# Handout for Nerds

**By Chris ten Dam, Urban Futures Studio, Utrecht University**

# Part 1: a sustainable energy supply

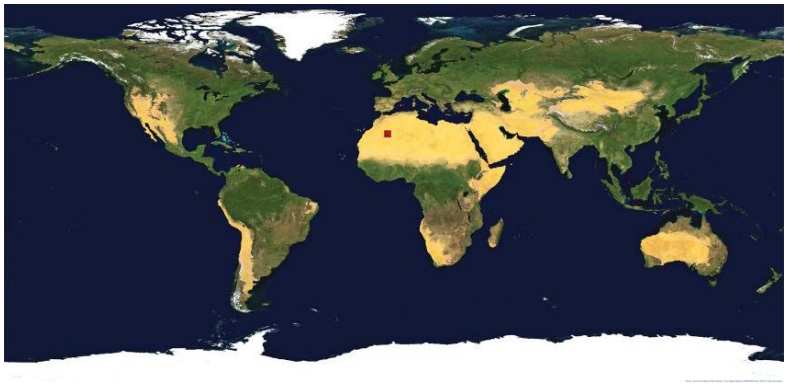
By Chris ten Dam with the help of Ton Dassen and Wilfried van Sark

## Coal versus the sun

Huge amounts of fossil energy are stored underground: enough for the coming centuries. Do we have enough renewable resources to replace all this energy?

Every year, the earth receives approximately a hundred times more energy from the sun than it contains in the form of coal that has been shaped over millions of years. This is almost six thousand times the annual global energy production! Check it yourself. There is 836,000 MToe (Megaton oil equivalent) of energy in recoverable coal reserves in the entire planet[1]. This is 35,001,648 PJ. 1.08 x $10^{17}$ Joules solar energy reaches the earth every second[2]. This is 3,405,888,000 PJ per year. 3,405,888,000/35,001,648 = 97. In 2015, we produced 577,360 PJ of energy worldwide[3]. This production also includes energy-forms such as gasoline for our cars, natural gas for our boilers and coal for our blast furnaces. 3,405,888,000 PJ solar energy/577,360 PJ energy production = 5899.

Coal reserves are the biggest source of fossil energy on earth. Conventional oil reserves contain three times less energy, namely 251,000 MToe = 10,508,868 PJ[1]. Conventional gas reserves contain four times less energy, namely 206,000 MToe = 8,624,808 PJ[1]. We can enlarge these reserves with resources such as oil from tar sands and shale-oil and -gas. However, the sun remains by far the largest source of energy on earth. According to Der Spiegel, you can even supply the entirely world with energy by covering the red square below with solar panels[4]:



## A matter of space

Conclusion: we get more than enough energy from the sun to replace our fossil fuels. However, our clouded polder-country does not actually receive a lot of solar rays. A seventh of the Dutch surface area should therefore be covered with solar panels in order to supply the entire Dutch energy consumption[5].

Check it yourself. Around 4000 MJ/$m^2$/year solar energy reaches the land-surface in the Netherlands[6]. The efficiency of a solar panel is around 20%. Around 25% of the produced electricity gets lost for a variety of reasons. In theory, it should therefore be possible to produce 4000*0.2*0.75 = 600 MJ/year of electric energy with one square meter of solar panel. It is impossible, however, to completely cover the ground with such panels. One can therefore only produce around 360 MJ/year per square meter of surface area[7]. The Netherlands used 2076 PJ final energy in 2015[8]. That is 2076 x $10^9$ MJ. (2076 x $10^9$)/360 = 5,766,666,667 $m^2$ = 5,766 $km^2$ = 13.9% of the Dutch surface area (excluding the North Sea).

---

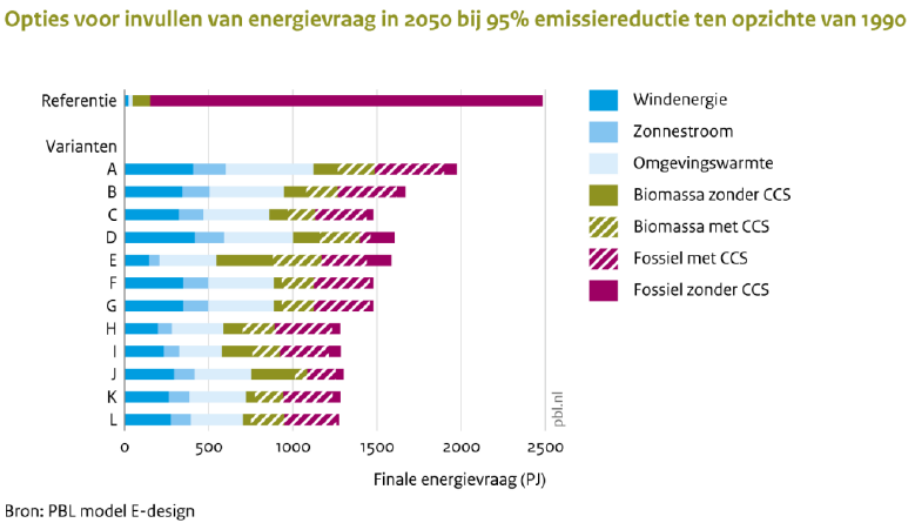
[1] World Energy Council. 2018. Energy resources (https://www.worldenergy.org/data/resources/).
[2] World Energy Council. 2013. Solar.
[3] International Energy Agency. 2018. World: energy indicators for 2015 (http://www.iea.org/statistics/statisticssearch/report/?product=Indicators&country=WORLD).
[4] Der Spiegel. 2009. Desertec: Strom aus der Wüste.
[5] Electricity from solar panels and windmills is a high-quality form of energy though. With one Joule of electricity, we can replace 3 to 5 Joules of gas for space heating (see part 2). The calculations in this chapter are therefore rather conservative.
[6] European Commission. 2006. Photovoltaic solar electricity potential in European countries.
[7] Wilfried van Sark (Copernicus Institute of Sustainable Development, Utrecht University).
[8] Energy research Centre of the Netherlands, Netherlands Environmental Assessment Agency, Central Bureau of Statistics, Netherlands Enterprise Agency. 2016. National Energy Outlook 2016.

What about wind? 20 to 100% of the Dutch surface area (excluding the North Sea) would have to be covered with windmills in order to supply the entire Dutch energy consumption. Windmills produce around 50 to 250 MJ/$m^2$/year depending on the windspeed[7]. Double this speed and the amount of energy produced increases eightfold. Windmills should therefore be placed at sufficient distance from each other such that they do not catch each other's wind, which limits the maximum energy production per square meter. (2076 x $10^9$)/50 to 250 MJ/$m^2$/year = 8,304,000,000 to 41,520,000,000 $m^2$ = 8,304 to 41,520 $km^2$ = 20 to 100% of the Dutch surface area (excluding the North Sea).

Fortunately, however, there is no good reason not to take the North Sea into account. Stronger still: the North Sea is crucial for a renewable energy supply due to her large surface area and the high wind-speeds that occur there. According to a recent report of the Netherlands Environmental Assessment Agency[9], we can produce up to 60 GW with windmills in the North Sea by 2050. That is 60 GJ per second and 60*$10^9$*3600*24*365 = 1890*$10^{15}$ Joules per year = 1890 PJ per year = 91% of the current Dutch yearly energy consumption[8]. We will have to cover about a quarter of the Dutch part of the North Sea to achieve this though. Yet, other activities such as fishing, aquaculture, shipping and nature conservation also require space. It is therefore crucial for the energy transition that we do not only spatially order our land, but also our seas, no matter how absurd this may seem.

## Our energy system in 2050?

The Dutch government wants to contribute to limiting global warming to 2.0 degrees. Almost the entire energy supply will have to be renewable in 2050 in order to achieve this goal, versus only 6% now (see diagram below). Large wind- and solar-parks will have to be constructed if we want to produce all this energy within our own borders. Fortunately, there are also other climate neutral energy sources such as ambient heat (heat from the air and ground), sustainable biomass and fossil energy combined with CCS (Carbon Capture and Storage: the capture of carbon-dioxide at a large source such as a coal- or gas-fired powerplant). By combining sustainable biomass and CCS, we can even remove $CO_2$ from the air: the plants absorb the $CO_2$ while growing, but this $CO_2$ is captured in the (biomass-fired) powerplant and is therefore not re-emitted into the atmosphere. We do have to consider the carbon payback time of the biomass though (see part 2, 'alternative: the pellet burner - why not?'). Alternatively, we can also save a lot of energy in order to reduce the total energy demand. We can do this by for instance using more energy-efficient appliances and by turning down the thermostat (see part 2).



Bron: PBL model E-design

The diagram to the left shows twelve possible energy systems (A-L) for the Netherlands in 2050 if we want to reduce our greenhouse-gas emissions with 95%. The horizontal axis denotes final energy demand in PJ. The reference (*'referentie'*) is the current situation in which we are almost completely dependent on coal and gas without CCS ('*fossiel zonder CCS'*). Dark blue = wind energy, light blue = solar energy, very light blue = ambient heat, green = biomass, purple = fossil, stripes = combined with CCS.[10]

[9] Netherlands Environmental Assessment Agency. 2018. De toekomst van de Noordzee – de Noordzee in 2030 en 2050: een scenariostudie.
[10] Netherlands Environmental Assessment Agency. 2016. Wat betekent het Parijsakkoord voor het Nederlandse langetermijn-klimaatbeleid?

# Part 2: beyond gas

By Chris ten Dam

80% of the heat consumed in the Netherlands comes from natural gas[1]. Countering this gas-dependence is necessary to limit global warming and to prevent future earthquakes in Groningen. As a consumer, you can 1) use less heat by turning down the thermostat 2) use your heat more efficiently by insulating your house and 3) produce the heat you use more efficiently and/or sustainably. You will probably have to combine multiple measures in order to get rid of your gas boiler entirely.

## Turning down the thermostat

You can save huge amounts of gas without investing any time or money by turning down the thermostat. You can calculate how much you can save with Heating Degree Days. These are the number of days that the average temperature is a certain number of degrees below your reference temperature (the thermostat setting). For instance, you have 50 HDDs if your reference temperature is 20 degrees and if it is either 10 degrees for 5 days or 18 degrees for 25 days ((20-10)*5 = (20-18)*25 = 50). The total number of HDDs is proportional to your energy use for space heating: halve the number of Heating Degree Days by lowering the thermostat setting and you halve your gas consumption.

Online, you can easily compute the number of HDDs for a certain reference temperature at a certain location. The site www.degreedays.net does this automatically for weather stations around the world. The only thing you have to remember is to choose a reference temperature outside (measured by the weather station) that is around 2 degrees lower than the desired temperature inside (the thermostat setting) to account for the insulation of an average house. What does such a calculation yield for Leeuwarden? With an outside reference temperature of 18 degrees (around 20 degrees inside), there were 2782 HDDs in Leeuwarden from February 2017 till February 2018. With an outside reference temperature of 13 degrees (around 15 degrees inside), there were only 1388. You could thus have halved your energy/gas consumption for space heating in a normally insulated house in Leeuwarden by turning the thermostat five degrees down (1388/2782 = 0.498). With an outside reference temperature of 8 degrees, there would only have been 469 HDDs. By setting the thermostat at 10 instead of 20 degrees, you could thus have reduced your energy/gas consumption for space heating with 83% (5/6$^{th}$). To sum up: you can lower your gas-bill considerably by wearing a jumper inside your house.

## Insulating your house

If you do not want to wear a jumper, then you can also build your house in such a way that you simply never need any active heating to maintain a comfortable temperature. First of all, you will need excellent insulation: no heat should be able to escape through your roof, walls, floor and windows. Moreover, you can position your house and windows in such a way that your house captures as much solar heat as possible in winter and that it is thus heated naturally. You can place your windows below your roof such that they do block solar radiation from above, thus keeping your house cool in summer when the sun shines high up in the sky. Furthermore, you can use a heat-exchanger to preheat incoming air with outgoing air to also prevent any heat from escaping through the ventilation. If this is not enough, you can even add a small heat-pump to extract some extra heat from the outgoing air (see ‘alternative: the heat-pump’ below). It is possible to build a house that only needs 15 kWh active heating/m$^2$/year by using these ‘passive building techniques’ (Dutch average = 105 kWh/m$^2$/year). This house then complies with the official ‘Passive House’ standard and barely needs any active heating. The neighborhood ‘Bahnstadt’ in Heidelberg contains thousands of these passive houses. See the ‘*Neighborhood of the Future’* ring binder in the construction shack in exhibition room nr.9 for more information.

[1] Netherlands Environmental Assessment Agency. 2017. Toekomstbeeld klimaatneutrale warmtenetten in Nederland.

## Alternative: the pellet burner – why not?

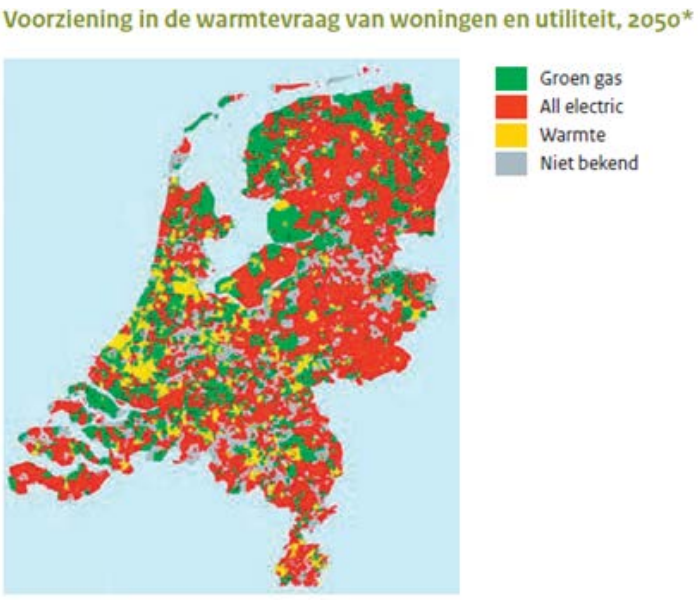
You can of course also produce your heat in a different way if you want to reduce your gas consumption. But do not replace your gas boiler with a pellet burner! First of all, burning wood and other biomass causes air pollution and thus results in health damage in your own neighborhood. Moreover, we actually do not have enough biomass in the Netherlands. If we would want to replace all our gas for space heating with wood, we'd need to cover half the country with forests. What biomass we do have, we urgently need in the transport and industrial sector. Finally, replacing gas with biomass actually leads to more greenhouse-gas emissions in the coming decades. Why? Because producing biomass requires claiming land by for instance cutting down a forest. Huge amounts of $CO_2$ are thereby released from the trees and the ground. More $CO_2$ is released during the harvest, processing and transport of the biomass (see part 4 for more information on the climate impact of agriculture and forestry). Even the replacement of gas with residual wood therefore results in extra greenhouse-gas emissions during the first twenty to fifty years[2]. The total payback time mainly depends on the type of biomass (residual wood or palm oil?), the former land use (grassland or rain forest?) and the type of fuel that you replace (gas or coal?). In the worst-case scenario, the payback time can amount to more than 300 years[2].

## Alternative: the heat-pump

Fortunately, there are much better alternatives for your gas boiler than the pellet burner. A heat-pump uses electricity to move heat. The heat-pump in your fridge for instance moves heat from your frozen food to the kitchen. If you have proper insulation, you can also use a heat-pump to keep your house warm by extracting heat from the outside air or the ground (so called 'ambient heat'). All the electricity a heat-pump uses to move this heat gets converted into more heat inside the house and therefore does not get lost. Consequently, a heat-pump always provides more (heat) energy to the house than it uses itself. To indicate the efficiency of heat-pumps, we use the Coefficient of Performance (COP): the ratio of delivered heat over used electrical energy. Most heat-pumps have a COP between three and five and are thus many times more energy-efficient than gas boilers or simple electric resistance heaters. A cheaper electric alternative for the heat-pump may be the infrared panel which is also much less efficient, but which uses radiation to only heat your couch/workplace instead of the entire house. IR-panels are often not a comfortable replacement for your gas boiler though.

## District heating or heat-pump?

Heat-pumps are superefficient. Unfortunately, they are also very expensive. In addition, many heat-pumps can together cool the ground or outside air. It is therefore not possible to heat densely built areas with heat-pumps without pumping heat back into the ground in summer. District Heating Networks on the other hand – piping networks that transport hot water – actually become cheaper and more efficient when the population density increases. The heat that these networks transport can be ambient heat from heat-pumps, but also residual heat from factories or geothermal heat from inside the earth[3]. A final way to heat your house sustainably is to consume 'green gas'. Examples include biomass produced by fermenting waste or hydrogen produced with renewable electricity. The main advantage is that you can keep using the existing gas-infrastructure of the Netherlands.




The best solution depends on where you live. The cheapest way to sustainably heat your house (without greenhouse-gas emissions) is through district heating in the most densely populated areas (yellow) on the map to the left. These areas together contain more than half the Dutch heating demand. Red areas can be heated cheapest with electric heating such as heat-pumps and green areas with green gas[1].

[2] Netherlands Environmental Assessment Agency. 2016. Greenhouse gas impact of bioenergy pathways.
[3] Currently, many District Heating Networks transport residual heat from coal- or gas-fired powerplants though.

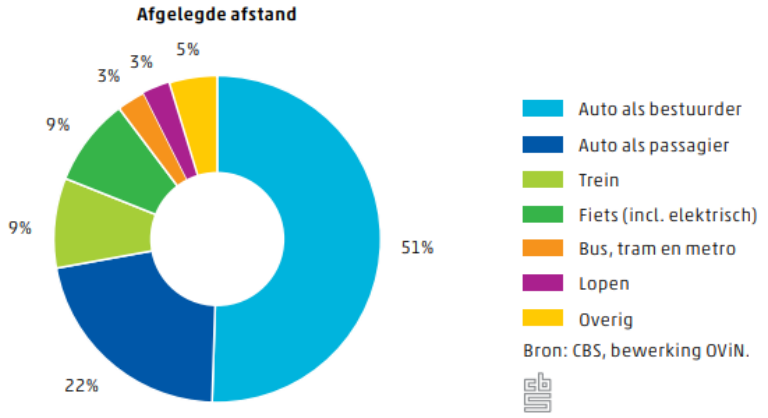
# Part 3: commuters and tourists

By Chris ten Dam with the help of Ton Dassen and Gabrielle Uitbeijerse

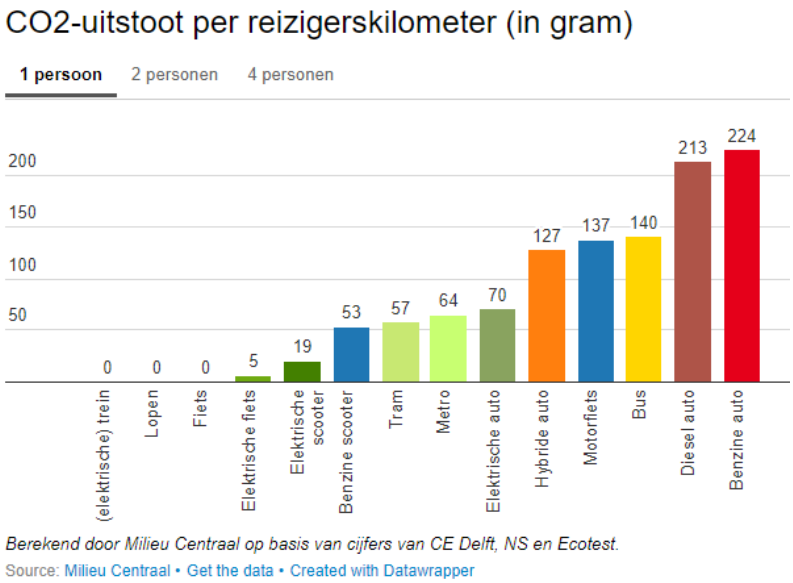
We will also have to travel more sustainably if we want to limit global warming to 2.0 degrees. But how much does the average Dutchman actually travel? And how much does that contribute to climate change? And how about air-based travel? Let's have a look at the numbers.

## Daily commuting

Dutch people travel 32 kilometers per day on average[1]. We cover almost three quarters of this distance by car. Commuting to work (29%), recreation (17%), social visits (16%) and doing the groceries (10%) are our main reasons to travel[2]. How much we travel in total depends on where we live: people from Friesland travel 35 kilometers per day on average whereas people from South-Holland only travel 28 km/day[1]. This is due to the lower population density in Friesland, causing destinations such as work or school to be further away.




In addition, urban dwellers tend to have better public transport facilities at their disposal. People living in cities therefore cover 61% of their daily distance by car versus 80% in very sparsely populated areas[3]. See a diagram of the average percentage of travelled distance per transport mode in the Netherlands to the left[1].




This implies that urban dwellers emit less $CO_2$ for their daily transport needs. Cars emit 1.6 times more $CO_2$ per kilometer for one passenger than busses and motorcycles and 4.0 times more than trams (224 versus 140 and 57 $gCO_2$/km/passenger respectively, see diagram to the left)[4]. A car with four passengers of course emits almost four times less $CO_2$ per passenger. Moreover, new cars are only allowed to emit 95 $gCO_2$/km starting from 2021[5]. But when it comes to sustainability, even a shared, superefficient car cannot match the bicycle or train (which is 100% powered with climate-neutral wind-energy in the Netherlands)[4].

[1] Central Bureau of Statistics. 2016. Transport en mobiliteit.
[2] Netherlands Environmental Assessment Agency. 2012. Nederland verbeeld.
[3] Harbers A. 2017. Does urban living reduce energy use?
[4] Milieu Centraal. 2018. Fiets, OV of auto (https://www.milieucentraal.nl/duurzaam-vervoer/fiets-ov-of-auto/).
[5] European Commission. 2018. Reducing $CO_2$ emissions from passenger cars (https://ec.europa.eu/clima/policies/transport/vehicles/cars_en).

## Air-travel

However, urban dwellers are not necessarily more sustainable than their countryside peers. Recent research has shown that inhabitants of urban areas tend to make a lot of long-distance plane-trips[6]. This results in a much higher climate-impact due to air-based travel because airplanes emit two to four times more $CO_2$ than cars and seven to eleven times more $CO_2$ than trains to cover the same distance[7].

Such a difference in climate impact due to air-based travel can easily match a difference in climate impact due to daily transport patterns. A return-trip to New York causes 2500 kg of $CO_2$-emissions[2]. This is more than the emissions due to the yearly car-use of the average Dutchman (2400 kg[2]) and more than twice the global per capita carbon budget for 2050 to limit global warming to 2.0 degrees (1100 kg[8]). Planes' $CO_2$-emissions can be approximately halved by 2050 through, inter alia, more efficient jet-engines and lighter/more aerodynamic airplanes[9]. They can also be strongly reduced by using sustainable (bio)fuels (see part 2, 'alternative: the pellet burner – why not?)[9]. It is unlikely, however, that climate-neutral electric flying will become possible for long-distance trips[9]. Regular holidays to the US and Thailand can therefore not be a part of a sustainable future.

## But what about my holiday?

Fortunately, there are sustainable alternatives for your flying holiday. You can for instance go camping in Drenthe, sailing in Friesland or cycling in the Black Forest in Germany. A relaxed holiday around the corner!

You can also take the train if you want to travel a bit further away. The train is many times more energy-efficient than the car or airplane and therefore much more sustainable. Some trains (like those from NS) already use renewable energy and are thus climate neutral. Think for instance of a trip to Eastern Europe or Switzerland. Or even further away: it is already possible to travel directly from Moscow to Beijing by train if you have the time and budget for it (see route below)!

Or maybe you can travel more sustainably by simply going on holiday less often? By making a true journey of discovery to India or Eastern Africa once or twice in your life by train, boat and car (or maybe by plane for that one time). By travelling slower and really experiencing a country rather than hopping from highlight to highlight in a couple of weeks.

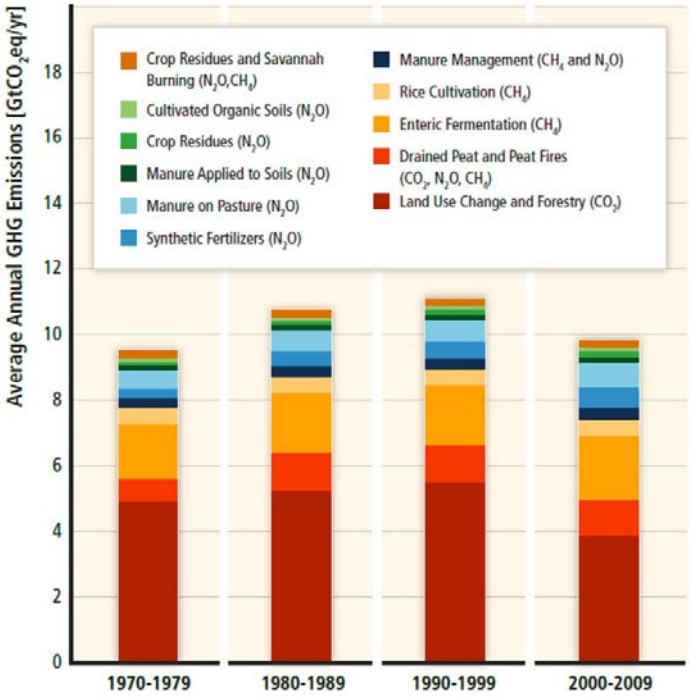
10

[6] Reichert. 2014. Mode use in long-distance travel. DOI: 10.5198/jtlu.2015.576.
[7] Milieu Centraal. 2018. Vliegen of ander vakantievervoer? (https://www.milieucentraal.nl/duurzaam-vervoer/vliegen-of-ander-vakantievervoer/).
[8] Netherlands Environmental Assessment Agency. 2016. Wat betekent het Parijsakkoord voor het Nederlandse langetermijn-klimaatbeleid?
[9] Gabrielle Uitbeijerse (Netherlands Environmental Assessment Agency).
[10] The China travel company. 2018. Trans-Siberian tours from Beijing (http://www.thechinatravelcompany.co.uk/pages/trans-siberian-tours.php).

# Part 4: the climate impact of food

By Chris ten Dam with the help of Ton Dassen and Vanessa Timmer

The production of our food also contributes to global warming. Agriculture, forestry and other land use causes almost a quarter of global greenhouse-gas emissions (see an overview of the emissions and their causes to the right)[1]. Huge amounts of $CO_2$ are emitted from the trees and ground when a forest is cut down to make way for an agricultural field or plantation. Something similar occurs when peat is drained, causing organic material to get in touch with the air. A lot of $CO_2$ is of course additionally emitted when producing, processing and transporting the agricultural products (this is not included in the graph). Yet, $CO_2$ only accounts for around half the climate impact of the sector. Bacteria in rice paddies and cattle produce methane ($CH_4$), which contributes much more to global warming. Moreover, manure and synthetic fertilizers emit nitrous oxide ($N_2O$), which is an even stronger greenhouse gas. The total climate impact of agriculture, forestry and other land use will likely decline in the future due to technological progress and a shrinking (more intensely used) agricultural surface area[1]. Nonetheless, we will have to reduce the greenhouse emissions from this sector a lot faster in order to limit global warming to 2.0 degrees.

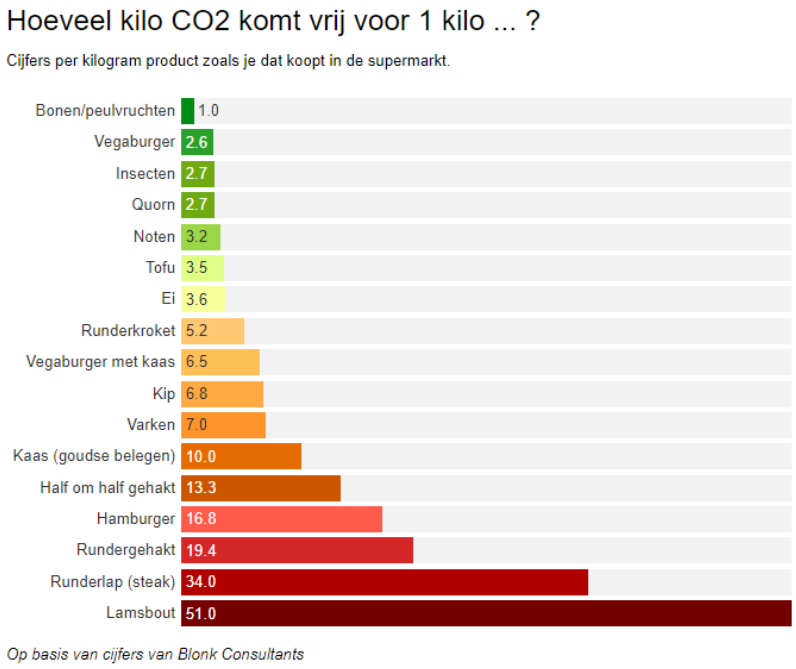



## You are what you eat

We can reduce the greenhouse-gas emissions from the agricultural sector by paying attention to what we eat. By not eating steak for instance. Animal production accounts for 14.5% of global greenhouse-gas emissions (and 11% of Dutch emissions)[2][3]. Cow, sheep and other ruminants emit methane, which is a much stronger greenhouse-gas than $CO_2$. Moreover, one needs around five kilograms of animal feed to produce one kilogram of meat[4]. Animal production is responsible for 80% of global agricultural land use when taking the production of this animal feed into account[5], resulting in huge amounts of greenhouse-gas emissions (see above). According the Netherlands Environmental Assessment Agency, producing an ounce of beef therefore requires around 6 times more greenhouse-gas emissions and 14 times more land-use than producing an ounce of chicken[3]. Producing an ounce of legumes even requires 45 times less greenhouse-gas emissions and 34 times less land-use[3]! Other sustainable alternatives for our steak are nuts, meat from insects or maybe even cultured meat from the lab. The first cultured meat-ball of 975 euros has already been cooked[6]. A shift towards such alternatives would help mitigate climate change and would free up huge amounts of space in the Netherlands for nature and recreation.

---

[1] Intergovernmental Panel on Climate Change. 2014. Fifth assessment report – Agriculture, forestry and other land use (AFOLU).
[2] Food and Agriculture Organization. 2018. Key facts and findings - by the numbers: GHG emissions by livestock. (http://www.fao.org/news/story/en/item/197623/icode/).
[3] Netherlands Environmental Assessment Agency. 2012. Nederland verbeeld.
[4] Milieu Centraal. 2018. Vlees, vis of vega (https://www.milieucentraal.nl/milieubewust-eten/vlees-vis-of-vega/).
[5] Food and Agriculture Organization. 2018. Animal production. (http://www.fao.org/animal-production/en/).
[6] Volkskrant. 2018. Kweekvlees is hard op weg naar uw bord.

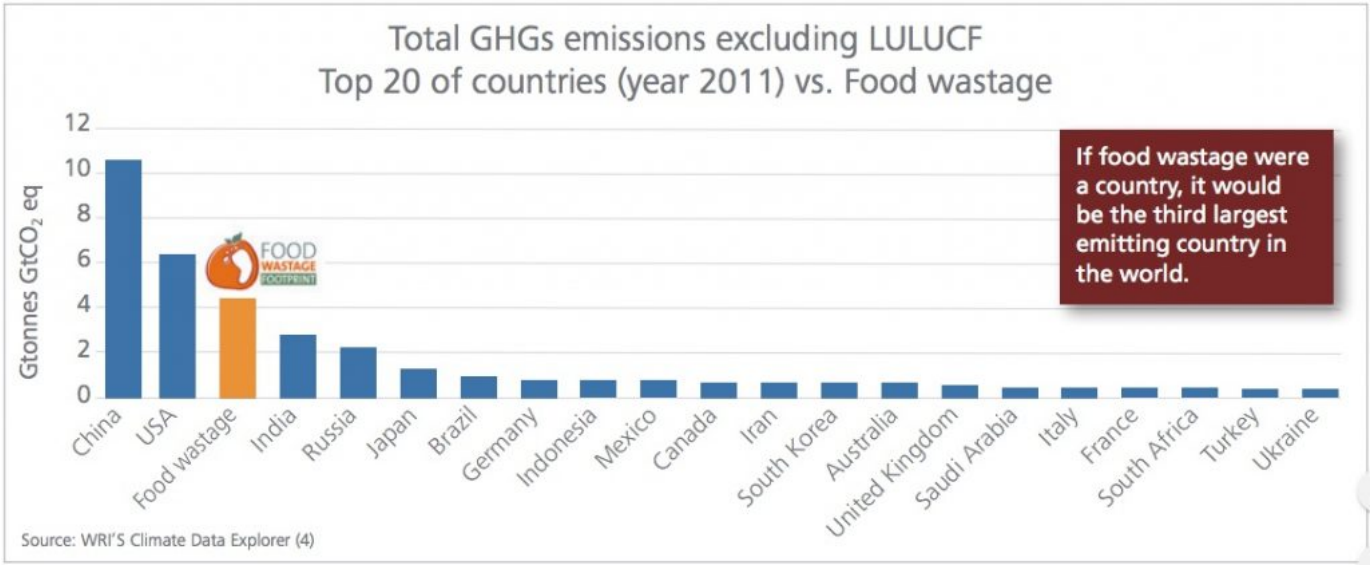



A more extensive estimation of the kilograms of $CO_2$-emissions per kilogram of food product is given by Milieu Centraal (see left)[4]. The emissions of methane and nitrous oxide have hereby been converted to equivalent emissions of $CO_2$. From top to bottom: beans/legumes, vegaburger, insects, quorn, nuts, tofu, egg, *´kroket'*, vegaburger with cheese, chicken, pig, cheese, mixed minced meat, hamburger, beef minced meat, steak and lamb. Using these numbers, you can easily calculate that eating an ounce of cheese and an ounce of steak every day results in the emission of 1606 kg $CO_2$equivalents per year. We have to limit our emissions to 1100 kg in 2050 if we want to limit global warming to 2.0 degrees[7]. An ounce of chicken a day is still compatible with this goal: that only results in 248 kg $CO_2$equivalent emissions per year.

## Eat the leftovers!

We also have to waste less food in order to limit global warming to 2.0 degrees[1]. Dutch households threw away 129 kilograms of food on average in 2015[8]. With all the food that is wasted in Europe as a whole, we can feed 200 million people[9]. Around a third of this food is thrown away by the households/consumers. The rest is wasted in the agricultural sector and in the processing and distribution of the food[10].

Global food waste caused around 8% of global greenhouse gas emissions in 2015. If food waste would be a country, then only the USA and China would emit more (see graph below)[10]. We therefore have to be much more careful with our food if we want to avert dangerous climate change! This is possible by not buying and cooking more food than you need. Maybe by buying fresh products in neighborhood stores instead of buying in bulk at the supermarket once a week.




[7] Netherlands Environmental Assessment Agency. 2016. Wat betekent het Parijsakkoord voor het Nederlandse langetermijn-klimaatbeleid?
[8] Netherlands Environmental Assessment Agency. 2017. Tussenbalans van de leefomgeving 2017.
[9] Food and Agriculture Organization. 2018. Key facts on food loss and waste you should know! (http://www.fao.org/save-food/resources/keyfindings/en/).
[10] Food and Agriculture Organization. 2013. Food wastage footprint – impact on natural resources.

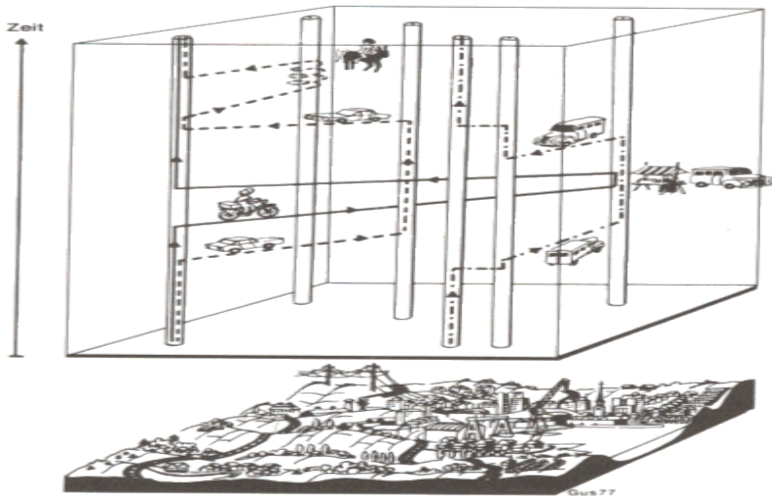
# Part 5: mobility patterns

Peter Pelzer, with very valuable input from Michiel van Meeteren and Ate Poorthuis

In part 3 of this hand-out, we have seen that living in the city – without travelling to New York on a regular basis – is more sustainable because distances are smaller and because it easier to use the bus or bicycle to cover these distances. Not all people want to live in giant metropolises though. Some value space and tranquility above all else. Fortunately for these people, the 'unavoidable' climate impacts of living outside the city depend on a fixed idea of how one spends his daily, weekly and monthly life. Revisiting concepts such as time, space and the system in which we travel gives valuable new insight in how we can rearrange our country and our lives to reduce our impact on the global climate and more importantly: to increase our wellbeing.

## Hägestrand revisited – the value of time-space paths

We often use concepts such as neighborhood, village, city or country in a rather loose way. We for instance say that we are from Nijlân or Utrecht because we live there or because we were born in these places. That does not mean, however, that our behavior complies with the borders these concepts draw. Someone from Nijlân can for instance have a job in Groningen forcing him to commute back and forth every day. And for someone from Utrecht with a lover in Chelsea, '*liefs uit London*'[1] ('love from London') will not suffice. Rather, he will most likely cross the canal by Eurostar or airplane on a regular basis. In this case, he is a '*Utrechter'*, but also a London-dweller, a traveler and maybe also a 'Liverpudlian' if he visits his parents in law in Northern England.




The Swedish geographer Torsten Hägestrand was one of the first to point to these varying levels of scale[2]. He is the founding father of time-geography; the idea that our spatial behavior is not only bound by space (like in the examples above), but also by time. This is schematically visualized in the figure to the left in which the vertical axis delineates time and the horizontal axis space. The transport modes (car, bus, motor, horse) all show a path through this three-dimensional time-space. A horizontal movement inherently leads to a vertical movement. After all, it is not possible to move through space without spending time doing so unless you have a time-travelling DeLorean at your disposal. Hereby, the vertical increase (in time) is of course much more limited when taking a fast transport mode such as an airplane than when using a horse.

The above seems rather evident on first sight. Yet, when making these ideas empirical – when linking them to a specific place or region – they have very interesting consequences. Both Hägestrand and his American peer Brian Berry became famous with this type of research[3]. A concept that hereby appeals to the imagination is that of the Daily Urban System: the sum of daily movements in a certain area. People commuting to work or doing the groceries are all part of this system. The concept can be used to determine whether something is part of one strongly connected system or multiple separate systems. The Netherlands Environmental Assessment Agency has for instance investigated Daily Urban Systems in the *Randstad* to find that this urban area still consists of multiple separate cities: the inhabitants of the Amsterdam-, Utrecht- and Rotterdam-metropoles tended to remain within these areas on a daily basis and inter-city travel was limited[4]. Such research can be used to determine when administrative units, such as the Amsterdam municipality, do not match real-world transport patterns. The

[1] Blof. 1997. Liefs uit London. (https://www.youtube.com/watch?v=aM5JU0juOSs).
[2] Hägerstrand, T. (1970, December). What about people in regional science?. In Papers of the Regional Science Association (Vol. 24, No. 1, pp. 6-21). Springer-Verlag.
[3] Berry, B. J. (1970). The geography of the United States in the year 2000. Transactions of the Institute of British Geographers, 21-53.
[4] Netherlands Environmental Assessment Agency. 2006. Vele steden maken nog geen Randstad.

ideas of Hägestrand therefore show that it is important to always empirically assess whether an area is in fact one entity instead of assuming it to be so because it happens to be an administrative unit or because people loosely claim it to be an entity by calling it their work- or birthplace ('I am from Utrecht').

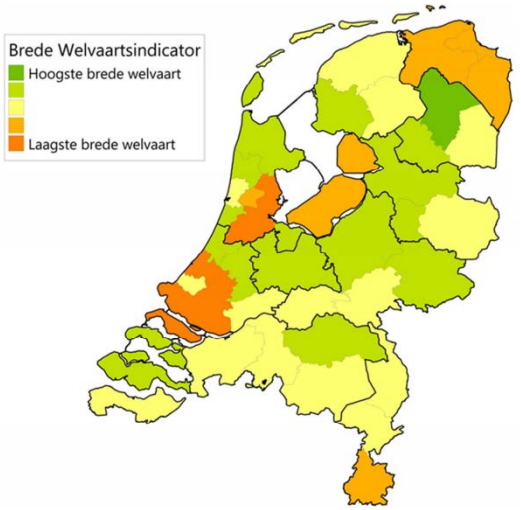
So how can we use time-geography to obtain an appealing vision of the future of the Netherlands? An interesting idea is to see the Daily Urban System as a Casino fruit-machine. This variant of Hägestrands 'diorama' is composed of three turning wheels which display time, the spatial unit and the degree of connectivity. In this way, we can rethink and reorder our daily, weekly and monthly patterns. The three concepts are elaborated upon below.

**Time:** we tend to assess time-space on a daily basis, or to be more exact: as a working day in which we commute to our office. This is too limited a perspective, however, because it ignores the division we make between worktime and free time on a weekly basis. Moreover, it is also limited because our daily division of time is artificial. Just because the earth needs 24 hours to revolve around her axis does not mean that we have to reset our lives in this time-span. We for instance tend to go out or to participate in cultural events in the evenings. As a result, the Daily Urban System fails to describe our tram rides to the city center at Thursday eight pm or our car-trips to Friesland during the weekend.

**Space** is about how far we have to travel to get somewhere. A well-known concept of space is the so-called 20-minutes' neighborhood: the idea that all functions in a neighborhood (shops, schools, etc.) should be within 20 minutes' travelling distance. As such, it should no longer be necessary to leave this neighborhood on a daily basis. A differing concept is 'borrowed size': the idea that cities in the '*Randstad*' use each others facilities. This is a regional concept in which the cultural elite of Rotterdam uses the '*Stedelijk Museum*' in Amsterdam and in which inhabitants of Utrecht look for suitable jobs in the Hague.

**System** is the most complex concept of the three. The spatial interaction of individuals is often presented as commuting between two places. This is also a too limited perspective though. First of all because we have more than our jobs: we want to relax in the weekend and we go to the movies in the evenings. More and more people also become independent entrepreneurs ('*ZZPers')* without a regular daily pattern. Furthermore, increasing technological opportunities such as Skype allow us to have intensive contact without actually being at the same place. One then gets a situation in which mobility is an option, in Luca Bertolini's words[5], causing Hägestrands beautiful 'diorama' to become obsolete. For now, that is a far-away future though that may never become a reality.

The above reconstructions of time, space and the connected system may seem like interesting, but abstract ideas. Yet, they allow us to rethink our transport-systems in order to come to new arrangements. Think for instance of a National Weekly System. Using this concept over the Daily Urban System, we can live in the countryside of the Northern Netherlands without straining the climate or infrastructural system by working from home and only travelling to our offices in the '*Randstad'* once a week. This can result in a major improvement in wellbeing since the living environment in provinces such as Drenthe and Friesland tends to be safer, healthier and more relaxed with a better balance between work and free time (see figure to the right)[6]. Alternatively, we can also adopt the Weekly Neighborhood System, whereby we have patterns which are structured around the week (e.g. workweek – weekend). The Monthly Benelux System on the other hand includes incidentally visiting unique places in Belgium, such as Ghent or Antwerp, with a high-speed train connection. Such a monthly system may provide an interesting alternative to regular plane-based city trips. The opportunities are endless. The question is what we want. This is an interesting and important question to investigate at Places of Hope in the coming months, but also something to consider in the '*Nationale Omgevingsvisie*'.




[5] Bertolini, L. (2014). Mobiliteit als optie. AGORA Magazine, 30(2), 30.
[6] Utrecht University, Rabobank. 2017. Brede welvaartsindicator 2017 – brede welvaart in Nederland: nationaal en regionaal.

## Part 6: Living more, not just having more

By Vanessa Timmer

Do we get happier from buying things or from doing things together? Studies in the field of psychology and 'sustainable lifestyles' show an actual conflict between materialistic values and other values such as concern for the well-being of others[1]. Those who focus on power and achievement, financial success, image and status end up reporting lower levels of happiness and a reduction in externally-focused values. In contrast, when people act in ways that benefit others, have self-acceptance, and connection to family, friends and communities, they also report higher personal wellbeing with less depression and anxiety.

There are many reasons why pursuing physical possessions does not bring the life fulfillment we might expect. The attractiveness of things fades – especially when they begin to fall apart or when the next new (and better!) thing arrives in stores. The more we buy, the more we end up craving the feeling of instant gratification that comes from acquiring new things. Buying can become an addiction. We can suffer buyer's remorse and wish we'd bought something else. We compare ourselves with others and always find someone who has more or better possessions than us. We may become overwhelmed: more things can bring more stress as we need to use, find back, store and maintain them. We get frustrated: the more stuff we have, the less time we have to spend with each of our material goods. In fact, there is evidence that those who are materially wealthy are less able to savour and enjoy each of their possessions fully[2].

Every day, we are surrounded by advertisements telling us that we gain our worth, success and happiness from our money and possessions. Yet across human cultures and time, there are many philosophical and religious traditions that warn against materialism: they alert us that acquiring money, things and status does not lead to quality of life but instead undermines our spirit. Rather, it is generosity, collaboration with others, social support and a sense of trust that make us happy[3]. Of course, our things aren't meaningless. We have many objects in our life that bring us joy– a great book, our grandmother's watch, clothing that expresses who we are or that match our personality[4]. We also need a certain level of material goods to meet our basic needs to be fed, clothed and sheltered. And it's not just advertising that drives materialism – it can also fill an emotional need. For example, people understandably reach for material comforts when they feel insecure about, for instance, their relationships, finances or health.

Moreover, those with less materialistic values report higher concern for environmental issues, including the ecological costs of our consumer goods[5]. These ecological costs can be reduced by only buying what we need, maintaining and fixing what we own, sharing and borrowing more of our products, and buying low impact items. They can also be reduced by encouraging resource-efficient strategies by our cities and governments to create the enabling context for sustainable living and behaviour[6]. We can support business models that provide a service rather than a good, such as bike sharing and tool libraries.

One of the strongest actions we can undertake is to shift our focus away from consumption and instead start placing more value on experiences to fill our social and personal needs. Experiences such as taking a trip, sharing a meal with a friend, or learning a new skill show more promise than material goods in advancing wellbeing because they require us to be in the moment and can be relived over time as memories[7]. Ultimately, our happiness is not dependent on our things. Spending time to connect with ourselves, others and our natural world, building trust and giving generously, and serving our communities has an amazing impact on our health and well-being. Furthermore, such a shift away from the accumulation of goods to these more enduring approaches to wellbeing has a huge impact on our carbon footprint and advances our collective effort to limit climate change to 2,0 degrees.

---

[1] Kasser, T. (2002). The high price of materialism. Cambridge, MA: MIT Press.

[2] Quoidbach, Jordi, Elizabeth W. Dunn, K. V. Petrides, Moïra Mikolajczak, (2010), "Money Giveth, Money Taketh Away: The Dual Effect of Wealth on Happiness," Psychological Science, 21 (6), 759-763.

[3] United Nations World Happiness Report 2018 - http://worldhappiness.report/

[4] *Money Buys Happiness When Spending Fits Our Personality*. Sandra C. Matz, Joe J. Gladstone, David Stillwell. Psychological Science, April 2016, SAGE Publishing; DOI: 10.1177/095679761663520

[5] Babette Porcelijn (2016). De Verborgen Impact: Alles voor een eco-positief leven. Porcelijn Publicatie: Oktober.

[6] Swilling, M., M. Hajer, et al. (2017) The Weight of Cities: Resource Requirements of Future Urbanization. A report for the International Resource Panel. Paris: United Nations Environment Programme, December. http://web.unep.org/ourplanet/december-2017/unep-work/weight-cities

[7] Gilovich, T., A. Kumar, and L. Jampol (2015) A wonderful life: Experiential consumption and the pursuit of happiness. Journal of Consumer Psychology, 25:1, pp. 152-165.

**Learn more:**

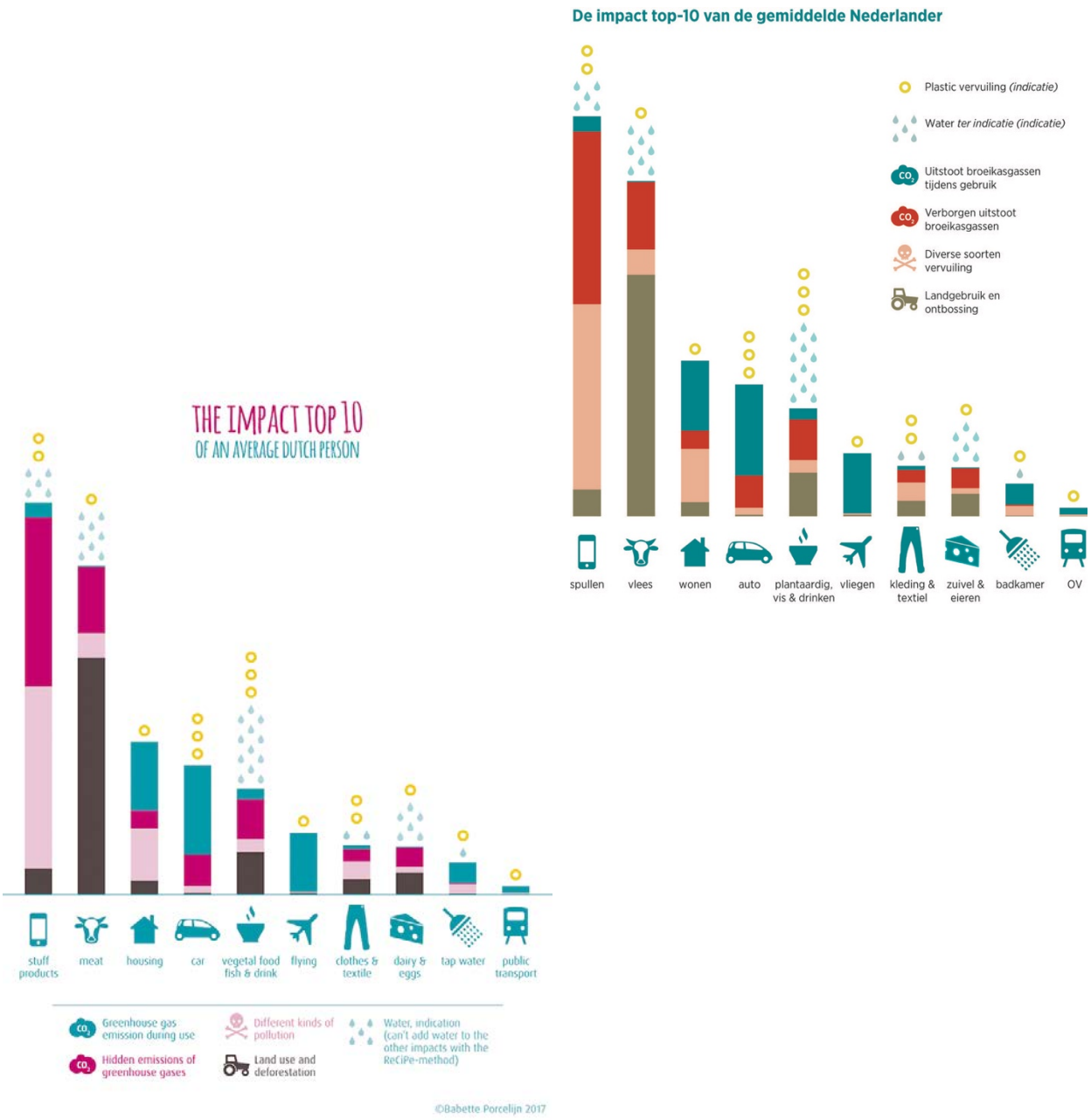
World Happiness Report - http://worldhappiness.report/
OECD Measuring Wellbeing - https://www.ncbi.nlm.nih.gov/books/NBK189567/
Measuring Wellbeing and Progress - https://www.oecd.org/std/OECD-Better-Life- Initiative.pdf
Tim Kasser (2002). *The high price of materialism*. Cambridge, MA: MIT Press.

Impact of Consumer Goods:

Swilling, M., M. Hajer, et al. (2017) The Weight of Cities: Resource Requirements of Future Urbanization. A report for the International Resource Panel. Paris: United Nations Environment Programme, December. http://web.unep.org/ourplanet/december-2017/unep-work/weight-cities
Babette Porcelijn (2016). De Verborgen Impact: Alles voor een eco-positief leven. Porcelijn Publicatie: Oktober.

And:

The Little Book of Hygge: The Danish Way to Live Well
https://www.penguin.com.au/books/the-little-book-of-hygge-9780241283912
Lagom: The Swedish Art of Balanced Living http://www.linneadunne.com/my-book-about-lagom/
The Life-Changing Magic of Tidying Up: The Japanese Art of Decluttering and Organizing
http://tidyingup.com/books/the-life-changing-magic-of-tidying-up-hc



# Part 7: towards a regional economic narrative

By Maarten Hajer & Peter Pelzer

What can we do to create new economic futures for peripheral regions? In fact, are we at all capable of making a difference? Recent studies in economic geography show a growing divide in development. Strong regions (such as the '*Randstad')* produce more new jobs, while other areas are left behind. As a result, some of these areas face a shrinking population and confined labour market. This is sometimes suggested to be a quasi 'natural' process. But there is a strong policy component in economics. Governments can, in principle, try and stimulate developments as they see fit. National governments can for instance try to 'lure' businesses to particular regions by (re)distributing tax revenues to build high-quality infrastructure or to improve the educational profile of regions in order to produce a highly-skilled labour force. This is no guarantee for economic prosperity though; as is illustrated by the Eemshaven development, which initially did not lead to investments (although it did, many years down the road).

So what can governments do to strengthen regional economies? We single out narratives and networks.

## Narratives

It is, first of all, important to invest in developing strong *narratives* of future development. Most research indicates that regions are strongly 'path dependent'. One simply cannot and should not start from scratch in strengthening regional economies. Instead, it is crucial to use regions' existing qualities and to constantly tinker and recombine them to achieve new innovative formats. Put differently, narratives have a Janus face: they are rooted in a path dependent context but they are simultaneously an intrinsic part of path creation towards to new future.

## Networks

Secondly, it is important to stimulate regional networks encompassing both the variety of public parties (local and provincial, education, health) as well as private parties (business and industry) and civil society (NGOs). Creating jobs is one thing, but it is similarly important to educate a workforce in the particular sphere of interest, to make sure the appropriate educational system is in place and that ample amenities (cultural life, good places to live, recreational facilities) are available. For instance, a city that wants to develop a bio-medical profile developing a 'bio-science park', needs to be strong in chemical and biological science and industry from the outset, but will also have to invest in educating lab attendants and providing proper housing and recreational services for these employees in order to be successful in attracting new businesses.

A regional specialism should not be picked lightly. Economic geographers like Frank van Oort and Frank Neffke have pointed at the importance of 'relatedness' for economic growth. Relatedness is about the extent to which sectors are proximate to each other (typically measured through labour mobility). If a regional ecosystem has more relatedness, then this means that sectors can profit from one another. So, when selecting a regional specialism, it is critical that this sector is connected to similar sectors in the region.

## A perspective for the North

While the merits of collaborative governance and specialization are well understood, we should not trick ourselves into thinking that all peripheral regions will end up doing well. In his *The new geography of jobs* (2012), the American economic geographer Enrico Moretti shows that not all American cities manage to equally exploit the so called 'agglomeration effects' of urbanization – the idea that a high density of people grouped together in a particular city or region will automatically spur economic growth because it makes it easier to share information and ideas, to match investors and skilled employees, and to learn from one another.

What does this all mean for a region like Leeuwarden/Friesland? Obviously, one never can match the agglomeration advantages of central cities like Amsterdam or London. Peripheral regions can develop a specialism, however, based on what they are already good at. They can try to group as many entrepreneurs, visionaries, education managers and policy makers as possible together in order to develop new narratives of regional development. Moreover, being away from the 'buzz' and continuous spreading of new ideas might also be beneficial as it leaves more time and space for ideas that are more rooted and better contemplated. As such, distance might actually be an asset.

## Read more?

The website of PBL - the Netherlands Environmental Assesment Agency has a range of various relevant resources, e.g.: http://themasites.pbl.nl/verdeelde-triomf-banengroei-en-economische-ongelijkheid/

Grabher, G., & Ibert, O. (2013). Distance as asset? Knowledge collaboration in hybrid virtual communities. Journal of Economic Geography, 14(1), 97-123.

Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. Journal of economic geography, 6(4), 395-437.

Moretti, E. (2012). The new geography of jobs. Houghton Mifflin Harcourt.

Neffke, F., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. Economic Geography, 87(3), 237-265.