P5 PRESENTATION
The Urban Energy Transition
Matthijs Wentink
Urban Regeneration & kWh/m2
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 CO2 wastes.
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The Ecological Footprint measures the biologically productive area that people use for provision of renewable resources, occupy with infrastructure, or require for absorption of CO2 wastes.
Adverse effects on nature...
...balance of power is shifting...
When Will the Oil Reserves Run Out?

How many years do we have until we deplete all known oil reserves?

42 years: the estimate of how long we have until the oil runs dry *

...running out of fossil resources.
We all know this...
...we depend on fossil energy completely.
Wealth play an important role...

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 CO2 wastes.
...but is this a good precedent?
So, what if oil becomes too expensive...
...will we still be able to live here...
...shop here...
... and keep comfortable?
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?
Why is this a (spatial) challenge?
...or reduce our energy demand.
The living environment influences energy consumption.
Can we live on renewables?

Wind:
- 20 kWh/d

PV, 10 m:
- $\frac{2}{5}$ kWh/d

PV farm (200 m$^2$/p):
- 50 kWh/d

Biomass: food, biofuel, wood, waste incin’
- 24 kWh/d

Hydro:
- 1.5 kWh/d

Shallow offshore wind:
- 16 kWh/d

Deep offshore wind:
- 32 kWh/d

Wave:
- 4 kWh/d

Tide:
- 11 kWh/d

Geothermal:
- 1 kWh/d

Solar heating:
- 13 kWh/d

Car:
- 40 kWh/d

Jet flights:
- 30 kWh/d

Light:
- 4 kWh/d

Gadgets:
- 5

Food, farming, fertilizer:
- 15 kWh/d

Heating, cooling:
- 37 kWh/d

Transporting stuff:
- 12 kWh/d

"Defence":
- 4

Stuff:
- 48+ kWh/d

Figure 18.1. The state of play after we added up all the traditional renewables.

The red stack in figure 18.1 adds up to 195 kWh per day per person. The green stack adds up to about 180 kWh/d/p. A close race! But please remember: in calculating our production stack we threw all economic, social, and environmental constraints to the wind. Also, some of our green contributors are probably incompatible with each other: our photovoltaic panels and hot-water panels would clash with each other on roofs; and our solar photovoltaic farms using 5% of the country might compete with the energy crops with which we covered 75% of the country. If we were to lose just one of our bigger green contributors – for example, if we decided that deep offshore wind is not an option, or that panelling 5% of the country with photovoltaics at a cost of £200 000 per person is not on – then the production stack would no longer match the consumption stack.

Furthermore, even if our red consumption stack were lower than our green production stack, it would not necessarily mean our energy sums are adding up. You can't power a TV with cat food, nor can you feed a cat from a wind turbine. Energy exists in different forms – chemical, electrical, kinetic, and heat, for example. For a sustainable energy plan to add up, we need both the forms and amounts of energy consumption and production to match up. Converting energy from one form to another – from chemical to electrical, as at a fossil-fuel power station, or from electrical to chemical, as in a factory making hydrogen from water – usually involves substantial losses of useful energy. We will come back to this important detail in Chapter 27, which will describe some energy plans that do add up.

Here we'll reflect on our estimates of consumption and production, compare them with official averages and with other people's estimates, and discuss how much power renewables could plausibly deliver in a country like Britain.

The questions we'll address in this chapter are:

1. Is the size of the red stack roughly correct? What is the average consumption of Britain? We'll look at the official energy-consumption numbers for Britain and a few other countries.

2. Have I been unfair to renewables, underestimating their potential? We'll compare the estimates in the green stack with estimates published by organizations such as the Sustainable Development Commission, the Institution of Electrical Engineers, and the Centre for Alternative Technology.

3. What happens to the green stack when we take into account social and economic constraints.

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?
De vraag naar energie en energiebesparing | TWEE ontwikkelingen aangevuld met ontwikkelingen op basis van bestaand beleid kunnen in dat referentiebeeld al tientallen procenten aan efficiencyverbetering en opleveren. Maar er is nog meer mogelijk, zowel met technische besparingsopties als met gedragsveranderingen. In paragraaf 2.4 geven we daarvan een overzicht voor alle sectoren. In de daaropvolgende paragrafen worden de besparingsopties per sector toegelicht.

2.2 Productie-consumptieketens

Energie is nodig voor het produceren van goederen en producten en bij het gebruik ervan. Daarbij zijn de drie belangrijke aangrijpingspunten voor het verminderen van de energievraag herkenbaar (figuur 2.1):

1. minder of ander gebruik van producten;
2. aanpassen van de producten zodat ze zuiniger zijn in het gebruik, of minder materialen vragen;
3. efficiëntere productieprocessen.

Figuur 2.1 Aangrijpingspunten voor de vermindering van de energievraag

Productieketens:
- Grondstoffen
- Materialen
- Bouw
- Installaties
- Apparaten
- Goederen
- Transport
- Dienstverlening

Energiegebruik

Ontwerp en vormgeving

Gebruik van:
- Woningen
- Transportmiddelen
- Voeding
- Apparaten
- Goederen
- Diensten

Energieaanbod

Productstromen
Energiestromen

source: PBL, 2011
Conclusions:
- Renewable energy production demands space
- Reduction has the most potential

But is the city the answer?

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!
Apartments can be very efficient and create an efficient, dense city.
Houses can easily be autarkic, but this requires space and result in a rural typology.
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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Attractive
Theory

Case Study
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

10.428 GWh
10.428 GWh

6133 ha
0.19 x the area

Solar PV
1.70 GWh/ha

91.316 ha
2.85 x the area

Wind 7.5 MW
0.114 GWh/ha

Biomass
0.0159 GWh/ha
Enercon E-126

- Power: 7.5 MW
- Height: 140 meter
- Amount: 56
- Costs: €11,000,000
- Investment: €616,000,000
5.214 GWh

639.8 GWh - 12%
Waste energy potential

- Storage
- Transport
- Distribution
5.214 GWh

2450 GWh 47%
5.214 GWh

1600 GWh 31%
Only 90%...
Possibilities

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

Reduction potential
2451 GWh
3362 GWh

Gas potential
47% of target

Car potential
64% of target

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(1) Regionale potenties
(2) Lokale potenties
(3) Actieradius schaal R=800 meter
(4) Actieradius schaal R=9000 meter
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Make use of the local energy potentials (production and intermittency).
Reach bubbles
300/400 meters
Train
Metro
Tram
New Tramline
Offer a living environment that stimulates energy lean-lifestyles.

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

Make use of the local energy potentials (production and intermittency).
Before 1946: 80%

Construction period:
- 1946-1968: 2%
- 1969-1993: 31%
- 1994-: 11%

Housing stock:
- Huur particulier: 23%
- Huur corporatie: 21%
- Koop: 16%

Average CITO score: 513,2

Unemployed: 22%

Average Income/hh: €14,600,-

Density: 79,6 dwellings/ha

Inhabitants: 9,419

Afrikaanderwijk

Inhabitants: 3,220

Housing stock:
- Huur: 8%
- Huur corporatie: 85%
- Koop: 7%

Construction period:
- Before 1946: 52%
- 1946-1968: 2%
- 1969-1993: 32%
- 1994-: 13%

Average CITO score: 510,6

Unemployed: 27%

Average Income/hh: €14,300,-

Density: 57 dwellings/ha

Inhabitants: 9,419

Hillesluis*

Inhabitants: 11,346

Housing stock:
- Huur: 17%
- Huur corporatie: 58%
- Koop: 25%

Construction period:
- Before 1946: 78%
- 1946-1968: 0%
- 1969-1993: 11%
- 1994-: 11%

* The data is for the entire Hillesluis area.
Offer a living environment that stimulates energy lean-lifestyles.

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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
Offer a living environment that stimulates energy lean-lifestyles.

- Make use of the local energy potentials (production and intermittency).
- Make this environment as efficient as possible.
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Make use of the local energy potentials (production and intermittency).
Paris

Rotterdam
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).
Activation of the existing power plant.

Residual heat from the harbour.

Transfer to the city network.
Offer a living environment that stimulates energy lean-lifestyles.

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Enercon E-126

- Power: 7.5 MW
- Height: 140 meters
- Amount: 56
- Costs: €11,000,000
- Investment: €616,000,000
435 GWh 8%

5.214 GWh
Offer a living environment that stimulates energy lean-lifestyles.

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Lake principle

Dike with turbine

Dike

Lake principle

10 meter fluctuation

3.5 meter fluctuation
Conclusions
5.214 GWh

639.8 GWh 12%
435 GWh 8%
1225 GWh 24%
...

intermittency

Waste energy potential

storage

transport
distribution

Enercon E-126
power 7.5 MW
height 140 meter
amount 56
costs € 11.000.000
investment € 616.000.000

138 meter
64 meter

spaceing distance

safety circle
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.

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

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