



Research and innovation in transport and mobility: supporting the green and digital transition

Transport and mobility is one of the core areas which can help to achieve the goals set by the European Green Deal and the European Union's digital strategy. While the green transition in transport is driven by the need to drastically reduce emissions and increase energy independence, the digital transition is instead an on-going process driven by the advent of new or disruptive technologies. When integrated and implemented in a holistic way, digital technologies can support green solutions and bring substantial benefits. Combined research and innovation activities are essential to move this interlinked transition forward. This policy brief aims to give an overview of recent EU-funded research actions in transport and mobility.

INTRODUCTION

The transport sector contributes to more than 25% of the greenhouse gas emissions in Europe. With the ambitious targets of the European Green Deal [1] to reduce emissions by 2050, several challenges arise to achieve these goals. Additionally, with the Europe fit for the digital age [2] priority, the European Union (EU) aims to strengthen digital technologies, while also directly supporting the green transition. For transport, the green and digital transition priorities are set out in the Sustainable and Smart Mobility Strategy [3], which defines clear milestones for transport to become smart and sustainable. Moreover, the synergy between climate neutrality and digitalisation is highlighted in

the recently established 100 Climate-neutral and Smart Cities Mission [4], which fosters collaboration between different sectors, including mobility, to work together on solutions to help achieve climate neutrality in cities.

Within this context, this policy brief aims to highlight ongoing and concluded research projects funded by the Horizon 2020 framework programme for 2014-2020 (H2020) that support the green and digital transition of the transport sector. As projects from Horizon Europe, the EU's research and innovation programme for 2021-2027, are in their early stages, the European partnerships are showcased instead.

European partnerships are a key implementation tool of Horizon Europe. They have the goal of bringing the European Commission closer together with private and public partners to address some of Europe's most pressing challenges through research and innovation initiatives. The partnerships provide the European Commission with input on relevant call topics through agreed Strategic Research and Innovation Agendas, and the grants resulting from the calls are funded by Horizon Europe. Private partners in the partnership carry out also other activities not funded by Horizon Europe, which are described in each partnership's Strategic Research and Innovation Agenda. By bringing private and public partners together, European Partnerships aim to avoid the duplication of investments and contribute to reducing the fragmentation of the research and innovation landscape in the EU.

RESEARCH AND INNOVATION IN GREEN AND DIGITAL TRANSITION

This section provides highlights of project results from H2020 that contribute to the green and digital transition in transport.

INCIT-EV and **USER-CHI**: the projects will promote large-scale electromobility market uptake through smart solutions, novel business models and regulatory framework conditions. The projects demonstrate different charging infrastructure technologies in European cities and associated business models, improving the fundamental user-centric experience and the smartification of the grid.

PINTA3: follows up on the PINTA and PINTA2 projects, and develops demonstrators for the next generation of railway traction systems, smart maintenance, virtual validation, and research on battery and hydrogen powered trains. It aims to develop future traction systems improving the life cycle cost and reliability, and contribute to higher train capacity achieved by weight and volume reduction.

SCALE-UP: the project is exploring innovative solutions to reduce transport and mobility emissions. It is assisting three European urban nodes (Madrid, Antwerp and Turku) to become better connected and climate resilient while developing and operating scalable complex multimodal transport systems.

HyMethShip: the project aimed to develop a hydrogen and methanol ship propulsion system using carbon capture technologies. The proposed solution reforms methanol to hydrogen, which is then burned in a reciprocating engine. The system was validated and demonstrated on shore on a small scale prototype plant, with 75% CO₂ emissions reduction when compared to conventional engines and fuels.

NOVIMAR: the project introduced a new waterborne transportation concept which makes optimal use of existing short-sea, sea-river and inland waterways, expanding the entire waterborne transport chain into the urban environment. The concept of a vessel train was investigated, which consisted of one fully manned leader vessel and automated follower vessels, operating with a reduced crew.

JIVE and **JIVE 2**: the JIVE initiative aims to advance the commercialisation of hydrogen fuel cell buses and to carry out large-scale deployment of vehicles and infrastructure, bringing them closer to commercial availability. A principal goal of the projects is to deploy large fleets of hydrogen fuel cell buses in several European cities, in coordination with public transport operators.

GROWSMARTER: the consortium developed, applied and tested an energy management system for the charge flow of electric vehicles, demonstrating the feasibility of vehicle to grid services. The technology can be used to take advantage of high solar energy output during daytime, or to compensate for high grid demand during peak times.

European Partnerships - part I

Clean Aviation - The partnership will develop disruptive new aircraft technologies to support climate neutrality goals. The aircraft developed will enable net CO₂ reductions of up to 90% when combined with the effect of sustainable 'drop-in' fuels, or zero CO₂ emissions in flight when using hydrogen as energy source.

Towards zero-emission road transport (2ZERO) -

The partnership aims to accelerate the development of zero tailpipe emission road transport in Europe. Main achievements by 2030 will focus on the wide deployment of zero-emission, affordable user-centric solutions, CO₂ emission reduction and air quality improvements.

Zero-emission waterborne transport -

The partnership aims to develop and demonstrate zero-emission solutions for the main ship types and services before 2030. It will develop technologies for decarbonisation and elimination of other harmful emissions to air and to water, enabling zero-emission waterborne transport by 2050.

Industrial Battery Value Chain (Batt4EU) -

Supports a research and innovation battery ecosystem towards European industrial leadership in the design and production of the next generation of battery technologies, accelerating the development and deployment of battery solutions for clean mobility.

ATM4E: the project researched improved metrics for the environmental assessment of flight trajectories, aiming to mitigate their environmental impact. The project partners developed an algorithm-based environmental change function and applied it in a test run, while also carrying out daily flight route analysis to verify the climate effects of the optimisation.

JETSCREEN: the objectives of the project were to develop a digital screening and optimisation platform to assess the risks and benefits of alternative fuels for aviation. The platform integrates distributed design tools and generic experiments to optimise alternative fuels for a maximum energy per kilogram of fuel and a reduction of pollutants emissions.

ASSURED: the project is aimed at boosting the electrification of urban light duty vehicles, trucks and buses, and their integration with high power fast charging infrastructure, evaluating several infrastructures in different European cities.

TIMON: the project created a cooperative platform with integrated traffic and transport management capabilities. It developed a cloud based system which connects data from mobility users such as cars, pedestrians and cyclists. The system processes this data using artificial intelligence, and provides real-time planning services to the final users.

European Partnerships - part II

Europe's Rail - The partnership aims to deliver a high-capacity integrated European railway network by eliminating barriers to interoperability, providing solutions for full integration, achieving faster uptake and deployment of innovation. It promotes digitalisation and automation to reduce costs for the rail industry, increase capacity, and higher flexibility and reliability.

SESAR Joint Undertaking - The partnership supports the digital transformation of air traffic management, to make the European airspace more efficient and environmentally friendly. Key areas include improving connectivity, air-ground integration and automation, increasing flexibility and scalability of airspace management and safe integration of drones.

Connected, Cooperative and Automated Driving (CCAM) - The partnership aims to accelerate the implementation of cooperative, connected and automated mobility systems and services. By bringing together the diverse actors of the sector, it aims to implement a coherent and long-term European research and innovation agenda.

Clean Hydrogen - The partnership aims to accelerate development and deployment of European clean hydrogen technologies across the whole value chain. This ranges from production towards applications, including storage and distribution, in all sectors of the economy, including mobility.

NetZeroCities: the NetZeroCities project is supporting the 100 Climate-Neutral and Smart Cities by 2030 Mission under Horizon Europe. It provides cities with a platform and targeted support to assist them in reaching climate neutrality. A core area of focus is on mobility and transport, providing city authorities with solutions, instruments and strategies to reduce emissions from urban transport.

MAASIVE: the project focused on developing and improving IT solutions for travel shopping, trip tracking, booking and ticketing, with the objective of making rail services more attractive. It also included the creation of a travel companion application for smartphones. The value of digital applications is highlighted, with the potential combination of other modes of transport, offering solutions for holistic mobility services.

ASSURED-UAM: the project is developing recommendations for the safe, sustainable and efficient deployment of urban air mobility in cities. It draws on aviation best practices, standards and recommendations as well as on organisational solutions. Its objectives also include contribution to climate neutrality in transport and supporting integration of urban air mobility with surface modes.

SHOW: The project is carrying out large scale and pilot testing in urban environments. The project is deploying autonomous road vehicles (cars, taxis, buses, cargo vehicles) in mixed traffic conditions and with dedicated service lines in 20 European cities, while evaluating new business models and technical solutions.

The Cities Mission

The Horizon Europe "100 Climate-neutral and Smart Cities by 2030" Mission has as main goal to help 100 cities from all 27 EU Member States to reach climate neutrality by 2030. A second objective is to ensure that these cities act as experimentation and innovation hubs to help all other cities in their transition to become climate-neutral by 2050.

CONCLUSIONS AND FINAL REMARKS

In H2020, research and innovation efforts in transport and mobility had a strong focus on the reduction of emissions and on advancing digitalisation. The projects have paved the way for new technologies and solutions to emerge. Their further development is supported by Horizon Europe, including through European Partnerships. Taking into account the highlighted projects and the scope and results of a broader range of projects, conclusions and outlooks are:

Waterborne transport research has included the development of technological solutions to directly decrease emissions and methods which use smart and digital solutions to optimise operations. On the technological aspects, there have been efforts on areas such as ship hull design, power and propulsion, alternative fuels and energy sources. Examples include wind assisted propulsion, increased engine and energy efficiency, electrification, hydrogen fuel cells, ammonia as alternative fuel, as well as lightweight materials for structural components and hydrodynamic hull design. Digitalisation in this area supports the green transition by developing load and path optimisation methods, while integrating novel technologies such as global navigation satellite systems for logistics, and advancing the state-of-the-art on autonomous ship technology. In Horizon Europe, waterborne research is supported by the Zero-Emission Waterborne Transport partnership.

For **road transport**, research leading to reduction of emissions has focused on zero emission, battery and fuel cell powered road vehicles. The development of user centric technologies is key to achieve a paradigm shift for personal mobility, from car ownership-dependence towards inclusive, smart, safe and sustainable mobility. Connectivity plays an important role for road transport, with traffic management systems enabling congestion reduction and optimal routing. Cooperative, connected and automated mobility leverages automation with sustainable objectives to contribute to a safer and more sustainable transport system. By shifting

from a driver-centred to mobility-user oriented approach, it aims to reduce emissions, decrease congestion and support shared mobility solutions in public and private transport, for people and for goods. In Horizon Europe, research is supported by the ZZERO, CCAM and Clean Hydrogen (for Heavy Duty Vehicles) partnerships.

In **aviation**, research has contributed to the green and digital transition. It focused on reducing aviation emissions with new aircraft technologies, pathways for sustainable aviation fuels and optimised air traffic management operations. Aircraft technologies include improved aerodynamics and lightweight materials, eco-design and lifecycle assessment, propulsion technologies, and using alternative fuels or electrification. Air traffic management research focused on optimising routes and improving environmental impact assessment tools, and understanding short and long term environmental impacts of aviation. The combination of green and digital technologies is highly present in aviation, through the use of modelling and simulation tools for aircraft design and manufacturing, as well as in air traffic management technologies and operations. In Horizon Europe, aviation is supported by three partnerships: Clean Aviation, Clean Hydrogen and SESAR.

For research projects in **rail**, greening and digitalisation have a strong synergy. Research on reduction of emissions in the sector has concentrated on improving the performance of engines to decrease energy consumption, with efforts to reduce the weight of wagons especially for freight applications. Hydrogen and batteries as alternative to diesel power has been addressed as well. Being the greenest transport mode, rail is expected to play a central role in multimodality. Digitalisation has the potential to significantly increase rail capacity and to help shift users to rail, enabling user centric applications and improving reliability, increasing attractiveness. In Horizon Europe, rail research is supported by the Europe's Rail partnership.

When focusing on **urban areas**, collaborative efforts were not only technology-focused but also encompassed sustainable urban mobility plans. The electrification of transport, the deployment of supporting infrastructure and a shift to public transport and active mobility are crucial to achieve emissions reduction, increased quality of life in cities and improved safety for all. Efficient and zero-emission urban freight transport for last mile delivery is an equally important objective.

Finally, **multimodality** plays a key role in the green and digital transition. The true potential of digitalisation comes from its ability to optimally integrate transport modes. It is therefore important that research focuses on multimodal integration for both personal mobility and the transport of

goods, seeking synergies and achieving greening of transport with the support of digital technologies and infrastructures.

To conclude, the development of innovative solutions in mobility and transport, together with a shift to less harmful modes of transport has the potential to reduce the environmental impacts of the sector, aiming at offering clean, accessible and affordable transport even in the most remote areas. In this sense, the green transition presents a major opportunity for European industry by creating markets for clean technologies and products. While a single solution cannot solely achieve emission reduction goals, it is possible to exploit their full potential by jointly developing them, combining the green and digital technologies for a more substantial contribution of research efforts to policy goals. For the successful deployment of green and digital solutions, it is also important to factor in potential conflicts in the twin transition, as well as key requirements for example to avoid rebound effects, take into account privacy concerns and ensure social acceptance and equality [5]. Future research initiatives have a key role to play in ensuring that such challenges are properly addressed in the transition.

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