

The contribution of transport research and innovation to the European Green Deal

Headlines

- Despite improvements in the energy efficiency of vehicles, the transport sector struggles to reduce its overall greenhouse gas (GHG) emissions.
- Research and innovation (R&I) in the fields of transport electrification and low-emission alternative energy for transport have been intensified both in terms of funding from EU Research Framework Programmes, number of projects and actors involved.
- In spite of the significant spending on R&I, the market uptake of new technologies and alternative fuels is slow. More efforts are needed to speed up the transition and to deploy innovative technologies that reduce overall transport GHG emissions and induce systemic changes. These are crucial to meet EU carbon reduction targets, in line with the objectives of the European Green Deal.

Introduction

GHG emissions in 2017 in the EU-28 accounted for 4,565.2 million tonnes CO₂ equivalent, which means a 17.2 % reduction when compared to 2005. However, in 2017, the transport sector accounted for approximately 32.1 % of the total GHG emissions, which is an increase from the 26.8 % share registered in 2005. Other sectors have significantly reduced their overall contribution to GHG emissions; however, the transport sector remains a particular concern with rising GHG emissions, low uptake of renewable energy sources and insufficient reductions of transport fuels' life-cycle emissions^{1,2}. This is in spite of improvements in the energy efficiency of vehicles. Increasing transport GHG emissions are mostly due to a growing demand for both passenger and freight transport and the slow market take-up of alternative propulsion technologies and fuels.

In 2017, the European Commission's Strategic Transport Research and Innovation Agenda (STRIA) identified priority areas with specific actions for future research and innovation, outlined in seven roadmaps:

1. Cooperative, connected and automated transport
2. Transport electrification
3. Vehicle design and manufacturing
4. Low-emission alternative energy for transport
5. Network and traffic management systems
6. Smart mobility and services
7. Infrastructure

The Transport Research and Innovation Monitoring and Information System (TRIMIS) supports STRIA by monitoring the status of transport research across Europe. TRIMIS helps policymakers and researchers in identifying opportunities for innovation in transport, so that additional supportive measures can be taken. This policy brief assesses the progress of R&I in two key strategic areas: transport electrification (ELT) including hydrogen and low-emission alternative energy for transport (AF). They can contribute to breaking transport dependency on oil and decarbonising the transport sector. It is essential in the short- and medium-term to increase the use of renewable energy sources and improve the overall energy efficiency of the transport system. The deployment of alternative technologies and sustainable fuels will have the benefit of not only reducing GHG emissions but also pollutants that are responsible for poor urban air quality.

Decarbonised electricity generation will provide cleaner electricity to propel electric vehicles (EVs). EVs will be able to provide storage services to the grid favouring further expansion of renewables. The development of energy storage technologies and devices remains the cornerstone of a fully electrified transport system integrated in a clean energy network. Decreasing battery costs, increasing energy density and lifetime will speed up electrification of road transport. The deployment of an adequate network of publicly available recharging points is another key enabling condition for transport electrification.

Increasing the share of alternative low-emission energy in the transport sector poses technical and environmental challenges. The development of a new generation of powertrains will require research and innovation efforts to be focused on a step change in technology. One that allows increasing and more efficient use of alternative energies to reduce GHG emissions. For energy production, research and innovation efforts need to focus on novel low-emission alternative energies based on renewable and sustainable sources. An analysis of the impact on transport systems and

¹ https://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2019_en

² <https://www.eea.europa.eu/highlights/climate-change-significant-drop-in>

services of these technologies for road, rail, waterborne transport and aviation will also be key.

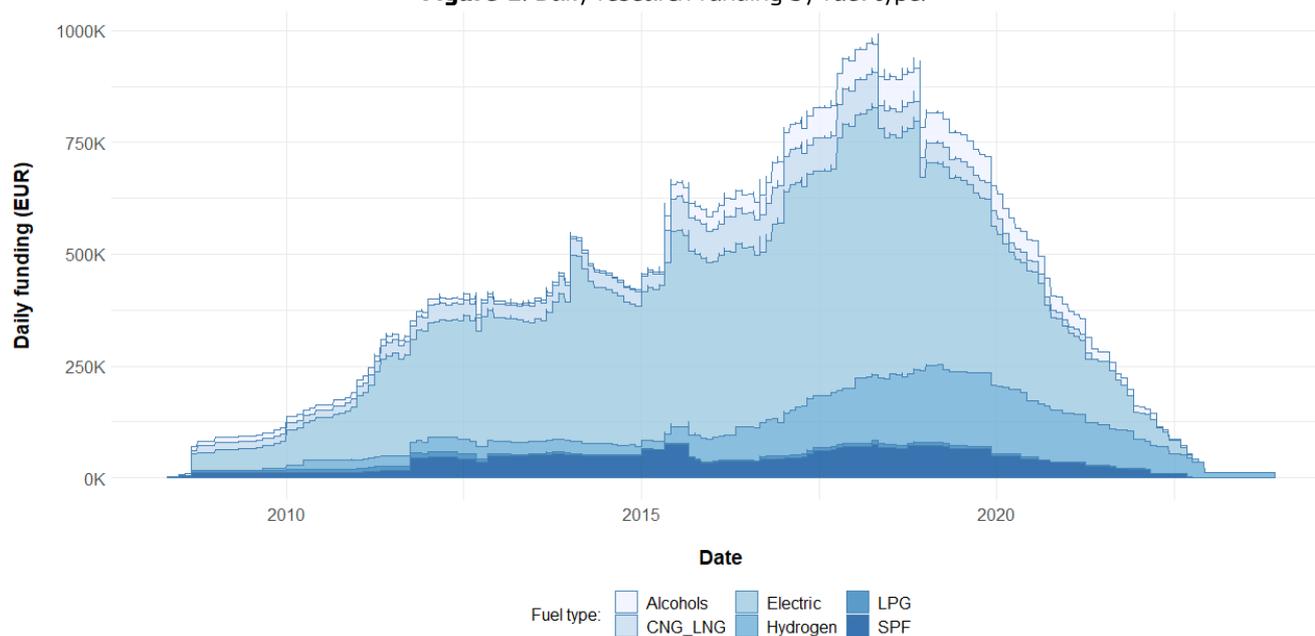
The two strategic R&I areas have been analysed separately due to the notable difference in terms of funding levels and number of technologies identified.

Investments in transport electrification

In line with the STRIA roadmap on Electrification, the assessment of transport electrification covers both electricity and hydrogen for transport. The remaining fuels fall under the Alternative Fuels STRIA roadmap presented further on in the policy brief. Under the 7th Framework Programme for

Research (FP7) and Horizon 2020 (H2020), about EUR 2.8 billion has been invested in ELT research projects. This includes EUR 1.76 billion of EU funds and about EUR 1 billion of own contributions by beneficiary organisations. Figure 1 shows the aggregated funding trend since 2008, assuming that funds are spread equally throughout the project's duration. The figure shows that funding has increased, particularly both in the fields of electricity and hydrogen. The daily funding culminated in the first quarter of 2018 above EUR 700,000. A funding forecast is also provided, which is based on projects that were awarded by August 2019. As there are still upcoming H2020 calls, it is expected that the final funding will be higher.

Figure 1. Daily research funding by fuel type.



Investments in low-emission alternative energy for transport

Over EUR 810 million has been invested under FP7 and H2020 in AF research projects. This includes EUR 610 million of EU funds and contributions from beneficiary organisations equal to EUR 200 million. Synthetic Paraffinic Fuels (SPF) receive 38 % of funding followed by methane-based fuels (e.g. Compressed Natural Gas (CNG), Liquefied Natural Gas (LNG), Bio-methane and E-gas) with 31 % while Propane and butane based fuels (e.g. Liquefied Petroleum Gas (LPG) and BioLPG) receives only 4 %. Alcohols, Ethers and Esters (e.g. Ethanol, Butanol, Methanol, Ethanol-based blend of 95 % (ED95)) have the remaining 27 % of the funding. Figure 1 shows that H2020 increased the research budget compared to FP7. It is also noticeable that more funds are directed towards research on alcohol-based fuels. The daily research spending peaked in the first quarter of 2018 at approximately EUR 200,000. A funding forecast is also provided based on projects that were awarded by May 2019, meaning that the final funding may still be higher.

Spatial allocation of research funds

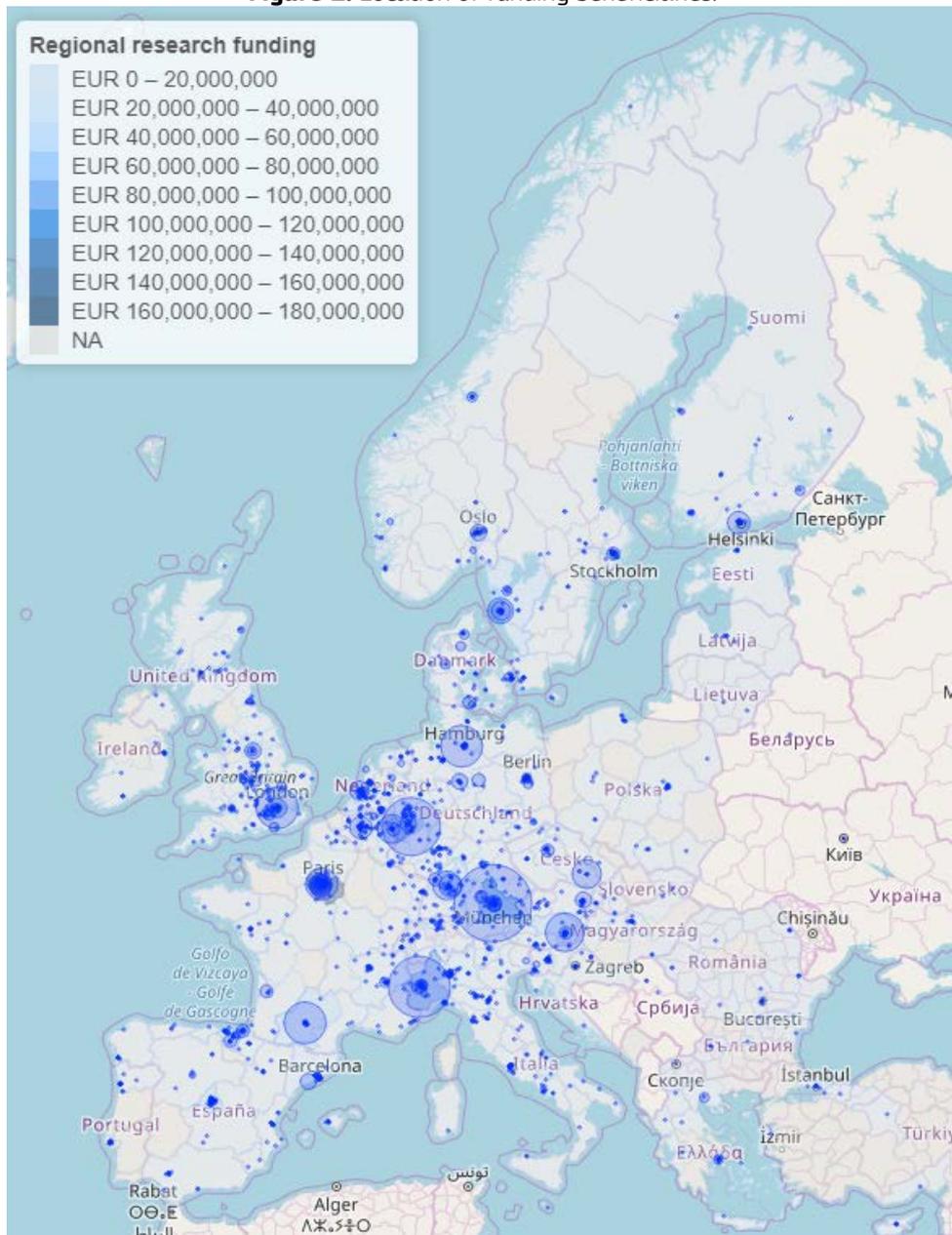
A total of 2,432 unique organisations participated in FP7 and/or H2020 projects on ELT and AF. Figure 2 provides a

deeper look into the geographical spread of the funds. Several beneficiaries in Germany, France and Italy receive a large share of the funding, as indicated by the size of the circles. The main beneficiaries appear to be located in areas where car and aircraft manufacturers operate. The spending of research funds may happen in a different location than where a beneficiary is registered. This could be the case when pilot studies occur at different sites. The map does however provide a reasonable approximation of resource allocation. Organisations from the EU-13 receive a smaller share of the funds.³

³ More info on ELT in the forthcoming JRC report: Tsakalidis, A., van Balen, M., Gkoumas, K., Haq, G., Ortega Hortelano, A., Grosso, M., and Pekár, F., *Research and innovation in transport electrification in Europe: An assessment based on the Transport Research and Innovation Monitoring and Information System (TRIMIS)*, Publications Office of the European Union, Luxembourg, 2020.

More info on AF in the JRC report: Ortega Hortelano, A., van Balen, M., Gkoumas, K., Haq, G., Tsakalidis, A., Grosso, M., and Pekár, F., *Research and innovation in low emission alternative energy for transport: An assessment based on the Transport Research and Innovation Monitoring and Information System (TRIMIS)*, Publications Office of the European Union, Luxembourg, 2019.

Figure 2. Location of funding beneficiaries.



Top researched technologies

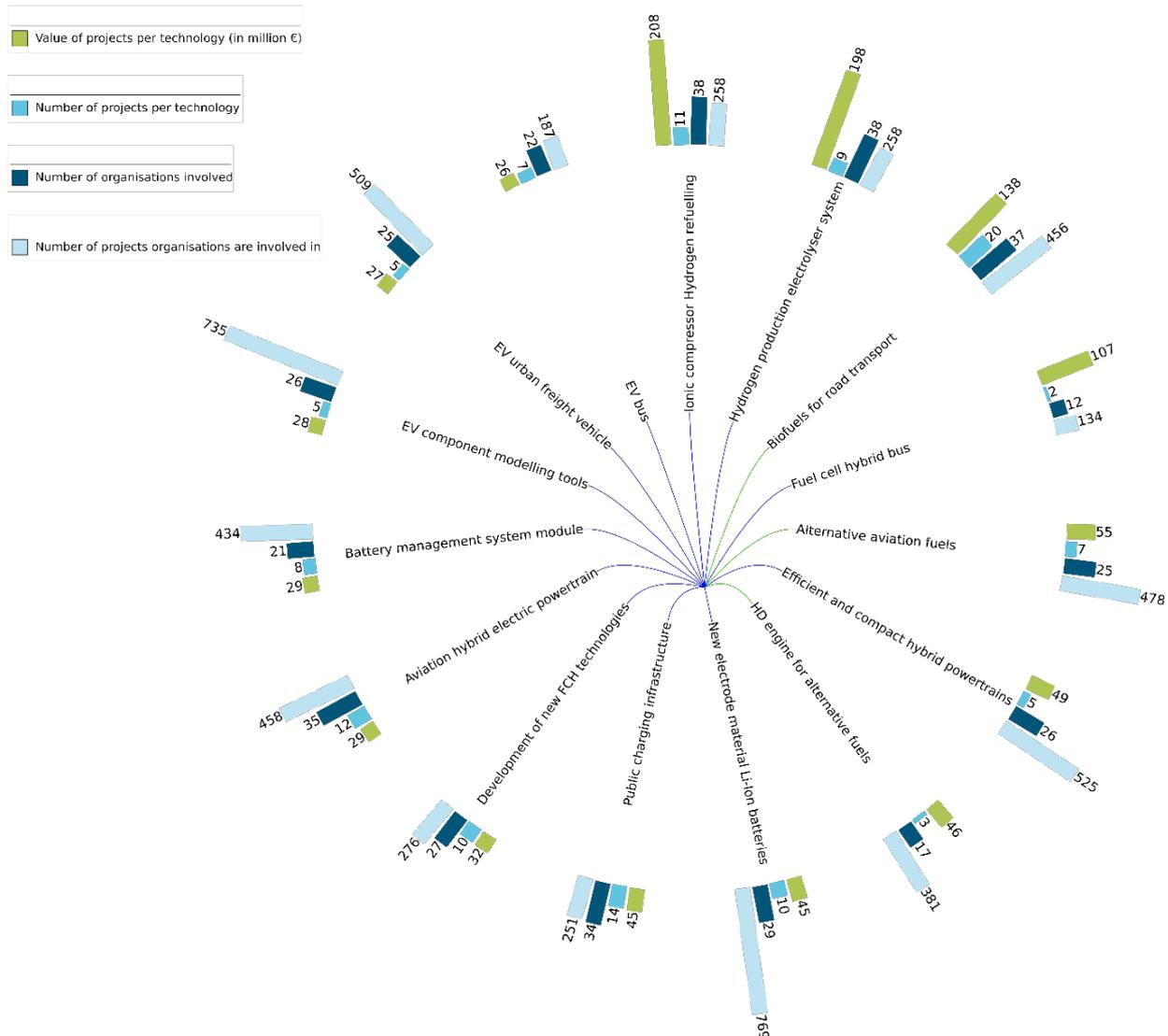
The analysis currently focuses on technologies researched in European Framework Programmes, specifically projects from FP7 and H2020, with a total of 2,242 projects falling within the scope. A total of 797 technologies were identified, also showing that many European funded projects do not focus solely on technology development. 137 of the identified are linked to the ELT roadmap, and 25 to the AF roadmap. Figure 3 focuses on the overall 'top 15' technologies in terms of total investments identified for the two roadmaps. The metrics analysed are the following:

1. total value of all projects that have researched the technology (i.e. the total investment, by both the EU and industry, in the development of the technology);

2. number of projects that have researched the technology
3. number of organisations that have been involved in projects that have researched the technology;
4. total number of projects that the organisations (identified under 3.) have been involved in.

The first two metrics highlight the combined effort that has been put into the technology, while the third and fourth proxy the level of interest in the technology in industry and academia, indicating the available capabilities to bring the technology to market. By linking several technology metrics with organisational data, it becomes possible to identify technology value chains, including opportunities, as well as indications on overspending and inefficiencies. In the future, these analyses will be provided in greater detail.

Figure 3. Top 15 ELT and AF technologies in EU research Framework Programmes.



EV – Electric Vehicle; AF – Alternative Fuels; HD – Heavy Duty; FCH – Fuel Cells and Hydrogen. ELT: blue branches; AF: green branches. Bars not in scale.

Conclusions

Under FP7 and H2020 about EUR 3.6 billion has been invested in research projects related to Transport Electrification (2.8 billion, including hydrogen) and other Alternative Fuels (0.8 billion). The funding gap between these roadmaps explain differences in the number of researched top technologies.

There is a high level of similarity between the stakeholders and their geographic allocation in the fields of ELT and AF.

Electrification of transport is likely to play a dominant role in the long-term, but other vehicle powertrain technologies and increased uptake of renewable energy sources will be required as well to fully decarbonise the transport sector. It is essential in the short- and medium-term to increase the use of renewable energy sources and improve the overall efficiency of the transport system. Despite improvements in the energy efficiency of vehicles and the significant R&I investments in alternative propulsion technologies and

sustainable fuels, the transport sector's GHG emissions continue to increase. Thus, further efforts are needed to ensure that transport contributes to the European Green Deal and the EU's GHG emission reduction targets. These will speed up the transition process of introducing alternative fuels and systemic changes in transport.

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The views expressed here are purely those of the JRC TRIMIS team and may not, under any circumstances, be regarded as an official position of the European Commission. The complete dataset can be found at trimis.ec.europa.eu.