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"Is the 2050 target realistic or is it dreaming?"

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Abstract:

Statement of the Problem: In 2050 it is expected to reduce CO2 to 80% in all sectors [1]. Some want net-zero [2]. But if there are no precise paths it seems impossible for most scientists, economists and politicians. 20% is 2%/year and 0% is 2.7% average. It should go faster in before 2030 to avoid problems close to 2050. CO2 could be a valuable resource, to valuable and too risky to dump underground. However a few examples could give ideas how things could change without big costs. In practice also some big steps may be easier to implement than a series of small steps. Why improving a step of 5% when a step of a factor 5 is also possible? **An example could be heating of dwellings in the northern countries**: it is even possible in several ways. An example is, if still natural gas is used and CO2 storage, to use SOFC with bottom cycle GTCC and vacuum insulation at dwellings, a factor 10 is realistic[1]. Another way is to store heat in hot water (= the re-invention of hot water). If 100 m^3 of storage is used, it has an equivalent of 8000 kWh of heat[2]. If the same is done with hydrogen, it is less easy[2].Well insulated houses do not need so much energy and to make PV or other means still energy is needed. The major part of that energy can be generated by a full PV roof, so all directions. Today, PV panels cost in detail 65 €/m^2 taxes and transport included, and 33 €/m^2 in large scale without taxes and transport [3]. "Full roof PV" should be preferred or imposed instead of tiles. It is possible to get roofs tight[3], even when using standard panels and even recuperate the warm air under it. A third way is having a centralized PV farm where methanol is made with CO2 from air (it will be > 500 ppm at that time, and even more inside buildings with people). A factory can make methanol from CO2 using renewable electricity [Olah Iceland, geothermal and hydro]. Air conditioning could work during sun and store in ice. **Another example is the daily person mobility.** Today, electric cars need about 15 kWh/100 km, but transport 1500 kg for typically one or two persons, often at an average speed of 20-45 km/h and a maximum speed of 120 km/h. If an electric ultralight vehicle of 150 kg is used[4], two persons could be moved behind each other at max. 90 km/h using 3-4 kWh/100 km, we have the factor 4 from 2020 at 80% to 2050 at 20%. Further on, 4 PV panels of 1.65 m^2 could compensate the electricity needed for 20000 km/year. **A third example is airplane mobility.** Short distances could use batteries, most of model airplanes and drones are already electric driven. Long range could be obtained using by methanol or derived substances from it. In fact, the cheapest PV electricity is much cheaper than wind or hydro. Some processes are reported form CO2 and H2 at below 250°C [5]. The efficiency from PV to methanol and from methanol to could be similar to hydro to methanol. If CO2 is recuperated for free, and optimized, about 10 kWh of electricity is needed to produce 1 liter of methanol. Can one still fly 10000 km/year? It needs 44 m^2 of PV roof[4] if conversion and airplanes are optimized*. People think they could do the same with cars, however it would be wrong to "waste" all PV surface to move the today heavy cars. So airplane mobility is still

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possible if the personal vehicle mobility is optimized, and also space heating/cooling. A fourth question could be, will we have enough electricity in the middle of the winter? The first idea is to import it from more sunny countries where mainly electricity is needed in summer for air conditioning. However, transporting it could be much more expensive than generating it. The cheapest recent bid was 0.0179 $/kWh in large scale in UAE [6]. If a good technology from PV to methanol is developed it can be cheaper than the today production from natural gas. The summer electricity from oversized panels in Europe could also deliver a part for the winter. Today most of PV roofs are a “patchwork” of some panels. At the actual price/$m^{2,}$ the whole roof can be PV: south, east, west and even north. The north roof plane produces as much as south in cloudy weather, and so equalizes the production, with is an advantage for the coupled converters and grid. If a DC technology is used instead of DC/AC, converters will be cheaper. A lot of appliances can be used during day and store themselves (electric boilers, laptop, electric vehicles). So using PV at home and at the job to charge. In the paragraphs before, mainly PV was emphasized, but hydro, wind, tidal, geothermal can help the renewable energy mix, they will be more expensive than pure solar, but cheaper than stored solar. It is under discussion but if biomass heating can be good for the country side, and if optimized at the city border, for district heating and carbon dioxide reuse.

Not that the IT sector might remain with a big relative part. There is some job to do: all household instruments have energy labels, but why not routers? It is a shame, this should change. Television sets have a stand-by of 0.1W and WIFI 9W? So one Wi-Fi has a stand-by of 90 TV sets and takes as much power as and a+++ fridge? It is stated that “All sectors need to contribute to the low-carbon transition”, so without exception [1].

Conclusion

At a first sight, 20% CO2 or even net-zero in 2050 seems an almost impossible task. However, if the best available technologies of today are combined, it seems more feasible than ever. Not forgetting that it will take time and effort to develop and implement these techniques. One should not be happy with small improvements, but rather think in a technology in large steps that gradually penetrates the society. It is even possible at an affordable cost, but it might be a slightly different living style, but where the major part of activities is still possible. The problem will be to convince the society that “business as usual” and some small changes are not enough.

Biography:

Alex P. M. Van den Bossche received the M.S. and the Ph.D. degrees in electromechanical engineering from Ghent University Belgium, in 1980 and 1990 respectively. He worked there at the Electrical Energy Laboratory (EELAB). Since 1993, he is professor at the same university in the same field. His research is in the field of electrical drives, power electronics on various converter types and passive components and magnetic materials. He is also interested in renewable energy conversion, PV converters, ultralight electric vehicles. He is an author of the book *Inductors and transformers for power electronics*. He was a starter of two spin-off companies active in energy conversion.