Research and Innovation Needs to Decarbonise the Transport Sector

The EU strategic long-term vision aims at achieving climate neutrality by 2050. The European Green Deal seeks a 90% reduction of GHG emissions from transport by 2050 by accelerating the shift to sustainable and smart mobility. Research and innovation are key factors to achieve the targets of the European Green Deal. This DEEDS Policy Brief outlines key features of EU research and innovation needs to promote EU transport decarbonisation leadership.

OVERVIEW

• The decarbonisation of transport requires a systems-based approach, and a deep understanding of cross sectoral synergies.

NO-REGRETS ACTIONS

• Strong policy intervention and harmonisation are necessary, including standards and support for infrastructure deployment.
• E-mobility is key to decarbonise road transport; bio / e-fuels for aviation and hydrogen carriers for shipping.
• Digitalisation enables Mobility-as-a-Service (MaaS), autonomous driving and a better understanding of demand.
• Actions need to start taking place now; the decade 2020-2030 is crucial in preparing for the transition towards transport decarbonisation in 2050.

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BACKGROUND

Transport poses a fundamental challenge for decarbonisation. Transport-related emissions make up more than a quarter of all CO₂ emissions in the EU and it is the only large sector whose emissions have increased vs. 1990 levels (Figure 1). Road-based modes account for almost three-quarters of transport GHG emissions (Box 1) and around half of all energy-related NOₓ emissions. The EU spends more than 100 billion € per year on importing oil for use by the transport sector. Shifting transport to more efficient modes and domestically produced energy carriers could bring substantial economic benefits to the EU and it would contribute to improve its energy security.

Transport choices are fundamentally dependent on built infrastructure with long lifetimes; thus, a deep transformation of transport cannot be achieved overnight. As transport is inherently transnational, intense coordination of open, accessible, interoperable and smart infrastructure across EU borders is needed for a successful shift towards sustainable EU-wide transport.

The last decade has seen many European cities shift their focus from car-centred infrastructure towards more sustainable mobility modes, including walking and cycling, and public transport. Battery-electric private car sales have begun to pick up, and alternative powertrain locomotive and vessel (shipping and ferries) technologies has been demonstrated. However, some modes are more challenging than others (Box 2).

[Box 1] Components of the system

Roughly half of the EU transport emissions can be attributed to private motorised vehicles

Figure 1: Evolution of EU GHG emissions compared to 1990 levels [1].

Figure 2: GHG emission shares of transportation modes in the EU. 2017 (including international transport) [1].
PRIORITIES ON RESEARCH AND INNOVATION

Because of the urgency of the transformation, research and innovation policy measures in the 2020-2030 periods need to focus on promoting and upscaling the deployment of market-ready solutions to reach cost-parity with fossil fuel incumbents, while at the same time encouraging the development of new technologies (Figure 3). It is also fundamental to investigate drivers for behavioural change that reduce transportation demand: new mobility and logistics business models; decarbonisation of energy sources; energy efficiency and digitalisation. Policies must consider the interactions between the transportation and energy systems as a whole, but also in relation to the design of sustainable cities, the implementation of social innovations and cost-efficiency of lower carbon businesses.

Society and Consumers

The increasing demand for transport puts a strain on current infrastructure and stresses the need to research how to improve its operational efficiency. With the support of big data, the development of new consumer-dedicated information systems will increase awareness of mobility options and users’ behaviours.

New Mobility Patterns

The analysis of future mobility demand patterns and lifestyle changes will influence modal and technological choices. Policies promoting walking and cycling will contribute to improve the health and well-being of citizens.

New Logistics Business Models

Innovative ideas in the area of last-mile deliveries will reduce carbon intensities in freight. Examples of these include cargo-bikes, urban mobile depots, consolidation centres, and collaborative logistics.

Transport Technologies

Policies must target efficiency improvements of vehicles, powertrain technologies and the decarbonisation of energy sources. It is also critical to adopt higher levels of digitalisation.

Decarbonisation of fuels and electro-mobility

Bioliquids and e-fuels can abate carbon emissions from internal combustion engines (ICE), but do not eliminate air pollutants completely. Electrification can achieve both targets. Private cars and light duty vehicles, as well as short-distance and slow speed rail and waterborne transport could be powered by batteries. Fuel cells are a good operational alternative for heavier duty vehicles and transport modes that require longer ranges. Policies supporting infrastructure deployment, standardisation of charging/refuelling systems and economies of scale are essential to decrease costs and stimulate demand. It is fundamental that batteries develop higher energy capacity, faster recharging times, the elimination of critical materials and improve recycling cost-efficiency. In the meantime, hybridisation and dual-fuel powertrains may contribute to the energy transition in transport.

Digitalisation

Information and Communications Technologies (ICT) stimulate collaboration and the shared economy (Box 3) as well as enabling operational optimisation and better information provision for users of public transport. Digitalisation and 5G are also enablers for MaaS and connected-and-autonomous vehicles; however, the rebound effects of improving accessibility to transportation services still needs to be investigated (Box 2). Digitalisation as an enabler of intelligent transport infrastructure can improve and optimise the management of transport networks.

System-based approach

Research and innovation on integration between transport and other sectors of the economy needs to be strengthened. The digitalisation of the energy and transport systems will facilitate sector coupling. This in combination with adequate pricing strategies to influence energy demand, will contribute to modulate the energy peak demand of battery electric vehicles, and potentially using these to provide services to the grid. This will mitigate the need to deploy additional generation capacity and it will facilitate the shift towards renewables, resulting in cheaper whole system costs and lower emissions. Similarly, due to the potential role of hydrogen in other sectors (heating, industry, energy storage) research is also required to understand how sector coupling and energy carriers can contribute to provide energy flexibility and security.

POLICY MEASURES

Although the long-term picture of a zero-emissions transport system in 2050 still has some uncertainties (e.g. the relative importance of battery-electric vs. hydrogen-based vs. e-fuels/bioliquids-based transport), it is likely that all three will play a role. The first steps to enable the transition towards a decarbonised...
sustainable transport system are clear: Policy action should support “no regrets” options, such as non-motorised and public transport; increasing the penetration of electromobility; and scaling up production and availability of advanced fuels for difficult to decarbonise modes (Figure 4). Policy makers need to ensure successful coordination and agile investment decisions processes to avoid market failures and prevent technology lock-in effects, while providing certainty and setting the road map for transport decarbonisation. Immediate policy action is needed to support and incentivise investments in charging and alternative refuelling infrastructure through setting deployment targets.

Policies promoting lower research costs for EU businesses (e.g. tax credits) and purchasing subsidies for EU consumers are likely to have a positive impact on sales, as economies of scale will translate to lower long-term total costs. Policies supporting the availability of advanced fuels need to be strengthened. These policies should take the form of regulatory targets on the fuel supply side to increase investors’ financial certainty and decreasing associated risks. Advanced fuels will most likely play a role in the medium and long term for decarbonising aviation and shipping; however regulatory targets have to ensure that sufficient demand for such fuels will be available.

**Harmonisation of policy measures**

Policy measures at national and local levels need to be harmonised with action taken at the EU level. While policies like the Renewable Energy Directive or the Alternative Fuels Infrastructure Directive are taken at EU level, these will not be successful unless suitable action is taken by all member states.

Dedicated support at the EU level in the form of exchanges of best practices (e.g. banning ICE cars from city centres; restricting parking spaces in urban areas; better public transport systems), or developing and harmonising shared visions, could substantially accelerate the transformation towards transport systems with lower negative externalities and more liveable cities. However, it corresponds to local policy makers to implement these. The provision of adequate financing for alternative infrastructure development, subsidisation of zero emission transport and taxation of older fleets are typically decided at national level. Harmonisation of transport policies and research and innovation in this area are closely linked to national industrial strategies. The development of recharging/refuelling networks is at the discretion of public policy, either directly, in case investment is made by bodies subject to public regulation, or indirectly, in case the state adopts the relevant legislative framework, also allowing private bodies to invest. Policy makers at a national and local level need to consider country/region specificities and align these in a way that promote country possibilities and the skills of the local labour market.

For instance, biomass feedstock-based fuels should be produced in regions with strong agricultural experience. However, the conversion of regions dependent on fossil fuels (e.g. coal mining) to more sustainable industries is an area of interest that could be pursued via superlabs. Leadership in local policy making will position certain cities at the forefront of technology innovation by enabling demonstration projects within living labs. This will help to identify market barriers and corrective policy

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**[Box 4] Risks & Mitigation**

There is a risk of ‘carbon leakage’ from the importation of fuels from non-EU countries. Energy certification schemes could reassure customers that these meet the same EU environmental standards. E-mobility is likely to add pressure to an already constrained power system. However, a holistic view of the whole energy system could optimise the energy allocation of each transport sector. The deployment of connected and autonomous vehicles could result in rebound effects as providing higher access to mobility services to people who would otherwise use public transport, may lead to higher congestion levels. Therefore, policies should react with appropriate measures to reduce transport demand when this leads to adverse emissions impacts.
Mandatory vs voluntary targets, regulations and standards
Mandatory targets have led to the introduction of more fuel-efficient technologies. With the same ambition, regulatory targets have been implemented on heavy-duty vehicles for 2025 and 2030. These are expected to reduce GHG emissions, fuel costs, oil dependency and increase GDP by promoting EU technological leadership. While the 2025 targets can be met with current technologies, 2030 targets will require alternative powertrains powered with batteries and fuel cells. Certainty and harmonised mandatory decarbonisation targets provide a roadmap for industry. Similar regulations need to be adopted by aviation, rail and shipping. Policy action needs to consider the sector specificities and potential technological limitations and constraints. In this respect, fuel standards need to apply, especially, in the case of aviation to ensure blending of conventional fuel with sustainable fuels like bio-kerosene and e-fuels. More stringent emission standards and the extension of low sulphur emission zones in the EU will combine a reduction in both GHG and air pollutant emissions around EU ports and it will drive the uptake of more fuel-efficient ships and ferries. The EU must promote the agreement of global GHG reduction targets in all sectors, to avoid competitive disadvantages of EU businesses. Harmonisation of standards decrease research and innovation costs, freeing resources to innovate in other areas.

POLICY RECOMMENDATIONS
Developing long-term transport decarbonisation path-ways to guide decision-making and private investment is critical. Standardisation of new infrastructure (e.g. recharging points; hydrogen refuelling stations), and new mobility concepts, is urgent. Market design of these aspects must be coordinated internationally. Decarbonising transport needs more than pure technical solutions. It is beneficial to empower people through bottom-up consultations and procurement programs to raise awareness and public acceptance for decarbonisation solutions. Therefore, it is positive to foster better modelling/analytical frameworks to understand long-term transport demand and choices in the context of changing social norms and individual behaviours. Supporting lower carbon vehicles, powertrains and energy sources for heavy freight and non-road transportation (shipping / rail / aviation) is necessary to achieve economies of scale and transport decarbonisation targets. Aligning such developments with the energy supply- and end-use sectors to develop flexible and sustainable supply chains for low carbon sources of electricity, hydrogen and e-fuels requires a whole systems approach to both transportation and energy policies. It is also necessary to ensure that energy networks are designed and operated appropriately to deliver the energy needed by the transportation system. Decarbonisation policies should also promote slow transport (walking, biking) and shared mobility concepts in cities and sub-urban living spaces as an alternative to private cars. Developments in big data and analytics present new opportunities for a fair allocation and accountability of CO₂ emissions, and to ascertain the impact of carbon taxation policies on GHG emissions. In light of the strong inertia of user behaviour and the resources required to overcome those challenges, the transition towards a sustainable zero-emissions transport system by 2050 requires speedy action on all levels from local to EU and by all actors, from governments to businesses to citizens.

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Endnotes
1 EU DG for Energy. EU energy statistical pocketbook and country datasheets. 2019.