

Solutions with tension

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Last week we showed that we need to tackle CO_2 emissions as a cause of global warming; climateneutral does mean no net CO_2 emissions for us at the moment. The only climate neutral raw material that we currently know is sustainably produced electricity. In this column we will list what we should do to fulfill all our needs with this exciting solution with tension.

The obvious first step is to make our own electricity use more sustainable. For a household with its own roof, this is also a relatively simple and economically feasible step. The average consumption in our country is for example 3500 kWh per year. Then 12 panels of 300Wp (about 20 m²) are enough on a favorable oriented roof. The costs are less than \in 2 per Wp, ie a maximum of \in 7000 for the entire installation including assembly. You save \in 700 per year with the installation (\in 0,20 per kWh). The installation is therefore financially returned in 10 years, while the lifespan is certainly twice as high. In asset management terms this is a no brainer¹. For most households, 20m² should be feasible, although there are still paper challenges for rented houses (skewed distribution of costs and benefits) or apartments (no own roof).

The second step is somewhat more difficult, that is the heat supply. An average consumption is 1500 m³ of natural gas in the Netherlands. If you would like to fulfill heating with an electric- and water heater, that costs 15000 kWh or 80 m² of extra panels. Most households will have no room for that. Use electricity from the grid is currently not a solution either, because it is much more expensive (gas costs only \in 0,07 per kWh) and also much less environmentally friendly (0,18 kg CO₂ per kWh of natural gas, 0,6 kg CO₂ per kWh of electricity). Only when the energy supply is fully sustainable, can this be climate neutral, but where are you going to generate that electricity? Fortunately, there are more sustainable alternatives for the one-to-one replacement by electricity. Warm water can for example be made directly with a solar water heater of 2 m² (this saves about 300 m³ per year), and heating can be done with a heat pump, with 1 kWh of electricity resulting in 4 kWh heating. The additional requirement is then only 3000 kWh, corresponding to 16 m² of extra solar panels. That does not seem unachievable. However a heat pump is still expensive. You talk about much more than \in 10000 for the whole system, plus another \notin 7000 for the extra panels. With a saving of \notin 1000 per year, the break even point is around 20 years. It remains to be seen whether the installation will achieve that age.

The third step is even more quite a challenge, namely transport². An average household has 1 car that drives 15000 km per year. With an average consumption of 1 in 15 km (very optimistic) this is 1000 liters of fuel, or 10000 kWh. So you drive 1,5 km per kWh of fuel. Electric cars do it better, they achieve 5 km per kWh. You only need 3000 kWh of additional electricity. But on the roof it implies another 20 m² extra, which brings the total to 60 m² per house. That will be unachievable for most homes. But even if this is possible³ the problem has not yet been resolved. The use of cars has a very skewed distribution. Most trips are relatively short (commuting to work, trips to supermarket and sports club), and a limited number is long (family visit, day trip, vacation). The electrification of short trips is easy to do. With a battery pack of 10 kWh you get 50 km far, accounting for about 80% of the usage. For the longer journeys you need much more capacity, you should think of 100 kWh. A car is then extremely expensive (at \in 1000 per kWh) and very heavy (5 kg per kWh). Charging on a trip takes a long time, even with a quick charger, so that is not a real solution. The thoughts then involuntarily go to a trolleybus-like overhead line on the motorways, where the battery is applied locally.

¹ This is also apparent from all initiatives taken to install solar panels, see for example <u>http://www.zonatlas.nl/home/</u> ² In this analysis, we only look at the direct energy consumption, not at the environmental impact of the production that seems significantly higher for an electric car. That may still be solved with recycling.

³ We live in the butt of a cow but even then it is difficult. Or do we now combine two expressions afterwards?

http://www.assetresolutions.nl/en/column/party and http://www.assetresolutions.nl/en/column/wicked-problem.-beautiful-living-afterwards



Now that we are talking about overhead lines, you can of course also take an electric car with driver, or the train⁴. That gives a huge improvement. A car costs 0,2 kWh per passenger kilometer (pkm) assuming only a driver, whereas a train costs only 0,02 per pkm⁵. The train is also suitable for longer distances, although it is not easy to take a mud with potatoes on holiday, let alone the caravan. For the really long distances a train does not work either. The travel time simply becomes too long, or (at an increased speed) the energy consumption increases drastically, possibly even to the level of an airplane. Only, flying over great distances on electricity is still impossible. The only solution is not to travel far anymore. But that has a serious impact on the quality of life.

The last step in our sustainability concerns the hidden climate impact of food, clothing, the stuff we use and so on. Below you see a picture of the total energy management of Europe⁶. Only half of the energy import is used immediately, much is converted into other products. And then there is not yet the influx of the imported goods. What is already clearly visible is that electricity in the total energy balance is only a (red) scraps of about 10%.



Even if you take into account the higher effectiveness of electricity, you would still need to generate at least 20000 kWh per household to become climate-neutral. That implies 120 m² of panels. That's not going to work. Moreover, it will not fit on the existing electricity network, which must be roughly 10 times as heavy. Our preliminary conclusion is therefore that sustainability will not succeed on your own, we will have to do it as a society. With this sobering observation we will now first commemorate in hopefully deafening silence, and then celebrate our freedom tomorrow. Let us insist that there is no need for a 4 May Memorial Day for climate in the future.

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⁵ https://www.nrc.nl/nieuws/2018/04/26/de-tgv-verstookt-echt-niet-minder-dan-een-boeing-deel-ii-a1600975

⁴ This of course requires that the train stops at the station, which in the vicinity of our head office does not seem to be happening for the time being

⁶ <u>http://ec.europa.eu/eurostat/web/energy/energy-flow-diagrams</u>