An EU “Paris consistent” transport policy? Is it possible and what would it take?

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Background.

The EU has signed up, in Paris December 2015, to do what it takes to ensure that global temperature rise will be kept below two degrees centigrade, - and preferably no more than 1.5 degrees. Before that the EU had “committed” itself to adhere to the previous IPCC finding, that in order to respect the two degrees limit the EU, as part of the “industrialized caucus”, would reduce its “domestic” emissions (international air and maritime transport excluded) by 80-95% by 2050 relative to 1990. What does this imply for the transport sector?

Rather than starting from the 80-95% reduction obligation (95% being in any realistic scenario impossible) one might take as a point of departure the underlying assumption, that respecting the two degrees would need global greenhouse gas emissions to be brought back to +/- 2 tons CO2eqv per capita by 2050. This quantity will, by and large, be taken up by the “necessary” food production and international air and maritime transport, with the implication that other transport sectors, primarily rail and road, will have to be virtually CO2 (and thus fossil fuel) free by 2050. How could that be envisaged and what would, at the practical level, have to be done?

The challenge, - and the option(s).

The main challenge, in short, is for road transport to move, within the next +/- 30 years from the present, from a virtually 100% fossil fueled (petrol, diesel, LPG, natural gas) situation to alternative energy sources. In principle there are several options: green electricity, hydrogen, liquid biofuels, biogas. However, these different options are not, and should not be considered, equal.

Liquid biofuels were introduced through a proposal by the EU Commission in 2001 in a specific context of increasing oil prices, fear of “peak oil” production and unused, set aside agricultural land (because of over production of food). The proposal was met with opposition from DG Environment, then responsible for climate change, but nevertheless adopted, first in the Commission, later by the Council and Parliament; largely due to support from the agricultural lobby.

Subsequently it has been demonstrated that liquid biofuels, particularly biodiesel based on palm oil which makes up a significant part of the overall, have very big negative impacts, both on CO2 emissions and on biodiversity, where the raw material is grown. Other liquid biofuels are less problematic, depending on “local” circumstances, but very few would pass an “impact assessment” analysis today; add to this, that the concerns about whether future oil supply possibilities will be sufficient has vanished, and it is difficult to see liquid biofuels delivering any significant contribution to decarbonization of the transport sector.
Biogas is not much better. Or rather, it has a very limited potential. In a future low emission scenario biogas does play a role, particularly as a possible way to convert certain organic wastes into methane, or biogas. However, the potential quantities are limited and the amount that can be produced should rather be used in sectors where no other alternatives are available or would be very expensive. Maritime transport, which is already, albeit on a modest scale, moving towards (fossil) natural gas, as well as certain industries might not be able to change to electricity. In conclusion, biogas is not to be seen as a mainstream replacement for petrol and diesel in road transport.

This leaves electricity and hydrogen as the only realistic, climate friendly, energy sources for road transport. Green hydrogen can be produced via two routes: from green electricity or from natural gas with subsequent CO2 storage (the CO2 capture is already an integrated part of the production of hydrogen). Neither of the two fueling options should be deemed out at this point, but:

Hydrogen is a difficult case. Producing hydrogen from green electricity (via electrolysis) is an established technology. However, it is expensive compared to producing hydrogen from natural gas, particularly if the idea is to use cheap electricity from (relatively short) periods with excess wind or solar PV generation, in which case capital cost for a production plant with low utilization and need for significant storage facilities makes this alternative rather unattractive. Add to this that it takes 2-3 times as much electricity to fuel a vehicle via electricity based hydrogen as just by electricity. All in all not a promising technology.

Hydrogen produced from natural gas with subsequent CO2 storage appears to be a more realistic possibility, also from an economic point of view. CO2 capture, the high cost element in carbon capture and storage, is already part of the production process, and natural gas would be expected to be relatively cheap in a future low fossil fuel world. As a fuel for road transport, hydrogen might be more attractive to long distance transport of goods rather than as a fuel for passenger cars, among other things because of a lesser need for a large number of (underutilized) refueling stations.

Whatever the future potential for hydrogen, electricity, at this point in time, appears to be the unavoidable road transport fuel, particularly for passenger cars, in a decarbonized road transport sector towards 2050. This is not without challenges. Before addressing those, one point should be made clear: electric vehicles are not the answer to how to cope with the intermittent character of wind or solar PV. Electric vehicles can, with “intelligent” charging, help levelling out the variations in electricity demand over the 24 hours. Demand is usually lower during the night, and most vehicles can, and should, be charged slowly during night hours, when the vehicle is anyhow normally not used. In areas with future high solar PV production this principle may be modified; however these areas also normally have a high demand for air conditioning so, dependent on circumstances, it may still mean night charging.

The main challenges in moving towards an electricity based road transport sector are performance, cost and infrastructure. As far as driving performance electric vehicles are as good, if not better, than petrol or diesel cars. The problem is autonomy; either you have to accept that your batteries have to be recharged...
every 100-150 km (taking longer than conventional refueling) or you have to install a big, heavy and expensive battery, which is only utilized when the car is going far. For these reasons it is important to have a battery capacity matching driving patterns as closely as possible.

As far as cost is concerned, apart from the battery, the vehicle itself is simpler and should then, in principle, be cheaper than conventional vehicles. However, as long as electric vehicles remain a niche product they have an inherent disadvantage over petrol and diesel fueled cars. Moving towards electrification therefore must focus on how to create the necessary volume. In addition, the cost of driving electric depends on how well battery size and daily driving are matched.

Infrastructure

Infrastructure is obviously a sine qua non if a new transport energy source is going to work successfully. Much has been said about the so called chicken and egg dilemma, in this case no electric cars without sufficient coverage with recharging facilities, no broad coverage without a sufficient number of vehicles to be served. This is, of course, in principle right. However, experience shows that if there is sufficient expectation of future customers infrastructure will appear. It may be useful to support for a while recharging points, particularly in less densely populated areas, but by and large there is reason to expect that an efficient recharging network will be provided by the market if the market has reason to believe that the vehicles will show up.

How to make it happen?

Over the last 20 years the tendency has been to see economic instruments a superior to “traditional” command-and-control policies. Much of this transition, assuming that the market is best to choose, has been justified. However, where major structural changes are required one should not be driven by ideology. When it was decided, around 1990, to clean up traditional emissions from cars this was done by simply setting emission norms that could only be met by using catalytic converters; a successful policy that nobody seems to question today. Similarly, to push electric vehicles to the market it would make sense to request that all new passenger cars from a date in the (not too far) future would have to be equipped with a, for instance minimum 25 kWh, battery and electric drive. This is technologically possible already today, not prohibitively costly, and it would create a gradually increasing number of cars requiring recharging points. Let the car manufacturers decide about cars with bigger batteries or plug-in-hybrids. Neither bureaucrats nor car producers would be able beforehand to decide the right mix, but the important point is, that all cars will, from an early point, have electric drive.

Lorries and other professional vehicles.

Heavy duty vehicles (lorries, busses, etc) is a different, but not necessarily a more difficult challenge. However, it must be recognized that this is a mixture of different vehicles, whether because of size or operational pattern.

Most important is to be aware that many of these vehicles operate in strong competition with other operators, where even small differences in overall cost of operation can be much more important than with private cars. Therefore, it is important to ensure that the battery capacity is optimized against driving pattern.
Professional vehicles operating in towns (service cars, lorries distributing goods etc) usually have a limited, and predictable, daily driving range. These vehicles could relatively easily be turned into electricity driving with good use of the batteries and thus good advantage of the cheaper energy (electricity) than diesel. They would also be important as far as urban air pollution is concerned. The main problem is volume. Unless a sufficient number of cities join forces to require that professional vehicles operating in the cities be electrical it is unlikely that the price of these vehicles will make them competitive.

Long distance lorries transporting goods around Europe is a different story. One can imagine two possible ways forward: one based on continuous “external” electricity supply (like trolley busses), which would mean a dual fueled vehicle (diesel for going outside the main motorways or a small battery) or a system with batteries that can be changed for every x hundred kilometers (eg 400). An important factor in choosing between the two would be the future price of batteries, depending on cost of essential elements (lithium, cobalt) in battery production. Choosing between the two possibilities could not be left to the market because of infrastructure requirements and cost, but would/should be based on a thorough analysis of pros and cons between the two. Hydrogen might also be a medium/long term solution.

CONCLUSIONS

In conclusion, three actions will be required:

1. Ensuring, probably best by a legislative requirement, that all new passenger cars sold within the EU from a certain date in the near future will be electric or plug-in hybrids.

2. Encouraging cities, cooperating on different green agendas, to take action to ensure that not only publicly owned or operated vehicles, but also other professional vehicles will gradually be replaced by electric vehicles.

3. Insisting that the EU Commission initiates with Member States and stakeholders the necessary work to clarify which option(s) will be able to reduce and eliminate fossil fuel (diesel) in long distance goods transport.