T&E response to stakeholder consultation on an ‘EU strategy for Smart Sector Integration’

Making transport electrification work

15 May 2020

Summary

Smart sector integration can help to achieve full decarbonisation of all economic sectors in the EU by 2050 in the most-optimal way by promoting greater interdependence between different energy carriers and different sectors. In particular, **closer links between the power and transport sectors** have great potential to accelerate the decarbonisation of the transport sector.

Both direct and indirect electrification play an important role: Electric vehicles can charge electricity directly, or when direct electricity is not technically feasible, electricity can be used indirectly to produce transport fuels. When evaluating how to use direct and indirect electrification, smart sector integration should be guided by the **‘energy efficiency first’-principle**. In other words, choose direct electrification whenever technically feasible, in order to avoid the major conversion losses involved in indirect electrification.

Between now and 2030, smart sector integration of the transport and power sectors should focus on a smooth integration of the coming surge of electric vehicles (**‘batteries on wheels’**) in grids where variable renewable electricity sources will rapidly grow their share in the power mix. Such smart demand side management of electric vehicles will minimise ‘excess’ renewable electricity by means of peak shaving and load shifting.

How? Three measures can make this happen. Mark design of electricity markets needs to reward the relatively flexible demand of new loads like electric vehicles. Interoperability between the grid actors,

charging infrastructure and electric vehicles will require an EU-level push for standardisation, including access to battery state of health. Smart functionalities for charging infrastructure should be mainstreamed in the upcoming reviews of the Alternative Fuels Infrastructure Directive and the Energy Performance of Buildings Directive.

Indirect electrification or using electricity to produce hydrogen, ammonia, e-kerosene, and other **electrofuels produced from renewable energy will become the key tool for decarbonising shipping and aviation**. Other fuels such as advanced biofuels from waste and residues will only play a minor role in decarbonising transport, mainly due to their limited potential to be scaled up and competing uses for their feedstocks. Biofuels from food, feed and energy crops should not play any role in decarbonisation.

The EU must take two actions to promote the scaling up of renewable electrofuels.

1. **Policies are needed to target electrofuels at lead markets like aviation and shipping, where direct electrification is not an option.** T&E advocates policies such as fuel taxes and a low carbon fuel standard for aviation, an operational CO2 standard for ships calling at EU ports, inclusion of aviation and shipping in the ETS and using the revenues to help scale up the electrofuels industry. These policies will be needed to gradually increase the electrofuels production to meet the energy demand in shipping and aviation (798 TWh and 912 TWh, respectively in 2050).
2. A **robust sustainability framework on renewable electrofuels** is needed for their use in transport (and also other sectors). The lack of a clear framework will be a barrier for a nascent electrofuels industry: Stringent rules can help ensure that the electrofuels industry contributes to building new and additional renewable energy. Transparency is needed on how to assess the greenhouse gas emissions and other environmental impacts of producing electrofuels, in particular when an electrolyser is connected to the grid.

Renewable electrofuels are still expensive compared to fossil fuel. This is why the EU must focus on scaling up the production of renewable electrofuels and drive down their costs as a result. In doing so, the EU will support European companies to maintain its industrial leadership in this area of smart sector integration.

In this context, there is **no role for 'decarbonised gases'**, produced using steam methane reforming of fossil gas in combination with carbon capture and storage and they should not be regarded as zero-emission fuels given the many uncertainties about their carbon footprint (e.g. fugitive methane emissions).

1. What would be the main features of a truly integrated energy system to enable a climate neutral future? Where do you see benefits or synergies? Where do you see the biggest energy efficiency and cost-efficiency potential through system integration?

The biggest benefit of sector integration is in enabling demand side management from those sectors where electricity can be used directly and loads are flexible, particularly as variable renewable electricity sources like wind and solar will significantly increase their share in the electricity mix in the coming decade. The battery storage offered by electric vehicles is a case in point: Smart charging of these 'batteries on wheels' represent a major opportunity to manage intra-day fluctuations on the grid, e.g. evening peaks and reduce curtailment of wind and solar. Repurposing batteries from scrapped electric vehicles will add to the potential storage.

The EU's strategy on smart sector integration should ***not*** *be focused on using excess variable renewable electricity sources indirectly, in power-to-gas applications. If demand side management of directly using (renewable) electricity is optimised for electric vehicles (and other appliances like heat pumps, industrial boilers, etc.), the availability of negatively priced or 'free' excess wind and solar on European power markets will be limited and will only be temporarily available. Investments in wind and solar capacity that would lead to a high share of curtailment will not deliver return on their investments. As a result, excess or curtailed electricity will only be available for limited amounts of hours per year and not improve the economics of the electrolyser and the levelized cost of hydrogen. Using excess wind and solar in power-to-X will play only a marginal role in resolving the issues of seasonal storage or meeting the fuel demand of the aviation and shipping sectors.*

Further elaboration on the potential of 'batteries on wheels' of electric vehicles :
For the EU to live up to its commitments under the Paris agreement to keep global warming well below 2 degrees Celsius and pursue a limit of 1.5 degrees, the targets agreed under the Clean Energy Package are clearly insufficient. The European Green Deal offers an opportunity to increase the current 2030 target from 40% of greenhouse gas savings to at least 55% for the EU as whole.

To remain Paris-compliant, the no-regret actions that the EU will need to take to be - in 2030 - on track to meet its 2050 objectives are the following: A rapid and complete phase-out of coal by 2030 will need to be accompanied by a rapid growth of variable renewable electricity sources: Wind and solar should reach at least 50% of power production by 2030, around 60% by 2050. Total renewables production needs to reach 75% of the power production by 2030 and 94% by 2050. In a context of a rapidly rising share of variable renewables, a much stronger energy systems perspective is needed, linking the electrification of demand to its supply. Such integration of different energy sectors is needed to not only manage the increase of variable renewable energy sources, but also the simultaneous penetration of electric vehicles, heat pumps and a greater reliance on renewable electricity in other sectors as well[1].

As the electricity system relies more heavily on wind and solar and moves away from using coal and gas-fired power generation to respond to demand fluctuation, demand side management (DSM) becomes crucial. DSM can perform two important tasks[2]:

1. Minimising the requirement for dispatchable low carbon generation (such as flexible hydro, biogas generation, hydrogen-fuelled gas turbines, or interconnectors) to ensure security of supply during the hours of largest net-demand, i.e. the residual demand that cannot be met with wind and solar;
2. Limiting the wasteful curtailment of variable renewable energy sources (VRES) by shifting loads into periods, where net demand is negative.

The picture below demonstrates these 2 elements.[3]

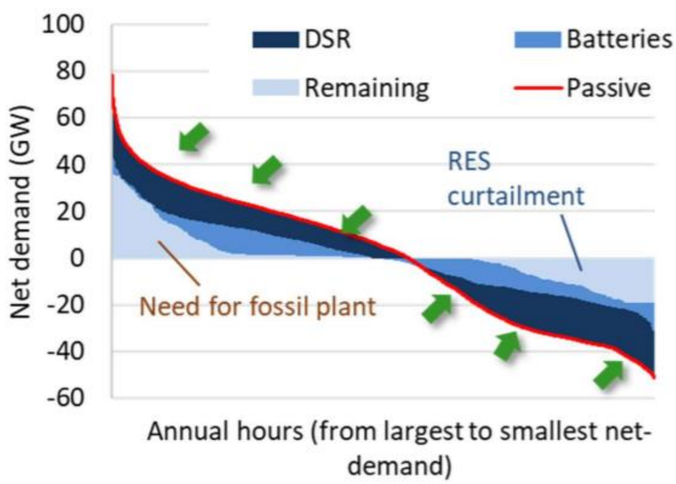

Figure 1: Figure 1: Example annual net load for a decarbonised power system

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[1] ECF (2018) Net Zero By 2050: From Whether To How. Retrieved from https://europeanclimate.org/content/uploads/2019/11/09-18-net-zero-by-2050-from-whether-to-how.pdf

[2] ECF (2019) Towards Fossil-Free Energy In 2050. Retrieved from https://europeanclimate.org/content/uploads/2019/11/14-03-2019-towards-fossil-free-energy-in-2050-executive-summary.pdf

[3] T&E (2019) Batteries on Wheels: the role of battery electric cars in the EU power system and beyond. Retrieved from https://www.transportenvironment.org/sites/te/files/publications/2019_06_Element_Energy_Batteries_on_wheels_Public_report.pdf

The battery storage offered by electric vehicles and its potential for demand side management is a key example of such zero-carbon flexibility that will be available to manage a renewables-dominated grid in 2030. There are currently about 1.3 million electric vehicles driving on European roads. That number will grow tenfold in the next 5 years. In 2030, there will be between 33 and 44 million electric vehicles in the EU.[4] The potential for distributed electricity storage will grow enormously in the coming decade.

Given this significant, additional load on the power system, the way in which vehicles are charged will determine whether EV charging represents a net cost or net benefit to the power system. Our 'Battery on Wheels' study, jointly commissioned with Renault Group, Iberdrola and Enel, demonstrated that unmanaged/passive charging would result in a significant additional cost to the power system, mainly network related investments due to the increase in peak loads. In contrast, smart charging could provide a net benefit to the energy system, by reducing curtailment of VRES, reducing fossil fuel use in power plants, and avoiding investment in peaking plants. A net benefit of smart charging (relative to passive) was consistent across the 4 grid systems of France, Great Britain, Spain and Italy, although the amount varied - in 2040 - between €0.5-1.3Bn/annum. The impact was greatest in countries where wind energy was significant; overnight smart charging improved consumption of wind energy that would otherwise be curtailed. In future PV dominated energy systems, there was a very large requirement for flexibility technologies, like smart charging but also utility battery storage. The analysis found a synergistic relationship between smart charging, batteries and PV in particular: the daily patterns of PV output increase the utilisation of batteries and increase the level of their economic deployment.[5] The example below shows how a combination of storage, smart charging and V2G in a country like Spain with big solar potential has the potential to significantly reduce curtailment of wind and solar by 70%, reducing the grid's carbon intensity by one third.

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[4] T&E (2020) RechargeEU: How many charge points will Europe and its Member States need in the 2020s? Retrieved from https://www.transportenvironment.org/sites/te/files/publications/01%202020%20Draft%20TE%20Infrastructure%20Report%20Final.pdf

[5] T&E (2019) Batteries on Wheels: the role of battery electric cars in the EU power system and beyond. Retrieved from https://www.transportenvironment.org/sites/te/files/publications/2019_06_Element_Energy_Batteries_on_wheels_Public_report.pdf

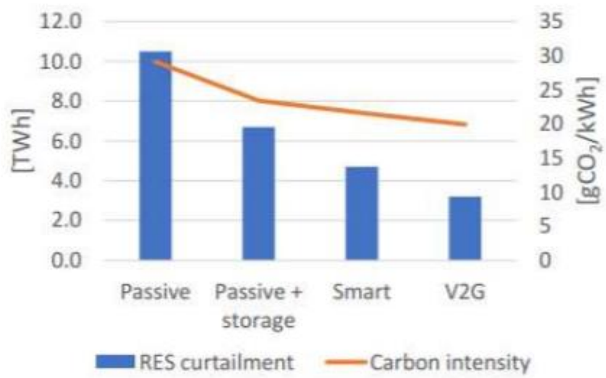

Figure 2: Curtailment and grid averaged CO2 reduction in Spain

This example from Spain shows that joined-up thinking from the start will be key to realising the flexibility potential of EVs. The use of the charging infrastructure - particularly at home and in the workplace - should be closely aligned with renewable electricity generation. For instance, countries with much solar potential should encourage charging infrastructure to be rather used during the day, while those with considerable wind resources should promote charging at night. Market design can help match renewable supply and EV demand (see section 2). Member states and local authorities can also help by integrating energy, transport and telecommunications planning to seek synergies and cost-effective, grid & data-friendly integration of electric vehicles. For example, Transmission System Operators (TSOs) and Distribution System Operators (DSOs) should study where it is best to install both fast and slow chargers, to minimise system costs for all players.

Our 'Battery on Wheels' study also found a synergistic relationship between battery deployment and VRES: increased storage deployment supports greater levels of wind and solar by reducing curtailment, in turn the increased variability of power generation supports the high cycling that batteries need to be economic. Vehicle to Grid – where EVs discharge back to the power system at critical times – may represent an extremely large store of electricity of national importance, potentially hundreds of GWh of short-term, electricity storage, distributed across the EU . Utilising V2G can be cost effective, if barriers related to customer behaviour and battery degradation are overcome.

Even after the electric vehicles reach the end of their technical lifetime, their batteries can be repurposed to be used in stationary storage applications. In 2030, out of the 125,000 electric vehicles scrapped, 105,000 battery packs would be considered for second life applications, the equivalent of 2.25 GWh. The expected lower costs of 2nd life batteries (compared to new) will boost the levels of deployed storage capacities on energy networks beyond the level achievable with new grid batteries.

In turn, this will limit curtailment of wind and solar, displace more fossil fuels and peaking plants, reduce energy cost to consumers and reduce CO2 emissions.[6]

2. What are the main barriers to energy system integration that would require to be addressed in your view?

Market design and interoperability are key to deliver on the potential of DSM, when electricity is used directly in e.g. electric vehicles. Member States need to secure a swift implementation of the revised Market Design rules. The Commission should issue a standardisation request to accelerate interoperable standards for smart charging of electric vehicles. Undistorted access to battery state of health (SoH) data should also be guaranteed to enable new business models and innovative businesses in the areas of smart charging, vehicle to grid services and second life applications. Smart functionalities for recharging infrastructure should be mainstreamed: For public charging, the Alternative Fuels Infrastructure should require intelligent metering systems as a minimum for all publicly accessible recharging points. For private charging at home or in the workplace, the Energy Performance of Buildings should introduce minimum smart functionalities that are tailored to private charging applications.

The lack of sustainability criteria for using excess renewable electricity to produce hydrogen and other renewable fuels of non-biological origin will constitute a barrier for Member States to promote their use in transport as well as other sectors.

Further elaboration:

Market design

The main barrier to fully realise the potential of demand side management is the market design of electricity markets in the EU: Electricity markets need to be adapted to two simultaneous developments that were outlined in section 1, namely the need to rapidly increase the share of wind and solar capacity and the need for DSM from new, relatively flexible loads that are added to the grid from sectors that will be electrified (transport and heating).[7]

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[6] T&E (2019) Batteries on Wheels: the role of battery electric cars in the EU power system and beyond. Retrieved from https://www.transportenvironment.org/sites/te/files/publications/2019_06_Element_Energy_Batteries_on_wheels_Public_report.pdf

[7] Regulatory Assistance Project (2019) Electric Cars Are a Lot Like Water Heaters. Retrieved from https://www.raponline.org/blog/electric-cars-are-a-lot-like-water-heaters/

The review of the Market Design Directive (EU) 2019/944 and the Market Design Regulation (EU) 2019/943 introduce some sweeping changes to the regulatory framework for electricity markets that will enable DSM to play its role in integrating a higher share of wind and solar on the grid. A swift and correct implementation of these new market design rules will be crucial. Such an ambitious transposition by Member States would include the following elements:

- An immediate roll-out of smart meters (or as a 2nd best option, guaranteeing the right of consumers to request a smart meter). Smart meters are a prerequisite for electricity contracts with dynamic, time-of-use pricing to become interesting for consumers, e.g. to engage in smart charging of their electric vehicle;
- Creating an attractive framework for new players like aggregators that can offer the flexibility of the load of hundreds of electric vehicles, heat pumps and other flexible electrical appliances on the wholesale electricity markets;
- Moving away from fixed network tariffs by introducing flexible tariffs, especially at the distribution level. Such flexible time-differentiated tariffs will encourage distribution system operators to procure flexibility services, including congestion management, from e.g. aggregators.[8]

Standardisation, access to data and interoperability

Market design is key, but the full realisation of its potential also depends on how the different actors involved in DSM cooperate and communicate. In other words, the issue of interoperability and how grid operators, utilities, aggregators, the manufacturers of electrical appliances (e.g. manufacturers of electric vehicles) can communicate with each other. Access to data and the interoperability of the various ICT components involved in DSM are crucial to enable electric vehicles to play their grid-balancing role. This is why smart charging technology needs to be supported by standards that ensure it is an interoperable, seamless and secure system. Since only a few standards underpinning smart charging are ready, it is necessary that EU policy makers and standardisation organisations ensure a swift development of technical specifications.

Standardisation efforts to support electromobility have historically focused on traditional electrotechnical issues, such as plugs, outlets and electrical safety. However, in order to ensure compatibility and communication between charging points, electricity distribution networks and electric vehicles, appropriate communication interfaces and data models also need to be standardised.

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[8] Regulatory Assistance Project (2018) Cleaner, Smarter, Cheaper: Network tariff design for a smart future. Retrieved from http://www.raponline.org/wp-content/uploads/2018/01/rap-ck-mh-aj-network-tariff-design-for-smart-future_2018-jan-19.pdf

Standardisation is therefore essential to allow an effective integration of electric vehicles into the smart grid and solve vendor lock-in by proprietary solutions.

T&E supports a recent call by ECOS to proceed with the swift development and implementation of international and European standards that support EU regulatory requirements for smart charging. The European Commission should issue a Standardisation Request to steer the standardisation work in the direction of the minimum technical requirements. These standards should be available by the time the review of the Alternative Fuels Infrastructure has been reviewed.[9]

As part of the upcoming sustainable battery regulations, access to key battery data must be granted. Battery management systems should be designed to provide standardised access to key battery parameters and usage data to enable innovative and smart battery services. As a minimum this should include:

1. static information: battery production date & location, carbon footprint based on the reporting above, chemistry, content of critical raw materials, instructions on how to repair/disassemble/dismantle, etc.
2. dynamic information connected to its use: state of health (remaining capacity & fade and voltage drop), as well as information on charging history and use.

Smartness of public, semi-public and private charging infrastructure

By 2030, there will be between 33 to 44 million electric vehicles and the charging infrastructure will need to keep pace with this rapidly growing share of electric vehicles in the fleet. The EU has two main regulatory instruments to accelerate the roll-out of charging infrastructure. The electromobility provisions in the Energy Performance of Buildings Directive and the Alternative Fuels Infrastructure Directive. Both regulatory instruments must help to promote the smooth grid integration of a rapidly electrifying transport sector.

With regard to charging in non-public spaces (at home or at work), the Energy Performance of Buildings Directive is the key instrument. T&E has called for the comprehensive cabling of all buildings - ie ducting and cabling of the parking lots for the later easy installation of wallboxes - by 2035 with intermediate 20% and 50% targets in 2025 and 2030; and for all existing and new commercial real estate companies with more than 10 parking spots to equip at least 20% of parking spots with a public or semi-public

[9] ECOS (2020) Electric Vehicle Smart Charging The Key To A Renewable And Stable Grid. Retrieved from https://ecostandard.org/wp-content/uploads/2020/04/ECOS-BRIEFING-SMART-CHARGING-HR.pdf

charge point by 2025 and 50% of the parking spots by 2030. More chargers would be a good start, but our Recharge EU report also highlights that quality and not only quantity matters.

For private chargers, the Energy Performance of Buildings Directive should require Member States to introduce smart metering provisions that include an intelligent metering system. Such a smart meter should be able to react and control the charging power by stopping or modulating the - and/or high renewable electricity production. Overall, the right balance should be struck between the cost of the meter, accuracy, technicality and features of the meters to avoid unnecessary stringency that would increase the cost of the charger too much.[10]

For publicly accessible chargers, the Alternative Fuels Infrastructure Directive is the key instrument. This Directive should make intelligent metering systems the standard for public charging in the EU, removing the condition of needing to be "technically feasible and economically reasonable" (article 4.7). Intelligent metering systems should be able to accurately measure and communicate information both ways (send and receive information) and receive information on costs and prices to both the system operators (or aggregators) and drivers.[11] Such intelligent metering systems will improve the potential of 'behind the meter optimisation'. In our report on improving charging infrastructure for trucks, we highlight how companies can reduce the grid impacts of high power demands from electric trucks by balancing the charging load between several charging applications which would smoothen the power demand curve. Also, stationary batteries could charge at a slow rate when there is an excess of renewable electricity and redistribute the energy to supply electricity when there is high charging demand. Dynamic time-of-use pricing of electricity will strengthen the interest in integrating smart functionalities and enable companies to adjust charging by responding to price and grid signals or local renewable electricity generation. This would be most effective for slower depot charging where there is more flexible charging demand.[12]

Sustainability criteria for Power-to-X

When electricity is not used directly and is converted - by means of power-to-X - into hydrogen and other electrofuels, the lack of a clear regulatory framework with stringent sustainability criteria is a barrier for

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[10] T&E (2020) RechargeEU: How many charge points will Europe and its Member States need in the 2020s? Retrieved from https://www.transportenvironment.org/sites/te/files/publications/01%202020%20Draft%20TE%20Infrastructure%20Report%20Final.pdf

[11] T&E (2020) RechargeEU: How many charge points will Europe and its Member States need in the 2020s? Retrieved from https://www.transportenvironment.org/sites/te/files/publications/01%202020%20Draft%20TE%20Infrastructure%20Report%20Final.pdf

[12] T&E (2020) RechargeEU trucks: Time to act! Retrieved from https://www.transportenvironment.org/publications/roadmap-electric-truck-charging

smart sector integration of the power sector and those transport modes in the transport sector, where direct electrification is not possible.

To guarantee the environmental integrity of the different types of electrofuels, the forthcoming delegated act on Renewable Fuels of Non-Biological Origin (RFNBOs) under RED II, will need to develop rules on the following issues:

- Additionality, or how to ensure that the expected increase in demand for electricity in the transport sector beyond the current baseline is met with additional renewable energy generation capacity or contributes to the financing of renewable electricity (e.g. by means of a power purchase agreement). In an 'ideal' scenario, an electrolyser has a direct connection to newly-added renewable electricity generation, like a dedicated wind farm, and is not connected to the grid.
- When electrofuel production facilities (e.g. an electrolyser) have a grid connection, clear rules are needed to assess the carbon intensity of that grid electricity and whether the production from that facility meets the requirement of at least 70% greenhouse gas savings.

Ensuring robust sustainability criteria can also help to build a competitive advantage for Europe's green hydrogen production compared to other competitors around the globe.

3. More specifically:

3.1. How could electricity drive increased decarbonisation in other sectors? In which other sectors do you see a key role for electricity use? What role should electrification play in the integrated energy system?

Electrification will play a key role in the decarbonisation of the transport sector. The combination of a growing share of zero-emission, renewable electricity generation on the grid combined with superior efficiency of electric vehicles makes electrification the most credible option left for the deep decarbonisation of road transport.

As elaborated under section 1, electrification of the transport sector offers a major potential for DSM and energy storage for an integrated energy system, where variable renewable electricity generation will continue to grow rapidly. However, the reverse is also true: smart sector integration of the power and transport sector will enable the most cost-efficient grid integration of millions of electric vehicles. Smart charging and Vehicle-to-Grid will reduce the need for costly upgrades to grid infrastructure to meet peaks in demand.

3.2. What role should renewable gases play in the integrated energy system?

Food, feed and energy crops should not play any role as transport fuels, because a majority of these biofuels in Europe increase rather than decrease emissions due to land use changes. Advanced biofuels/biomethane produced from waste and residues cannot be scaled up to meet a small fraction of the vast demand of the transport sector in 2050. This leaves electrofuels as the only credible option to decarbonise the parts of the transport sector that cannot be electrified. However, because of the inefficiencies involved in producing these electrofuels, they should be primarily targeted at those transport modes, where direct electrification is not an option: Shipping and aviation.

Further elaboration:

For the transport sector, renewable gases could encompass three types of fuels.

1. Biofuels from food, feed or energy crops
2. Advanced (liquid and gaseous) biofuels, produced from waste and residues
3. Electrofuels, produced from renewable electricity

Regarding #1, T&E has had a long-standing campaign against using any biofuels produced from energy crops, especially from food & feed crops. The reason is simple: the majority of these biofuels increase rather than decrease greenhouse gas emissions, have negative impacts on biodiversity and local communities.[13]

T&E's 2050 decarbonisation scenarios for the different transport modes made it clear that only renewable gases #2 and #3 have a role to play.

With regard to #2, using agricultural waste and residues to supply energy to other sectors is an example of smart sector integration. However, advanced liquid biofuels are expected to contribute only 2.3% of all transport energy (including cars, trucks, aviation) by 2030.[14] After 2030, their growth beyond this date is likely to be constrained due to land availability and competing industries.[15] We recommend to reserve any available sustainable advanced biofuels to the aviation sector. Similarly, the gas industry cannot

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[13] T&E (2020) Biofuels: 10 facts; Retrieved from https://www.transportenvironment.org/what-we-do/biofuels/10-facts

[14] T&E (2017) A target for advanced biofuels. Retrieved from https://www.transportenvironment.org/sites/te/files/2017_06_Advanced_biofuels_target.pdf

[15] T&E (2018) How to decarbonise transport by 2050. Retrieved from https://www.transportenvironment.org/sites/te/files/publications/2018_11_2050_synthesis_report_transport_decarbonisation.pdf

produce sufficient biomethane sustainably from wastes and residues to power a European car fleet. The maximum sustainable potential for waste based biomethane could cover only around 6.2% to 9.5% of projected EU transport demand for 2030, in a business as usual scenario and assuming all of it is used for transport.[16] What potential exists might be better used to help decarbonise sectors that currently depend on methane (residential, industry, power) and where no new infrastructure and engines are needed. In addition, using e.g. biomethane in transport does not help to address the transport sector's air quality problems. For example, if biomethane is used in trucks (instead of fossil gas), it does not reduce NOx emissions because the fuel characteristics of biomethane and fossil gas are approximately the same.[17] Advanced biomethane in transport can play a niche role in local projects, with vehicles running on 100% biomethane, refueling at local biomethane production sites.

Given the limitations of scaling up advanced biofuels or biomethane, this leaves only hydrogen and other electrofuels - produced from renewable electricity - as the only credible option for decarbonising those transport modes where direct electrification is not technically feasible. Most transport modes can be decarbonised following different pathways. However, they have very different implications for the overall energy system. Unless ways are found to exponentially increase the amount of zero emission electricity at low cost it will remain important to minimise the need for additional clean electricity. This means that an approach focused on using the most efficient pathways (direct charging) wherever possible is recommended. Given the much lower efficiencies of hydrogen but in particular electrofuels, these are optimally used only where no other alternatives exist.[18]

[16] T&E (2018) CNG and LNG for vehicles and ships - the facts. Retrieved from https://www.transportenvironment.org/sites/te/files/publications/2018_10_TE_CNG_and_LNG_for_vehicles_and_ships_the_facts_EN.pdf
[17] T&E (2019) Do gas trucks reduce emissions? Retrieved from https://www.transportenvironment.org/publications/do-gas-trucks-reduce-emissions
[18] T&E (2018) How to decarbonise transport by 2050. Retrieved from https://www.transportenvironment.org/sites/te/files/publications/2018_11_2050_synthesis_report_transport_decarbonisation.pdf

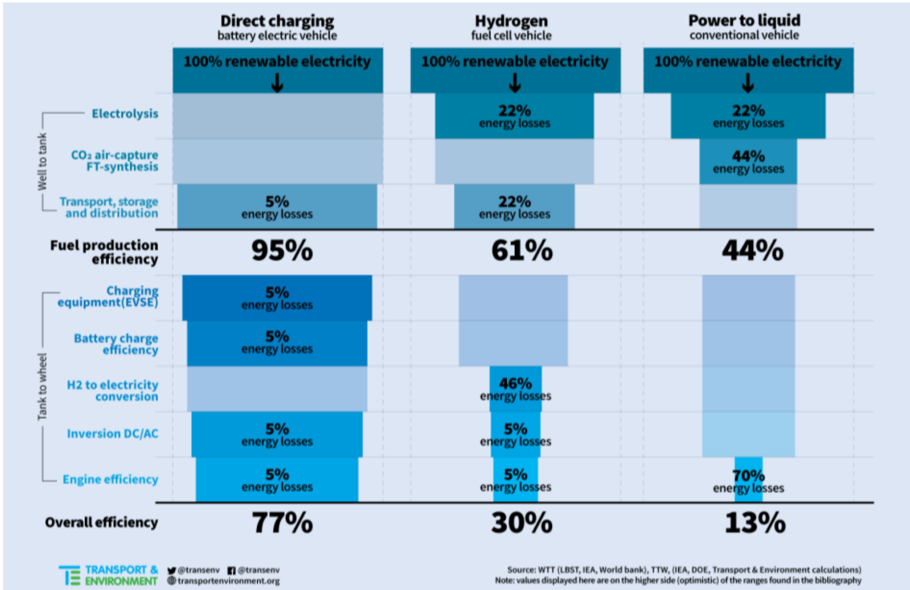

Figure 3: Efficiency of different passenger cars technology pathways based on renewable electricity.[19]

Shipping and aviation are sectors where vast amounts of hydrogen and synthetic fuels will be required. Supplying these two transport modes alone with electrofuels will require the equivalent of almost double the EU's renewable electricity generation in 2015, 1710 TWh in total according to T&E's 2050 decarbonisation scenarios.

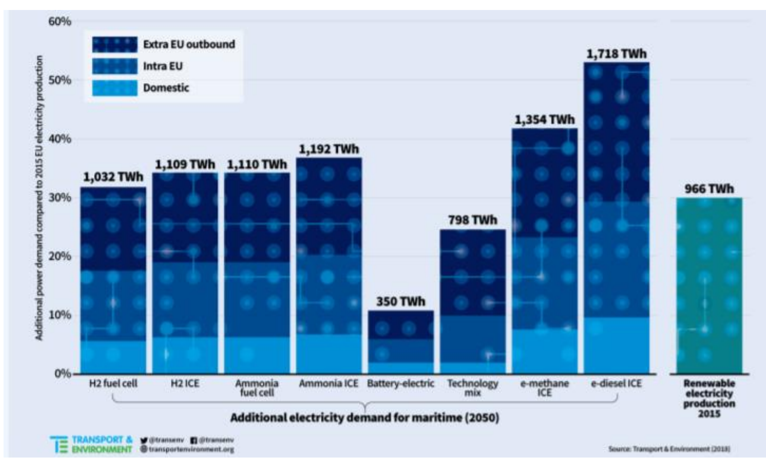

Figure 4: Impact on renewable electricity demand under different 2050 technology scenarios (TWh) in the shipping sector[20]

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[19] T&E (2018) Roadmap to decarbonising European cars. Retrieved from: https://www.transportenvironment.org/publications/roadmap-decarbonising-european-cars

[20] T&E (2018) Roadmap to decarboninsing European shipping. Retrieved from https://www.transportenvironment.org/publications/roadmap-decarbonising-european-shipping

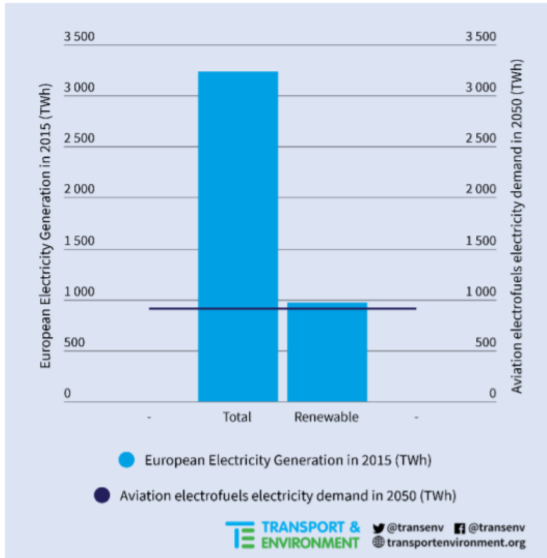

Figure 5: Electricity required to produce electrofuels for EU aviation in 2050[21]

If all transport modes would be decarbonised by using synthetic fuels, the decarbonisation challenge would be unattainable due to the amount of clean electricity required. The difference between an optimal pathway based on mostly direct charging and an one based on inefficient electrofuels is almost three times more clean electricity needed, four times more if looking at land transport only. See the table from our 2050 decarbonisation scenarios below.[22]

[21] T&E (2018) Roadmap to decarbonising European aviation. Retrieved from https://www.transportenvironment.org/publications/roadmap-decarbonising-european-aviation

[22] T&E (2018) How to decarbonise transport by 2050. Retrieved from https://www.transportenvironment.org/sites/te/files/publications/2018_11_2050_synthesis_report_transport_decarbonisation.pdf

Transport mode	Electricity Generation for electric vehicles (TWh)	Electrofuels		Optimal pathway (TWh)
		Hydrogen/ Ammonia[5] (TWh)	Synthetic fuels (diesel, petrol, gas and kerosene) (TWh)	
Motorbikes	34 (1.1%)	90 (2.8%)	203 (6.3%)	34 (1.1%)
Cars	475 (14.7%)	1236 (38.3%)	2187 (67.6%)	475 (14.7%)
Vans	146 (4.5%)	381 (11.8%)	672 (20.8%)	146 (4.5%)
Buses	119 (3.7%)	310 (9.6%)	547 (16.9%)	119 (3.7%)
Trucks (<16t)	112 (3.5%)	292 (9.0%)	515 (15.9%)	112 (3.5%)
Trucks (>16t)	364 (11.2%)	949 (29.4%)	1676 (51.8%)	364 (11.2%)
Trains	145 (4.5%)	219 (6.8%)[§]	NA	145 (4.5%)
Total land transport:	1395 (43.1%)	3479 (107.6%)	5799 (179.3%)	1395 (43.1%)
Shipping	350 (11%)	1032-1192 (32-37%)	1718 (53%)	798 (25%)
Aviation	N/A	N/A	912 (28.2%)	912 (28.2%)

Figure 6: Amount of clean electricity needed to decarbonise different transport modes.

The conversion losses and the resulting inefficiency of producing electrofuels in combination with the vast amount of energy needed in shipping and aviation clearly demonstrate that it will remain important to minimise the need for additional clean electricity.

3.3. What measures should be taken to promote decarbonised gases?

For T&E, smart sector integration needs to remain focused on the interaction between renewable electricity generation and the electrification of transport, using electricity directly or indirectly via renewable electrofuels. So-called 'decarbonised gases' produced from fossil gas in combination with carbon capture and storage (hereafter referred to as fossil hydrogen) distracts from the major challenge of building up the renewable electricity generation capacity needed to meet the challenge of decarbonising the shipping and aviation sectors.

Fossil hydrogen, even when combined with carbon capture and storage is not a zero-emission fuel. Fossil hydrogen's 'near zero' status depends on a number of assumptions:

1. Labelling fossil hydrogen zero-emissions ignores the issue of fugitive methane along the fossil gas value chain: Particularly since the growth of shale gas, measurements of fugitive methane have called into question the status of fossil gas as a lower-carbon fuel. The contribution of the oil and gas industry to global methane concentrations has been underestimated, recent research shows.[23]

[23] Scientific American (2020) Methane Emissions from Oil and Gas May Be Significantly Underestimated. Retrieved from https://www.scientificamerican.com/article/methane-emissions-from-oil-and-gas-may-be-significantly-underestimated/

2. Steam methane reforming technologies currently achieve only a 60% CO_2 capture. Higher - even up to 90% - capture rates are only possible, but require the development of advanced gas reformers.[24]
3. Carbon capture and storage is an energy-intensive process, involving an energy penalty of up to 40%.[25]
4. To avoid issues of public acceptance, the CO_2 captured from producing fossil hydrogen in the EU is likely to be injected in depleting oil and gas wells. For all but one of the 17 large scale-scale carbon capture and storage in operation, enhanced oil recovery is the primary storage for the captured CO_2.[26] Without a very high CO_2 in the EU' Emissions Trading System, this business case for carbon capture and storage without enhanced oil recovery will not improve.

These issues are unlikely to be resolved by 2030. Therefore, the EU should not undertake any measures to promote 'decarbonised gases'.

Instead, the EU should focus on developing a domestic industry, which produces hydrogen from renewable electricity sources. The price of renewable hydrogen is currently more than twice as expensive as fossil hydrogen, currently around EUR 1.50/kg. However, several recent analyses forecast that the cost reductions in renewable power and the learning effects generated by deploying electrolysers on a large scale will reduce the price gap from the current EUR 4.50/kg to well under EUR 2/kg by 2030.[27] With a higher carbon price of ~ EUR 45/tonne of CO_2 and a gas price of EUR 4,5/MMBtu, renewable hydrogen could become cheaper than its fossil counterpart. Several projects to produce renewable hydrogen in the EU are already moving ahead and the EU's actions will create the framework for more to follow. Examples include the port of Rotterdam, a project close to Nantes, the port of

Environmental Defence Fund (2020) European Satellite Data Reveals Extreme Methane Emissions in US Oil & Gas Field. Retrieved from https://www.edf.org/media/european-satellite-data-reveals-extreme-methane-emissions-us-oil-gas-field

[24] UK Committee on Climate Change (2018) Hydrogen in a low-carbon economy. Retrieved from https://www.theccc.org.uk/publication/hydrogen-in-a-low-carbon-economy/

[25] Umweltbundesamt (2018) Carbon Capture and Storage. Retrieved from https://www.umweltbundesamt.de/themen/wasser/gewaesser/grundwasser/nutzung-belastungen/carbon-capture-storage#grundlegende-informationen

For example, compressing and liquefying the CO_2 alone represents a significant use of energy, suggested to be as high as 12%

[26] Bui, Mai *et alia* 2018). Carbon capture and storage (CCS): The way forward. Energy and Environmental Science. Retrieved from https://doi.org/10.1039/C7EE02342A

[27] Bloomberg NEF (2020) Hydrogen: The economics of production from fossil fuels with CCS. Gniewomir, F. (2020) Path to emission-free Hydrogen at 1$/kg. Retrieved from: https://twitter.com/gnievchenko/status/1229760320555638787

Oostende, the Westkueste project in Germany, a solar + storage project in southern Spain, etc. All these project were announced over the last year.[28]

3.4. What role should hydrogen play and how its development and deployment could be supported by the EU?

As part of its European Green Deal, the Commission is assessing the legislative options to boost the production and supply of sustainable alternative fuels for the different transport modes, in particular for aviation and shipping fuels. As T&E, we welcome this focus on these hard-to-abate transport sectors, where direct use of electricity is not technically feasible (batteries in small coastal shipping is an exception). To promote the role of hydrogen, the EU should create lead markets. As outlined in section 3.2, the demand for hydrogen and other electrofuels for shipping and aviation alone will require the equivalent of almost double the EU's renewable electricity generation in 2015, 1710 TWh in total according to T&E's 2050 decarbonisation scenarios.

In aviation, T&E calls for a low carbon fuel standard, which will require carriers to start using zero-emission efuels. Using contracts for Difference (CfDs) can help to lower the costs of electrofuels by means of a reverse auction mechanism that rewards the lowest strike price.[29] Funding of these CfDs should come from the new revenues generated by abolitishing free allowance for the aviation sector under the ETS. Renewables-based electrofuels for aviation (e-kerosene) are currently very expensive, compared to fossil kerosene. Other policies such as carbon pricing (abolition of free ETS allowances) and fuel taxes to put a stop to airline emissions growth will also help to close the large price gap between fossil and e-kerosene.

In shipping, the EU's MRV Regulation provides a unique tool for EU policymakers to be able to regulate EU shipping emissions. The key policy measure for shipping is the implementation of an operational CO2 standard for ships calling at EU ports to be 40% more efficient (i.e. less carbon intensive) per

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[28] https://www.portofrotterdam.com/en/news-and-press-releases/largest-green-hydrogen-plant-in-europe
https://industryeurope.com/sectors/energy-utilities/french-start-up-unveils-plans-to-make-hydrogen-from-wind/
https://www.pv-magazine.com/2019/11/18/engie-and-air-liquide-join-forces-to-develop-green-hydrogen/
https://www.pv-magazine.com/2020/03/17/big-solarstorage-project-linked-to-hydrogen-production-in-spain/

[29] ICCT (2016) Development and analysis of a durable low-carbon fuel investment policy for California. Retrieved from
https://theicct.org/sites/default/files/publications/California%20Contracts%20for%20Difference_white-paper_ICCT_102016.pdf

transport work compared to the 2018 baseline. A sub-target could also be considered, with enough lead-time, to be achieved specifically by the uptake of renewable hydrogen/ammonia. In addition, the EU should include shipping into the EU emissions trading system, the revenues of which can be used in an EU maritime climate fund. This maritime fund can invest in zero-emission refuelling infrastructure in ports, provide operational subsidies for the zero emission vessels under contracts for difference (CfD) and support the necessary R&D to help the shipping sector decarbonise.

However, using hydrogen for passenger vehicles is not efficient or cost-effective from the energy, emissions or societal point of view. This is also not what the vast majority of the car industry is investing into: less than 0.4% of zero emission vehicle production in Europe planned by 2025 will be fuel cell cars; compared to a six fold increase in production of plug-in cars to 4 million units in 2025 alone. [30]

3.5. How could circular economy and the use of waste heat and other waste resources play a greater role in the integrated energy system? What concrete actions would you suggest to achieve this?

Using waste to produce transport fuels integrates waste resources in the transport sector, but this is not smart sector integration that the Commission should be pursuing. And this for the following reasons.

First of all, using a feedstock that the EU has been trying to significantly reduce is problematic: When it comes to the question of waste, the principle of the waste hierarchy and measures included in the Waste Framework Directive are crucial to take into account. In addition, the Green Deal and the new Circular Economy Action plan highlight the need for a significant reduction in waste.

Secondly, one particular 'waste-to-fuel' category under the Renewable Energy Directive is called 'Recycled Carbon Fuels' - fuels that can be produced come from any type of fossil waste, including plastic. Promoting these types of fuels would be counterproductive, considering regulatory efforts to promote recycling or waste reduction but also the negative climate impacts of these fuels and the absence of proper sustainability rules at EU level as of now[31]. The same concerns apply to the use of Municipal Solid Waste (MSW) for fuel production. Only the bio fraction of the MSW should be used for

[30] T&E (2019) Electric surge: Carmakers' electric car plans across Europe 2019-2025. Retrieved from https://www.transportenvironment.org/sites/te/files/publications/2019_07_TE_electric_cars_report_final.pdf

[31] Zero Waste Europe & Bellona (2019) Recycled Carbon Fuels in the Renewable Energy Directive. Retrieved from https://bellona.org/publication/joint-briefing-by-zero-waste-europe-and-bellona-recycled-carbon-fuels-in-the-renewable-energy-directive

fuel production, preferably after separate collection (as required by the Waste Framework Directive as of 2023).

Thirdly, improving the collection and the tracing of used cooking oils for energy use across Europe could potentially help in decreasing GHG emissions from transport fuels and reduce some EU countries' dependence on unsustainable imports. However, the volumes will always remain limited.

3.6. How can energy markets contribute to a more integrated energy system?

See our comments under section 2 on the importance of market design

3.7. How can cost-efficient use and development of energy infrastructure and digitalisation enable an integration of the energy system?

See our comments under section 2 on the importance of access to data and interoperability

3.7.1. Are there any best practices or concrete projects for an integrated energy system you would like to highlight?

In the absence of an adapted market design and interoperable standards that can make DSM work smoothly, examples of integrated energy management have so far remained limited to individual companies leading by example and pilot projects. Without flexible pricing, there is no economic incentive for EV owners to engage in smart charging. Similarly, the business case is not there for aggregators to organise a pool of electric vehicles to provide ancillary services by means of vehicle-to-grid.

3.7.2. What policy actions and legislative measures could the Commission take to foster an integration of the energy system?

For T&E, the Commission should pursue three actions to foster smart sector integration:

1. A swift and correct transposition of the Market Design rules. See our comments under section 2
2. Issue a standardisation request to develop European standards in the area of electromobility to promote access to data and interoperability. See our comments under section 2.

3. Introduce minimum smartness requirements for private and public chargers under EPBD and AFID respectively. See our comments under section 2.
4. Propose legislation to create lead markets for hydrogen and other electrofuels for the shipping and aviation sector.
5. Develop stringent sustainability criteria for renewable fuels for electrofuels produced from renewable energy, for the transport and other sectors.

Further information

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