P5 PRESENTATION
The Urban Energy Transition

Matthijs Wentink

Urban Regeneration & kWh/m2

LIVING PLANET REPORT 2012

ECOLOGICAL FOOTPRINT INDEX

Read the whole report

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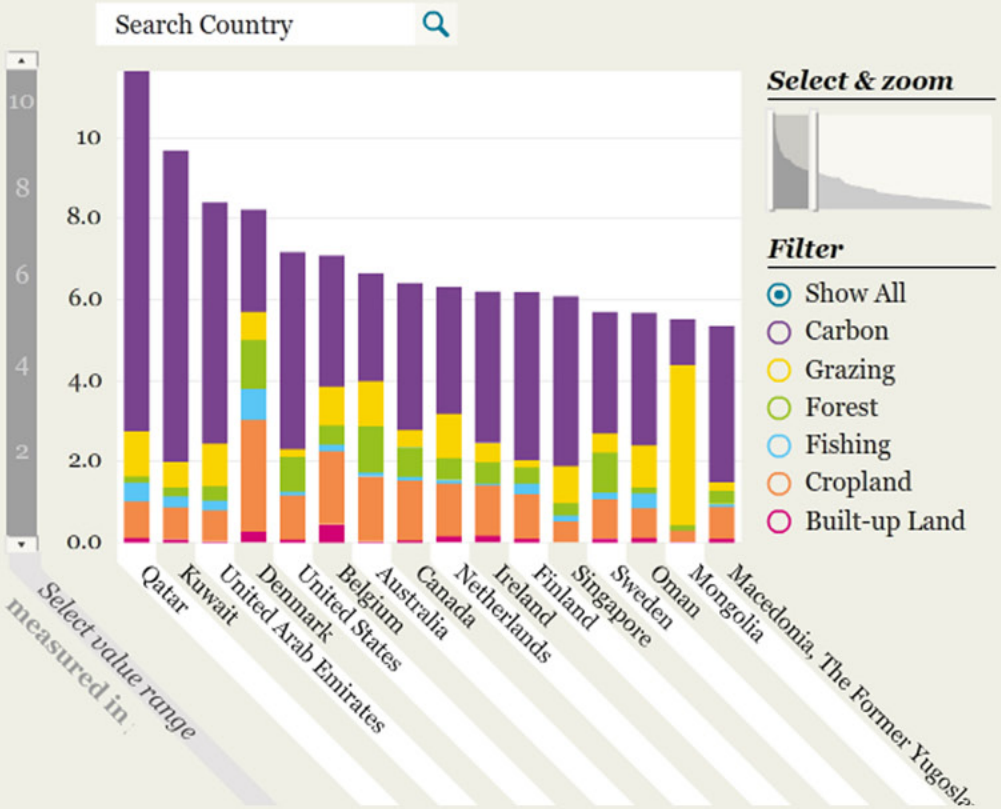
In 2008, people used the equivalent of 1.5 planets to support their activities.

The Ecological Footprint measures the biologically productive area that people use for provision of renewable resources, occupy with infrastructure, or require for absorption of CO_2 wastes.



9e

LIVING PLANET REPORT 2012

ECOLOGICAL FOOTPRINT INDEX

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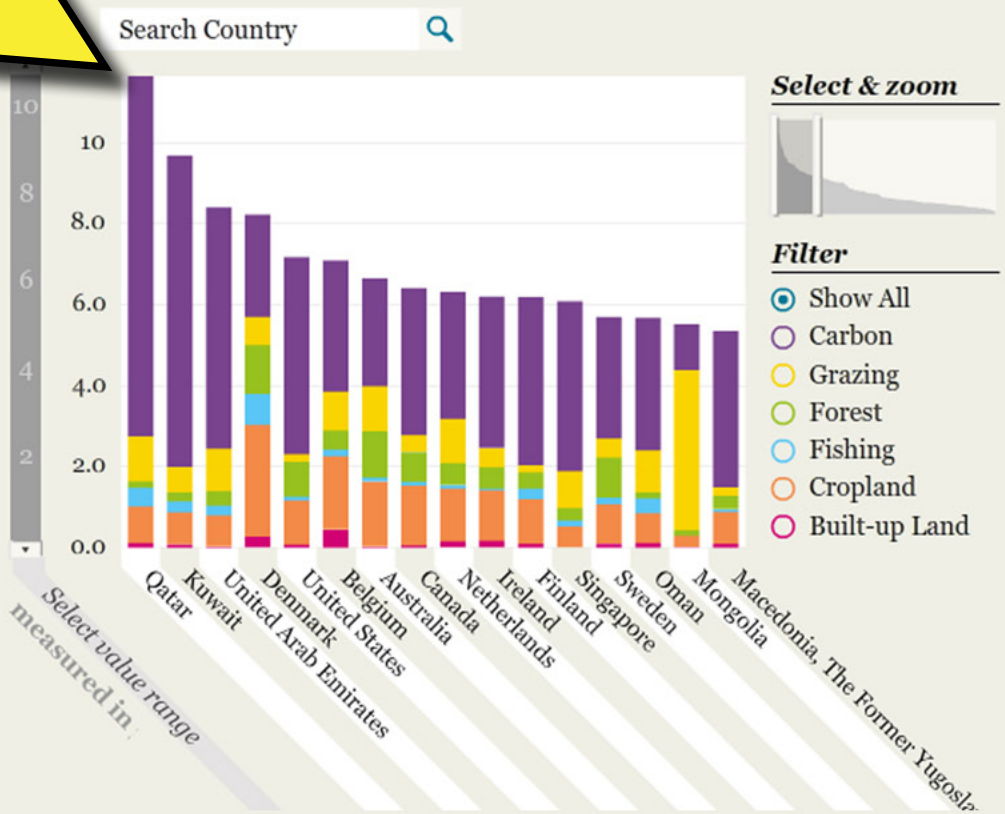
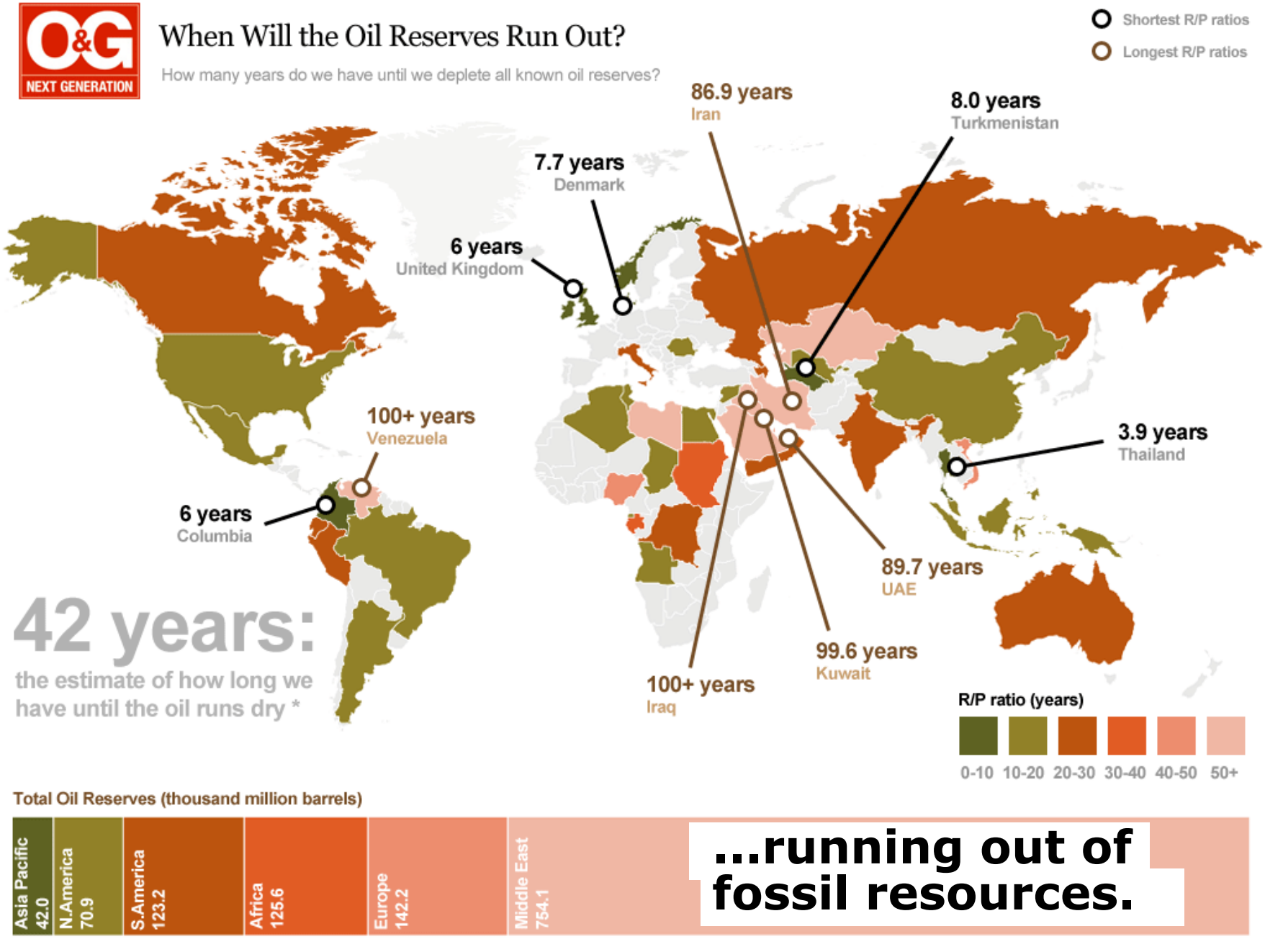
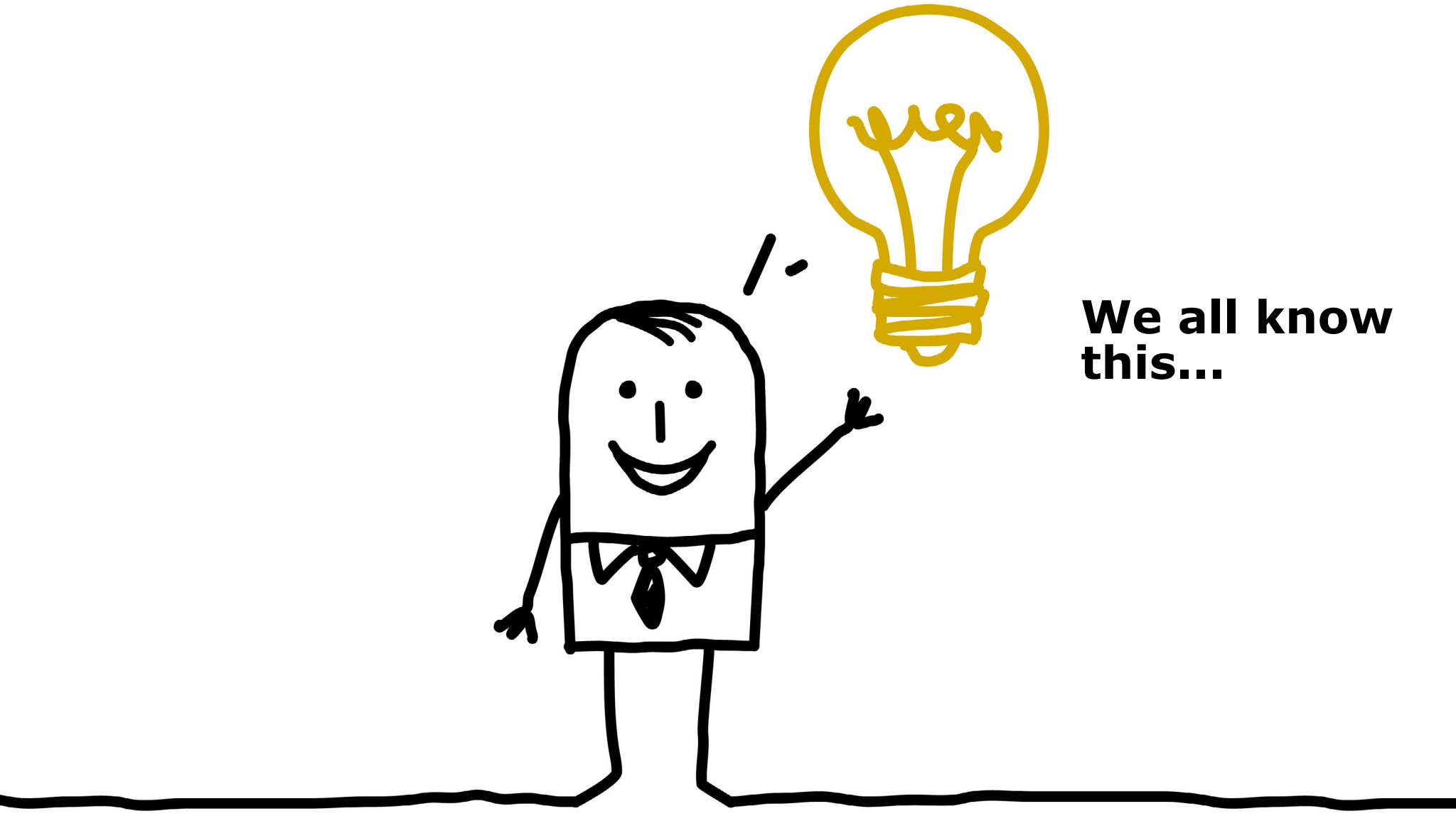



Adverse effects
on nature...

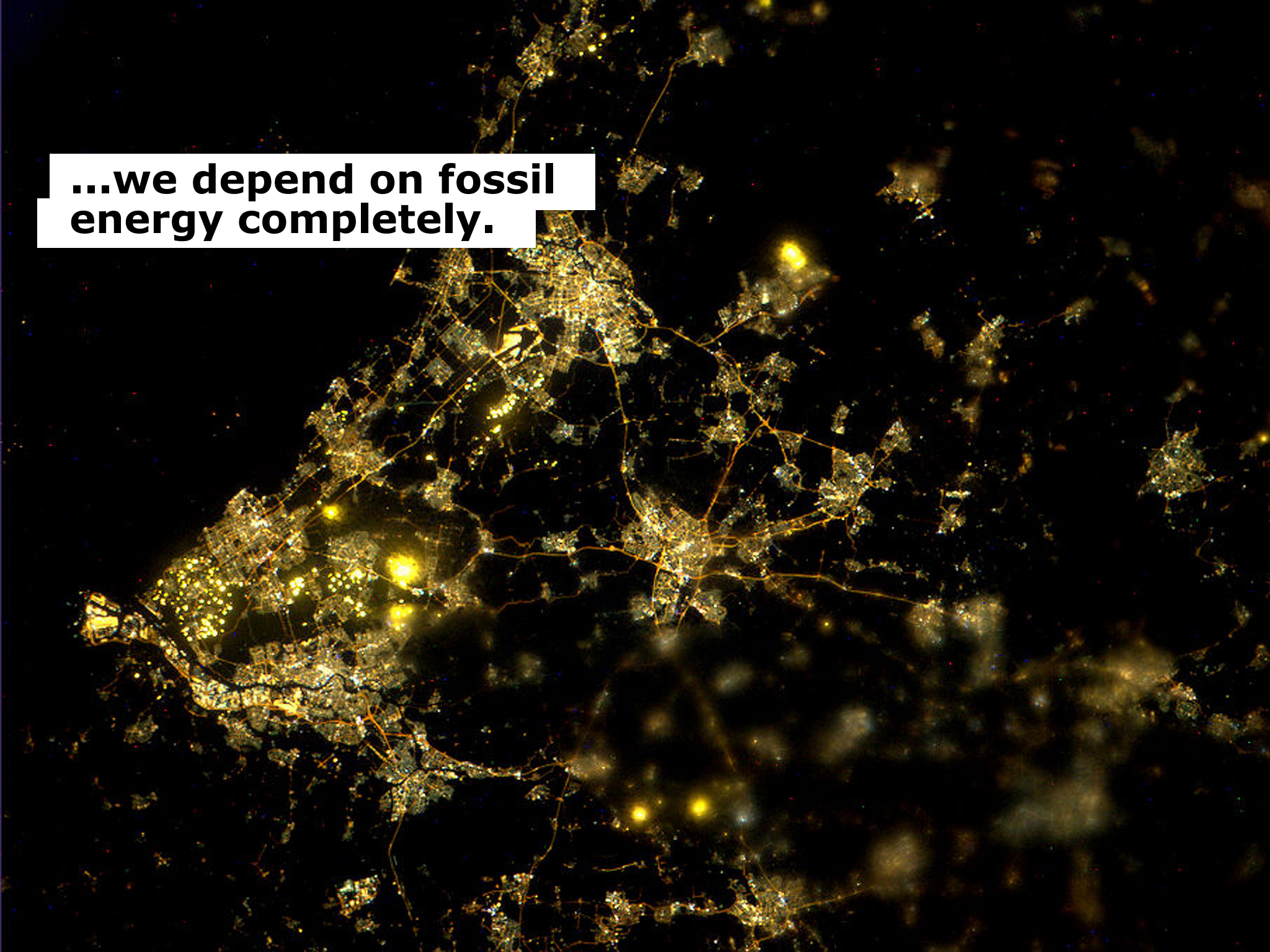

ORDEM
...balance of
power is shifting...

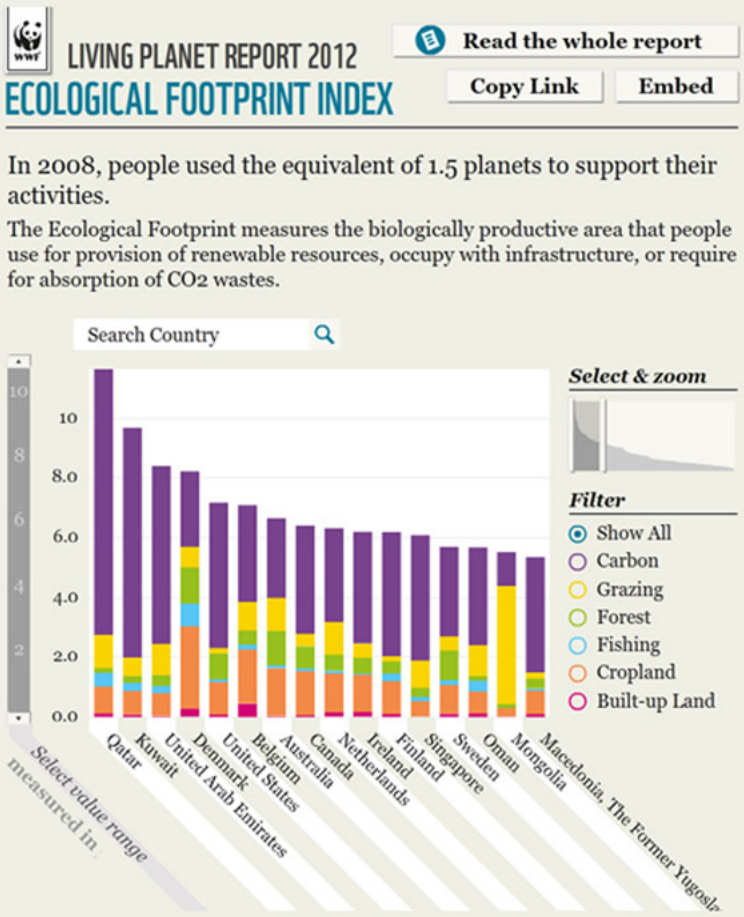

O&G
NEXT GENERATION
When Will the Oil Reserves Run Out?
How many years do we have until we deplete all known oil reserves?
Shortest R/P ratios
Longest R/P ratios
86.9 years
Iran
8.0 years
Turkmenistan
7.7 years
Denmark
6 years
United Kingdom
100+ years
Venezuela
6 years
Columbia
3.9 years
Thailand
89.7 years
UAE
99.6 years
Kuwait
100+ years
Iraq
42 years:
the estimate of how long we have until the oil runs dry *
R/P ratio (years)
0-10 10-20 20-30 30-40 40-50 50+
Total Oil Reserves (thousand million barrels)
Asia Pacific 42.0
N.America 70.9
S.America 123.2
Africa 125.6
Europe 142.2
Middle East 754.1
...running out of fossil resources.

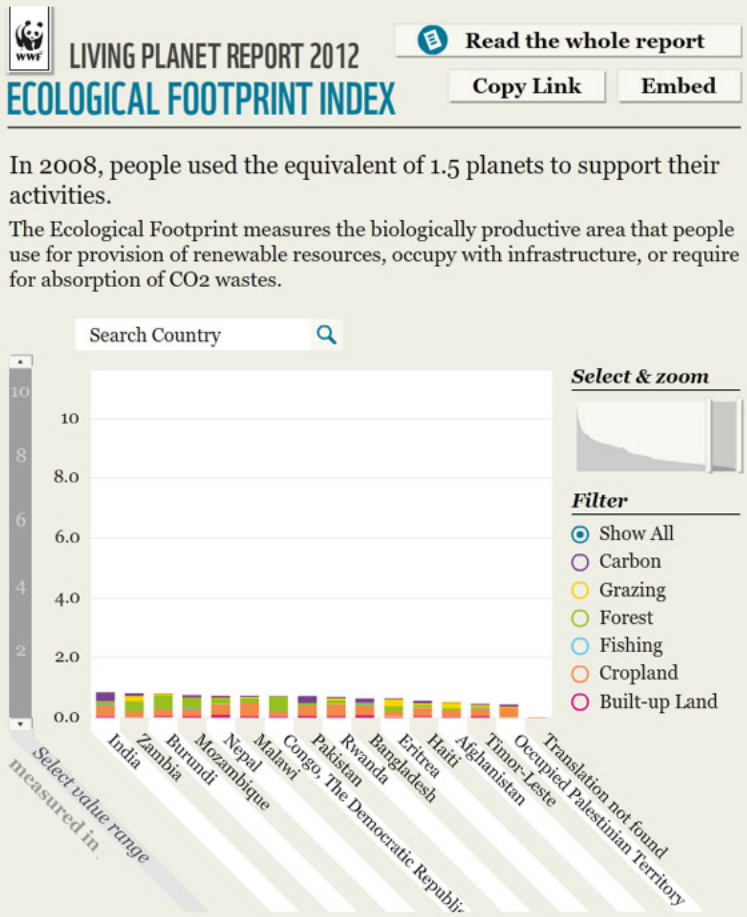


We all know this…


A 1 Luxury Limousine
of South Florida
561-964-7764
...and still...


...we depend on fossil energy completely.





Wealth play an important role...


...but is this a
good precedent?

So, what if oil becomes too expensive...

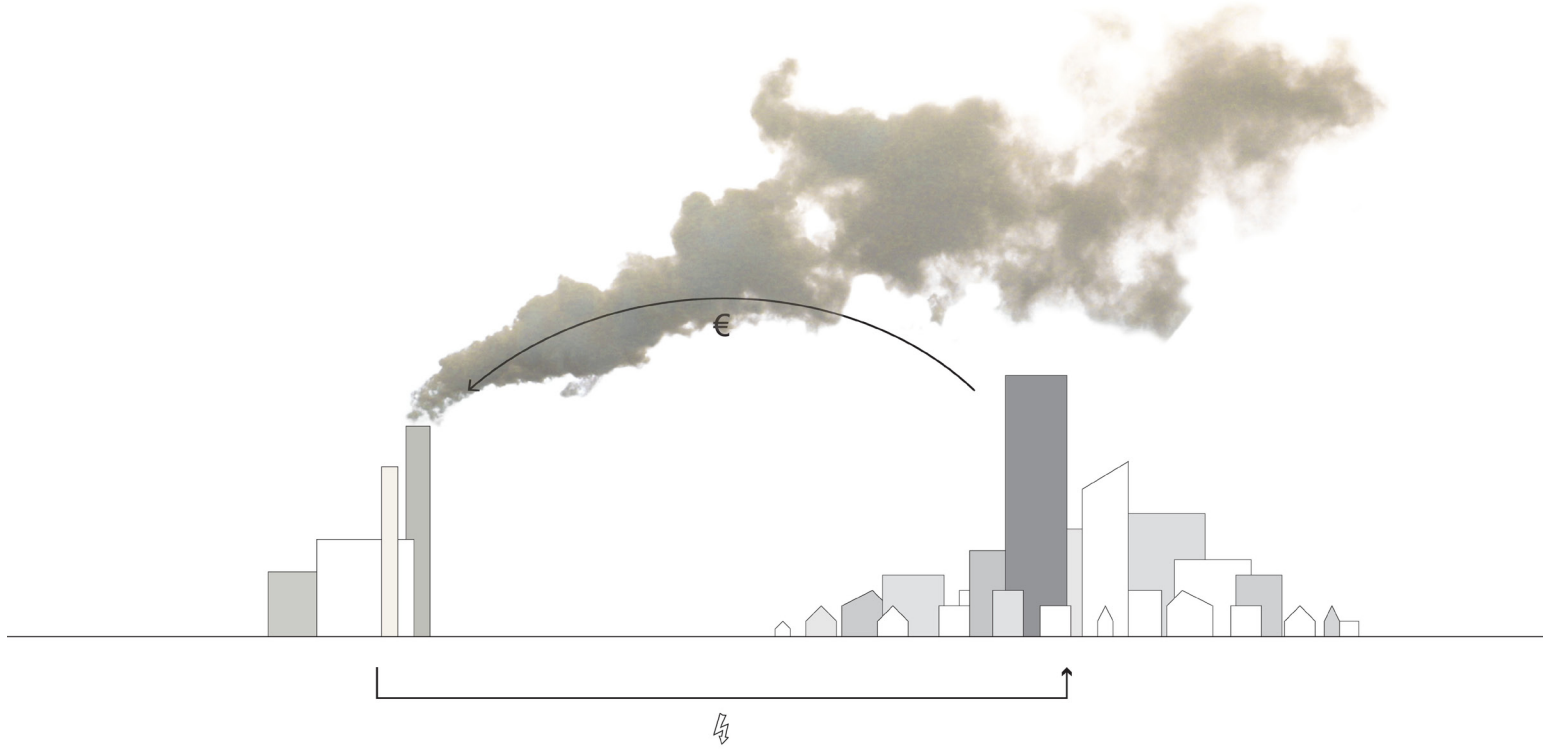

...will we still be
able to live here...

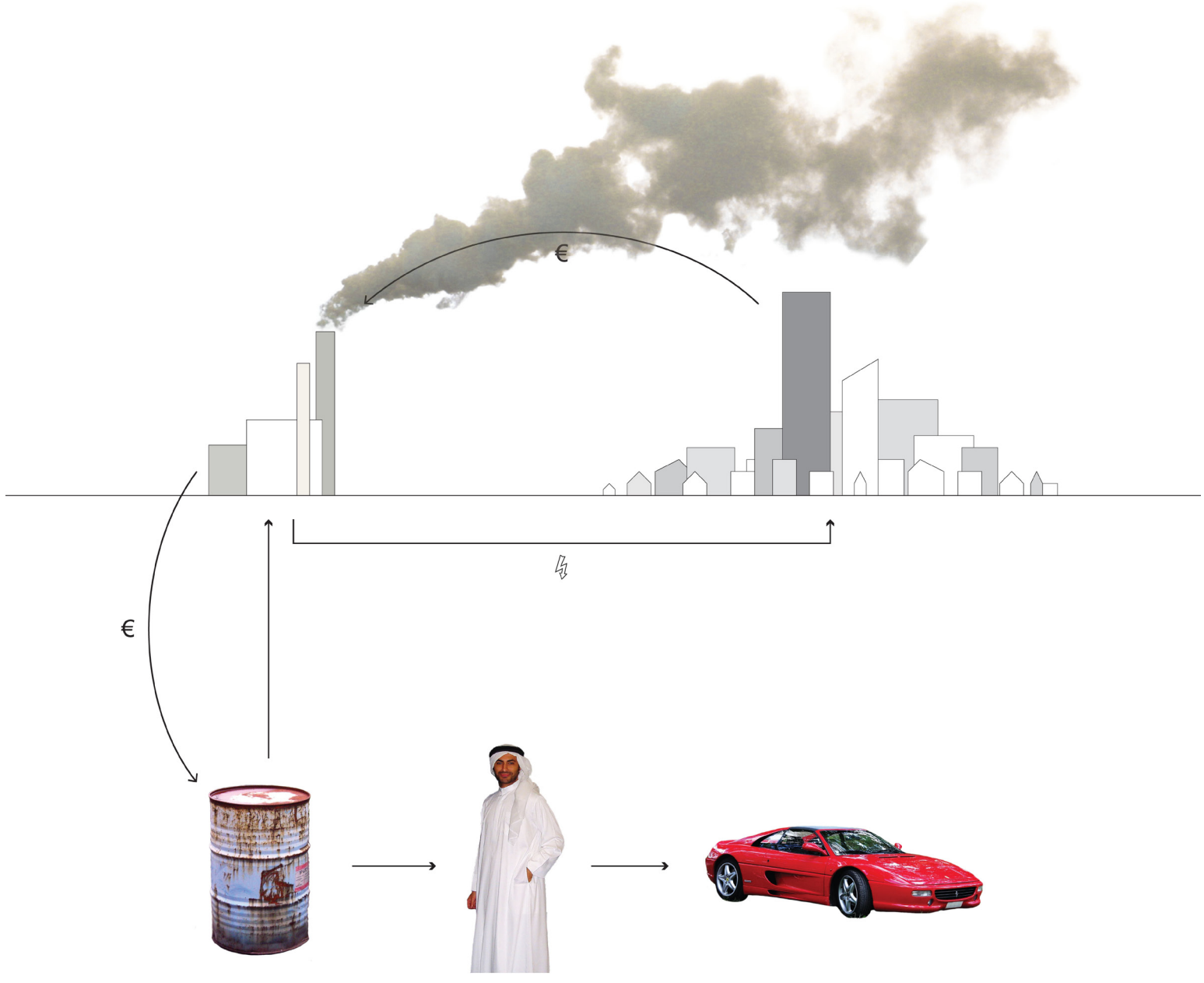

Prénatal
betaalbaar woonplezier
pets place XL
...shop here...

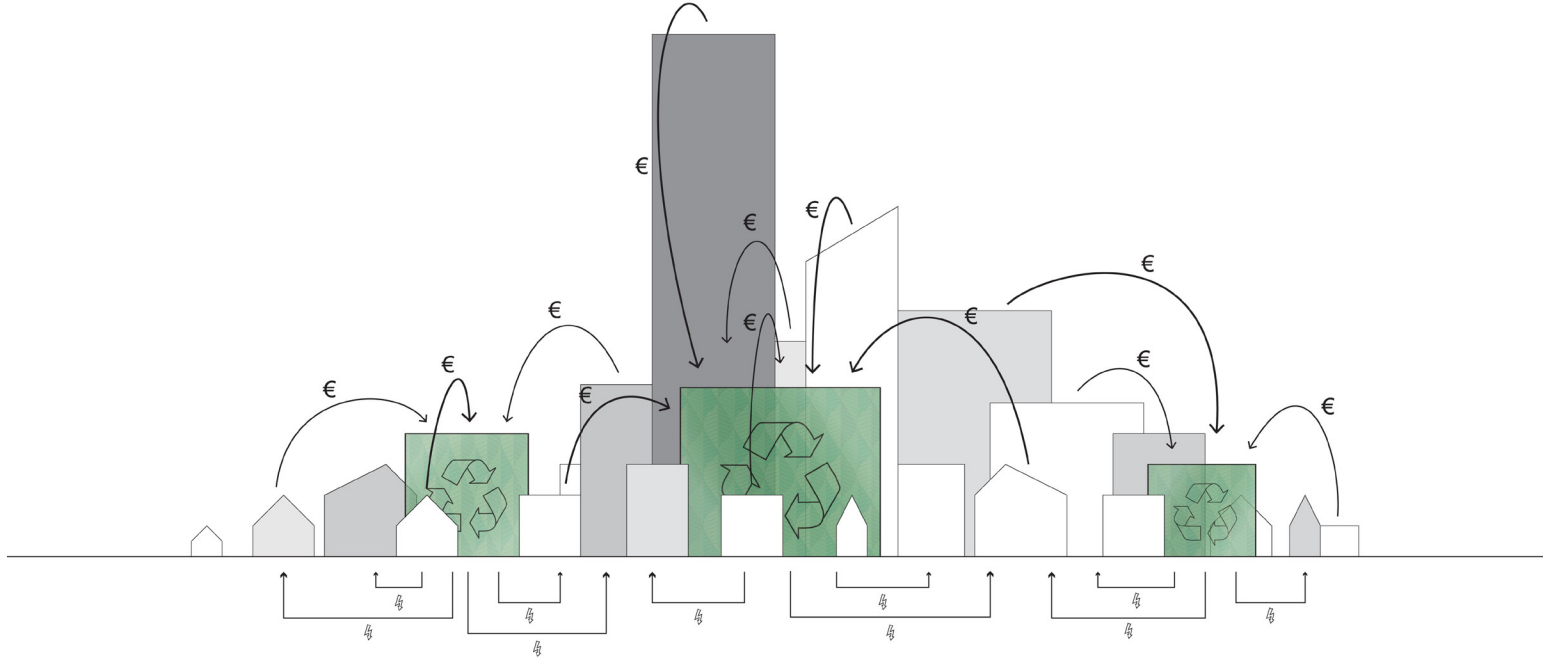

… and keep
comfortable?

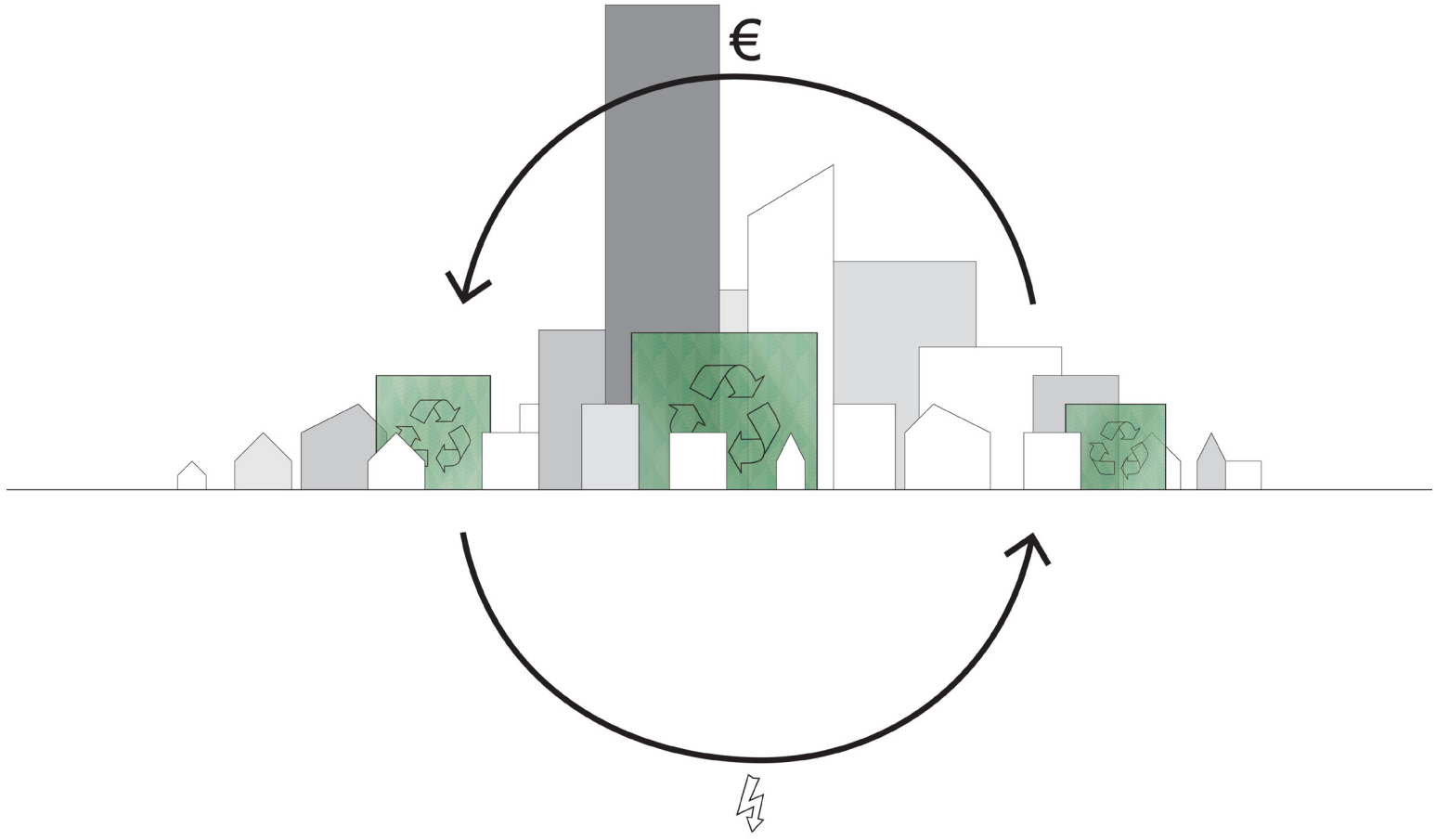
ROTTERDAM.**CLIMATE**.INITIATIVE

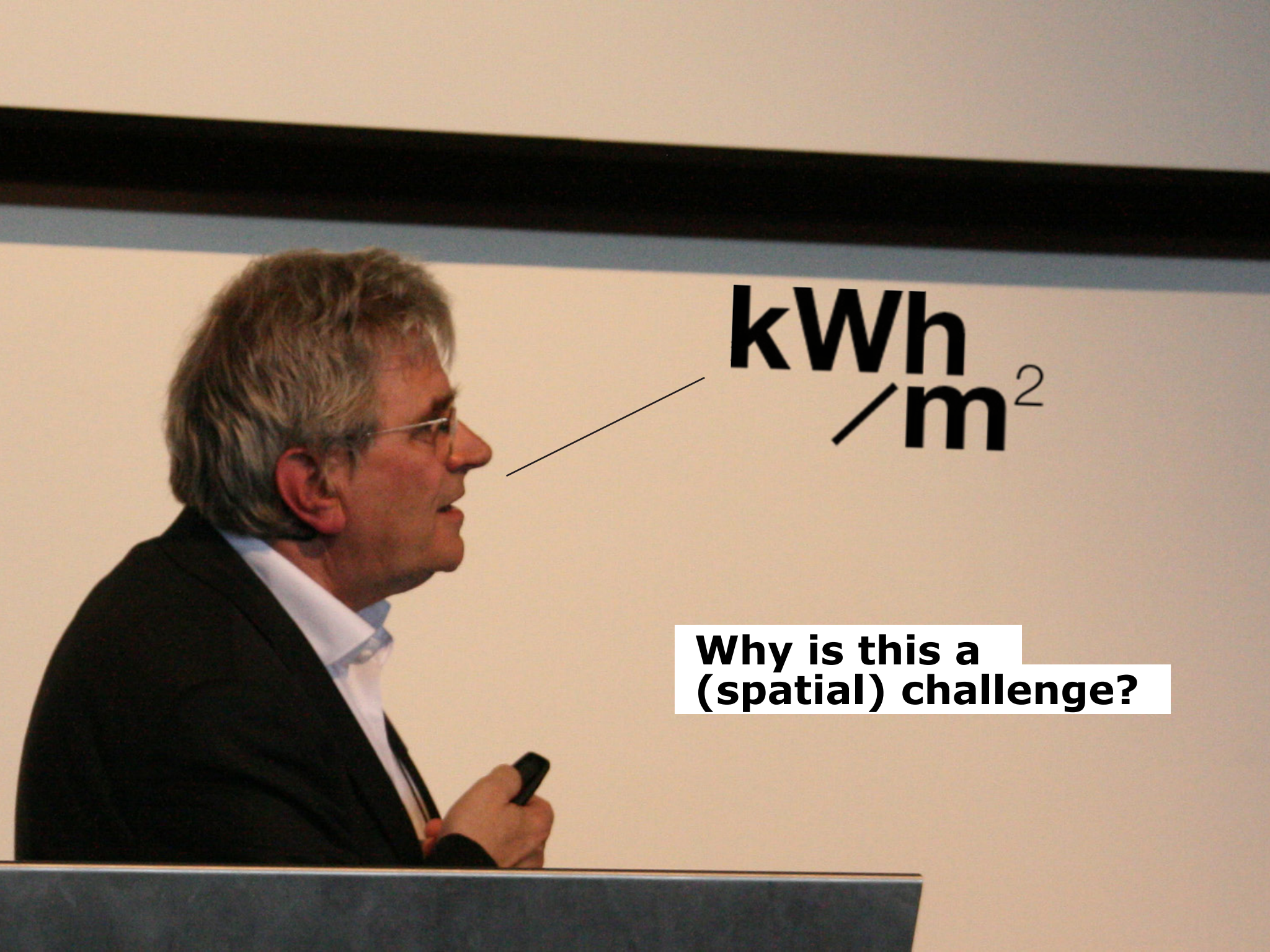
What are strategies for an existing urban area to make the transition to a more sustainable and less carbon emissive energy system and how can this transition be beneficial for the deprived neighborhoods within the urban area?

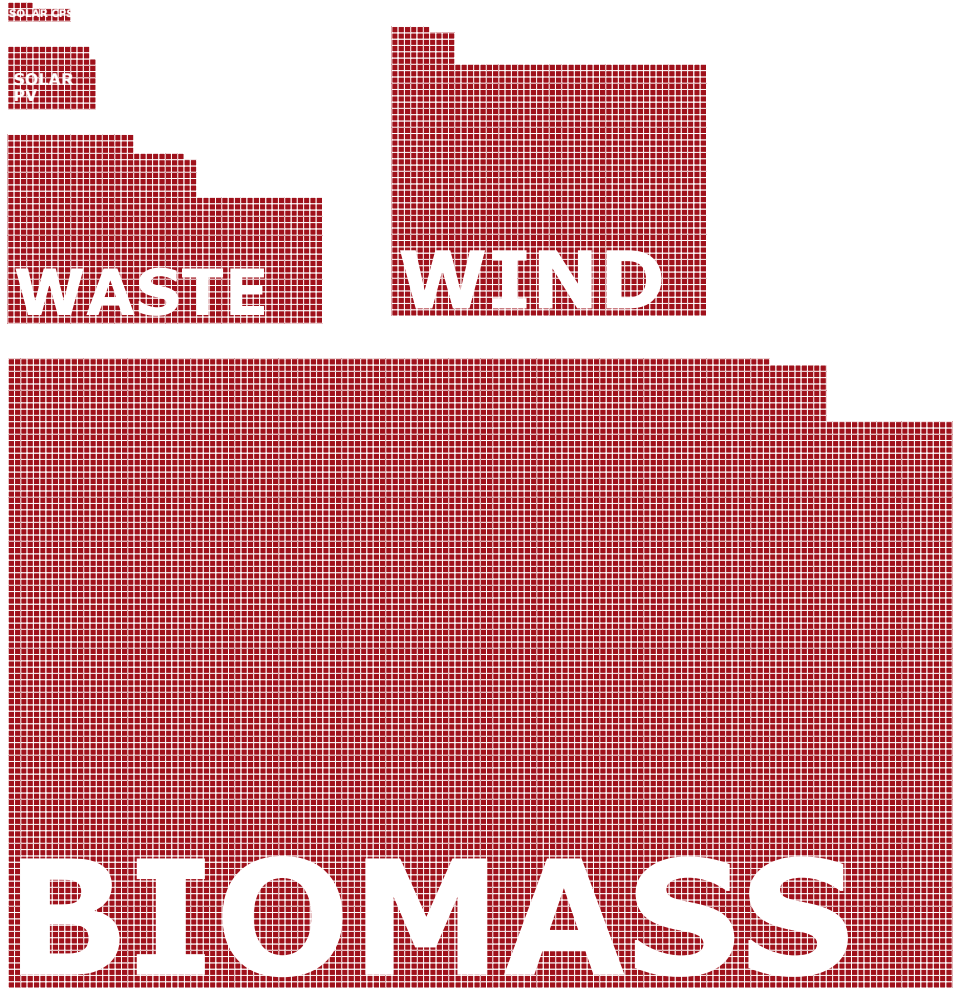


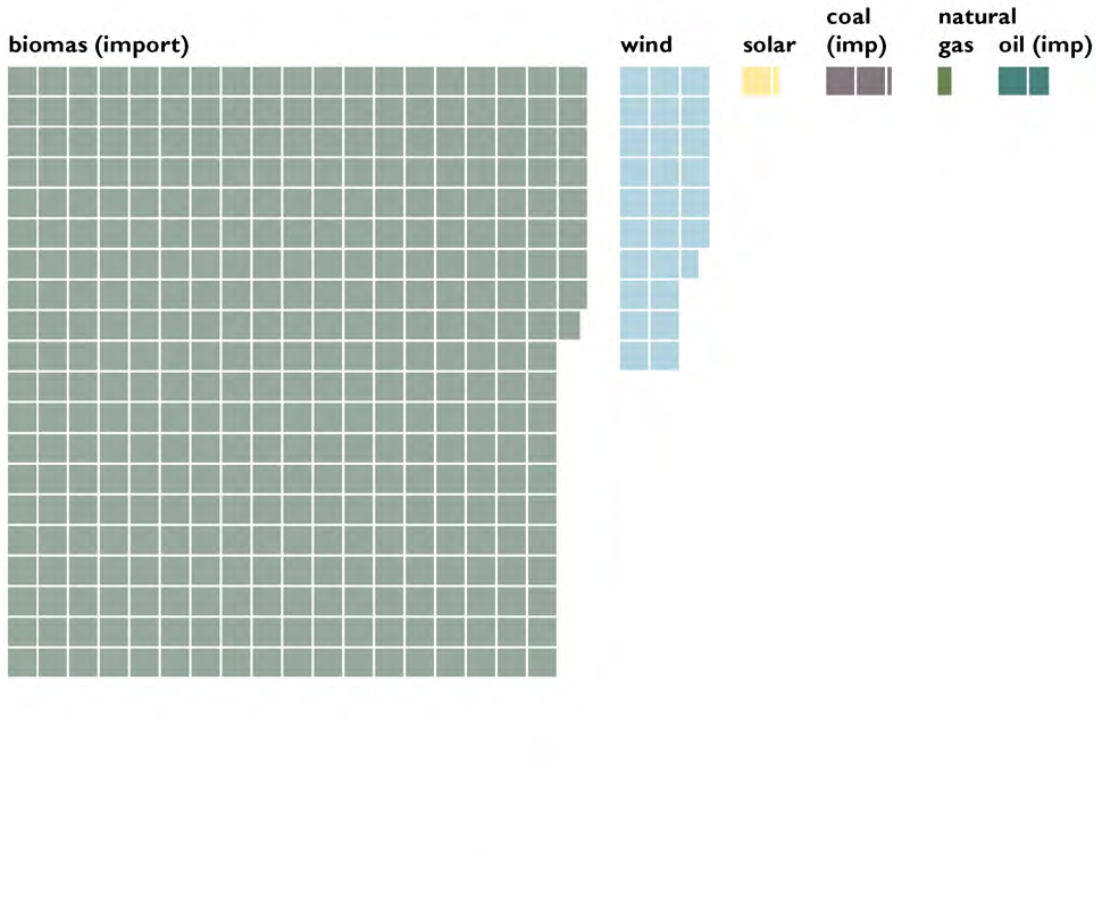


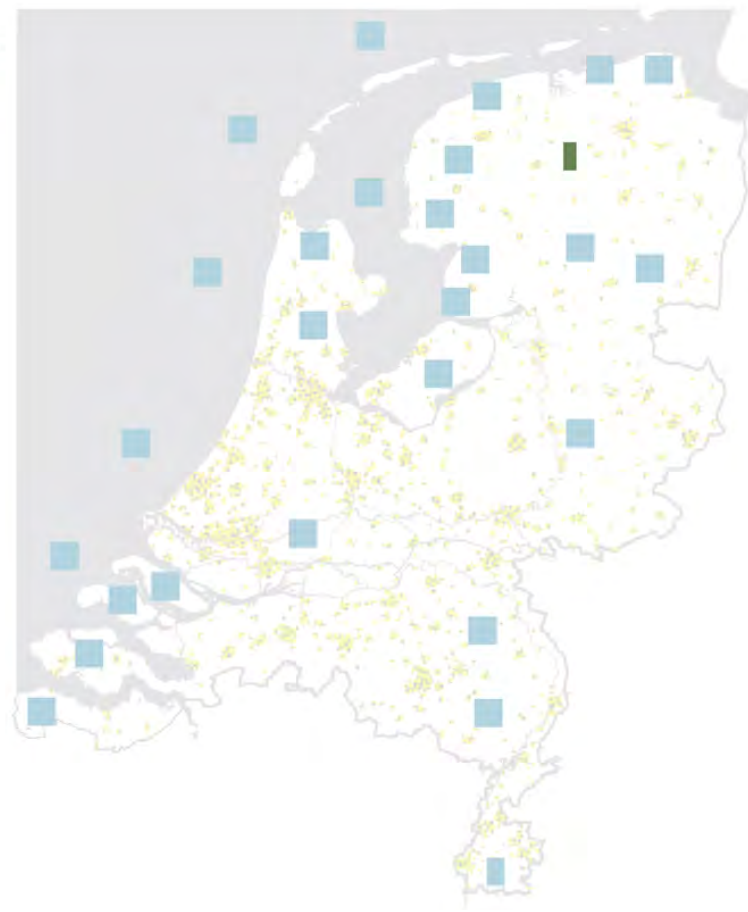





kWh
/m2
Why is this a
(spatial) challenge?


SOLAR PV
WASTE
WIND
BIOMASS


biomas (import)
wind
solar
coal (imp)
natural gas
oil (imp)



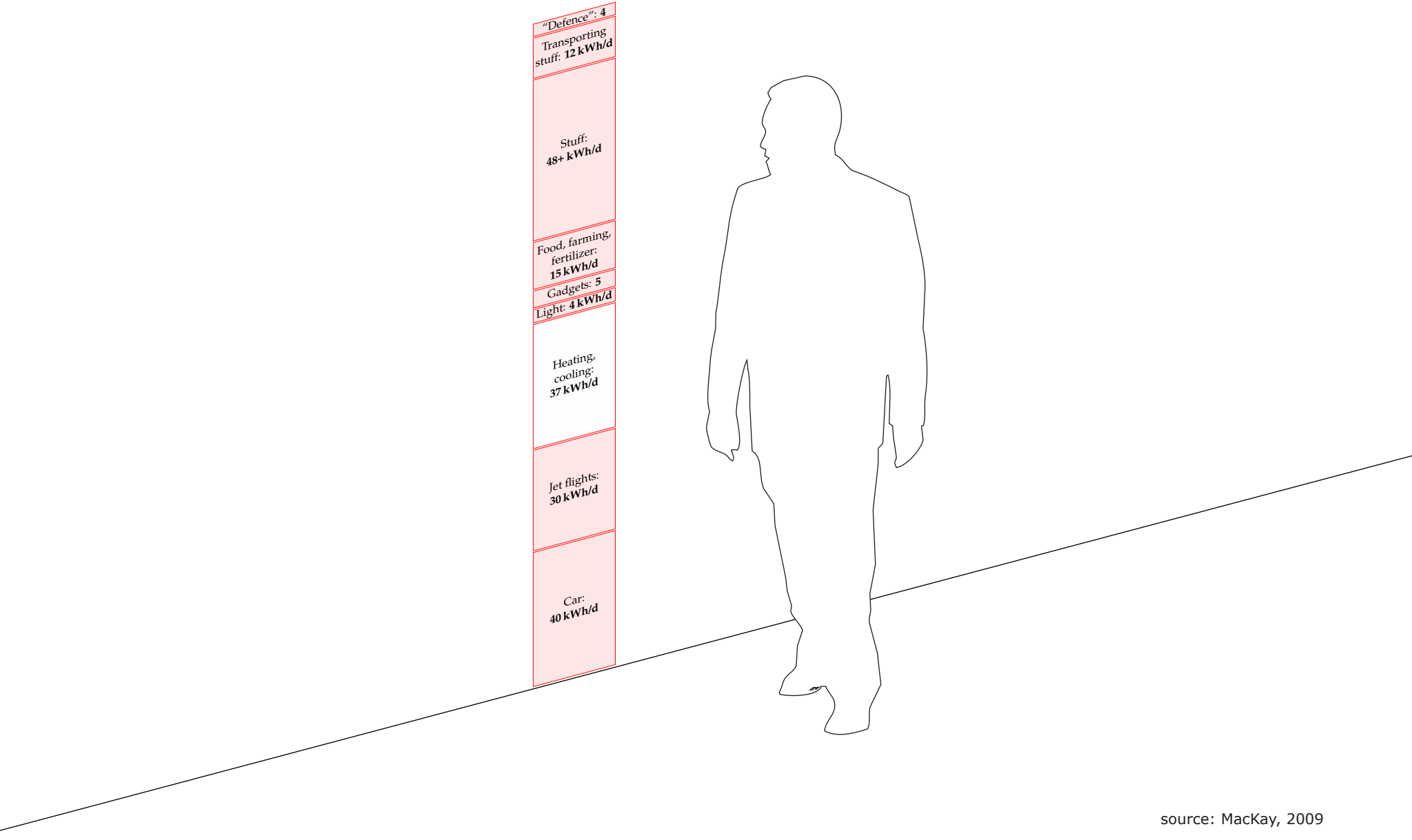

Find space...


...or reduce our
energy demand.

The living environment influences energy consumption.

Theory

Case study



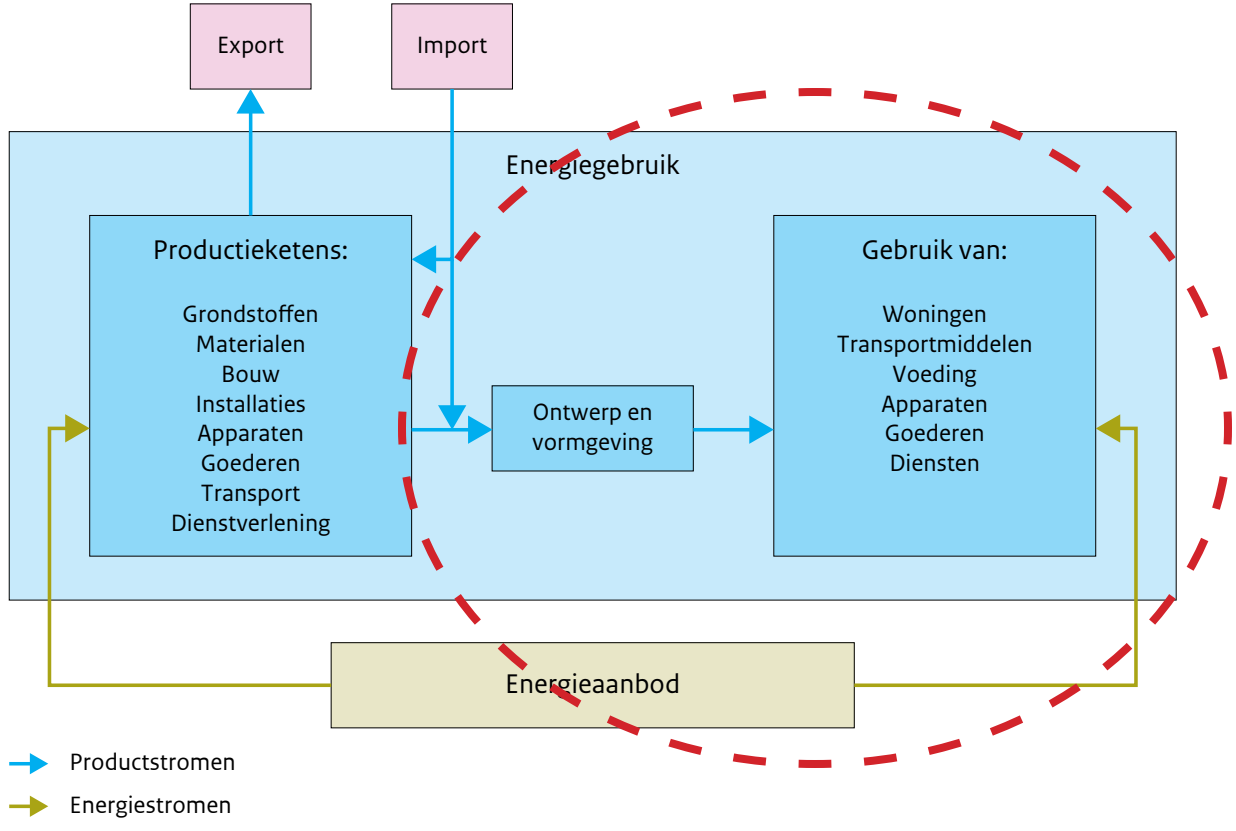
source: MacKay, 2009

Because we concentrate in cities, there is a strong relation with Urbanism.

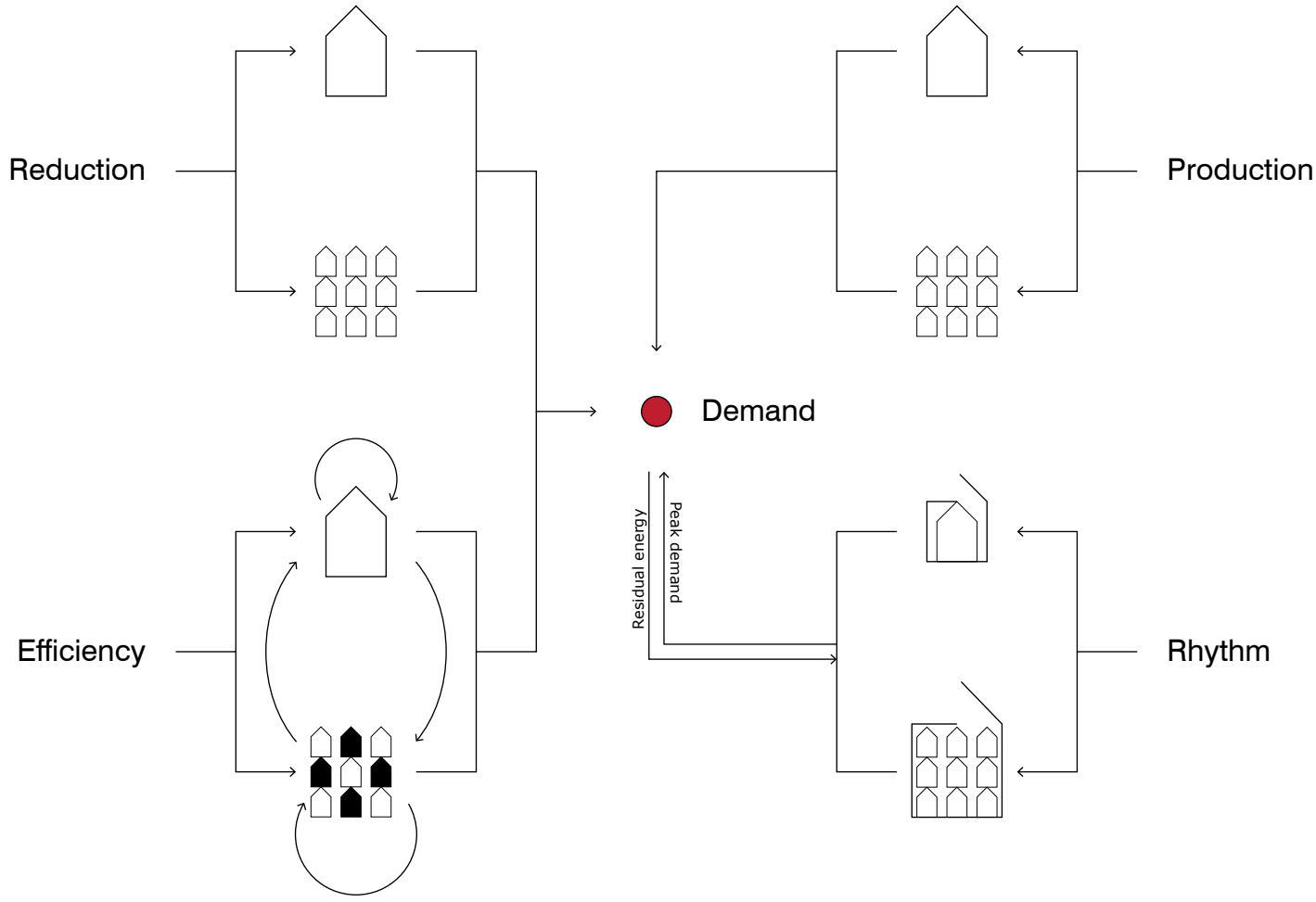
The direct link with Urbanism lies in the fact that half of the energy consumed in Europe is consumed in cities and a further 25% is needed for transportation.

(Herzog, Kaiser et al. 1996; Droege 2008)

But is the city the answer?



source: PBL, 2011


Reduction
Production
Demand
Efficiency
Residual energy
Peak demand
Rhythm

Conclusions:

- Renewable energy production demands space
- Reduction has the most potential

Offer a living environment that stimulates energy lean-lifestyles.

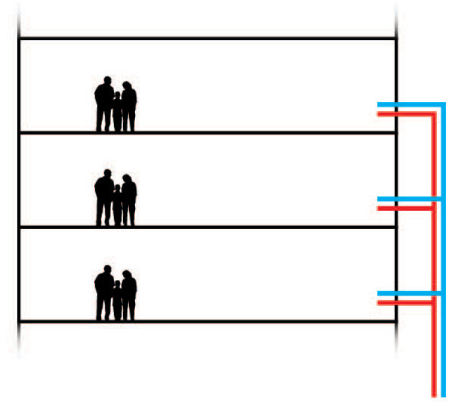
Make this environment as efficient as possible.

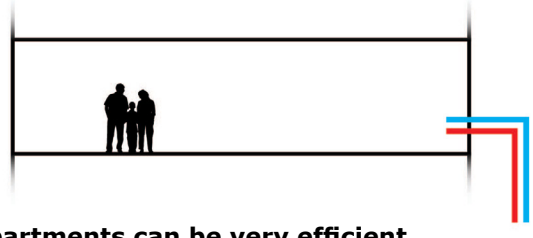
Make use of the local energy potentials (production and intermittency).

Make it attractive!
We should live in it!

But is the city the answer?

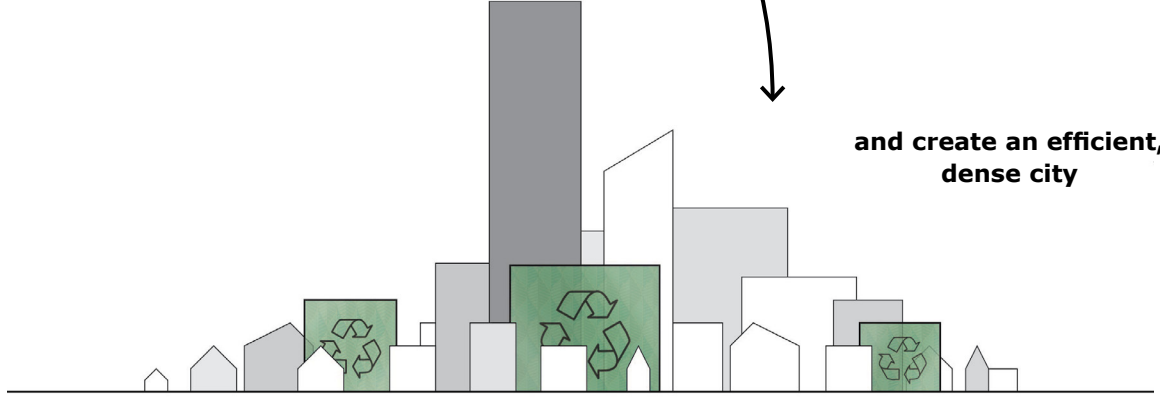
build in high densities



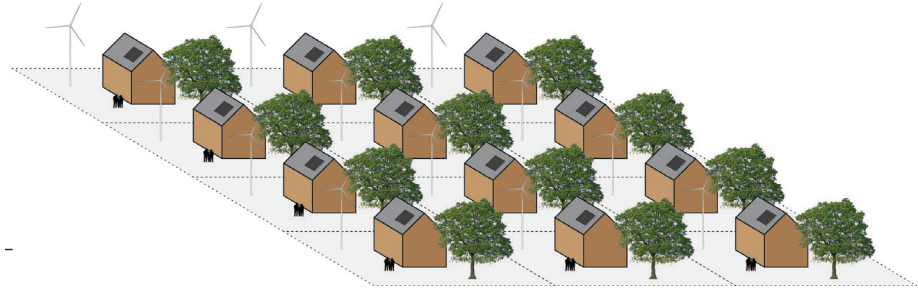


apartments can be very efficient

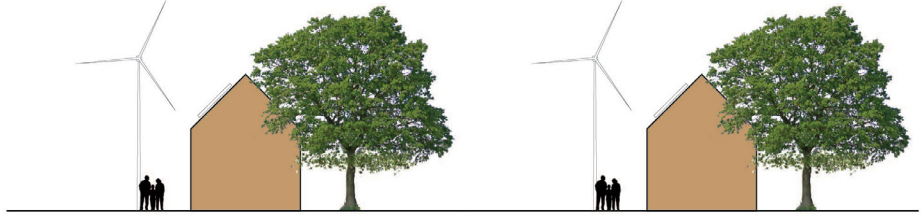
and create an efficient, dense city



houses can easily be autarkic



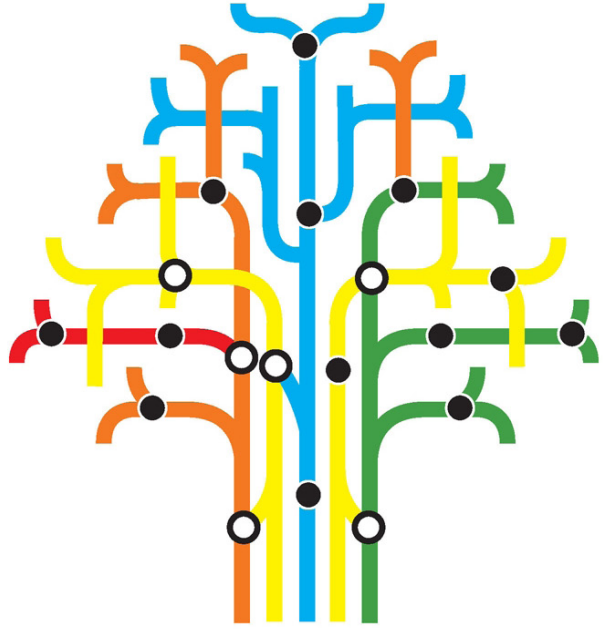
and result in a rural typology



but this requires space


Will this be
our future...


...or this?



GREEN METROPOLIS

Why Living Smaller, Living Closer, and Driving Less are the Keys to Sustainability

DAVID OWEN

Advantages

- Reduced need for travel.
- Public transportation can be dense and viable.
- People are forced to live in apartment buildings.
- People have less space to consume stuff.
- Because of technical measures, a highly efficient system can be created.
- Wealth is still accessible and quality of life can be maintained.

Characteristics

- **Dense**
- **Intricate structure, traditional block**
- **Mixed program**
- **Pedestrian friendly**
- **High quality public transport**
- **Attractive**

Offer a living environment that stimulates energy lean-lifestyles.

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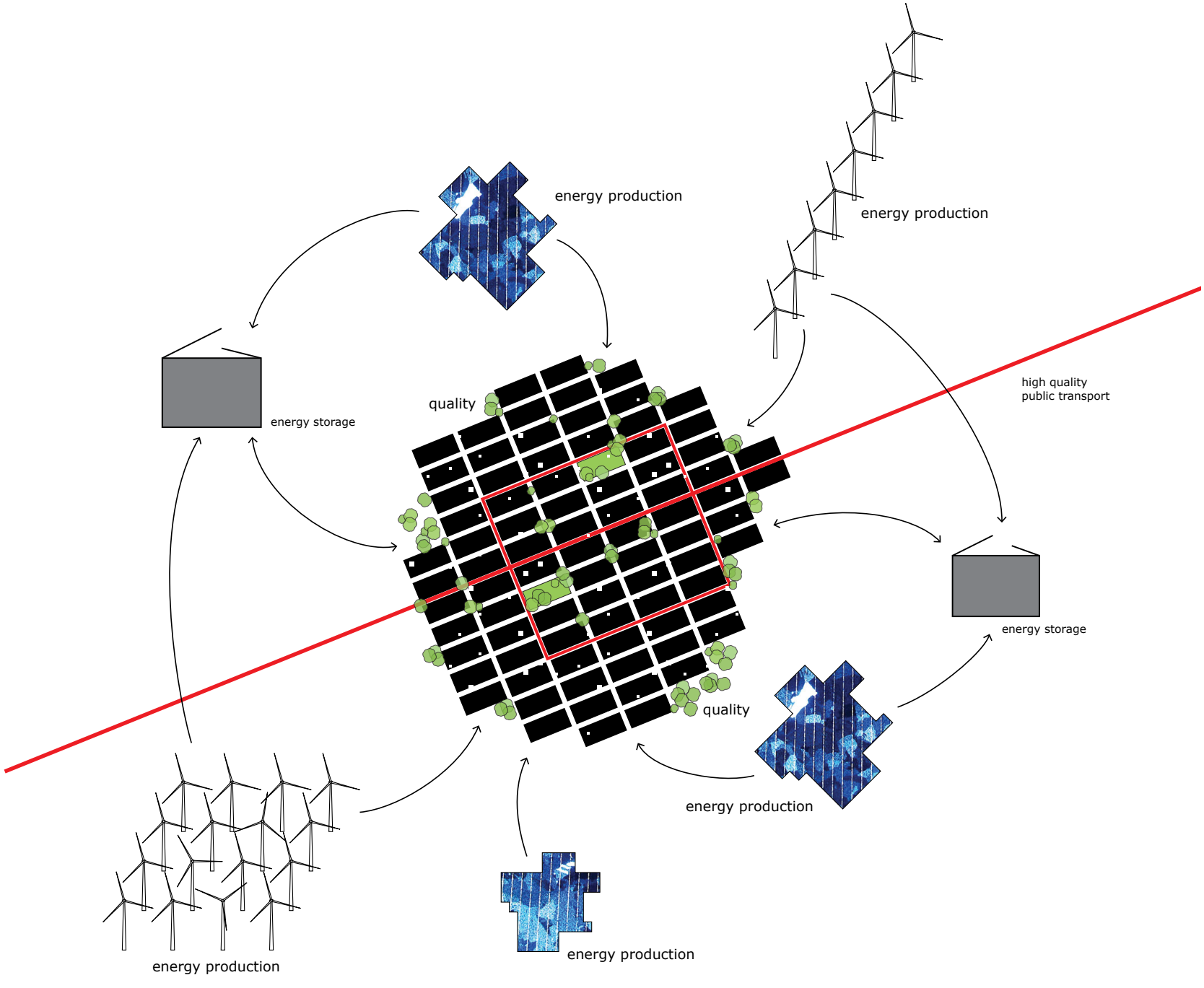
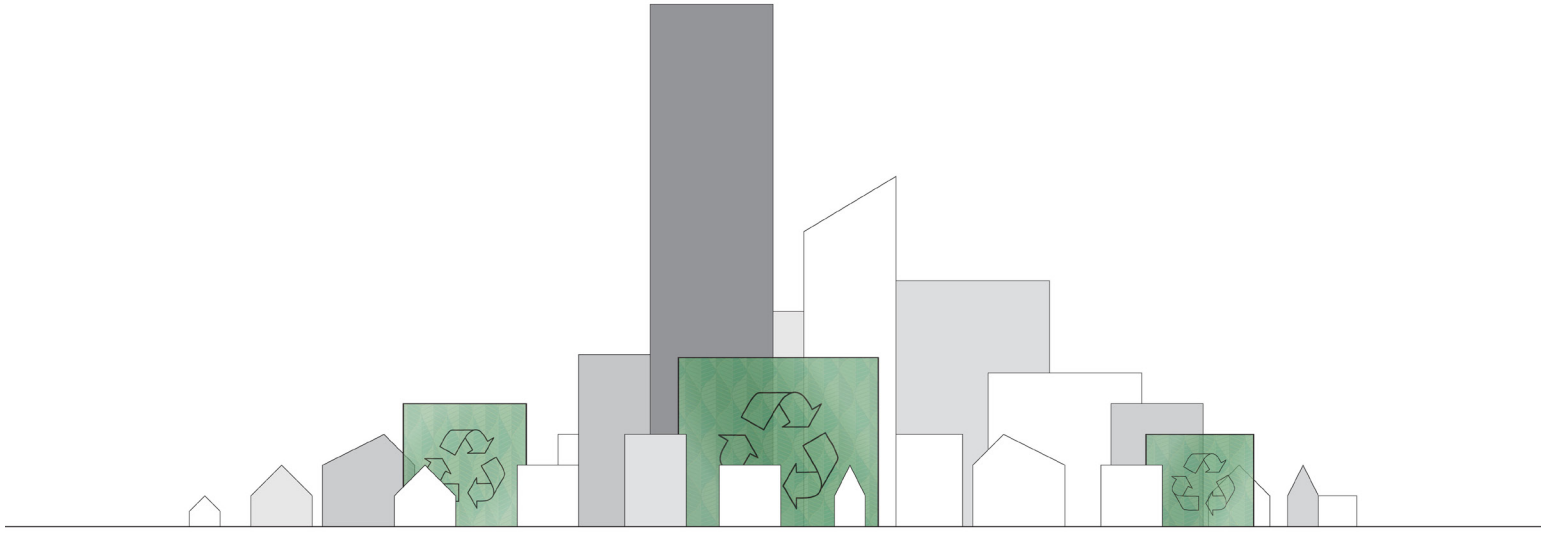
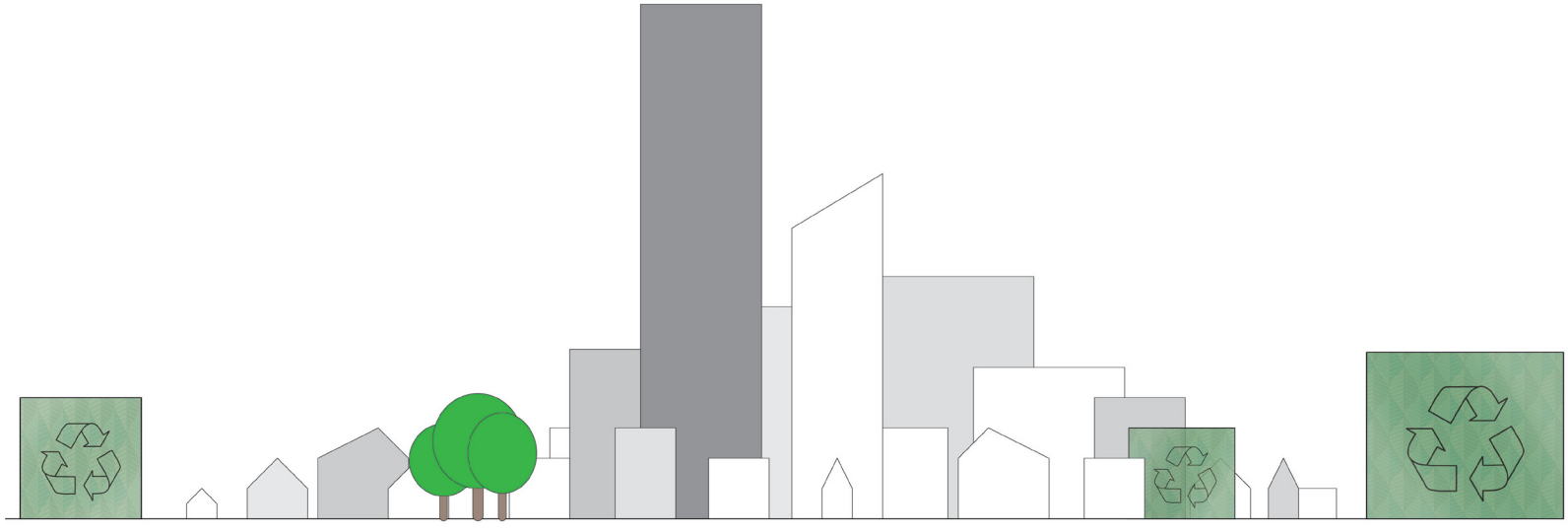

energy production
energy production
energy storage
quality
high quality
public transport
energy storage
quality
energy production
energy production
energy production

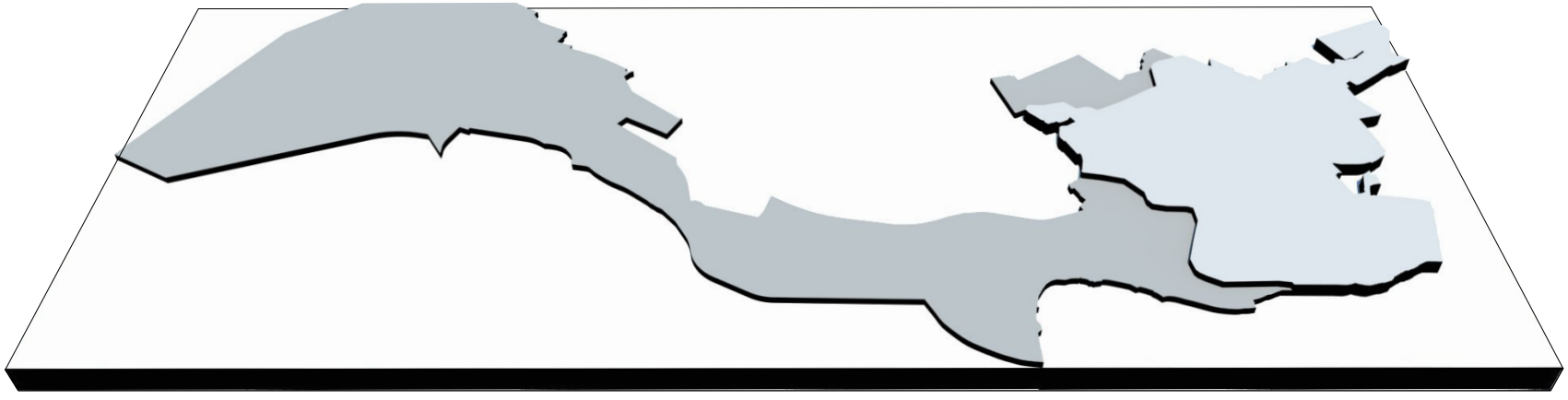




Theory

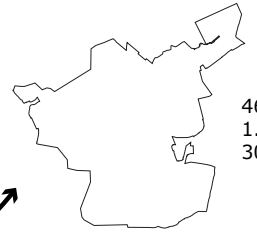
Case study


Regional scale

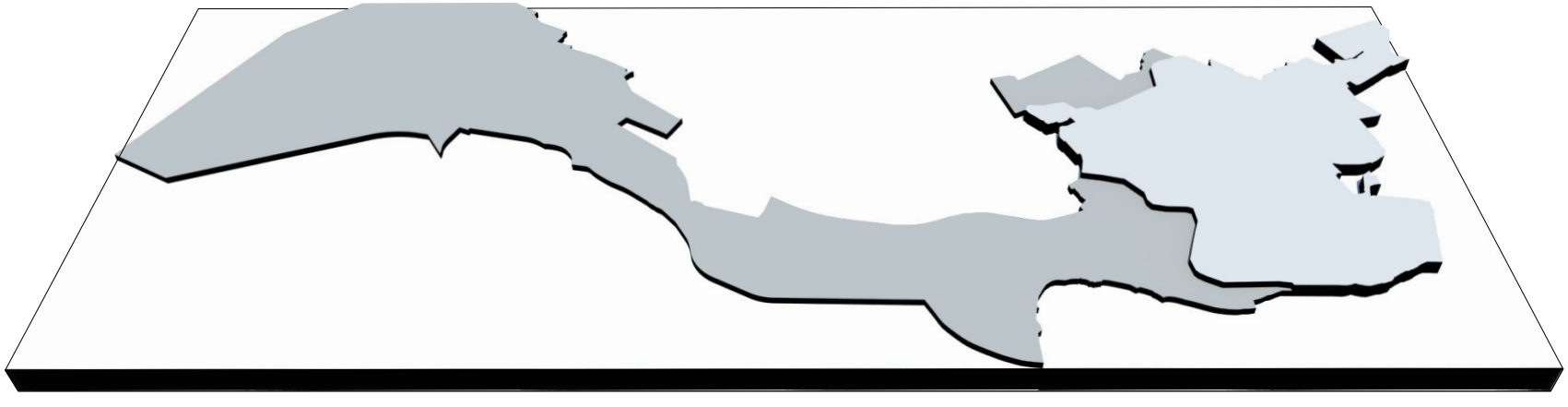


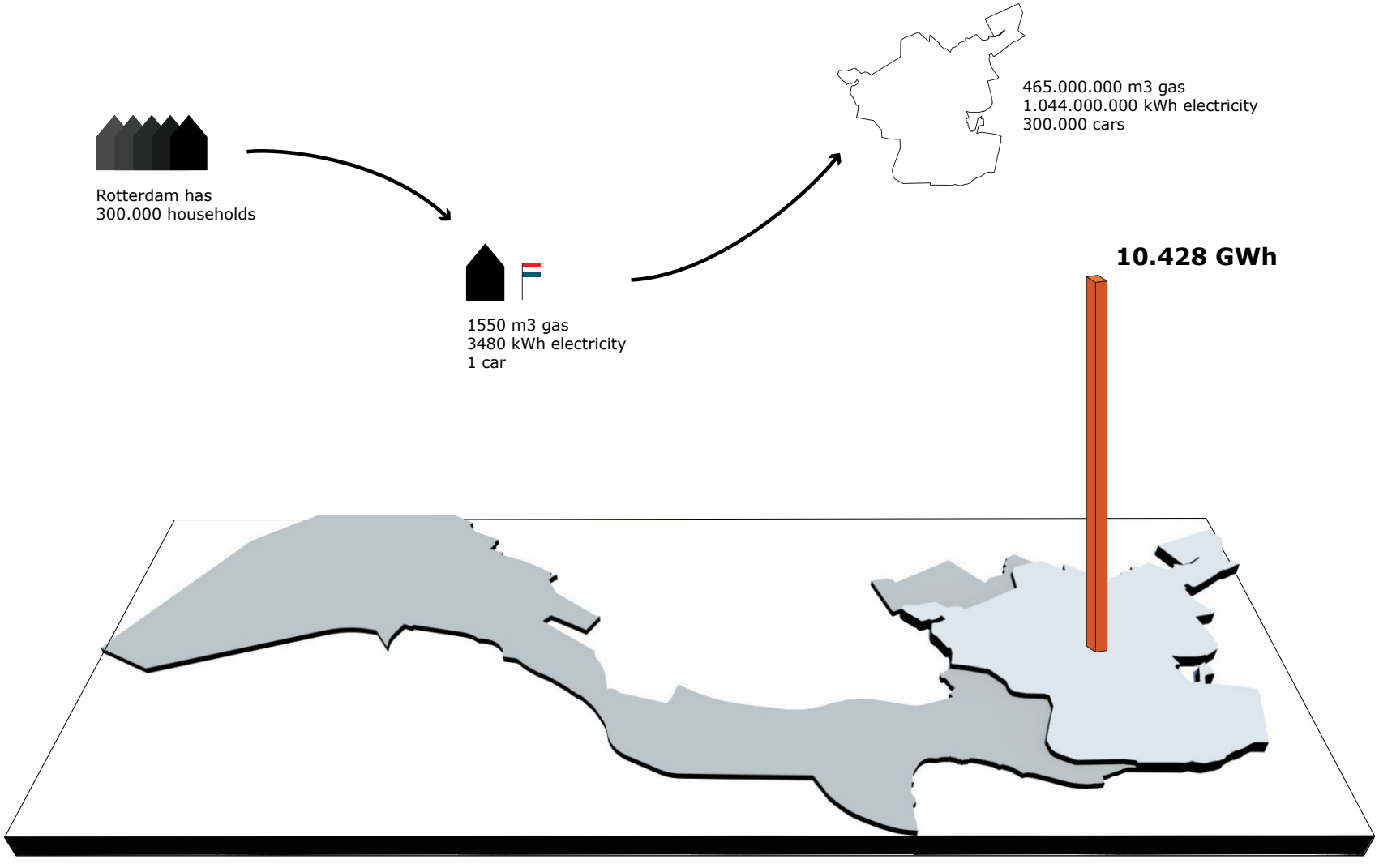
Rotterdam has
300.000 households

1550 m3 gas
3480 kWh electricity
1 car

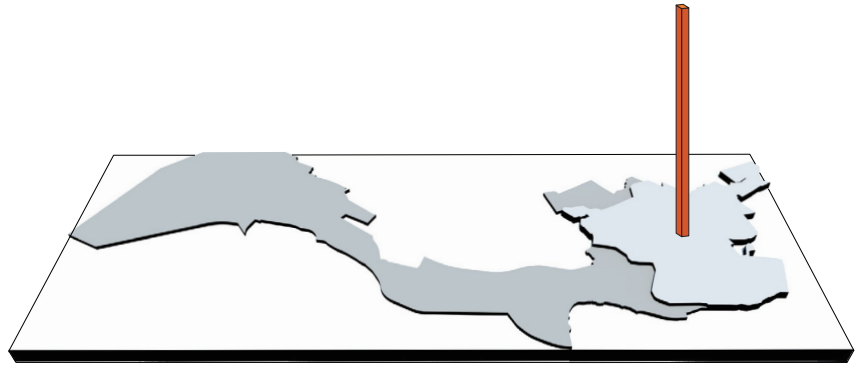


465.000.000 m3 gas
1.044.000.000 kWh electricity
300.000 cars

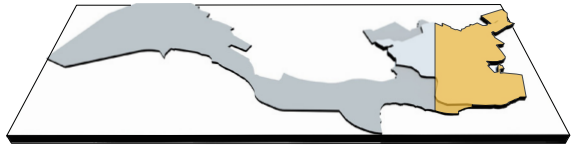



Rotterdam has
300.000 households
1550 m3 gas
3480 kWh electricity
1 car
465.000.000 m3 gas
1.044.000.000 kWh electricity
300.000 cars
10.428 GWh

10.428 GWh

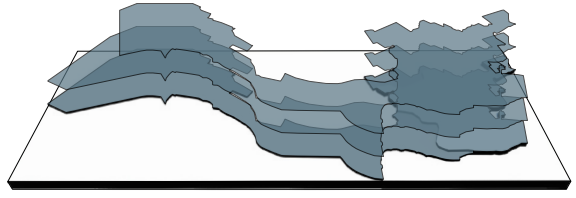


Solar PV
1,70 GWh/ha

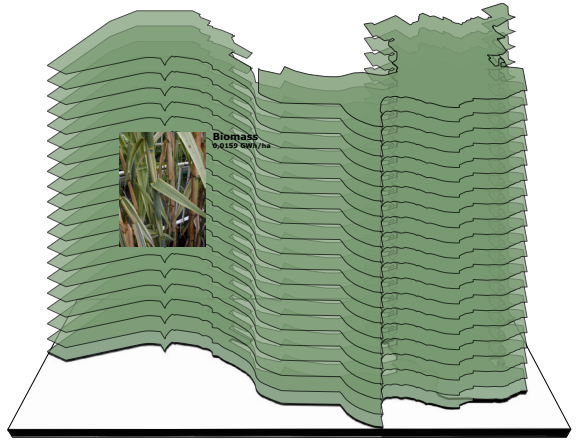


6133 ha
0,19 x the area

Wind 7.5 MW
0,114 GWh/ha



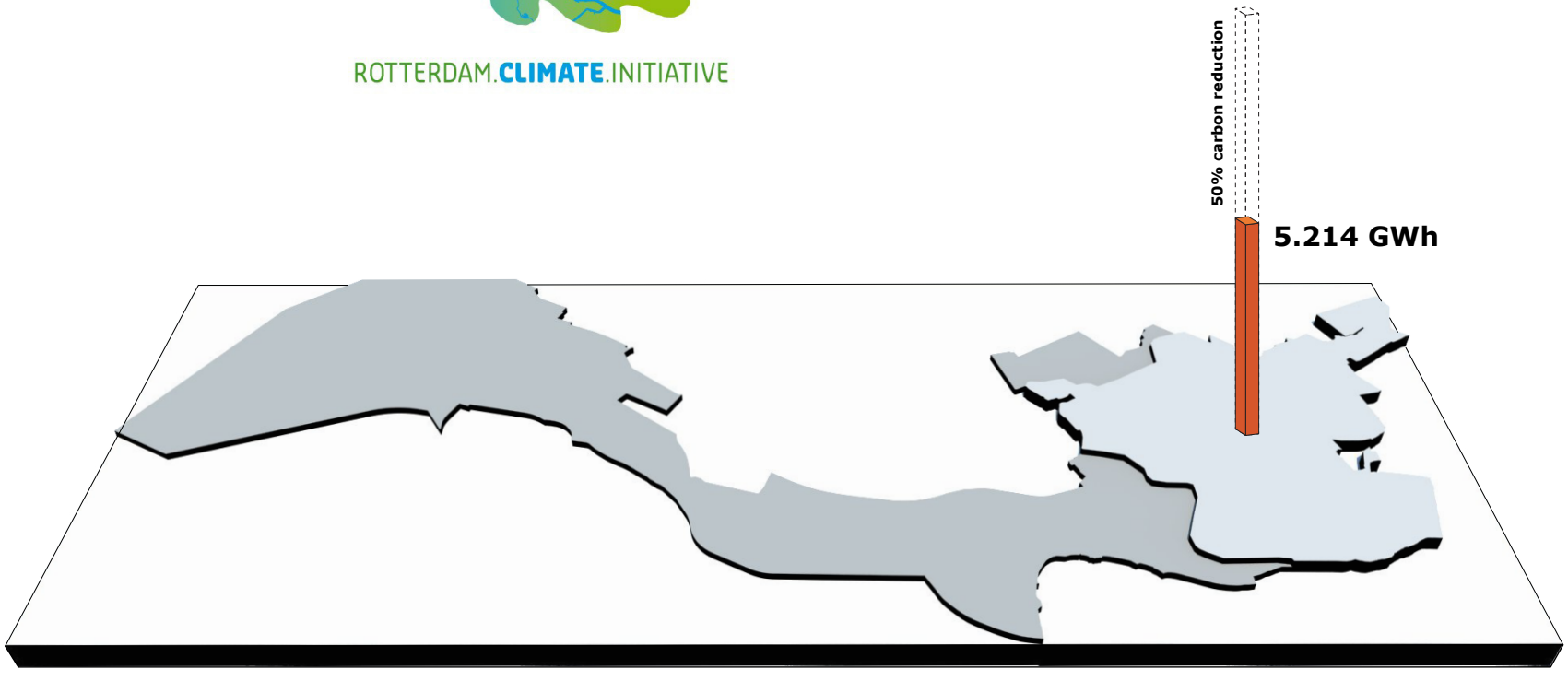
91.316 ha
2,85 x the area

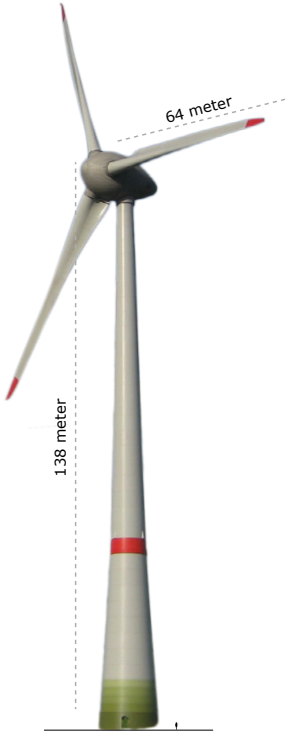


Biomass
0,0159 GWh/ha

656.840 ha
20,5 x the area

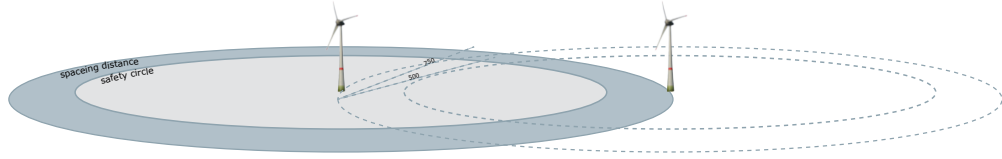
ROTTERDAM.CLIMATE.INITIATIVE





Enercon E-126

power	7.5 MW
height	140 meter
amount	56
costs	€ 11.000.000
investment	€ 616.000.000

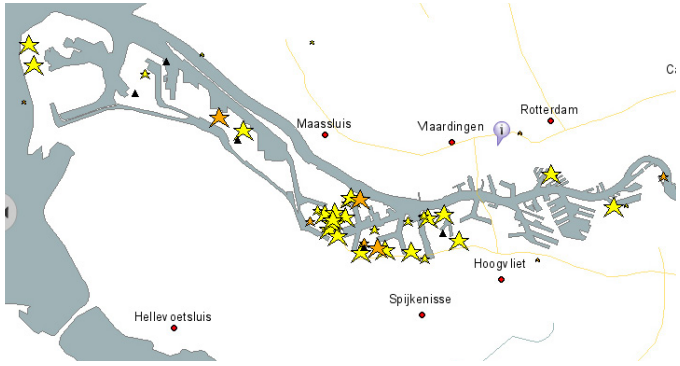



8.5
8.0
7.5
7.0
6.5
6

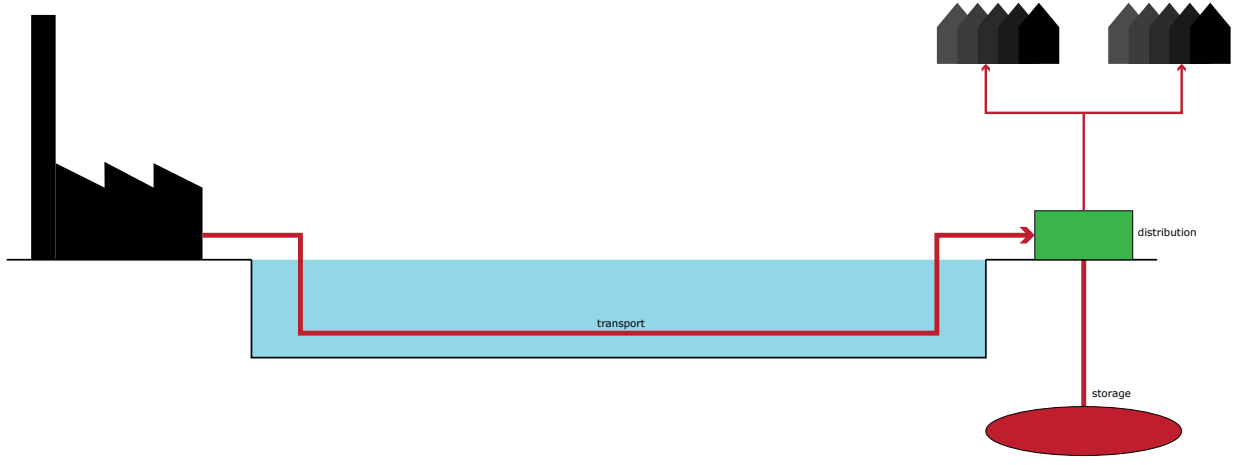

639,8 GWh 12%
5.214 GWh

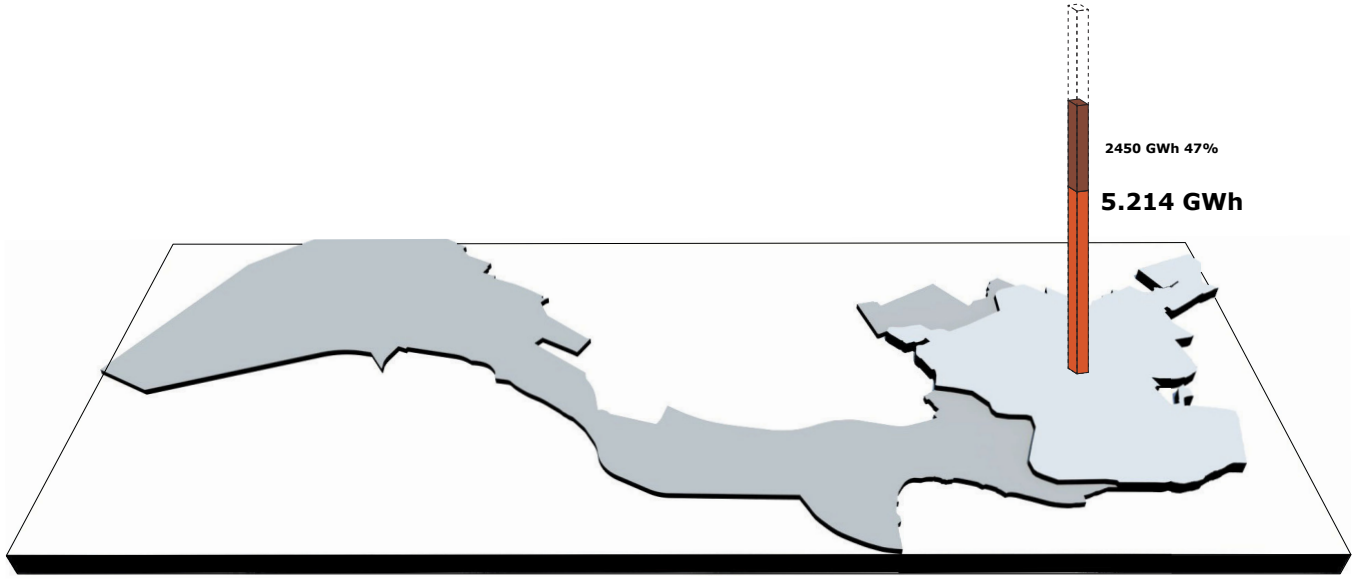

Image © 2012 DigitalGlobe
Image © 2012 TerraMetrics
Image © 2012 Aerodata International Surveys
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google
2005
51°53'00.32" N 4°26'13.77" O verh 0 m
Ooghoogt

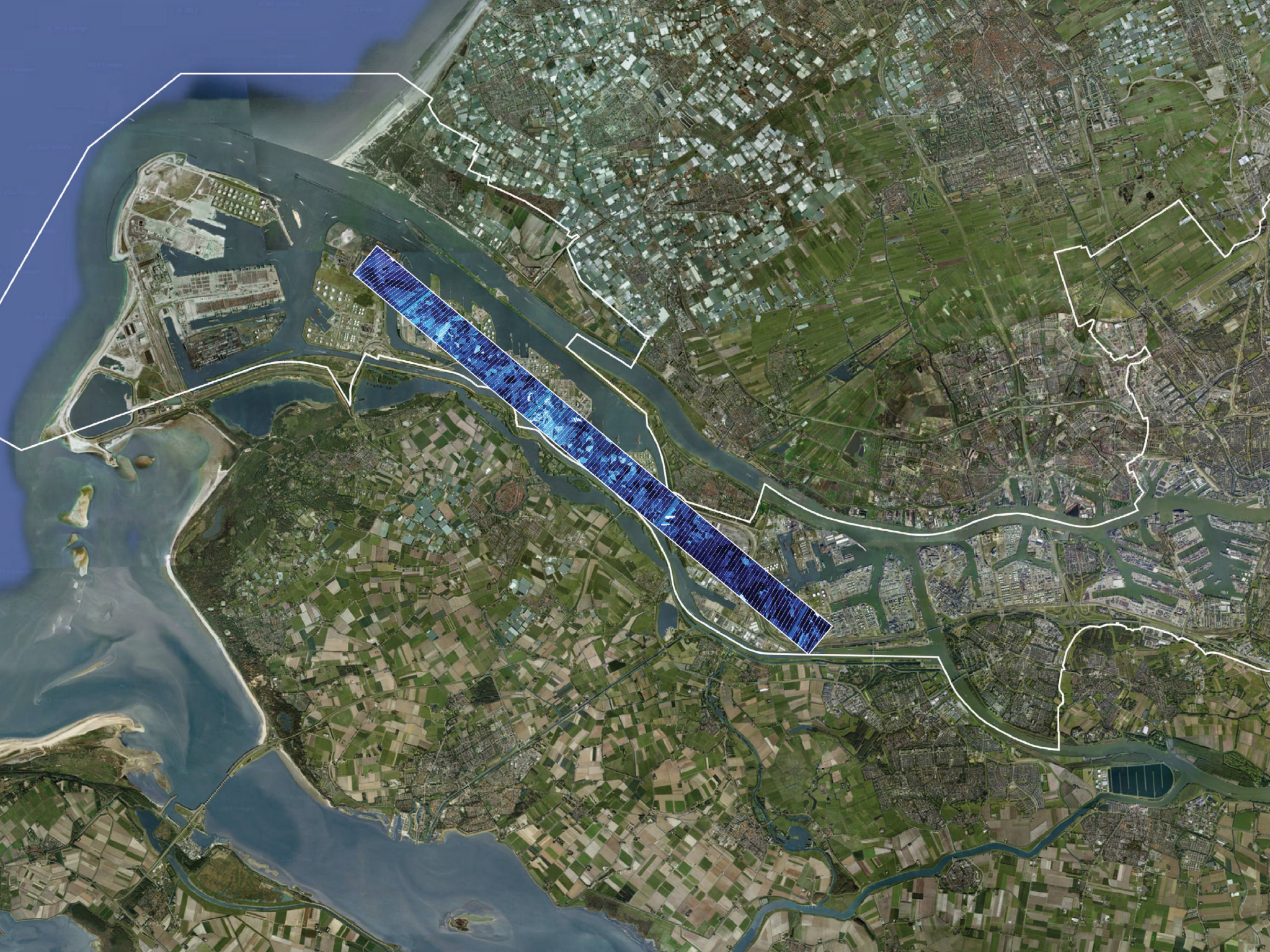
Waste energy
potential



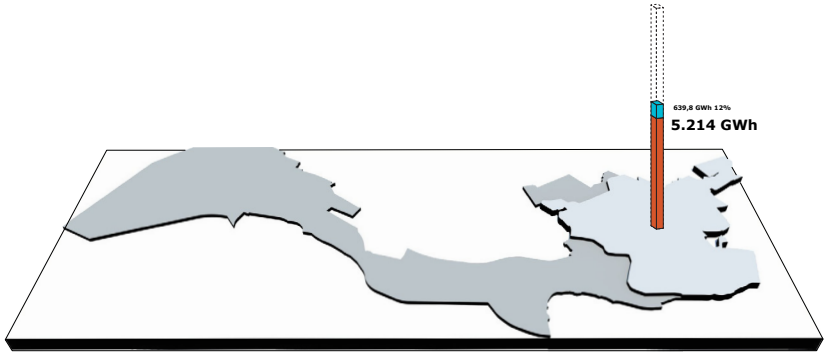
Restwarmte (120-200C) [TJ/jaar]
< 50 TJ
50 -500 TJ
> 500 TJ
geen data
Restwarmte (<120C) [TJ/jaar]
< 50 TJ
50-500 TJ
>500 TJ
geen data
Autowegen
Autowegen
Rivieren
Rivieren
Plaatsen
Plaatsen
Basis
Basis




2450 GWh 47%
5.214 GWh

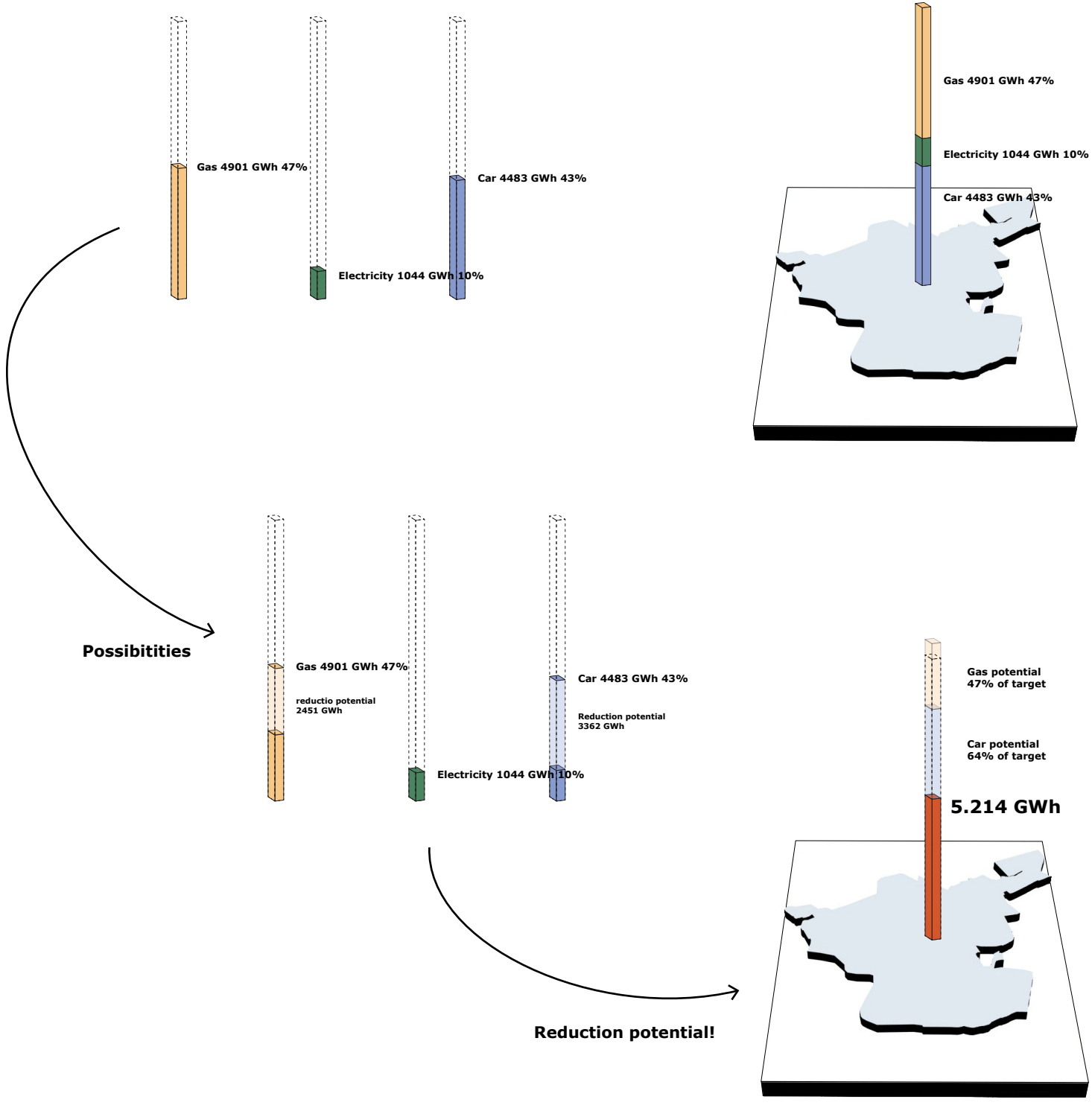



1600 GWh 31%
5.214 GWh



Only 90%...


City scale

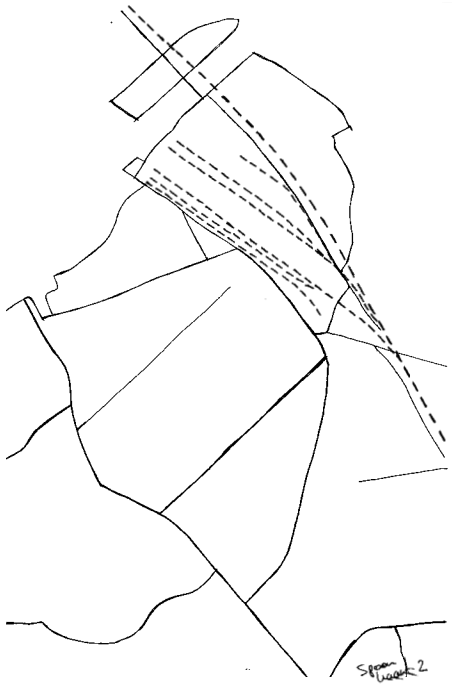

Gas 4901 GWh 47%
Electricity 1044 GWh 10%
Car 4483 GWh 43%
10.428 GWh
Gas 4901 GWh 47%
Electricity 1044 GWh 10%
Car 4483 GWh 43%
Possibitities
Gas 4901 GWh 47%
reductio potential
2451 GWh
Electricity 1044 GWh 10%
Car 4483 GWh 43%
Reduction potential
3362 GWh
Reduction potential!
Gas potential
47% of target
Car potential
64% of target
5.214 GWh

Offer a living environment that stimulates energy lean-lifestyles.

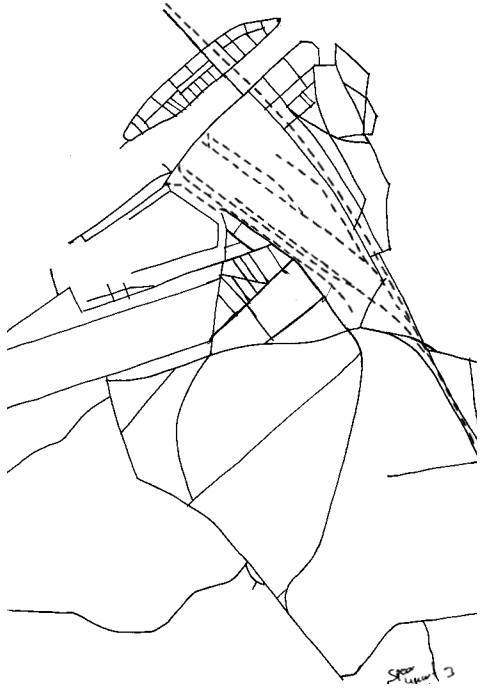
- **Dense**
- **Intricate structure, traditional block**
- **Mixed program**
- **Pedestrian friendly**
- **High quality public transport**
- **Attractive**

Make this environment as efficient as possible.

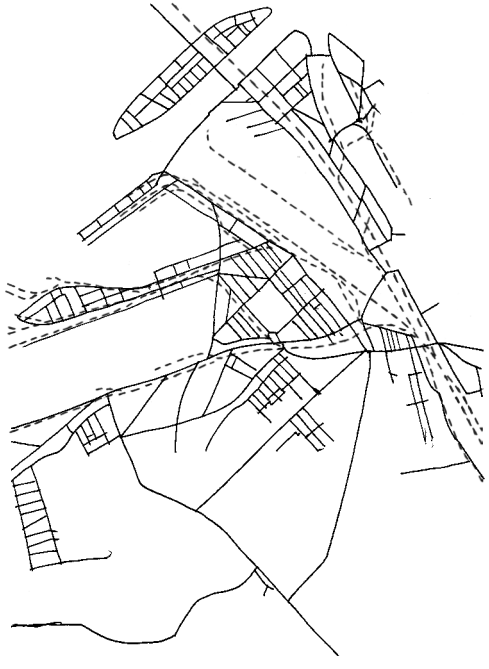
Make use of the local energy potentials (production and intermittency).



1874



1899



1919

1935

Binnenwerk


Centrum
Erasmusbrug
Havens 1273-1349
Afrikaander-
wijk
ss Rotterdam

Offer a living environment that stimulates energy lean-lifestyles.

Dense

Intricate structure, traditional block

Mixed program

Pedestrian friendly

High quality public transport

Attractive

Make this environment as efficient as possible.

Make use of the local energy potentials (production and intermittency).

Offer a living environment that stimulates energy lean-lifestyles.

Dense

Intricate structure, traditional block

Mixed program

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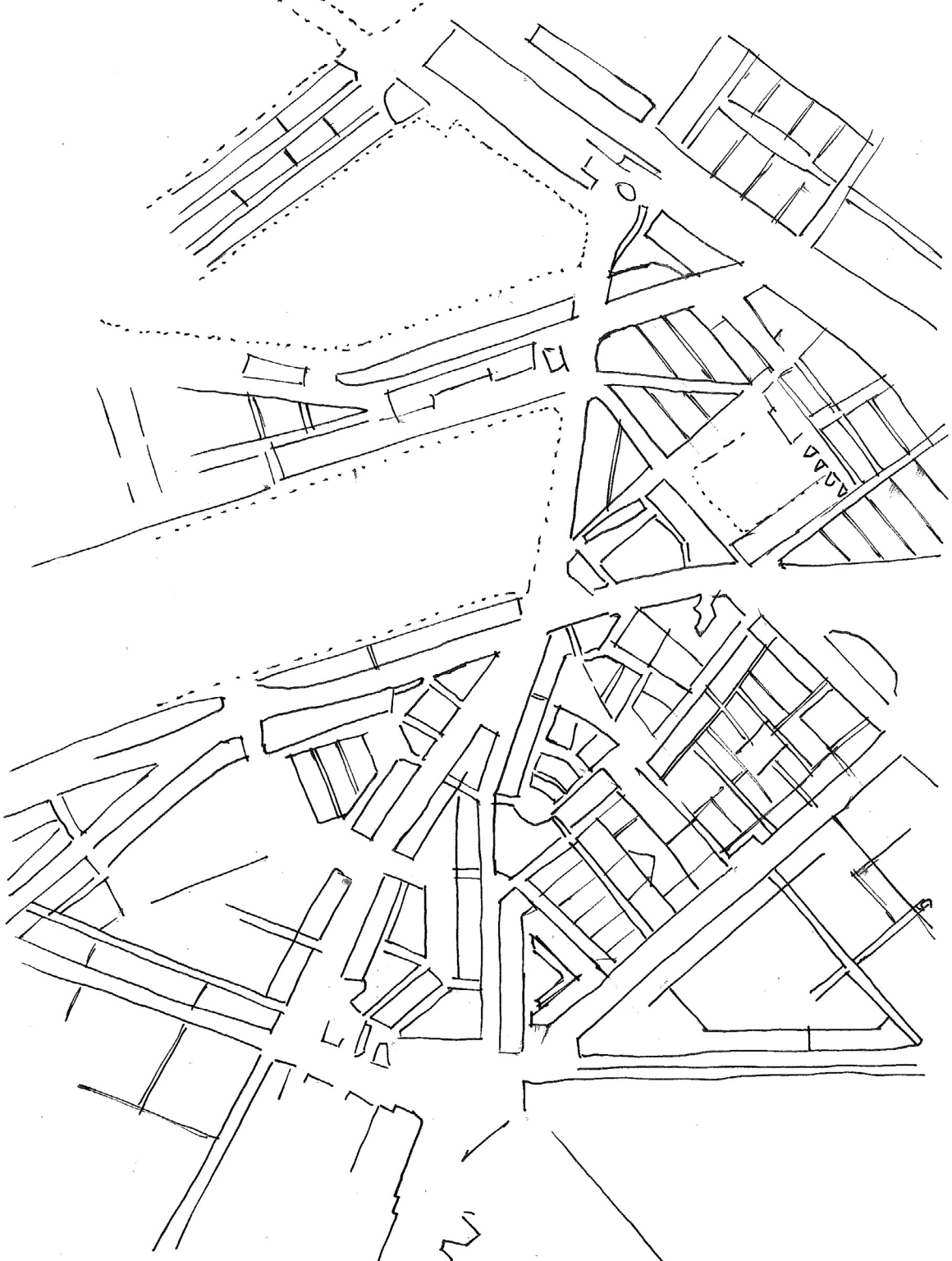

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- **Intricate structure, traditional block**
- Mixed program
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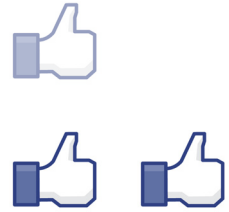
- High quality public transport
- Attractive



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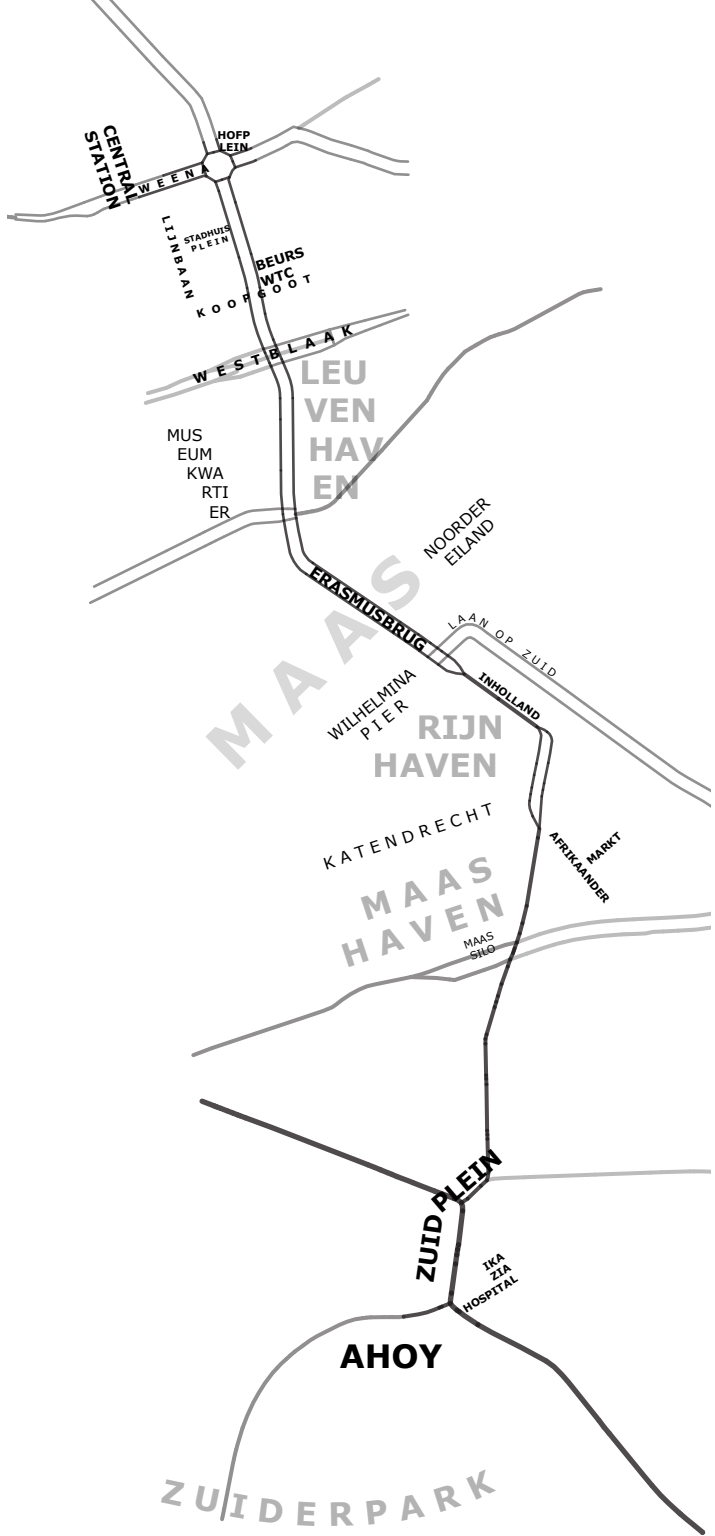
CENTRAL STATION
HOFPLEIN
WEENA
LIJNBAAN
STADHUIS PLEIN
BEURS WTC
KOOPGOOT
WESTBLAAK
LEUVENHAVEN
MUSEUMKWARTIER
NOORDEREILAND
ERASMUSBRUG
MAAS
LAAN OP ZUID
INHOLLAND
WILHELMINA PIER
RIJNHAVEN
KATENDRECHT
AFRIKAANDER MARKT
MAASHAVEN
MAAS SILO
ZUIDPLEIN
IKA ZIA HOSPITAL
AHOY
ZUIDERPARK

Offer a living environment that stimulates energy lean-lifestyles.

- Dense 
- Intricate structure, traditional block  
- **Mixed program** 
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Centrum
Erasmusbrug
Havens 1273-1349
Afrikaander-
wijk
ss Rotterdam

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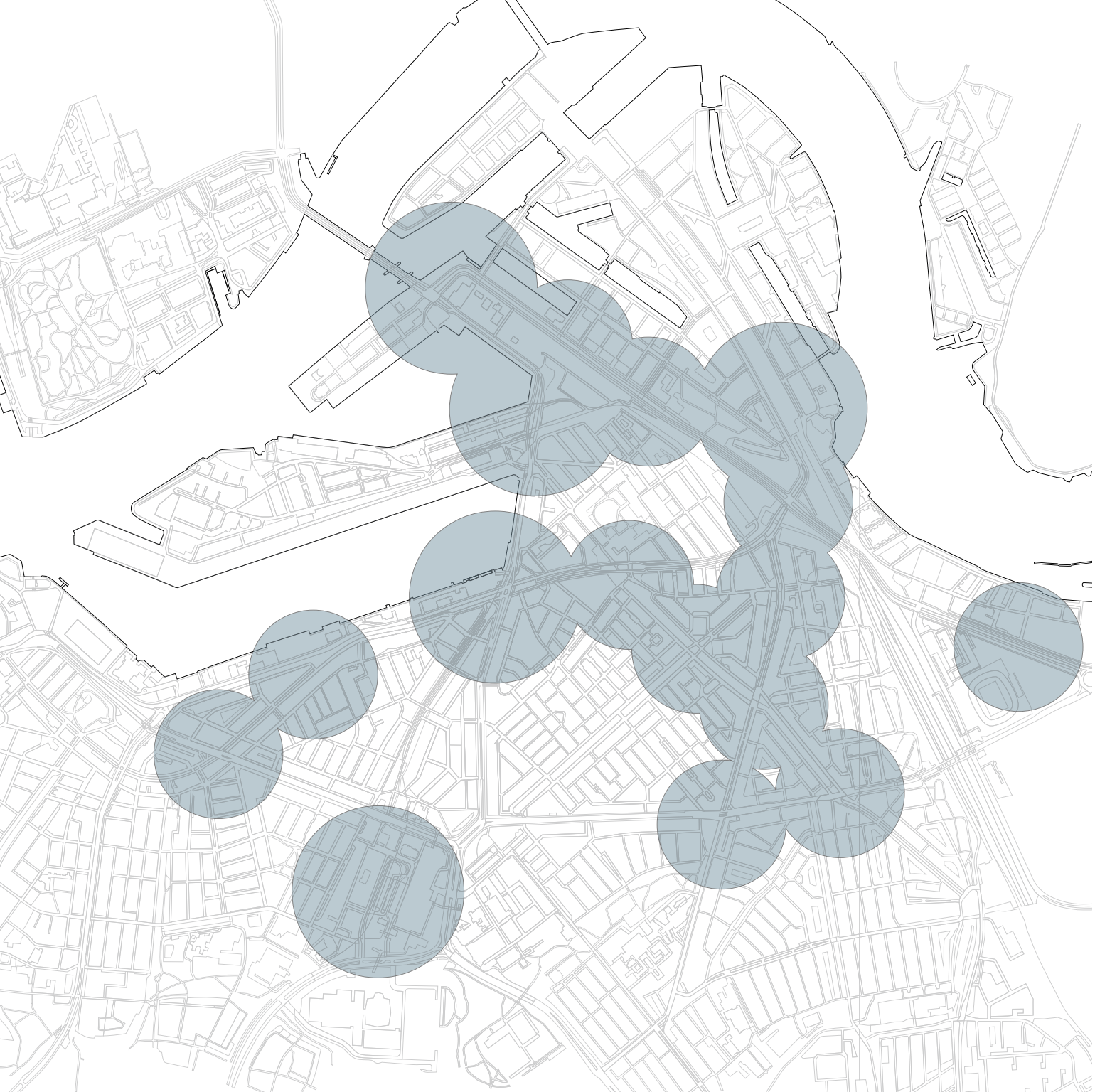
Train
Metro
Tram
New Tramline



Reach bubbles
300/400 meters

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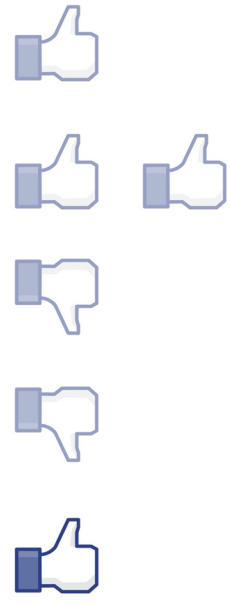
- Attractive



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ROFFA 5314

2007-2010 | Historisch Museum Rotterdam

trichis

Rotterdam

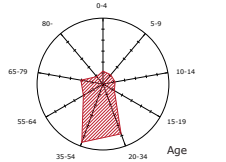
Inhabitants	588.718
Households (hh)	253.250
Average Income/hh	€ 18.200,-
	(Dutch average is € 20.200,-)
Unemployed	12 %
hh under poverty line	16%
	(Dutch average is 9%)
Average CITO score	533,2

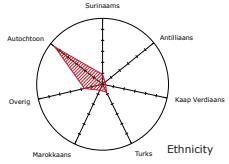
Housing stock

Ownership	
koop	27%
huur corporatie	52%
huur particulier	21%

Construction period

before 1946	34%
1946-1968	2%
1969-1993	31%
1994-	11%





Afrikaanderwijk

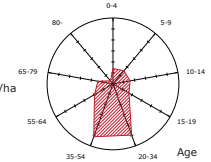
Inhabitants	9.419
Households (hh)	3.220
Density	79,6 dwellings/ha
Average Income/hh	€ 14.300,-
Unemployed	24 %
hh under poverty line	27%
Average CITO score	530,6

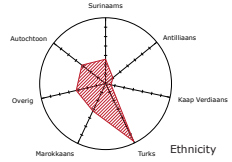
Housing stock

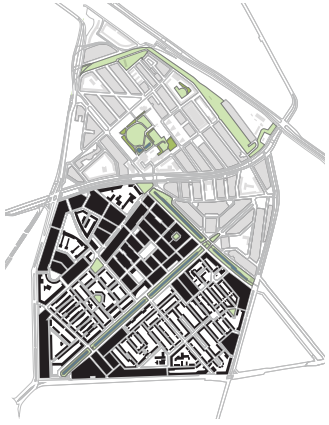
koop	8%
huur corporatie	85%
huur particulier	7%

Construction period

before 1946	52%
1946-1968	2%
1969-1993	32%
1994-	13%







Bloemhof

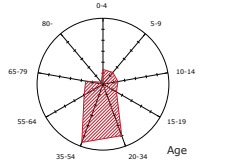
Inhabitants	13.222
Households (hh)	4.940
Density	81 dwellings/ha
Average Income/hh	€ 14.300,-
Unemployed	22 %
hh under poverty line	27%
Average CITO score	529,0

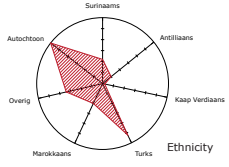
Housing stock

koop	16%
huur corporatie	60%
huur particulier	23%

Construction period

before 1946	80%
1946-1968	0%
1969-1993	8%
1994-	11%





Hillesluis*

Inhabitants	11.346
Households (hh)	3.960
Density	57 dwellings/ha
Average Income/hh	€ 14.600,-
Unemployed	22 %
hh under poverty line	26%
Average CITO score	529,6

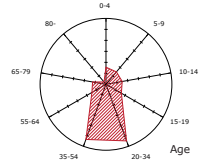
Housing stock

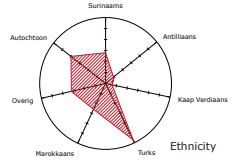
koop	17%
huur corporatie	56%
huur particulier	27%

Construction period

before 1946	78%
1946-1968	0%
1969-1993	11%
1994-	11%

* The data is for the entire Hillesluis area.





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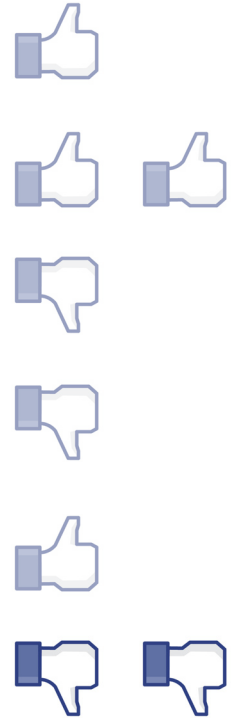

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Offer a living environment that stimulates energy lean-lifestyles.

Dense	👍
Intricate structure, traditional block	👍 👍
Mixed program	👎
Pedestrian friendly	👎
High quality public transport	👍
Attractive	👎 👎

Make this environment as efficient as possible.

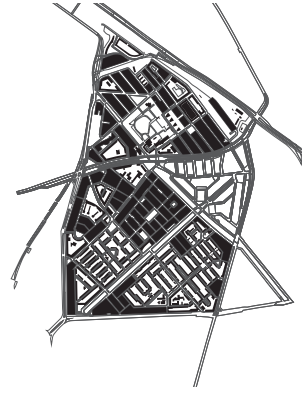
Make use of the local energy potentials (production and intermittency).

Energy demand average Dutch household

Gas	1550 m3
Electric	3480 kWh
Car	1

Energy demand average household Afrikaanderwijk & Bloemhof

Gas	1300 m3
Electric	2450 kWh
Car	0,5



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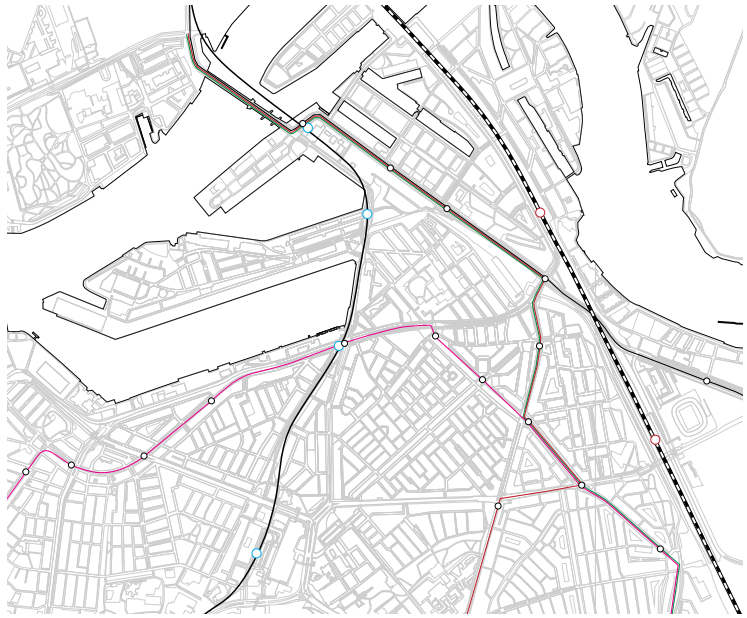
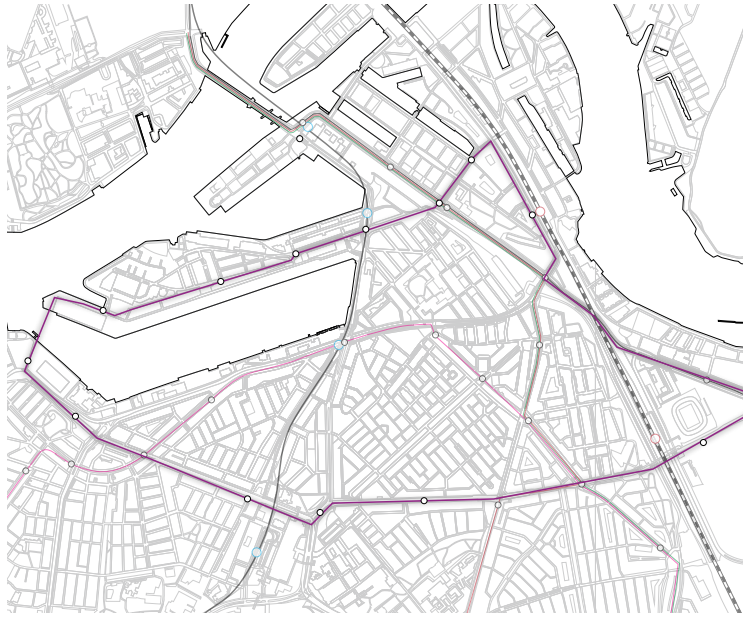


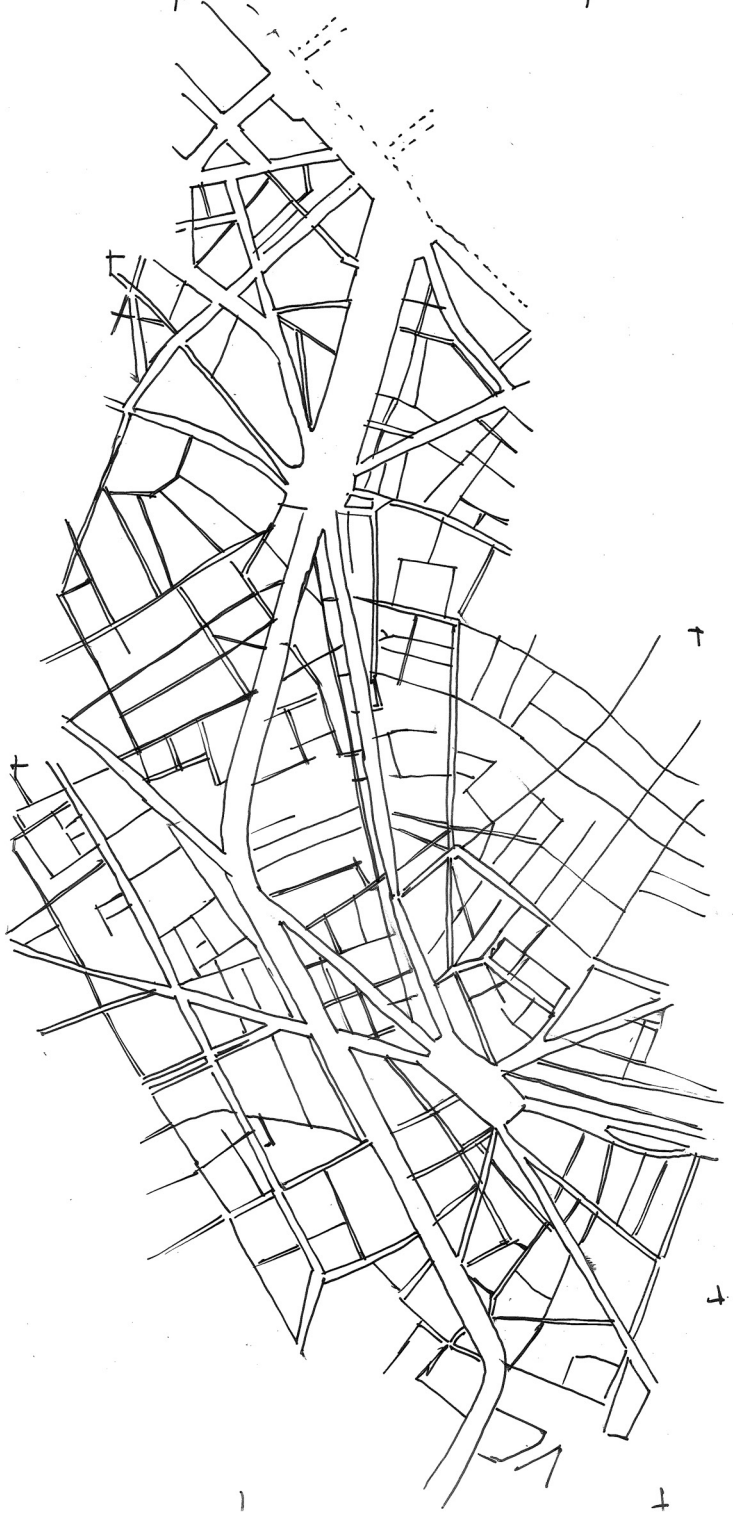


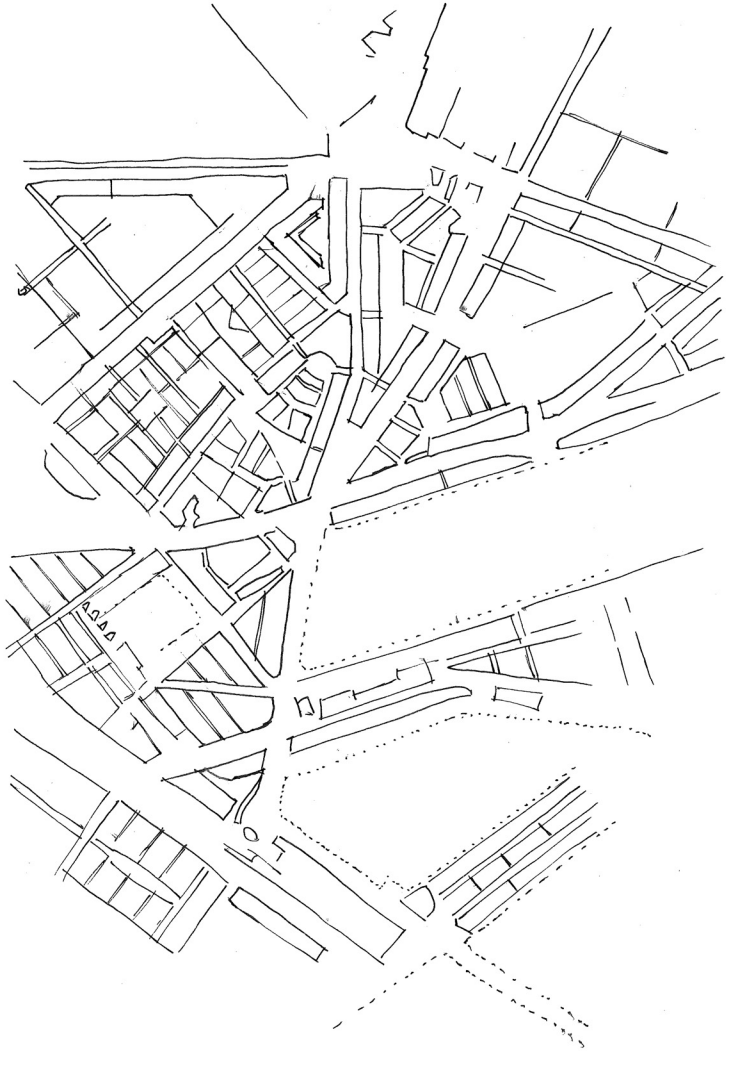
Reach bubbles
300/400 meters

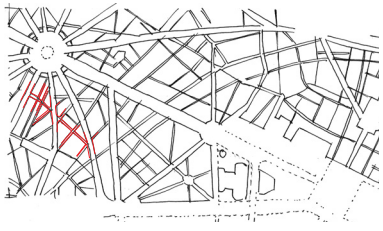
Train

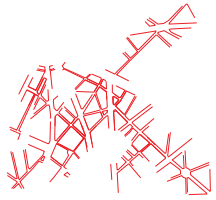
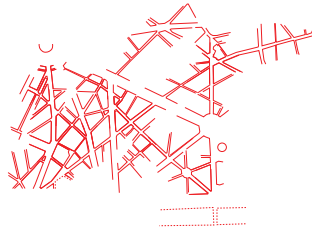
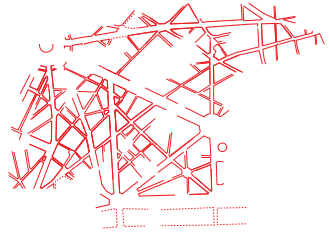
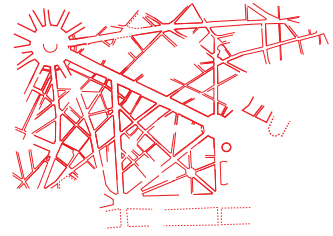
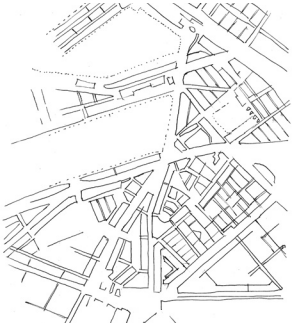
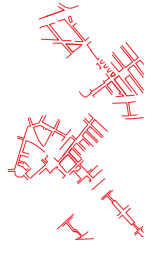
Metro

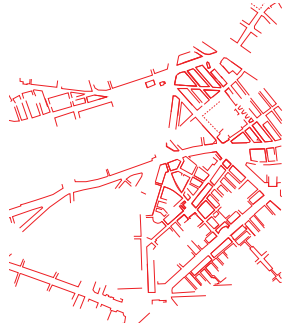
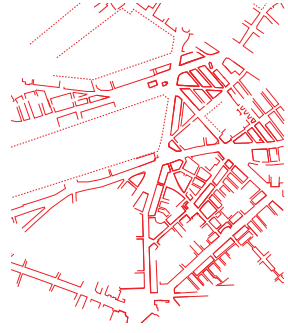

Centrum
Erasmusbrug
Havens 1273-1349
Afrikaander-
wijk
ss Rotterdam





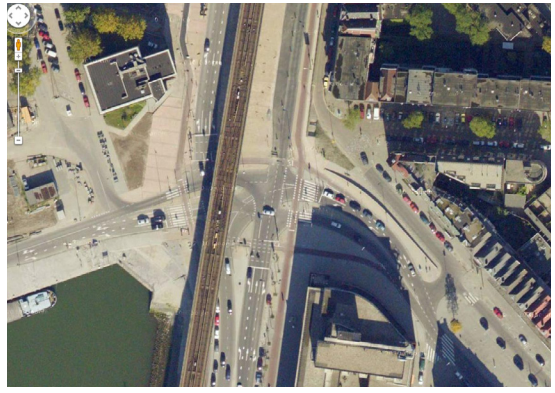


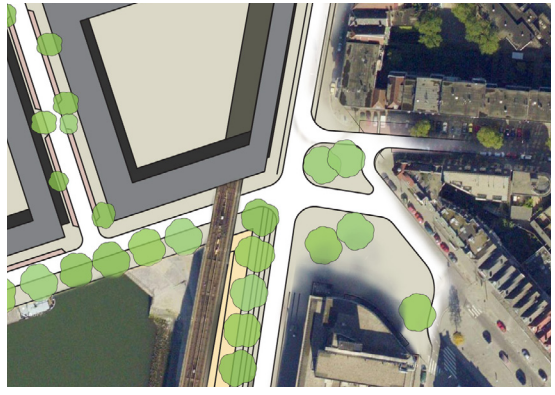







Paris

Rotterdam





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Make this environment as efficient as possible.

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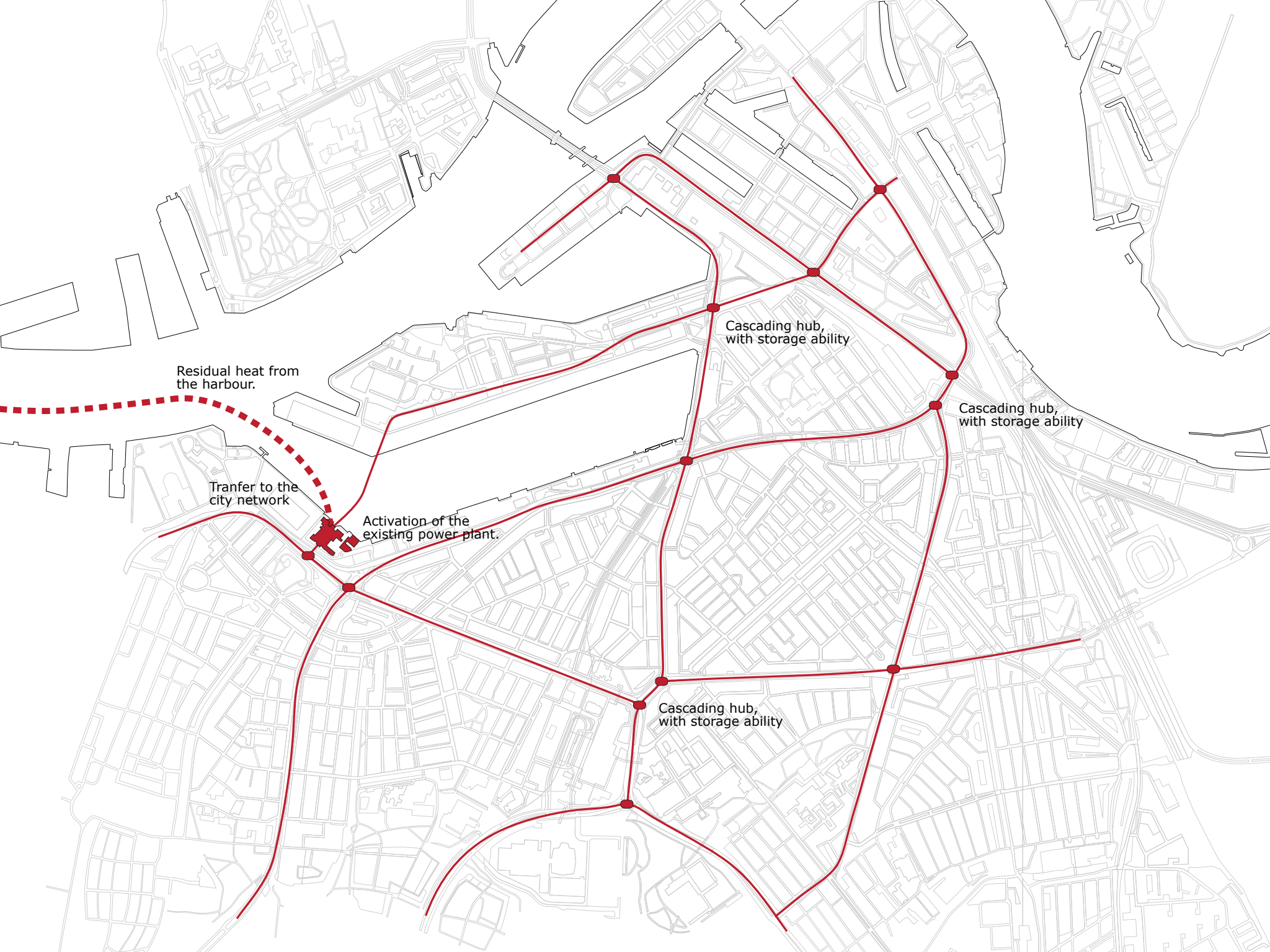
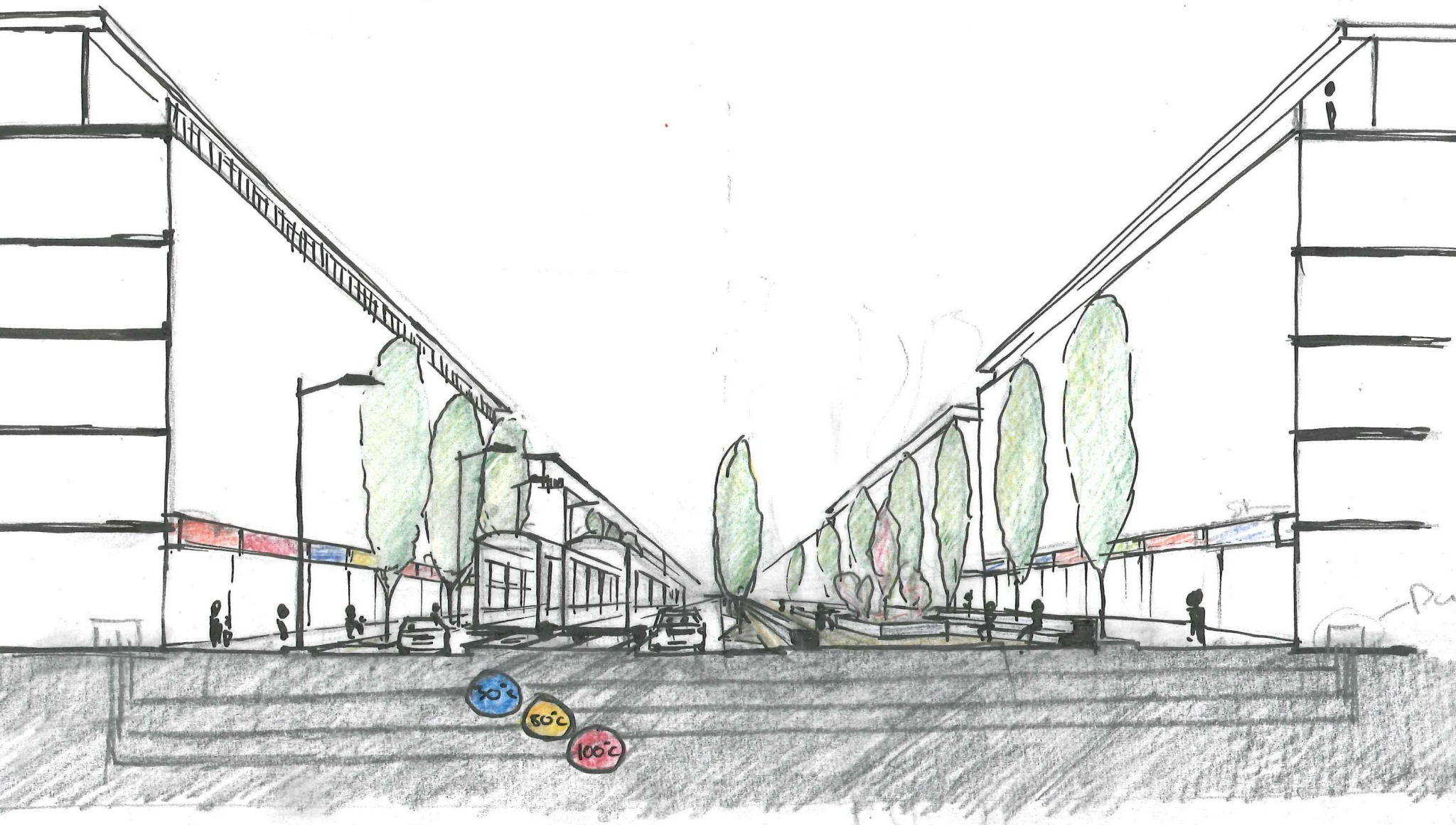

Residual heat from
the harbour.
Tranfer to the
city network
Activation of the
existing power plant.
Cascading hub,
with storage ability
Cascading hub,
with storage ability
Cascading hub,
with storage ability


Boels


30°C
80°C
100°C

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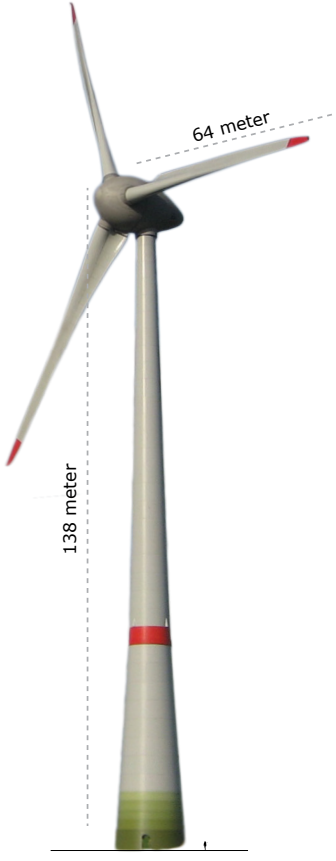
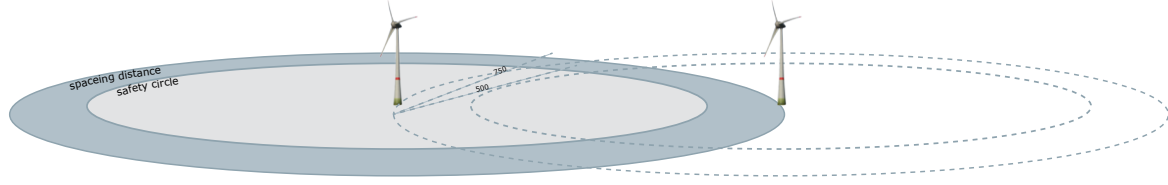
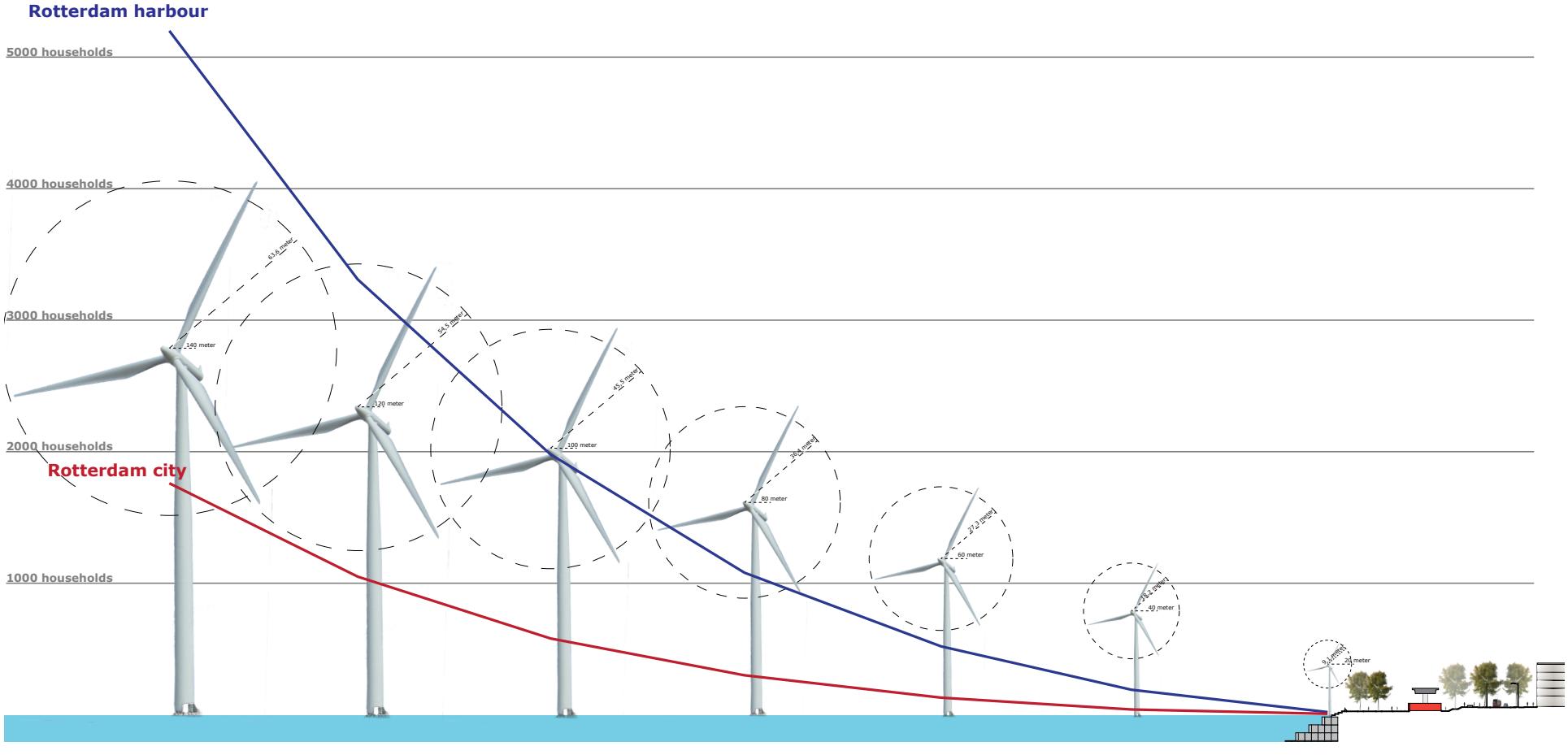
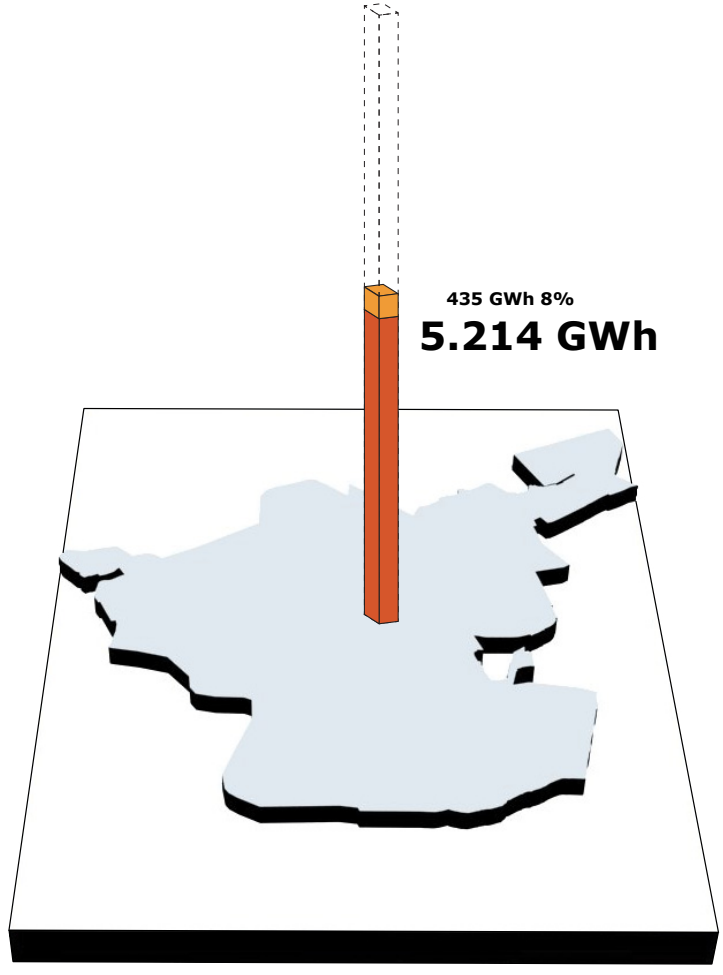


Enercon E-126

power	7.5 MW
height	140 meter
amount	56
costs	€ 11.000.000
investment	€ 616.000.000




Rotterdam harbour
5000 households
4000 households
3000 households
2000 households
Rotterdam city
1000 households
140 meter
120 meter
100 meter
80 meter
60 meter
40 meter
20 meter


435 GWh 8%
5.214 GWh

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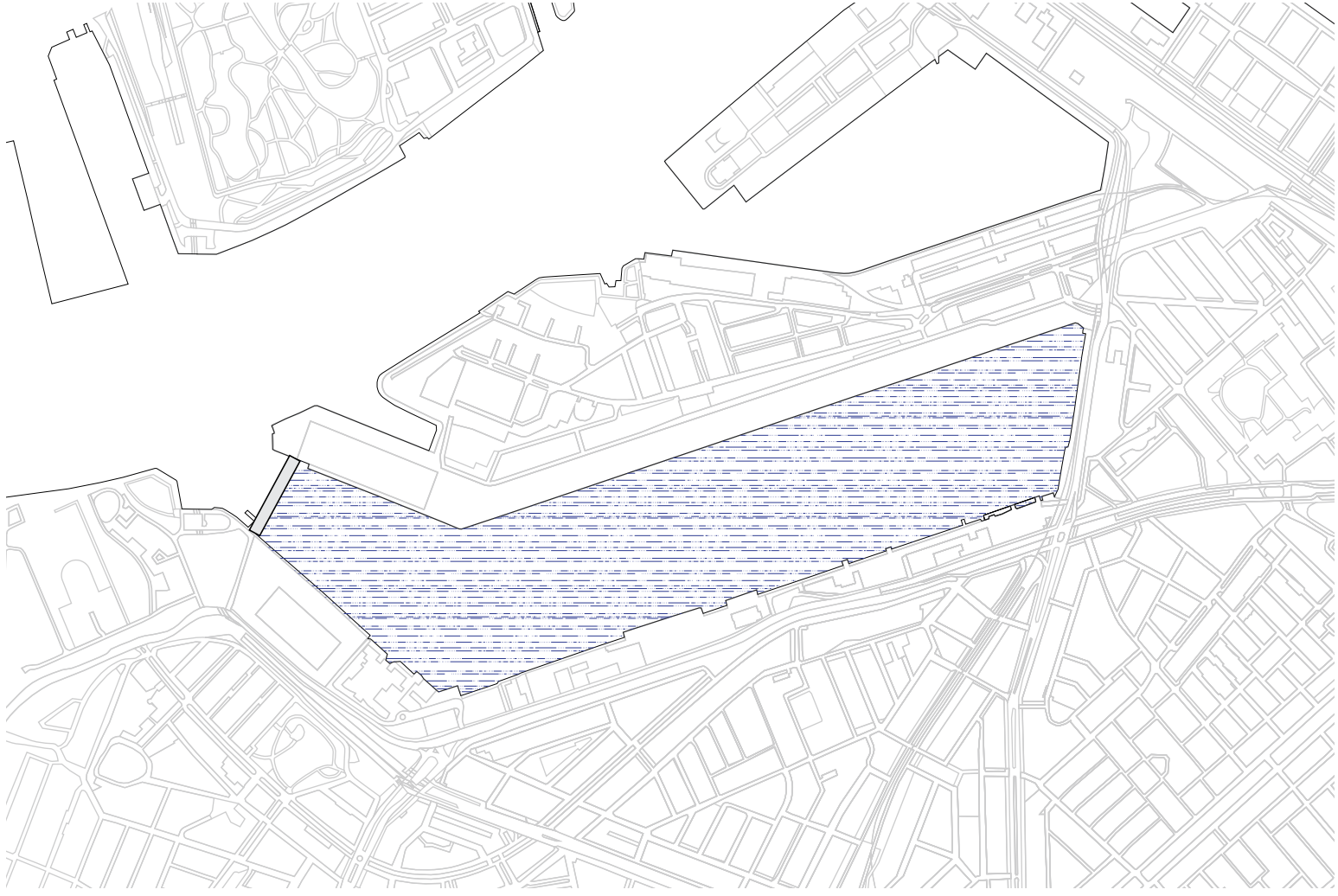
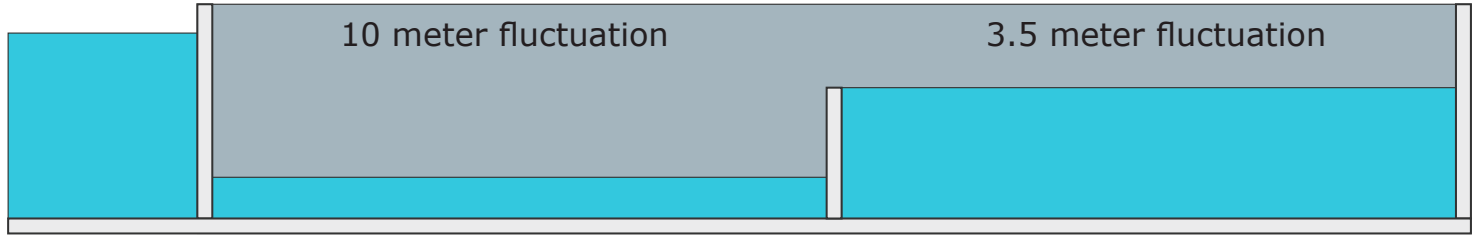
VARIATIE
2005274
PLUS NON OLET

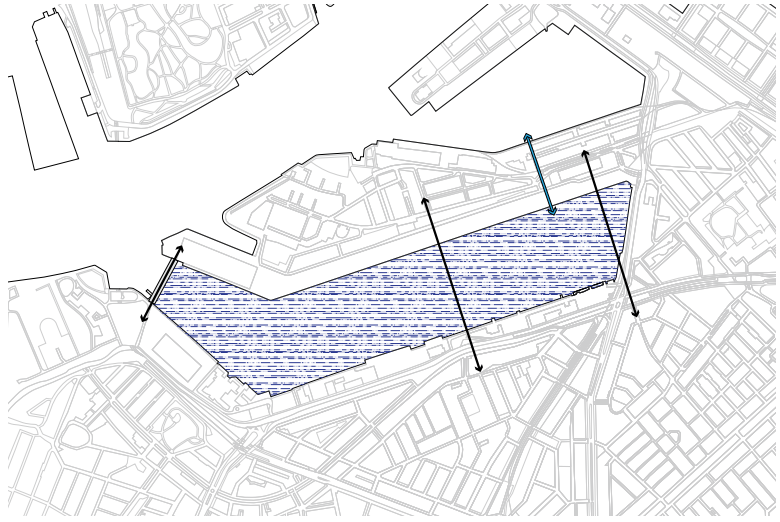


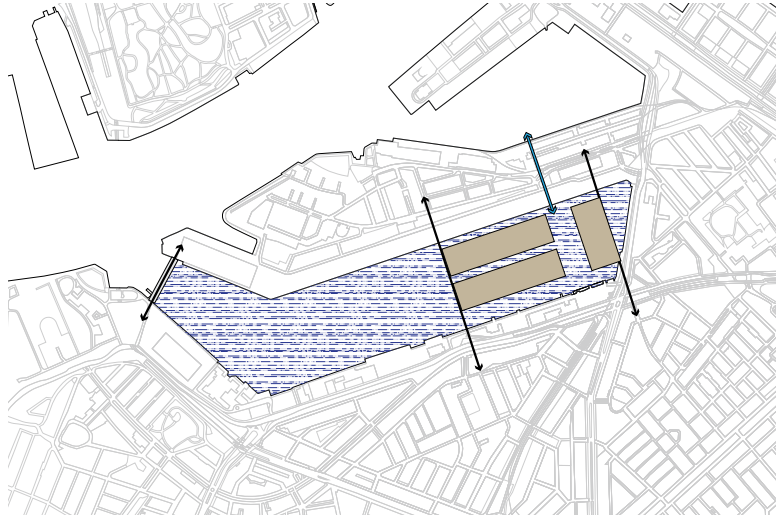


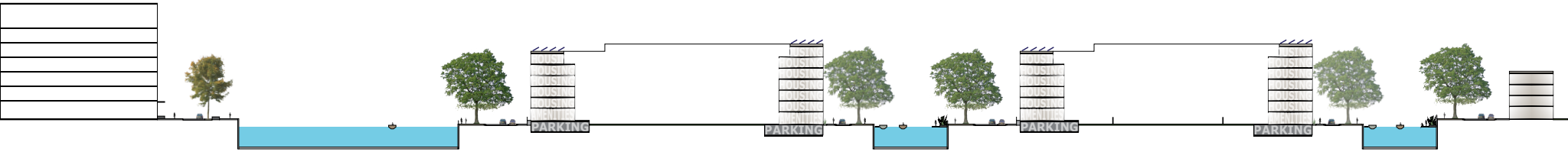
Dike with turbine

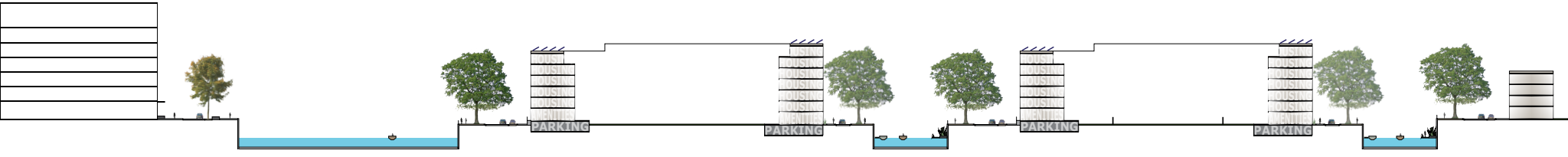
Dike

Lake principle






PARKING
PARKING
PARKING
PARKING


PARKING
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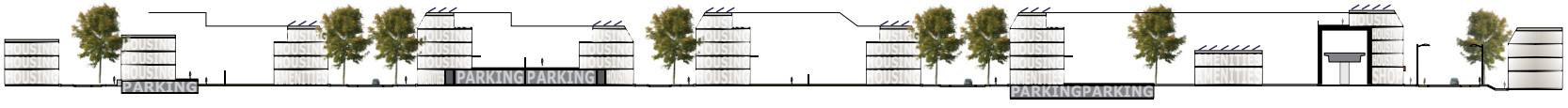
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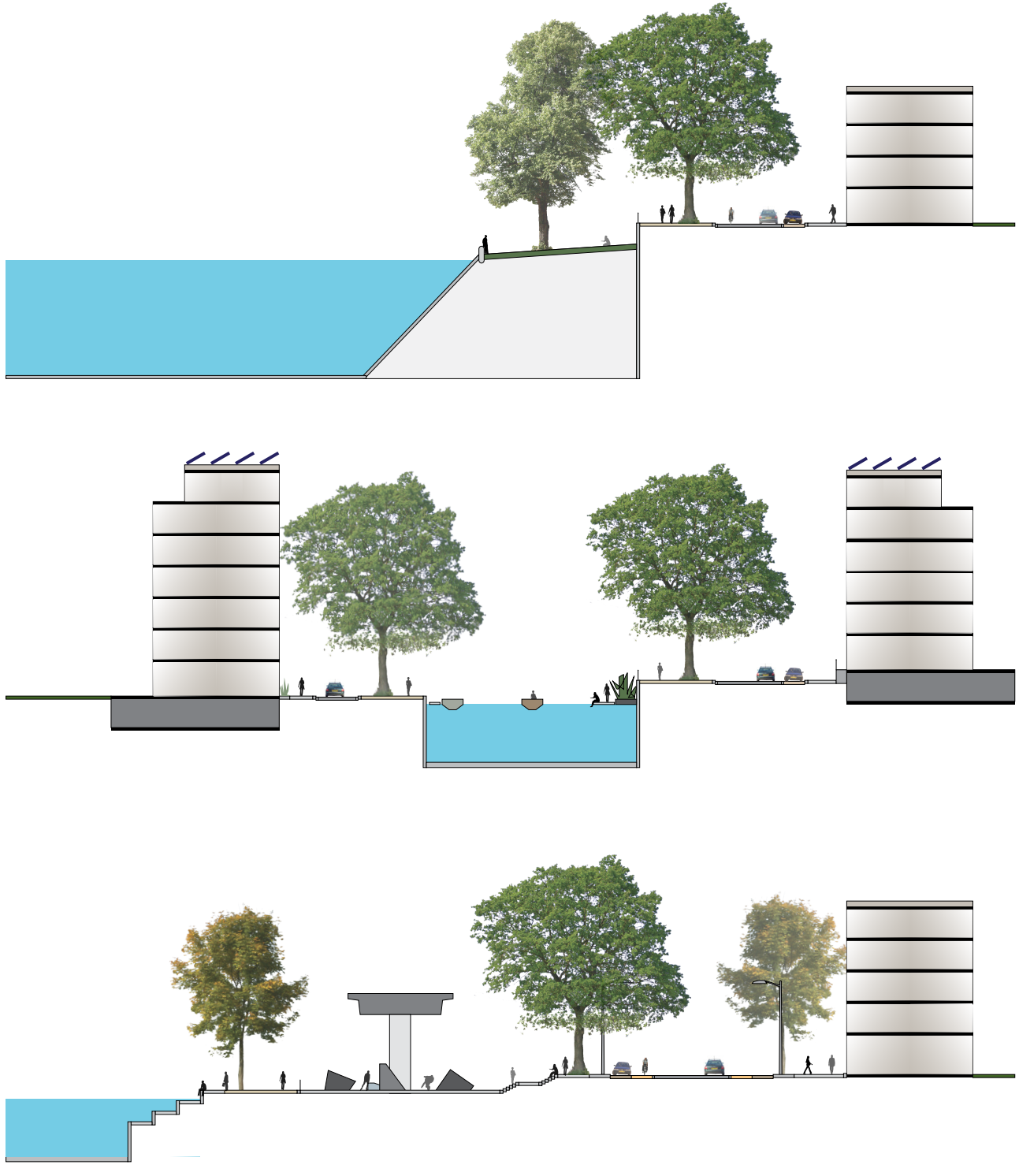
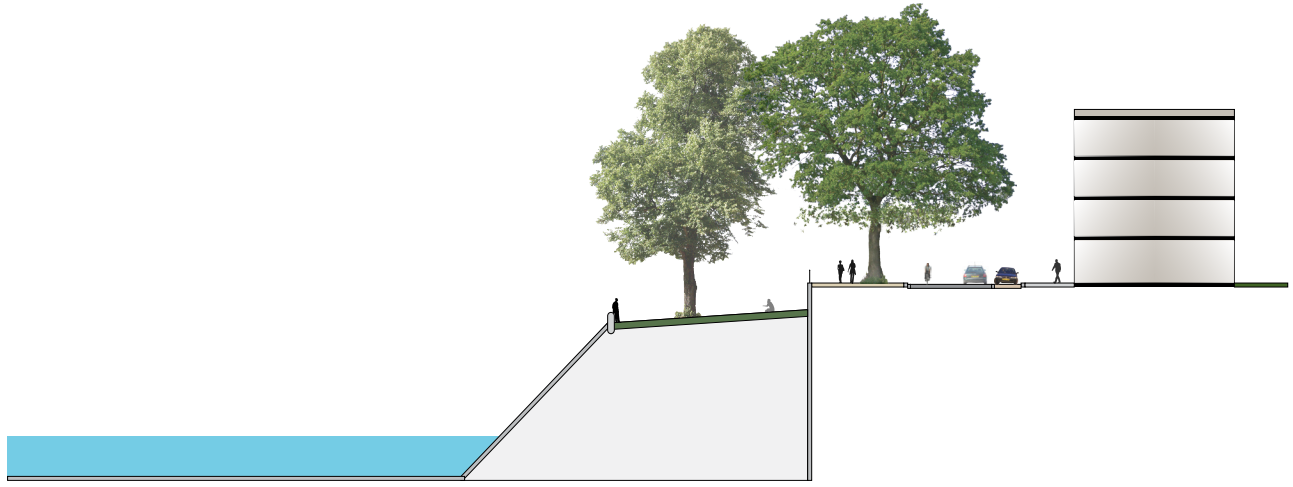
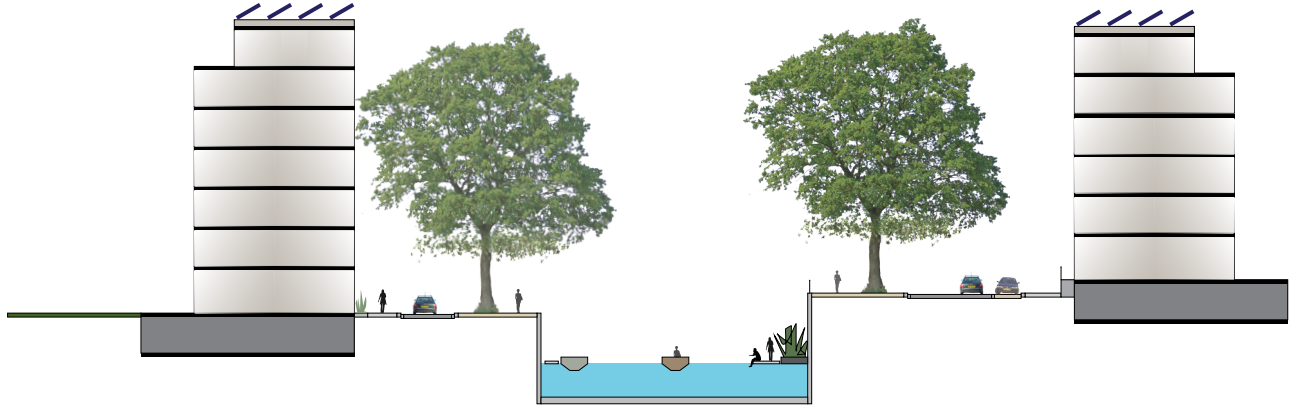
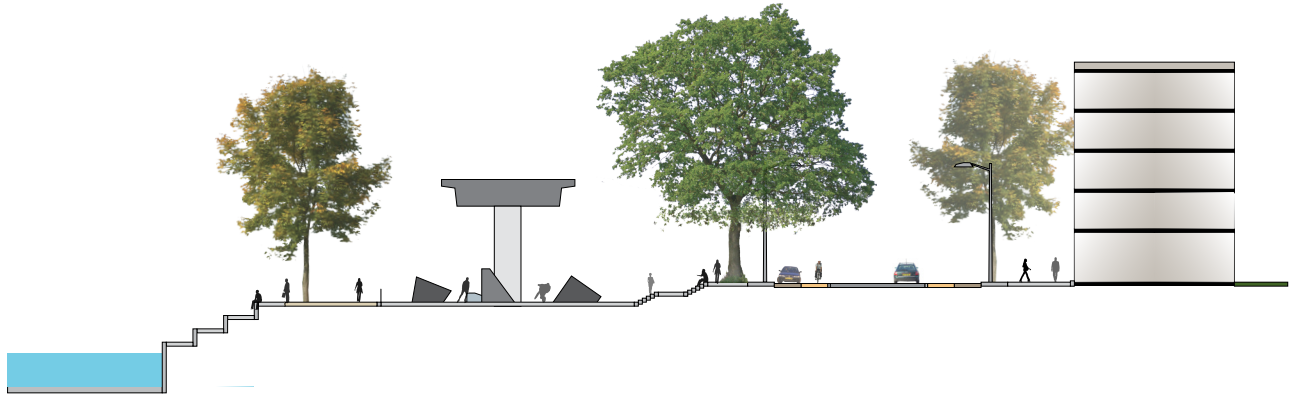
PARKING

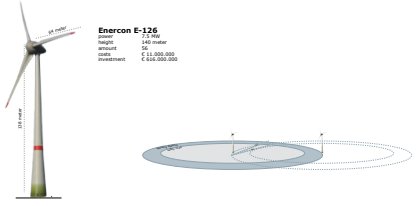


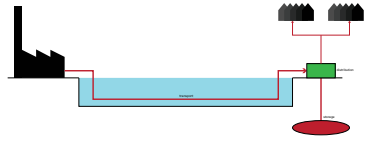




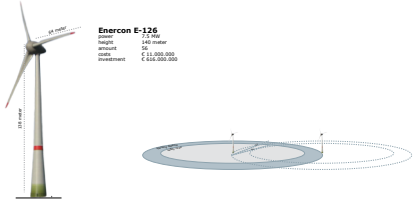


Conclusions


Enercon E-126
power 7.5 MW
height 140 meter
diameter 126 meter
costs € 11.000.000
investment € 616.000.000




... GWh ?%
2450 GWh 47%
435 GWh 8%
1600 GWh 31%
639,8 GWh 12%
5.214 GWh
intermittency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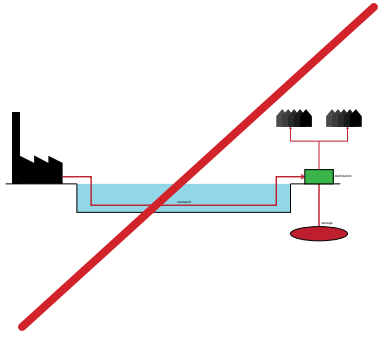
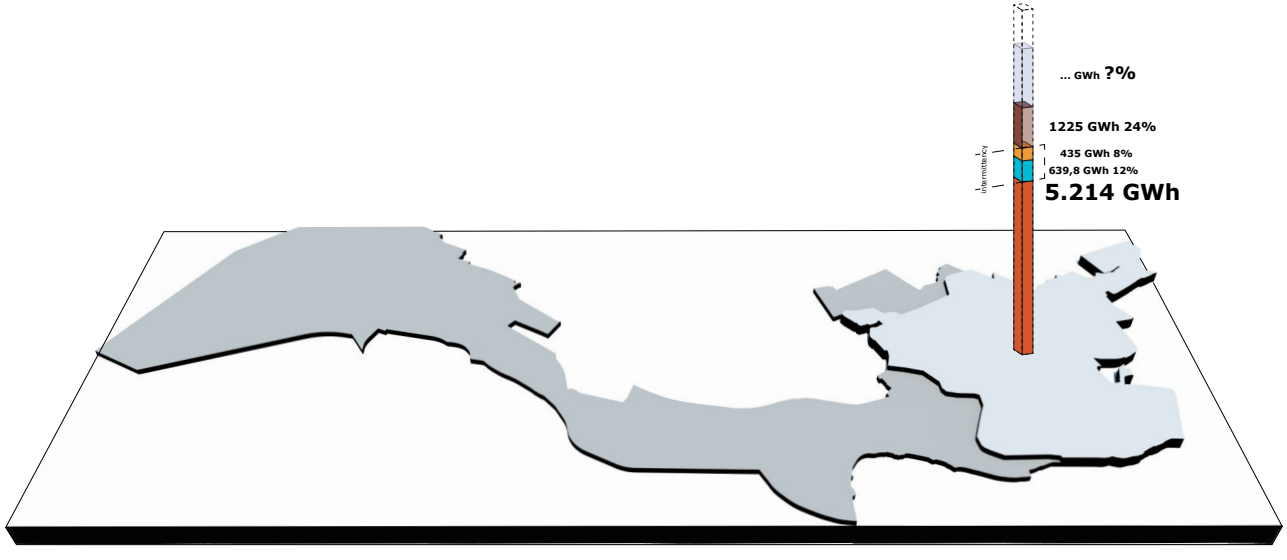
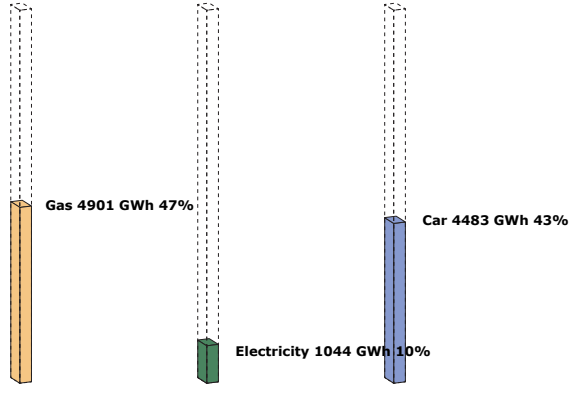
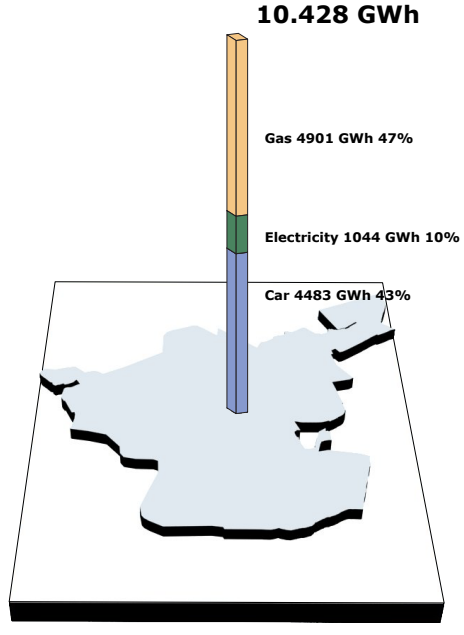



... GWh ?%
1225 GWh 24%
435 GWh 8%
639,8 GWh 12%
5.214 GWh
intermittency


Gas 4901 GWh 47%
Electricity 1044 GWh 10%
Car 4483 GWh 43%


10.428 GWh
Gas 4901 GWh 47%
Electricity 1044 GWh 10%
Car 4483 GWh 43%

Incentives ?

Offer a living environment that stimulates energy lean-lifestyles.

- **Dense**
- **Intricate structure, traditional block**
- **Mixed program**
- **Pedestrian friendly**
- **High quality public transport**
- **Attractive**

Make this environment as efficient as possible.

Make use of the local energy potentials (production and intermittency).


Questions?