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Common – Environmental issues: EEA reports underline importance of railways and waterborne transport for decarbonisation of passenger and freight transport

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【概要：Summary】

Considering the EU's commitments under the 2015 Paris Agreement and the target of the European Green Deal to reach net-zero GHG emissions and carbon neutrality by 2050, decarbonisation of the transport sector represents a major challenge. All transport sub-sectors will need to significantly reduce GHG emissions in order to reach the overall target of reducing the transport sector's GHG emissions by 90% by 2050 compared to 1990. A decisive shift towards the most sustainable transport modes could make an important contribution to reaching the European Green Deal 's objective. However, which transport modes are really more GHG efficient than others in passenger and freight transport and which mode has the lowest amount of CO_2e per person per km (pkm) or per ton per km (tkm)?

Therefore, the European Environment Agency (EEA) published two reports, analysing the transport modes' environmental costs and GHG emissions. The results show that there exist big differences in the GHG efficiency of motorised transport modes in Europe. The EEA analysis confirm that there exists a clear hierarchy of transport modes in passenger and freight transport regarding their GHG emissions. The results underline that it is important to substitute the less GHG efficient transport modes with more efficient and less GHG producing transport modes. However, the results also show that it has to be acknowledged that preconditions like geography, distance, journeys that are time critical and the need for door-to-door mobility will continue to set limits for possible modal shifts towards the more GHG efficient transport modes.

Therefore, it will remain equally important to improve the GHG efficiency of those transport modes with so far low efficiency, including aviation and also road transport, and to develop GHG emission mitigating technologies, if the EU wants to achieve its climate neutrality target by 2050.

【記事：Article】

1. The EU's 2050 net-zero GHG emission target and the transport sector's contribution

Based on the 2015 Paris Agreement, the EU committed to reduce their GHG emissions in order to make the Climate change related temperature increase to stay below a 1.5° C increase compared to pre-industrial levels. Furthermore, on 11 December 2019, the European Commission presented the European Green Deal (COM/2019/640 final) as a comprehensive multi-sectoral roadmap toward achieving climate neutrality by 2050. Regarding

the transport sector, which currently accounts for 24.6% of the EU's total GHG emissions, the European Green Deal calls for a 90% GHG emission reduction by 2050 compared with 1990. The proposal for a European Climate Law (COM(2020)563) in its amended version of 17 September 2020 intends to make the climate neutrality target legally binding and proposes a target of 55% GHG emission reduction by 2030.

According to the EEA report on trend and projections for the GHG emissions from installations under the EU-ETS of 10 December 2020, the GHG emissions decreased by 9.1% in 2019, compared to 2018 and represents the largest drop in CO_2 emissions since 2009. The decrease in 2019 was mainly driven by changes within the electricity and heat production sectors and by the replacement of coal with renewable and gas-fired power sources. Between the start of the EU-ETS in 2005 and 2019, GHG emissions from stationary installations decreased by 35%.

In contrast, the GHG emissions caused by the transport sector have risen, both for passenger and freight transport. According to the EEA's indicator assessment for GHG emissions in transport in Europe of 18 December 2020, following a 0.9% increase in 2018, the EU's transport emissions increased again in 2019 by 0.8% (not including shipping). Projections indicate that transport emissions could increase by 32% by 2030 compared with 1990 levels and if all policy measures are introduced, GHG emissions in the transport sector would still increase by 17% compared to 1990 levels.

Primarily, the transport sector's GHG emissions come from road transport (72%), while marine transport and aviation represent shares of 14% and 13% of emissions, respectively, and rail a share of 0.4% (considering the emissions by diesel trains only). Apart from their direct contribution to global warming and air pollution, GHG emissions that take place during the production, transmission and distribution of energy used by trains and aircraft are also considered. All transport sub-sectors will need to reach more ambitious targets if the sector wants to contribute to the European Green Deal's goal.

The European Commission's Communication COM/2020/789 final of 9 December 2020 on a "Sustainable and Smart Mobility Strategy - putting European transport on track for the future" calls for "…decisive action to shift more activity towards more sustainable transport modes…". The strategy identifies a doubling of high-speed rail traffic in Europe by 2030 and a tripling by 2050 as milestones for passenger transport. For rail freight transport, it aims at a 50% increase by 2030 and a doubling by 2050. Freight transport by inland waterways and short-distance sea shipping should increase by 25% by 2030 and 50% by 2050. The Communication on the Sustainable and Smart Mobility Strategy underlines that some modes of motorised transport are more energy efficient and less GHG intensive than others. Therefore, in order to achieve the European Green Deal's call for a 90% reduction of GHG emissions in transport by 2050 compared with 1990 and considering that the transport sector is currently responsible for 24.6% of the EU's total GHG emissions, the importance of shifting transport to the most efficient modes is an important target.

2. EEA report on environmental costs of passenger transport choices

Considering the European Green Deal 's objective of reducing GHG emissions from transport by 90% by 2050 compared with 1990, a shift towards more sustainable transport modes could make an important contribution to reaching this objective.

Recently, the EEA published a report showing significant differences of the transport modes' GHG emissions efficiency in passenger transport and environmental cost of choices of transport modes thereby

confirmed the Commission's choice to support the rail transport and waterborne transport due to their lower GHG emissions.

The EEA's Report No 19/2020 entitled "Transport and environment report 2020. Train or plane?" compares the passenger transport choices between 20 city pairs across Europe and analyses the impacts of rail and air travel regarding their environmental costs. The report aims to analyse the current status and environmental impact of rail and air passenger travel in Europe.

The EEA report considers the environmental cost categories including diesel train, aeroplane and car on the tank-to-wheel/-wake (TTW) emissions of GHGs and air pollutants. For the GHG emissions air pollutants, where possible, both well-to-tank (WTT) and tank-to-wheel emissions (TTW) emissions are considered. The latter are also called tank-to-wake emissions in the case of aircraft. Regarding cars, it includes also emissions related to tyre and brake wear combined and to road surface wear. Regarding electric train, aeroplane and car, the well-to-tank (WTT) emissions of GHGs related to fuel and electricity production, transmission and distribution is considered. Furthermore, regarding train, aeroplane, car, the noise pollution and the non-CO_2 climate costs of aviation are also considered. The report is based on a well- to-wheel/wake analysis, rather than a life cycle analysis, due to a lack of available data. Both rail and air travel lead to an increase in several environmental pressures, but in general the impacts of rail had a less detrimental environmental performance than aviation.

Regarding air transport, between 1990 and 2018, the TTW EU GHG emissions from domestic aviation (i.e., flights with departure from and arrival in the same country) in the EU-27 increased by 22%. Between 2013 and 2019, the total emissions of airline operators under the EU-ETS have increased by more than 27%. In 2019, the top 10 airline operators were responsible for 55% of aviation emissions.

According to the EEA's Report No 19/2020, although high-speed rail (HSR) accounts for about 27% of the pre-Brexit EU-28 rail travel, its environmental costs are about 9.4% of the costs for passenger rail in total. This is because electric trains are more energy efficient than diesel trains. Although high-speed trains have a higher electricity consumption per train-km than conventional electric trains they have a larger capacity and carry more passengers per train.

Regarding air transport, the main costs are related to the TTW GHG emissions, followed by the WTT emissions. For air pollution and climate change, a distinction is made between short-, medium- and long-haul flights for the emission costs of air transport. For the noise costs of air transport, this distinction cannot be made, and the costs are reported for all flights.

According to the EEA Report's No 19/2020 assessment, rail travel is the best and most sensible mode of travel, apart from walking or cycling. In contrast, the emission impacts of aviation are invariably higher on a passenger-kilometre basis. However, the report also shows, that over longer distances, the environmental costs of travelling by air increase less because the environmental costs of landing and take-off do not change with distance on a direct flight. According to the report, considering the non-CO_2 climate costs, travelling by air causes more than six times higher emission costs than travelling by High-Speed Railway (HSR). HSR is found to be the most environmentally friendly option because of the high occupancy rate. Furthermore, also travelling in a well-occupied diesel, petrol or electric car in case it has four passengers, it has significantly lower emission costs per passenger than travelling by air.

In general, the report shows that whether a train, plane or car is almost empty or 80% full, it makes a big difference regarding their environmental

costs. In fact, although the emission impacts of aviation are invariably higher on a passenger-kilometre basis than for rail, the report also found that flying is not necessarily the most harmful choice in passenger transport. Instead, according to the EEA Report No 19/2020, on the chosen emission cost basis, the most harmful choice is travelling in a conventional petrol or diesel-powered car, especially if the car driver is traveling alone and on a distance of more than 500km. A solitary trip in a petrol or diesel-powered car could release more emissions per passenger than an intra-EU flight and it worsens the environmental impact of this transport mode. Therefore, the factor of occupancy alone can make a mode of transport the best or the worst choice for the environment.

While vehicles with a single occupant were found to be the most polluting transport mode over 500km, the same car journey with multiple passengers is less polluting per person and drops then below the emissions of air travel per passenger.

The EEA Report No 19/2020 underlines that indeed, occupancy levels are the "single most important" factor when judging environmental harm of a transport mode.

Overall, the EEA Report No 19/2020 found that train travel was the most environmentally friendly transport mode and therefore, the EEA report concludes that shifting passengers from air to rail travel will play "a key role" in meeting the EU's goal of reducing transport emissions by 90% compared to 1990 levels.

The EEA Report No 19/2020 also expects that the environmental performance of rail and air transport will improve in the future. For air transport, the future environmental performance will depend on further technical improvements in aircraft design and technology, including a possible move to electric, hybrid electric or hydrogen-powered aircraft in some market segments and the uptake of sustainable aviation fuels. It will also depend on an improvement in air traffic management and improvements in air transport operations. Better traffic management, more efficient operations and other actions can improve the environmental sustainability of air transport.

The EEA Report also concludes that factors like travel time, frequency of the service and schedules influence the modal choice, but also factors such as convenience, comfort, quality of service and safety play a role. Consequently, a good understanding of all of these factors is essential in order to influence the travellers' choice of a transport mode and eventually shift the modal choice of travellers towards the most sustainable modes of transport.

3. New EEA study highlights different GHG emissions efficiencies of transport modes

In contrast to the EEA Report No 19/2020, which compared the transport modes by occupancy and environmental costs, a new study commissioned by the EEA entitled "Methodology for GHG Efficiency of Transport Modes. Final Report" compares the different motorised transport modes based on their gCO_2e per p/km and ton/km, respectively.

The study by Fraunhofer ISI and CE Delft and commissioned by the EEA points out how the different modes of transport, including road, rail, aviation, inland waterway transport and maritime shipping differ in their GHG emissions per unit transported in the EU. According to the related EEA briefing entitled "Rail and waterborne - best for low-carbon motorised transport", which highlights the results of the study, rail and shipping are both mentioned as the least carbon-intensive choices for motorised transport. All values presented in the study are "well-to-wheel", meaning that both, the emissions from the production and distribution of fuels and those from using them, are included in the calculation. As a next step, it would be desirable to also include the emissions from

vehicle manufacturing, maintenance and recycling, as well as those related to the construction and maintenance of transport infrastructure, if the data necessary for the life-cycle analysis becomes available at European level.

According to the Fraunhofer ISI and CE Delft analysis, trains are the most efficient motorised mode in passenger transport in the EU. The passenger trains' CO_2e emissions, or Carbon dioxide equivalent" (CO_2e) per pkm, meaning the number of metric tons of different GHG in a common unit with the same global warming potential, are only a fraction of those of most other modes of transport. In 2018, the passenger trains had 33g CO_2/per pkm, followed by maritime passenger with 61g CO_2/per pkm. The value for maritime passenger presented in the study mainly represents emissions from roll-on/roll-off ferries designed to carry both vehicles and passengers (RoPax). However, the CO_2e per pkm of other passenger vessel types like cruise ships can be much higher. Regarding the other transport modes, in road passenger transport, buses and coaches are the most efficient form of road passenger transport. However, the highest average CO_2e per pkm were reached by passenger flights with 160 CO_2e per pkm in 2018, followed by passenger cars with 143 CO_2e pkm. Therefore, passenger flights and cars are the least efficient forms of passenger transport and produce the highest GHG emissions per pkm, according to the Fraunhofer ISI and CE Delft. However, aviation and rail passenger transport efficiency improved by 12% and 13%, respectively over the period from 2014 to 2018. For rail, this is mainly the result of the electrification of the rail network and the declining carbon intensity of the EU's electricity mix. For aviation, the gains are based on the uptake of more efficient aircraft.

Therefore, the study's key results show that during the 5-year period from 2014 to 2018, covered by the study, rail and waterborne transport have the lowest emissions per kilometre and unit transported, while aviation and road transport emit significantly more.

Regarding freight transport, GHG efficiency rates vary so much that in the study a logarithmic scale was used. The relevant unit is tonne-km, which means moving the payload of one tonne over one kilometre. According to the Fraunhofer ISI and CE Delft's study results, the GHG emissions for freight transported by maritime shipping, rail and inland waterway are lower than those for freight transported by heavy goods vehicle (HGV). Air cargo instead shows by far the highest emissions, but in the 2014-2018 period, air cargo saw the biggest GHG efficiency improvement (12%) followed by rail freight (11%), based on more efficient aircraft and the electrification of railway lines. Instead, HGVs only showed a slight improvement of 3%.

The study's key results show that the passenger transport in rail and waterborne transport are much more GHG efficient than road transport and aviation. A similar result is shown in freight transport. The study also concludes that not all transport modes are equally suited to all transport tasks and it is not always possible to substitute one mode of transport for another. Finally, the study has also some limits due to the rather short 5-year analysis from 2014 to 2018, which is insufficient to document long-term efficiency trends of transport modes. Therefore, the study results are primarily intended as a baseline for measuring progress and for informing policy choices at EU level. In general, the study results confirm the assumptions of the EU's modal shift policy. Furthermore, the data basis seems to have its difficulties and data for road, rail, aviation, IWW and maritime shipping GHG efficiency indicators are not always available. However, it has to be considered that the knowledge on the different efficiencies of transport modes alone cannot lead to a modal shift towards the less GHG emission intensive modes. It has to be considered that depending on

the geography, the availability of infrastructure, time criticality (like for express delivery) and other factors, the possibility to substitute one transport mode by another has its limits. In addition, the most efficient motorised transport modes can only be used between transport hubs such as ports and rail freight terminals and, therefore, only function in combination with other modes. Therefore, besides shifting passengers and freight to rail and waterborne transport, improving the GHG efficiency of all motorised transport modes remains an important objective.

4. Conclusion

The two studies published and commissioned by the EEA, the EEA's Report No 19/2020 and the study by Fraunhofer ISI and CE Delft, compare the transport modes for their environmental costs, and their CO_2 emissions based on gCO_2e per pkm and per tkm. Both reports come to a similar conclusion although they are using different approaches. The main result is that rail remains overall the most environmentally friendly mode of motorised passenger transport in Europe. In freight transport, maritime shipping and rail transport remain the modes with the highest GHG efficiency. The EEA studies' results suggest that in general the EU's policies and measures to support a shift of passenger and freight transport to rail and maritime transport and to replace air transport with rail transport wherever possible is the most sustainable solution for passenger transport. Regarding freight transport, road transport and air transport should be replaced by waterborne transport whenever possible.

The approach to shifting to more sustainable transport can make an important contribution to reaching the carbon neutrality objective of the European Green Deal by 2050 and to reducing GHG emission from transport by 90% by 2050 compared with 1990. It will be imperative to make both passenger and freight transport more efficient and less dependent on fossil fuels and to shift both towards the most sustainable and lowest-emission transport modes.

However, while it is important to promote the shift to more GHG efficient transport modes, it has also to be acknowledged that preconditions like geography, distance, journeys that are time critical and the need for door-to-door mobility and other factors could limit the possibility to shift to more efficient transport modes with lower CO_2 emissions. Therefore, it will be important to continue to develop technologies and introduce measures that can improve also the GHG efficiency of aviation and road transport, if the EU wants to achieve its net-zero emission target and climate neutrality by 2050.

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