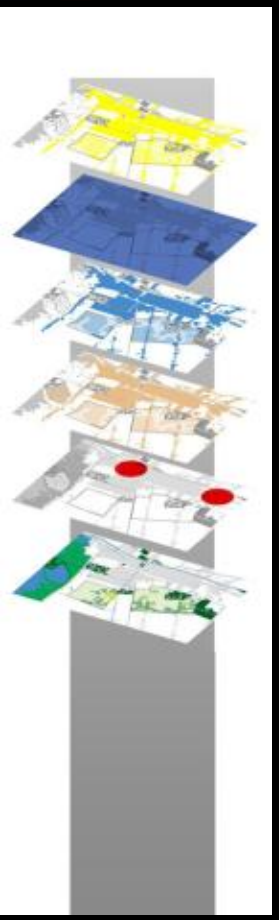
Nature and woodland maintenance: **→ DGC: 20 GWh_{pr}**

Energy potentials

Soil to 50 m. heatexchangers

10,5 GWh_e

26,5 GWh_{th}



6750 GWh_{pr}

12 GWh_e
35 GWh_{th}

0 - 160 GWh_e

5 MWh_e/turby

1,2 $GWh_{(e+th)}$

2 x 125 GWh_{th}

1,1 GWh_{Ae}
2,4 - 20 GWh_{pr}

zeer geschikt

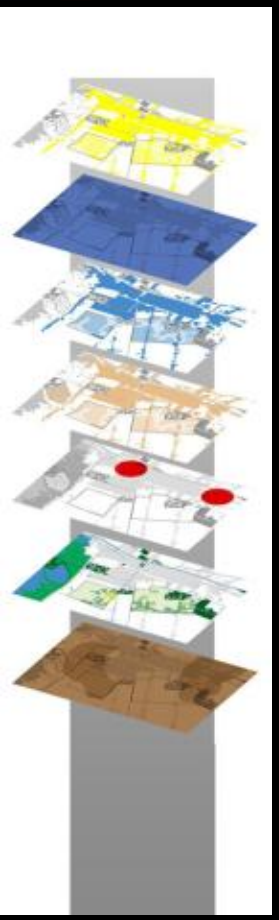
geschikt

Energy potentials

soil (50-500m): aquifers for heat cold storage

10,5 GWh_e

26,5 GWh_{th}



6750 GWh_{pr}

12 GWh_e

35 GWh_{th}

0 - 160 GWh_e

5 MWh_e/turby

1,2 $GWh_{(e+th)}$

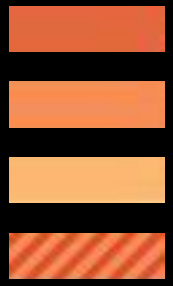
2 x 125 GWh_{th}

1,1 GWh_{Ae}

2,4 - 20 GWh_{pr}

z.g.

g.



Very good

good

Not good

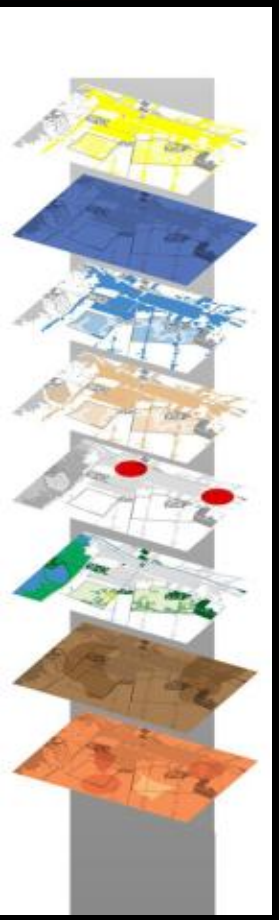
Restricted areas

Energy potentials

Soil(3000m): geothermal

10,5 GWh_e

26,5 GWh_{th}



6750 GWh_{pr}

12 GWh_e

35 GWh_{th}

0 - 160 GWh_e

5 MWh_e/turby

1,2 $GWh_{(e+th)}$

2 x 125 GWh_{th}

1,1 GWh_{Ae}

2,4 - 20 GWh_{pr}

z.g.

g.

Temperature at 3000m: 105 °C

TU Delft

Delft University of Technology

Energiepotenties

DGC; 700ha

Zon
9640 MWh_{pr}/ha — 6750 GWh_{pr}

Wind, 100m
228 MWh_{e}/ha — 160 GWh_{e}

Wind, 30m
56 MWh_{e}/ha — 5 MWh_{e}/turby

Afval, huishoudens
1,7 $MWh_{(e+th)}$/ha — 1,2 $GWh_{(e+th)}$

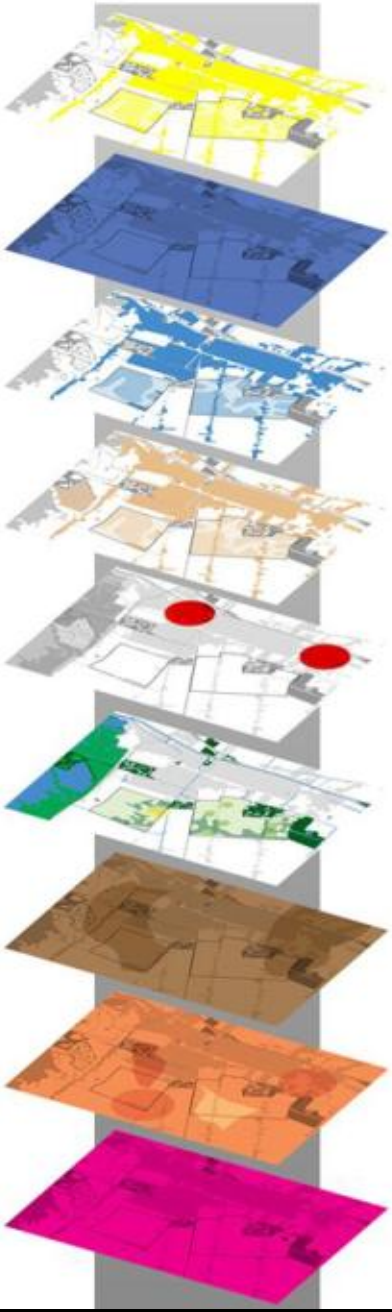
Restwarmte
Kappa
2x 125 GWH_{th}

Biomassa
Natuuronderhoud
4,7 MWh_{pr}/ha
Bosonderhoud
18,9 MWh_{pr}/ha
Onderhoud DGC
2,4 GWh_{pr}
Eifarm
1,1 GWh_{pr}
Onderhoud omgeving
20 GWh_{pr}

Bodem tot -50m
verticale WW
Bodemgeschiktheid WW
- Zeer geschikt
- Geschikt

Aquifers
w/k opslag
Aquifergeschiktheid
- Zeer geschikt
- Niet geschikt
- Onbekend
- Restrictiegebeiden

Geothermie, -3000m
105 °C
Geothermie
- Gasboorpunt



Toegepast

PV, daken
12 GWh_{e}
Zonne-collectoren, daken
25 GWh_{th}

Wind, grote turbines
160 GWh_{e}

Wind, turby's
39 GWh_{e}

Afval, verbranding
1,2 $GWh_{(e+th)}$

Restwarmte
Kappa
250 GWh_{th}
Biomassa
Onderhoud DGC
2,4 GWh_{pr}
Eifarm
1,1 GWh_{pr}
Onderhoud omgeving
20 GWh_{pr}

Energievraag 3000 hh:
10,6 GWh_{e}
26,5 GWh_{th}

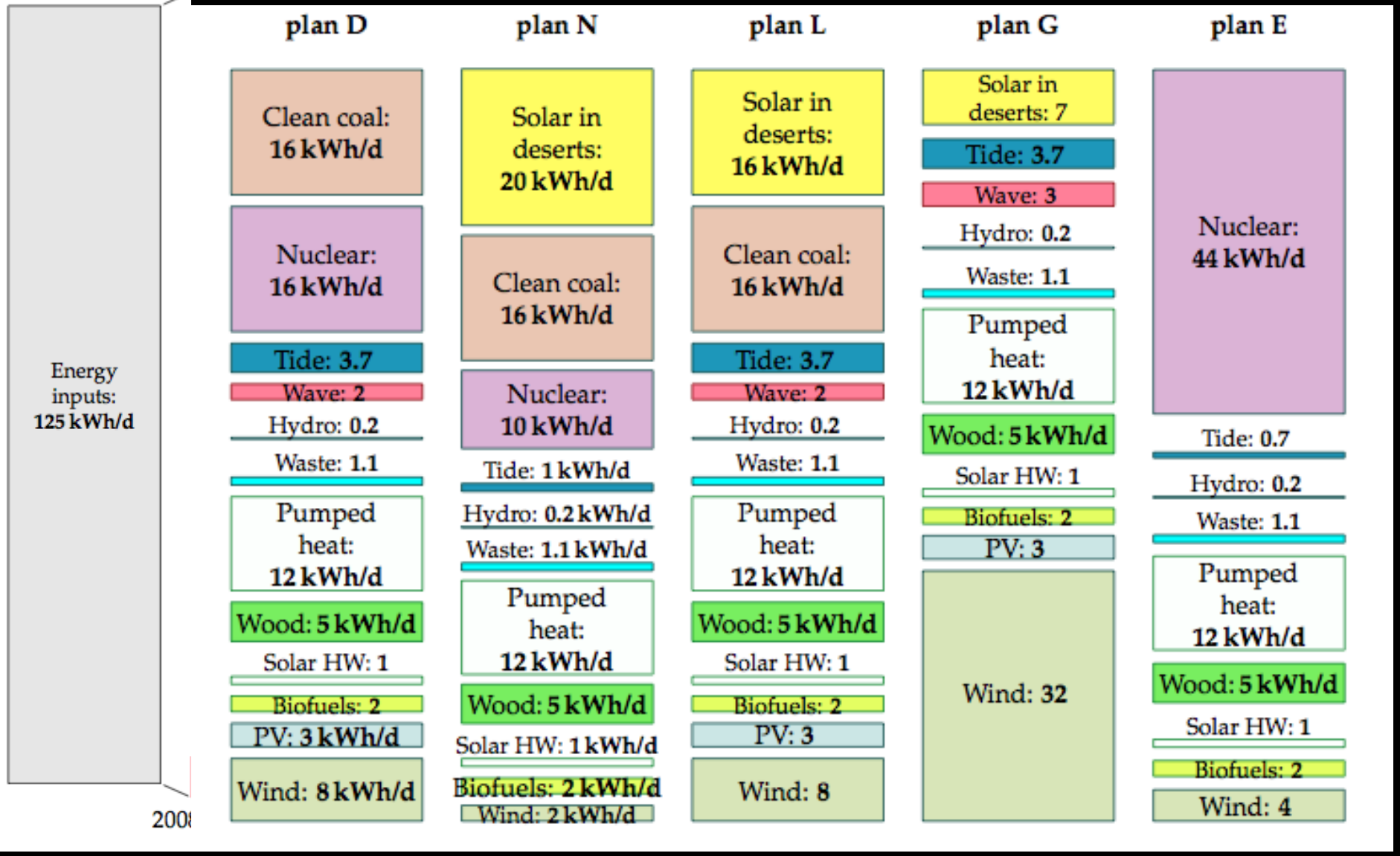
Energy = Space, so we need to plan with it also spatially

Power per unit land or water area	
Wind	2 W/m^2
Offshore wind	3 W/m^2
Tidal pools	3 W/m^2
Tidal stream	6 W/m^2
Solar PV panels	5–20 W/m^2
Plants	0.5 W/m^2
Rain-water (highlands)	0.24 W/m^2
Hydroelectric facility	11 W/m^2
Geothermal	0.017 W/m^2
Solar chimney	0.1 W/m^2
Ocean thermal	5 W/m^2
Concentrating solar power (desert)	**15 W/m^2**

Table 4. Renewable facilities have to be country-sized because all renewables are so diffuse. This table lists the power per unit land-area or sea-area offered by a number of renewables.

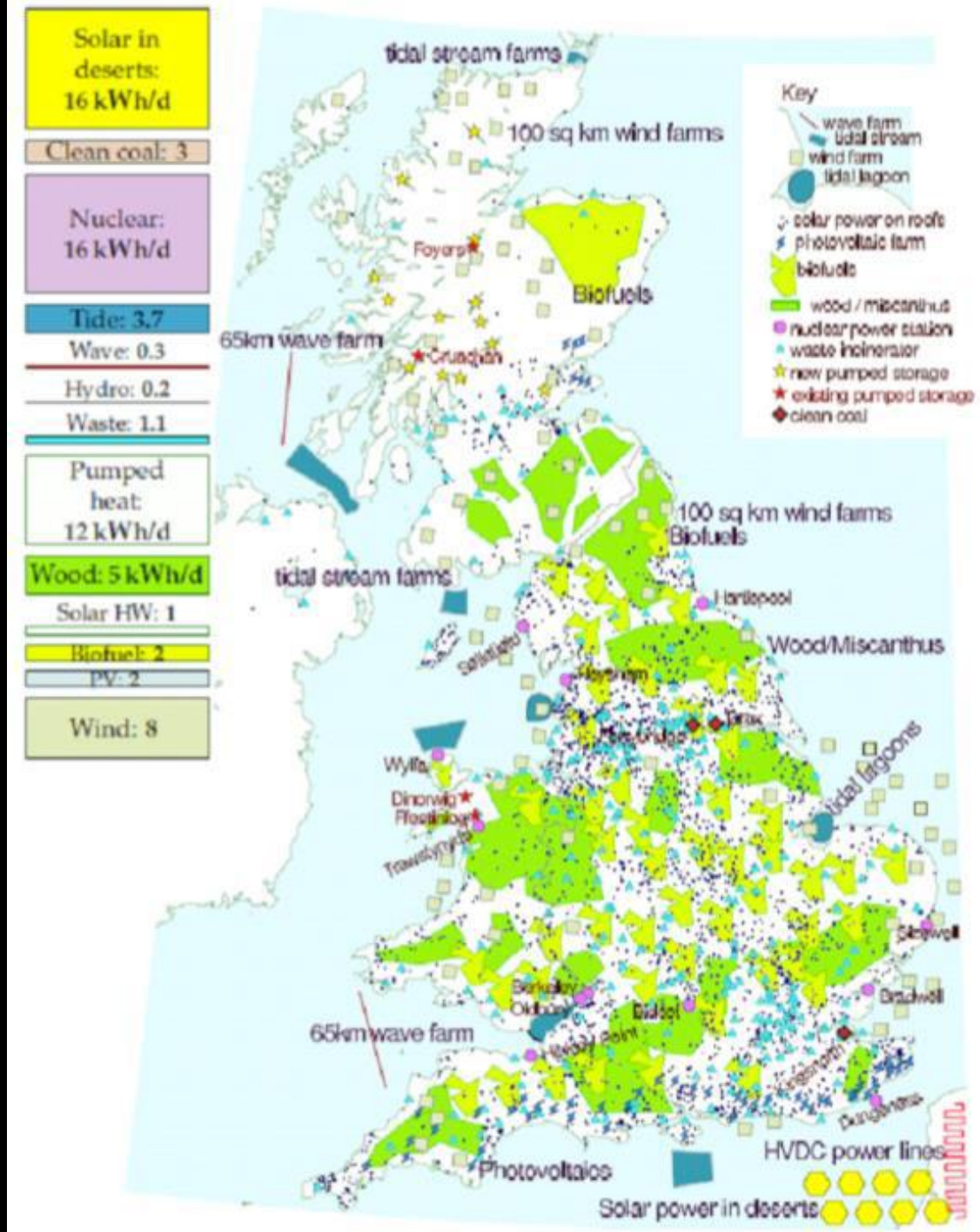
uit David Mackay, energy without hotair

5 sustainable energy scenarios



Domestic (alles in UK oplossen | NIMBY | Liberal | GREEN | Economic

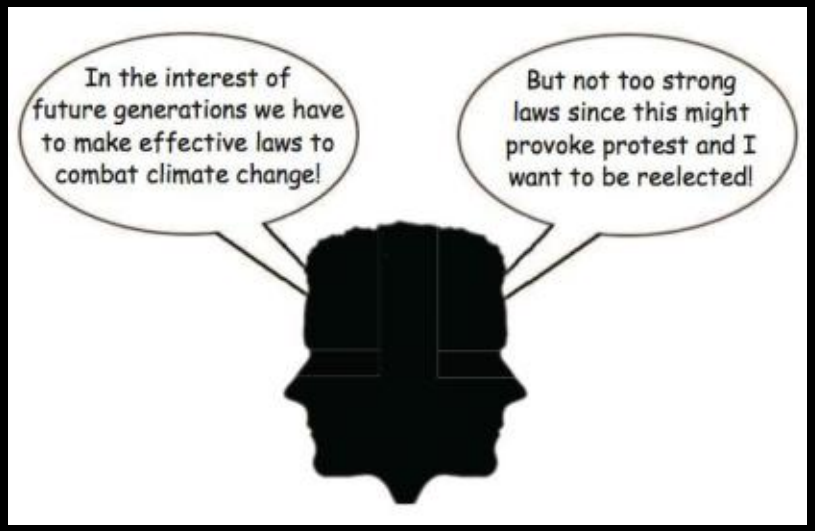
David Mackay, energy without hot air

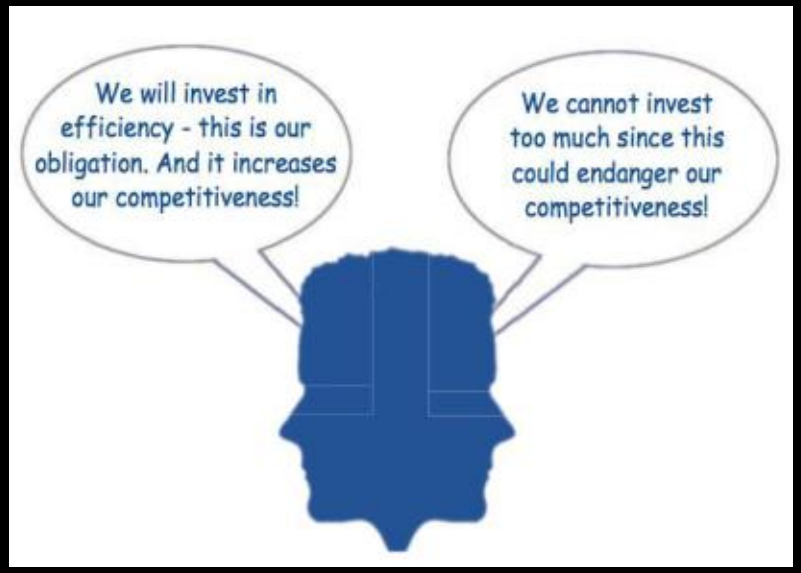


The medium scenario was put on in a map

uit David Mackay, energy without hotair

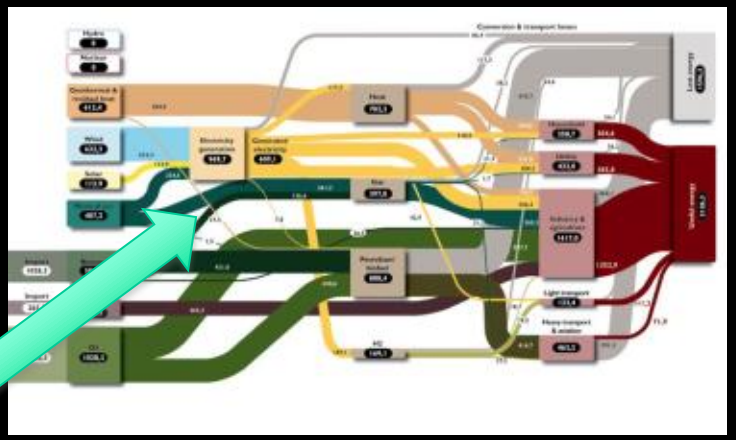
4. Energy scenarios for existing Cities/



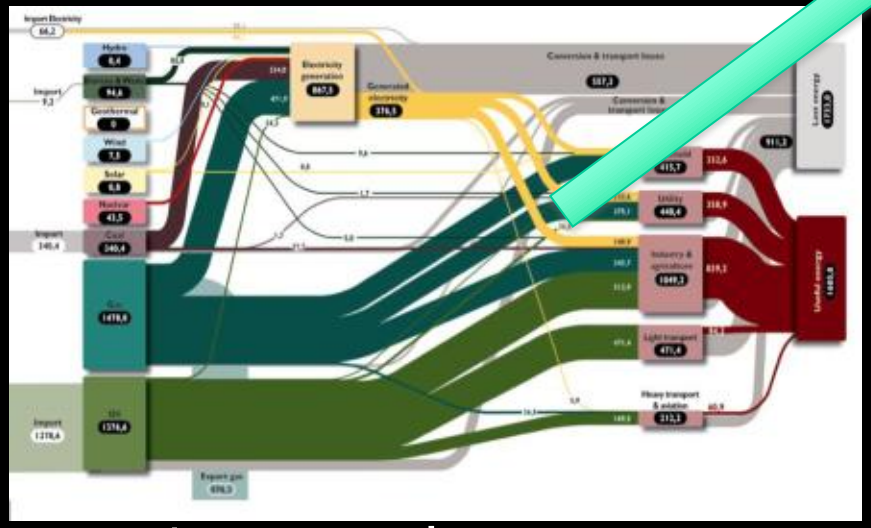


Different interests even within one group of stakeholders

And that while we have energytransitions as a task ahead of us.

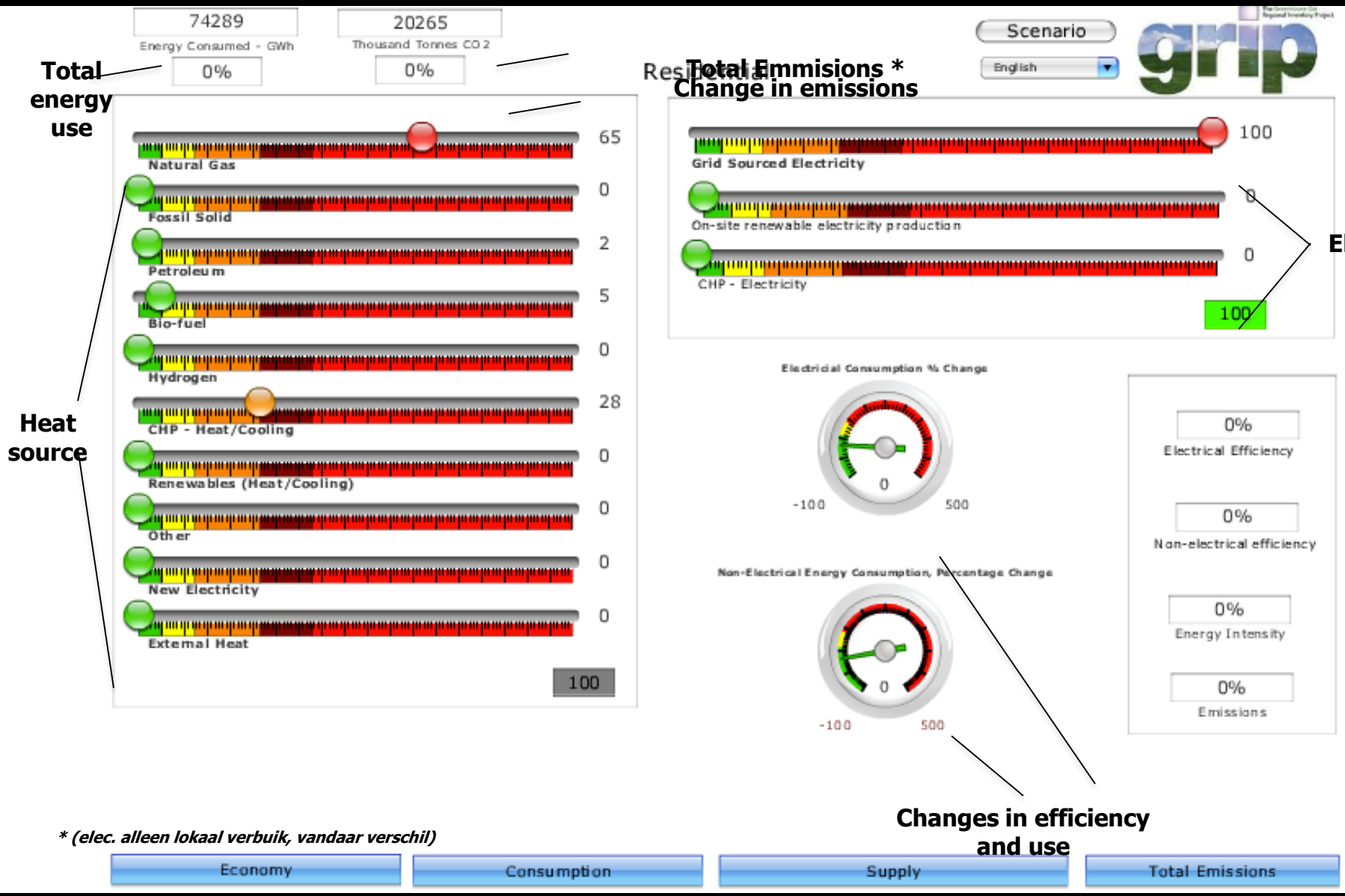


possible future mix



current energy mix

Scenariotool GRIP



Total energy use

Heat source

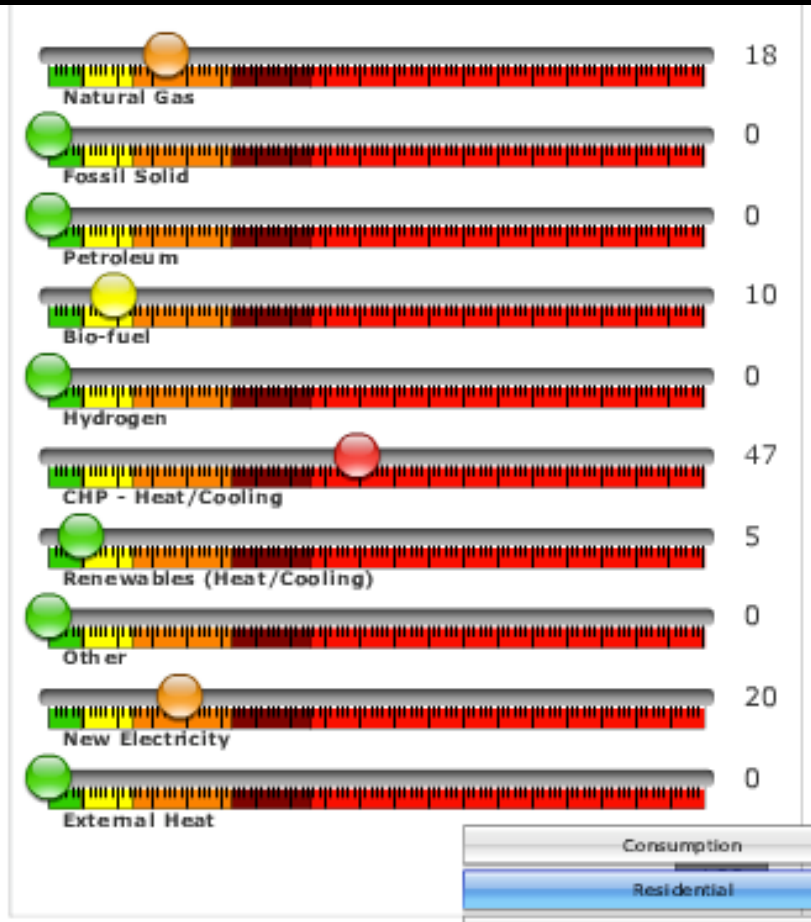
Total Emmisions * Change in emissions

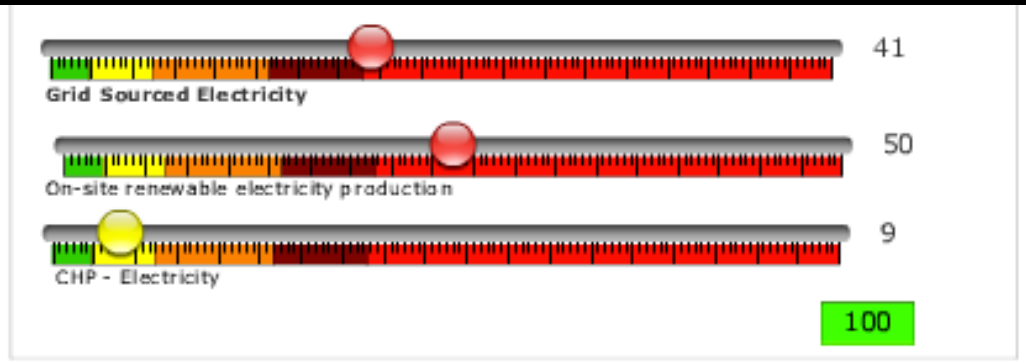
Electri

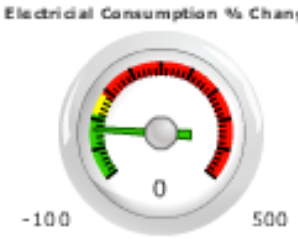
Changes in efficiency and use

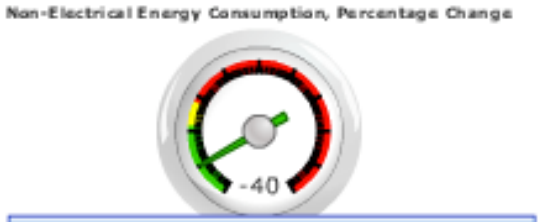
** (elec. alleen lokaal verbuik, vandaar verschil)*

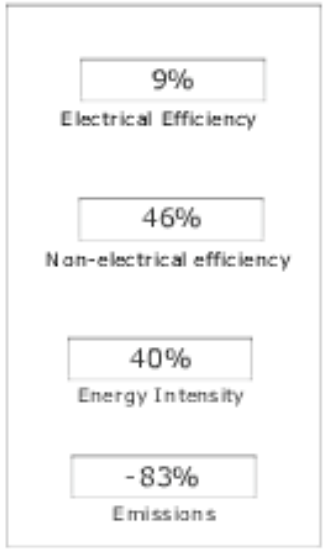
Economy/demografy consumption and supply see direct CO2 effects Low carbon !!

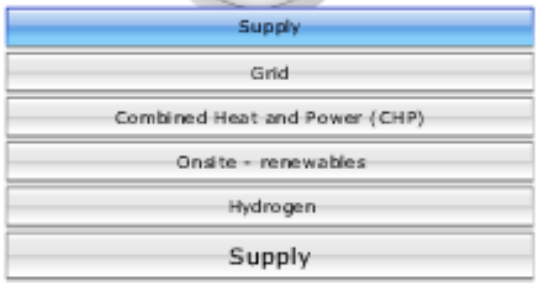












Energie scenario tools is fed by 'all the previous' and discussion from SH

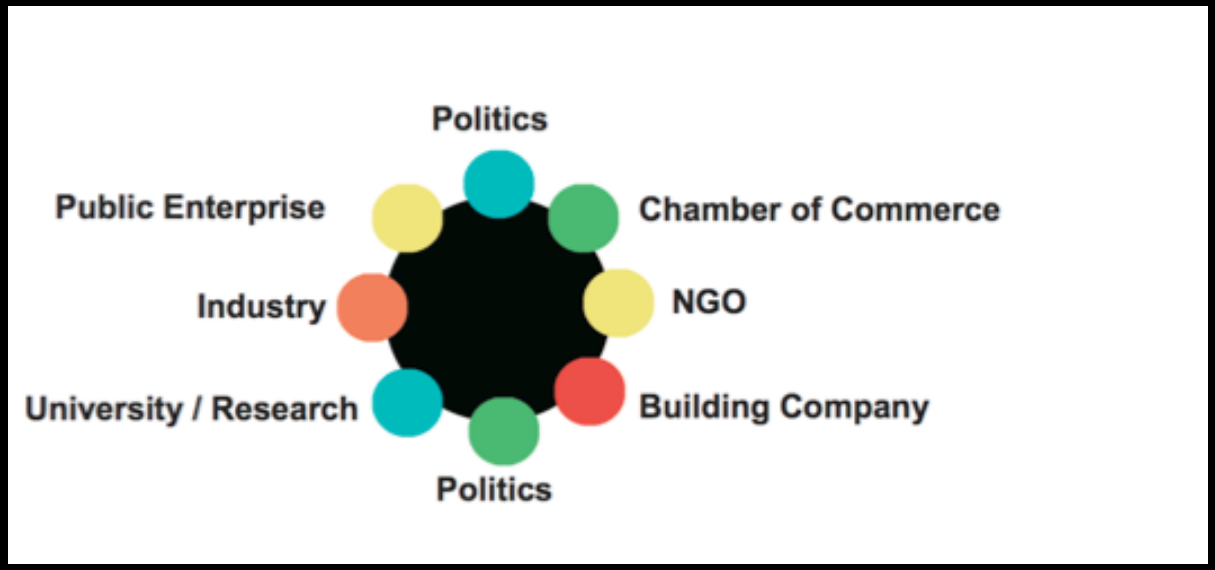
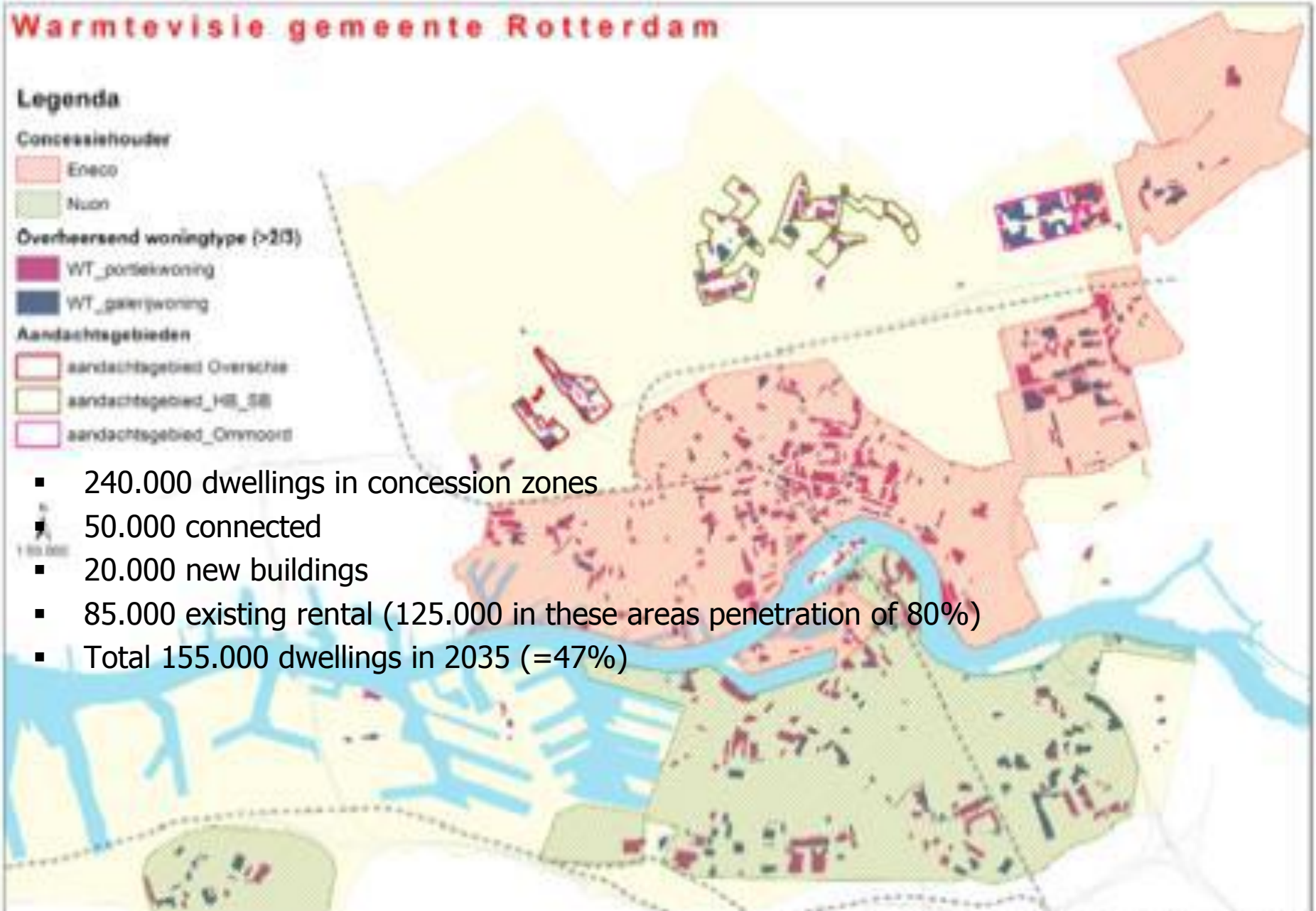


Figure metrex euco2 project

Having these results we can than use GIS for optimal locations where DH and all other solutions (might) go



- 240.000 dwellings in concession zones
- 50.000 connected
- 20.000 new buildings
- 85.000 existing rental (125.000 in these areas penetration of 80%)
- Total 155.000 dwellings in 2035 (=47%)

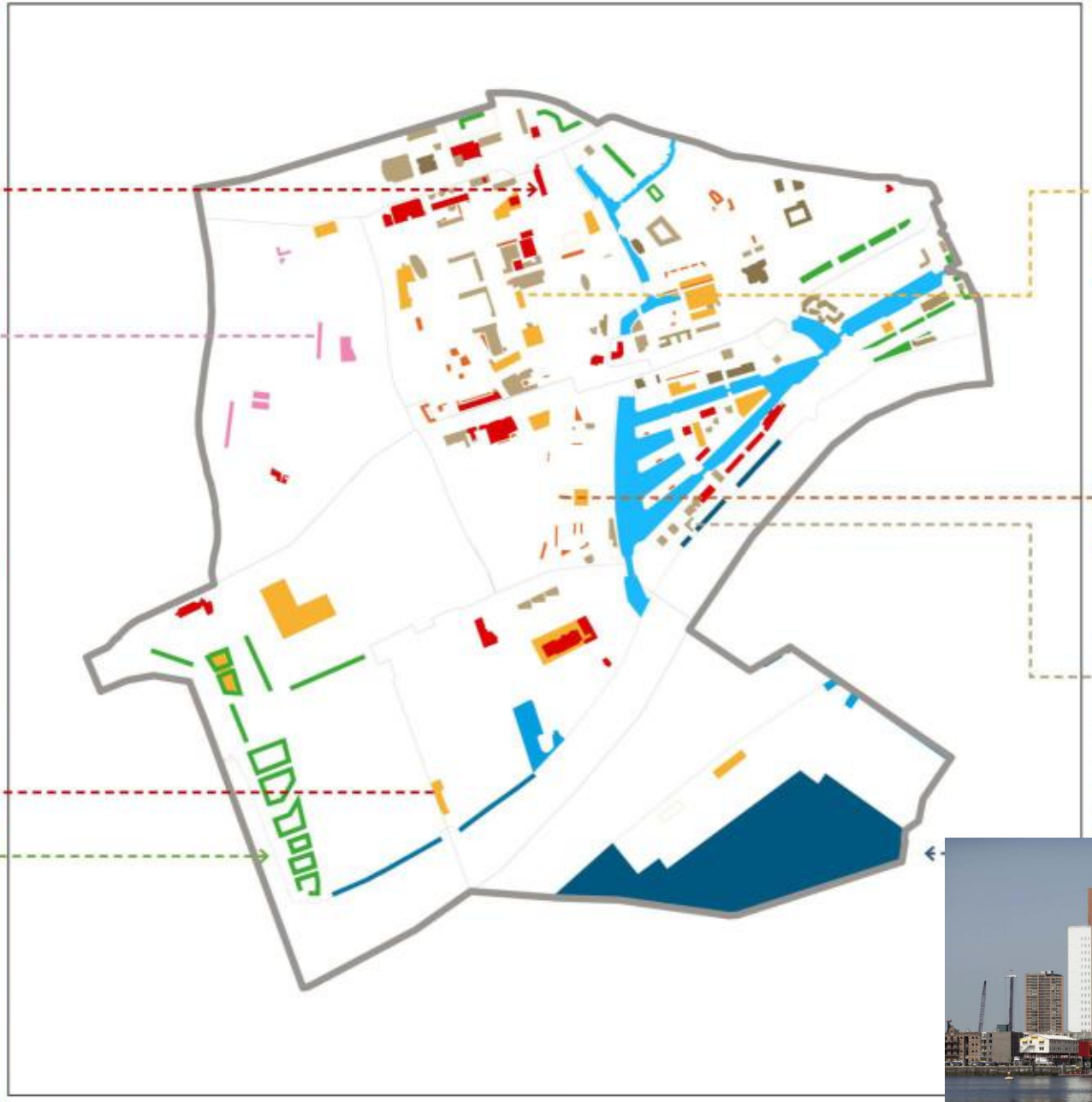
Part 3. Improve low carbon quality of life and living

see for pdf on internet at Rotterdam 'people make the innercity'

Densification plus Green = sustainable city ?
5000 trees, 80 ha of routes and green, 30.000 people?

- Walkability
- childfriendly
- Energy advatages
- Cycling
- Public transport
- More program, economic input
- Lively streets
- Cleaner air and water
- Less heat island effect

People in the city had already started so we just mapped it



Klushuizen / DIY houses Rotterdam

36

DENSIFICATION STRATEGY 07

DO-IT-YOURSELF

De bestaande woonvoorraad niet vergeten vraagt om een verdichtingsstrategie die omgang weet te vinden met een bestand aan te kleine, bouwtechnisch matig en slecht geïsoleerde woningen in vooral de negentiende-eeuwse ring binnen de binnenstad. Hierbij gaat het niet om verdichting in vierkante meters maar het geschikt maken van bouwblokken voor meer inwoners. Waar de te kleine woningen op de huidige woonmarkt alleen aantrekkelijk zijn als studio's en maisonnettes, kan juist het vrijgeven van samengestelde kavels als kluswoning ervoor zorgen dat grotere woningen voor gezinnen tot stand kunnen komen.

De bestaande stedelijke structuur in de oude stadswijken wordt benut in economische en sociale zin, alsmede de bestaande groenstructuur en speelruimten. Wooncónsument en coöperatie investeren samen in de verbouwkosten. Uitermate geschikt voor jonge stellen en gezinnen die een wooncarrière willen maken in een bestaande woning. Tevens biedt de aanwezigheid van bestaande scholen en levendigheid van de binnenstad een aantrekkelijk woonmilieu.

IN PROGRESS

?SHALL WE ADD ALL HOUSING COOPERATIONS FROM 19TH CENTURY?

POTENTIAL MAP 2040 & infografphics of +houses/district

But if you densify…
more green qualities needed 7 green strategies!!







Parking lot becomes green public space

Urban farming: what does the 'garden city' of the 21th look like reusing phosporus,producing biogas, social cohesion etc.

Childfriendly city 'woonerf revival ?' sidewalks go on for kids, special circulation for cars, public transport and bikes in all suburbs since 1980's

GREEN STRATEGY 05

PLAYGROUNDS

Kinderen zijn de toekomst van de stad

Hoe ben je zelf opgegroeid en wat waren jouw belangrijkste herinneringen? Met vriend
netjes buiten ravotten op het plein, klimmen in een boom, bloemen en bessen plukken kan ook in
Een kindvriendelijke buitenruimte is essentieel voor een wervend en compleet woonmilieu in de bi
vriendelijkheid heeft meer om het lijf heeft dan een aantal speelplekken te realiseren: het gaat om d
ing van de openbare ruimte. Brede stoepen, langzaam verkeer routes en drempelruimten (engels:
zones) spelen daarin een belangrijke rol. Brede stoepen bieden een informele ruimte voor spel. D
zijn overgangsgebieden tussen het privédomein en de openbare ruimte, waar kinderen beschut er
spelen. Daarnaast zijn ook specifieke voorzieningen voor allerlei doelgroepen nodig. Om de adolesc
een goede uitlaatklep te geven is er bijvoorbeeld het internationaal gewaardeerde skatepark aan
de kleinsten en allerkleinsten is er het speelplein op 't Landje en zijn er de openbare sportvelden o
werpplein aan de rand van het centrum. Sport, spel en groen zijn bijzonder belangrijk voor de het
vitale en gezonde kinderen. In de speelplekkenstrategie wil de gemeente oases voor kinderen make
spelaanleidingen en voldoende zitgelegenheid. In combinatie met de verschillende leefmilieus, on
ken en voorzieningen die eigen zijn aan een binnenstad wordt het centrum zo een waar eldorado vo
kinderen.

*Kinderen zorgen voor levendigheid op straat en voor sociale contacten tussen alles en ieder
zijn de dragers van de nieuwe stedelijkheid.* Quote Larry Beasley maart 2009

IN PROGRESS

POTENTIAL MAP 2040 & infografphics of +houses/district

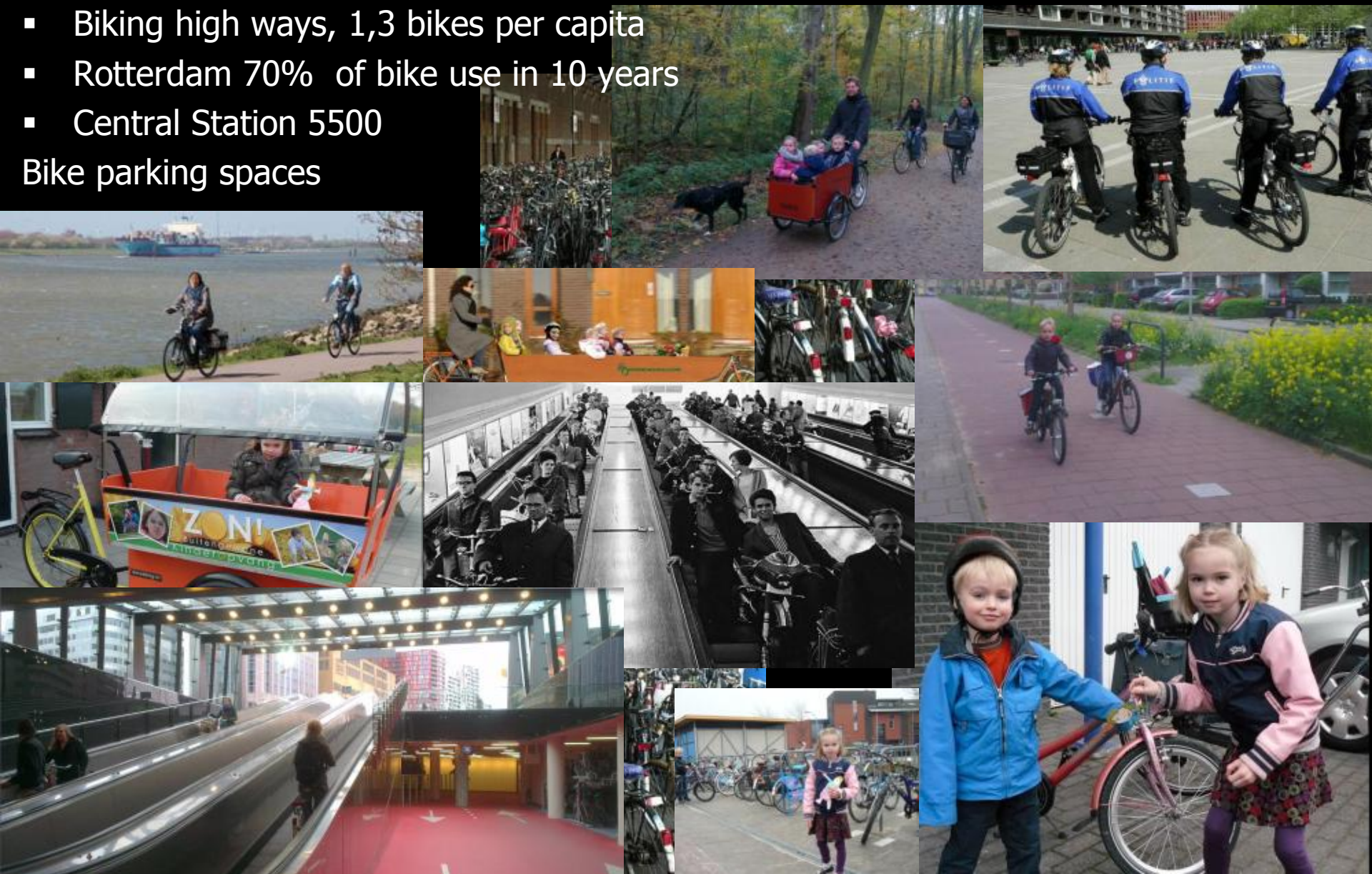
play wilderness

TU Delft
Delft University of Technology

Green network with more walking and biking

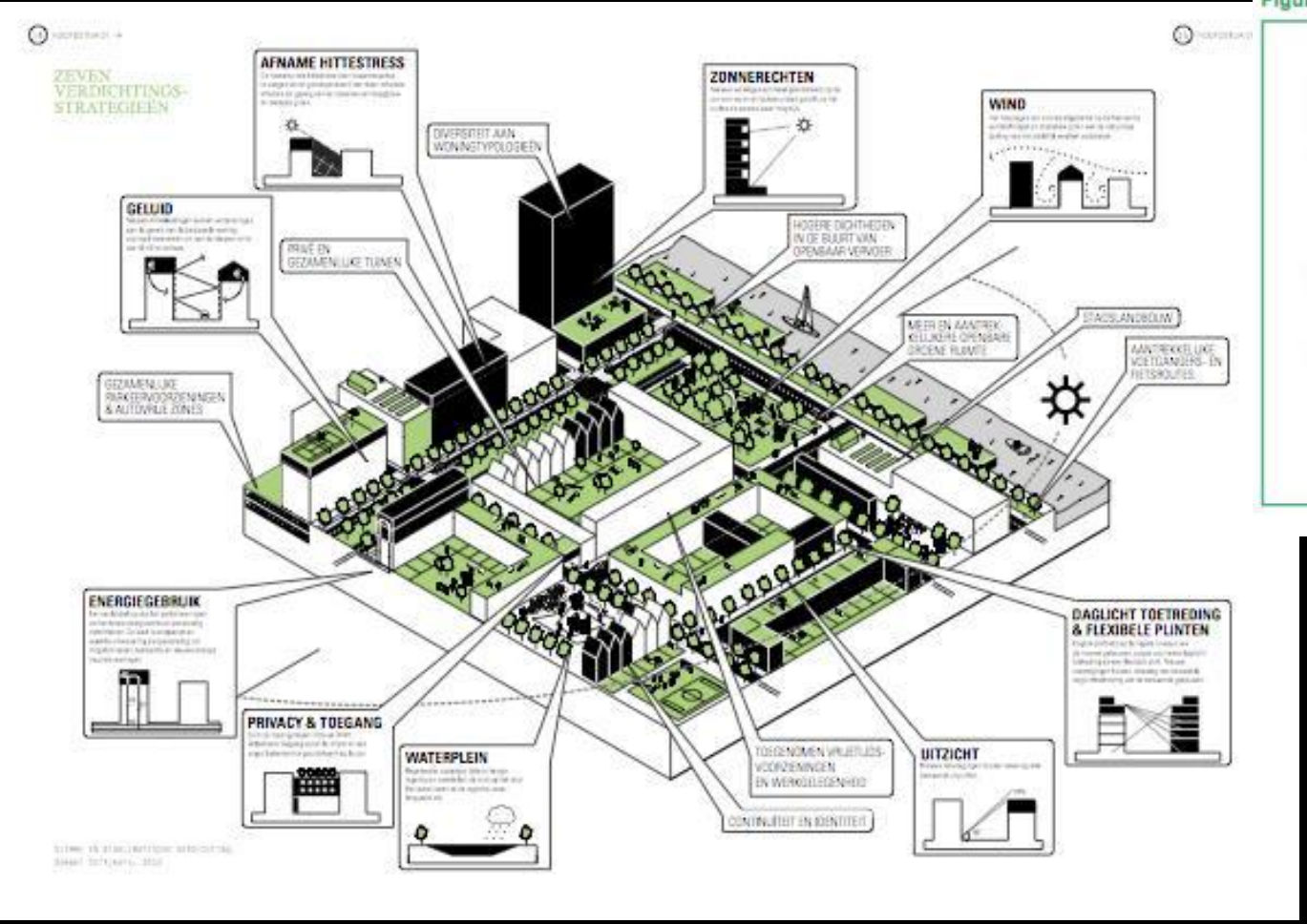
- Biking high ways, 1,3 bikes per capita
- Rotterdam 70% of bike use in 10 years
- Central Station 5500

Bike parking spaces



public transport 300 m from every home...and use grass!

Integrated planning with green



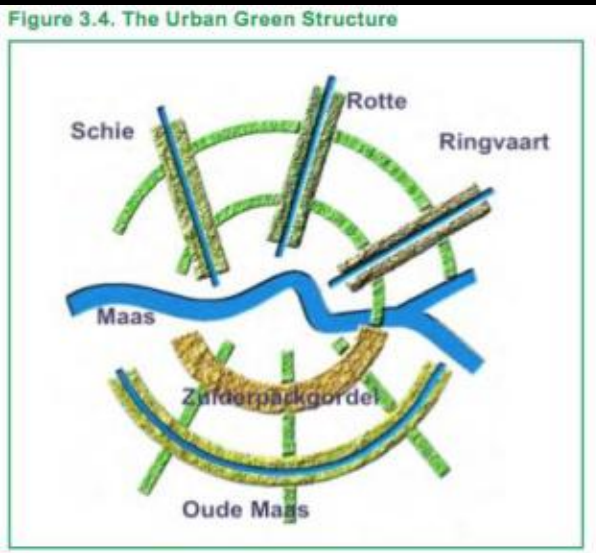


Image DoepelSstrijkers architects

…in neighborhoods for heatisland, watergardens, wind. solar rights etc

Assessment 30.000 inhabitants + 141 ha green

Healthy Life expectancy increased with two years

Quality of Life increases mainly by introducing a green/blue network and smart transport

Question is how does Rotterdam compare to other cities?

Part 4. Using City data & WCCD
comparing cities & city rankings

- Many rankings, standardization needed
- Feedback on your score
- standardized 3rd party verified data
- Indicator evolution
- Weighing black box
- Resilience, adaptation capacity
- Governance
- Use of local potentials (renewables)
- Indirect impacts of consumption elsewhere..so footprint

	City	Country	Rating
1	Melbourne	Australia	97.5
2	Vienna	Austria	97.4
3	Vancouver	Canada	97.3
4	Toronto	Canada	97.2
5	Calgary	Canada	96.6
6	Sydney	Australia	96.1
7	Helsinki	Finland	96.0
8	Perth	Australia	95.9
9	Adelaide	Australia	95.9
10	Auckland	New Zealand	95.7

	City	Country	Rating
1	Vienna	Austria	108.6
2	Zurich	Switzerland	108
3	Geneva	Switzerland	107.9
4	Auckland	New Zealand	107.4
	Vancouver	Canada	107.4
6	Düsseldorf	Germany	107.2
7	Frankfurt	Germany	107
	Munich	Germany	107
9	Bern	Switzerland	106.5
10	Sydney	Australia	106.3

	City	Country	2009
1	Munich	Germany	(04)
2	Copenhagen	Denmark	(02)
3	Zurich	Switzerland	(01)
4	Tokyo	Japan	(03)
5	Helsinki	Finland	(05)
6	Stockholm	Sweden	(06)
7	Paris	France	(08)
8	Vienna	Austria	(07)
9	Melbourne	Australia	(09)
10	Madrid	Spain	(12)

….see next presentation