2020

SHAPING
TRANSFORMATION
WITH
INNOVATIONS

NPM
NATIONAL PLATFORM
FUTURE OF MOBILITY

# PROGRESS REPORT

NATIONAL PLATFORM
FUTURE OF MOBILITY

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## PROGRESS REPORT 2020

# FOREWORD

**Dear readers,**

the year was largely dominated by the COVID-19 pandemic, which has left a deep impact on society, the economy and politics. Everyone has felt the impact of the restrictions in their everyday life, and also the extent to which our decisions and actions are currently fraught with uncertainties. The pandemic taught us early on that in many areas in the economy and society we have to be better and more resilient in dealing with unforeseen events so that if borders are closed, supply chains are interrupted and production is shut down there are no major bottlenecks in supply and everyday life in all areas can be maintained as best it can be.

COVID-19 has again brought home to us the profound upheaval the mobility system is undergoing. The sharp decline of air travel and travel by public transport and the lack of demand for vehicles have led to substantial sales losses, which has caused liquidity bottlenecks, funding problems and job cuts in many companies. Many companies in the mobility industry are in the difficult situation of having to invest in technologies that will be important in the future, but increasingly lacking the necessary resources. The government and parliament have responded to many situations of hardship by providing an economic stimulus and future technologies package and have allocated funds on an enormous scale.

The pandemic has led to positive developments in digitalisation and cycling. And we are seeing how the ramp-up of electromobility is being greatly accelerated as a result of the Federal Government's extensive funding. 2020 saw double the number of registrations for purely electric vehicles and triple the number for plug-in hybrids.

These developments have also been reflected in the work of the National Platform Future of Mobility. As well as its work on the challenges of a long-term transformation of the mobility system, the NPM, in a quick turnaround time, has delivered results for special assignments from the Federal Government to classify plug-in hybrid vehicles, the "$CO_2$ gap" for transport and the market ramp-up of alternative fuels. In total, 20 working group and task force reports and this progress report were published in 2020. The activities of the last few months have also demonstrated that as well as each individual topic we should maintain a holistic view of mobility that puts the users' needs at the centre.

On behalf of the steering committee, I would like to thank all those involved for your remarkable, dedicated and constructive commitment to the NPM this year. The fact that you have given up your time voluntarily has been recognised across the board, especially in view of the fact that work meetings – as is the case everywhere – have only been taking place virtually as of March. My thanks also go to the Federal Government and the supporting Federal Ministries – the Federal Ministry of Transport and Digital Infrastructure (BMVI), the Federal Ministry for Economic Affairs and Energy (BMWi), the Federal Ministry of Education and Research (BMBF), the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), the Federal Ministry of Labour and Social Affairs (BMAS) and the Federal Ministry of Finance (BMF) for the trust they place in us.

This progress report "Shaping transformation with innovations" seeks to impress upon our readers once more how the impact of the COVID-19 pandemic has meant that the future of mobility must be actively shaped and that there can be no sustainable changes without the appropriate technical and social innovations.

**Prof. Dr. Henning Kagermann,**
Chair of the NPM Steering Committee

# 1 EXECUTIVE SUMMARY

**Innovations are the foundation of a sustainable mobility system**

The year 2020 saw a change to the climate and economic policy framework for the transport sector at federal and European level, for example the $CO_2$ fleet limits in the EU or the national hydrogen strategy. The year was also marked by a sharp market ramp-up of electromobility with in some cases three-digit growth rates per month for electric vehicles and a 50 percent increase in charging points compared to the same period of the previous year. According to the Federal Motor Transport Authority, Germany had just under 222,000 battery electric and 195,000 plug-in hybrid vehicles on 1st October 2020. At the same time, the consequences of the COVID-19 pandemic affected all areas of the mobility industry – aviation, public transport, the automobile industry and tourism and events.

Because of these developments, the NPM is once again explicitly emphasising the importance of technical and social innovations. Innovations ensure the sustainability of a country. In the area of mobility, innovations are being inspired more than ever by the ever-increasing efforts made to combat climate change and bring about widespread digitalisation.

**Paving the way for a better future with resilient measures**

Besides controlling the pandemic, economic recovery is the top priority both in Germany and at EU level. The COVID economic stimulus package adopted in June 2020 to manage the crisis is geared towards climate change mitigation and towards promoting technologies that will be important for the future. It supports public transport, promotes hydrogen technologies and electromobility and supports the vehicle industry in its transformation. The NPM presented recommendations for action for optimum electric efficiency of plug-in hybrid vehicles (PHEV) in a special assignment for Concerted Action for Mobility. The recommendations based on the topics of automotive engineering, charging and grid infrastructure and user behaviour aim to support PHEV being used in electric mode at least 50 % of mileage.

**As a driver of innovation digitalisation creates user-friendly mobility**

Digitalisation facilitates a platform-based intermodal network of transportation, thereby optimising transport chains. Citizens want “one-stop shop” mobility that is simple, available at all times, affordable and convenient. An important prerequisite for this is the creation of a mobility data ecosystem providing a secure data exchange between vehicle manufacturers, mobility providers and infrastructure providers. This enables new services to be implemented, automated functions to be supported and, with an eye to the future, the way to be smoothed for the use of autonomous fleets.

**Standards and norms accelerate the implementation of sustainable solutions**

To accelerate transformation in the mobility sector, there is a need for standards and norms that companies can use as a basis for their developments. The NPM has presented focus roadmaps for intelligent load management and automated and connected driving addressing important questions concerning sector integration and type approval and certification. It also showed how standards and norms can boost the marketability of innovations for sustainable mobility, for example, by means of a uniform system of accounting.

**Translating $CO_2$ goals into concrete measures for effective climate change mitigation**

There is a great sense of urgency to close the $CO_2$ emissions gap in the transport sector, especially in the commercial vehicle sector. One of the goals of the 2030 climate action programme is to electrify one third of the mileage of commercial vehicles or provide it on the basis of electricity-based fuels. This is a challenging goal especially for heavy commercial vehicles used in long-distance traffic that cause the lion's share of $CO_2$ emissions: this is where several technology paths are being pursued in parallel due to the demanding requirements of the logistics industry – battery electric vehicles, fuel cell vehicles and overhead line heavy goods vehicles (HGVs). The NPM has developed a possible roadmap presenting the three technology paths, their marketability and infrastructural framework. The analysis revealed that currently only a combination of all these technologies is suitable for achieving the 2030 climate targets. Specific recommendations have already been incorporated into BMVI's overall concept for climate-friendly commercial vehicles.

**Having no technology bias promotes innovative drives and fuels**

The principle of having no technology bias is central to achieving sustainable and $CO_2$-reduced mobility by 2030 and it applies to the entire mobility sector. The focus is on technological electromobility concepts, hydrogen and fuel cells and alternative fuels. When it comes to battery electric mobility, costs and use of resources, especially battery production and battery cell production, must be reduced and the charging infrastructure expanded as required. The use of renewable energies is essential to ensure the sustainability of hydrogen production. The first pilot and demonstration plants are available to produce electricity-based fuels and second-generation biomass-based fuels. Framework conditions must therefore be created to accelerate deployment and market ramp-up.

**Infrastructure for electromobility must be needs-based and economical**

As well as approval from the population and the availability of attractive vehicles, the expansion of the charging and refuelling infrastructure is of central importance for a successful transition to sustainable transport. A charging and refuelling infrastructure that is needs-based and which can be operated economically must be created, both in the private and public sector. The Federal Government's charging infrastructure master plan takes up numerous recommendations from the NPM. The need for a charging infrastructure for electric vehicles is dynamically influenced by the development of charging technologies, vehicle ranges and user behaviour and in this way is a "moving target". Innovative solutions, such as the use of plug and charge, will play an important role. In principle, the expansion of public charging infrastructure for cars should be market-driven after 2025. For sites that are not economically viable, but which are nevertheless important for nationwide coverage, there is a need for appropriate financing models.

**Ensuring added value and employment for Germany as a place for mobility**

New drive technologies are accelerating structural change in the mobility industry and are bringing with them huge challenges. To achieve wealth and employment security, there must be an appropriate proportion of the added value of vehicle production in Germany. However, construction and expansion must take place today not just for value networks for new drives, but also for the recycling of batteries and electric machines, in order to create a truly cyclical process. The transformation also changes the demands placed on employees. New regional competence hubs can help to develop future job profiles and advise on suitable qualification measures for employees.

**Proving the potential of mobility innovations**

The future of mobility should not only be decided by experts. Considering public opinion and involving the population is essential for the transformation to be successful and accepted. The Reallabor Hamburg, a real-world laboratory, has been initiated by the NPM as a test room for innovations in digital mobility and addresses the requirements of different mobility spaces. By the end of 2021, with the involvement of users, innovative mobility services will be implemented on site, linked to each other and tried and tested in everyday life. Results from the real-world laboratory will be presented to the general public at the World Congress on Intelligent Transport Systems (ITS) in Hamburg in October 2021.

# 2 THE WORK OF THE NPM IN 2020

The past year has challenged the ***National Platform Future of Mobility*** and the work being done in the six working groups in a number of ways. New topics and activities have shown that the interfaces between the working groups are growing, increasing the workload. However, the strategic focus of the topic areas addressed by the NPM has also proved its worth in 2020. Political leaders continue to rely on the expertise of the NPM and have highlighted the important role of the work done by the NPM by awarding the NPM additional and short-term assessments – this being triggered by the serious consequences of the COVID-19 pandemic on the mobility industry.

However, in 2020, as well as the COVID-19 pandemic dominating everything, it was above all the political decisions at European level and at federal level that left a discernible mark on the future direction of the mobility system. These decisions are based on the assumption that the mobility system can be made sustainable, competitive and therefore fit for the future through progress and technological and social innovations.

## MAIN FOCUS AREAS FOR THE NPM




**AG 1**

Transport and climate change




**AG 2**

Alternative drive technologies and fuels for sustainable mobility



**AG 3**

Digitalisation in the mobility sector



**AG 4**

Securing Germany as a place for mobility, production, battery cell production, primary materials and recycling, training and qualification



**AG 5**

Connecting mobility and energy networks, sector integration




**AG 6**

Standardisation, norms, certification and type approval

# 2.1 POLITICAL FRAMEWORK FOR THE FUTURE OF MOBILITY

Climate and economic policy decisions at federal and European level in 2020 underlined that the achievement of climate targets and economic activity must be closely linked. The associated opportunities have gained centre stage in debates.

**Europe: new $CO_2$ fleet limits, green deal, European climate law, data strategy**

The new $CO_2$ emissions legislation for car and light commercial vehicle fleets came into force on 1st January 2020.[1] The new legislation aims to ensure that new cars emit an average of 37.5 % less $CO_2$ across all manufacturers in 2030 compared to 2021. From 2021, all newly registered vehicles from all manufacturers may only cause an average of 95 g $CO_2$/km.[2] For the manufacturers this means that they must significantly increase the proportion of electrified vehicles by 2030 if they want to avoid penalties.

At the end of 2019, the EU heads of state and government also agreed to achieve climate neutrality by 2050. Building on this, the Commission presented the ***European Green Deal***[3] as a new and above all sustainable growth strategy. As part of the ***European Green Deal***, the EU Commission submitted the proposal for a European Climate Law in March 2020, its objective being to establish binding union-wide greenhouse gas neutrality by 2050. The Green Deal stipulates a 90 % reduction in greenhouse gas emissions throughout the entire transport sector – road, rail, air and sea transport – by 2050. The tightening of the European climate target has also been proposed for 2030. Instead of a reduction in $CO_2$ emissions by at least 40 % compared to levels in 1990, the EU decided on the increased target of 55 % in December. To be able to meet this higher climate target for transport, it would take much more than the measures taken so far. The tightened EU regulation on type approval and market surveillance of motor vehicles has also been in force since 1st September 2020.

The Commission's data strategy[4], presented in February 2020, aims to create a European single market for data. Data rooms in a number of industries, including a mobility data room, are being built for this purpose.

**Federal Government: Federal Climate Change Act, National Hydrogen Strategy, Concerted Action for Mobility (Konzertierte Aktion Mobilität, KAM), Mobility Data Room**

With their Climate Action Programme 2030[5] adopted in the autumn of 2019 to implement the Climate Action Plan 2050, the Federal Government somewhat anticipated the developments at EU level. The Federal Climate Change Act[6] presented came into force on 18.12.2019 and the independent expert council appointed therein started its work in August 2020. In addition to managing the coronavirus pandemic, the German EU Council presidency, which Germany took over in the second half of 2020, focused on climate change mitigation and dealing with the climate crisis.

The law stipulated the greenhouse gas reduction rate for 2030 with a value of 55 % compared to levels in 1990 across all sectors. Concrete figures for annual emission rates for the transport sector have been laid down as in all other sectors. For 2020 the value is still 150 million tons of $CO_2$-equivalent, in 2030 it will still be 95 million tons, which corresponds to a reduction of 42 % compared to levels in 1990. The thereby accelerated market ramp-up of electromobility was already visible in 2020. According to the Federal Motor Transport Authority, Germany had just under 222,000 battery electric and 195,000 plug-in hybrid vehicles on 1st October 2020. This also applies to the expansion of the charging infrastructure, which also gained momentum as a result of the charging infra-

1 Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011.

2 The take-off point in 2021 is the fleet average in the EU across all manufacturers in the new type test cycle WLTP (on the basis of the legally established target translation with reference to the original 95 g CO2/km EU fleet goal).

3 European Commission: "A European Green Deal". URL: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_de [Last revised: 16.11.2020].

4 EEuropean Commission: "European Data Strategy – Making the EU a role model for a digital society". URL: https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_de#documents [Last revised: 16.11.2020].

5 Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2019): Climate action programme 2030 from the Federal Government to implement the climate action plan 2050. URL: https://www.bundesregierung.de/resource/blob/975226/1679914/e01d6bd855f09bf05cf7498e06d0a3ff/2019-10-09-klima-massnahmen-data.pdf?download=1 [Last revised: 16.11.2020].

6 Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: Federal Climate Change Act of 12 December 2019 (Federal Law Gazette I p. 2513). URL: https://www.bmu.de/gesetz/bundes-klimaschutzgesetz/ [Last revised: 16.11.2020].

structure master plan also adopted at the end of 2019. The master plan stipulates a short-term expansion to a total of 50,000 public charging points by the end of 2021, ramping up to one million by 2030, along with expansion in the private and commercial sector.

The Federal Government has used the National Hydrogen Strategy[7] presented in June 2020 to show the opportunities and future importance of green hydrogen as a climate-friendly energy source and as a primary material for the economy. Hydrogen can play an important role in the transport sector through direct use in fuel cell drives or indirectly to manufacture electricity-based fuels. The Federal Government will provide around nine billion euros for funding projects ranging from basic research to market ramp-up and for international partnerships.

In 2020, the top-level talks between the members of the initiative ***Concerted Action for Mobility*** (KAM) and the Federal Chancellor almost always had the topic of employment in the automobile and supply industry right at the top of the agenda. The structural change triggered by the transformation of mobility has been greatly intensified by the COVID-19 pandemic and has in the past year entailed short-time working and job cuts in many places. It was also announced at the KAM summit meeting in late summer that a data room was going to be created for the first time as the basis of modern mobility in close coordination with European and national initiatives. The project links up with the European initiative on data strategy. The focus is on data sovereignty and the development of innovative business models.

At the KAM meeting in November additional decisions were made to further support the market ramp-up of electromobility and transformation in the mobility sector.

The innovation premium for the purchase of electric vehicles is being extended until the end of 2025, linking the grants for plug-in hybrids to an increasing electric minimum range. The fleet renewal programme in the commercial vehicle segment intends to accelerate the exchange of older vehicles, with vehicles with electric and hydrogen drive being favoured. Furthermore, small and medium-sized companies especially will be supported in making changes to structure and employment, including through the establishment of training associations. One billion euros is also being made available for the “automobile industry future fund”.

Development of the public and private charging infrastructure and the fast-charging infrastructure at filling stations is proceeding at full speed and this is being guided by future demand. A statutory regulation will provide for a uniform payment system at charging stations. Building on these decisions, the necessary subsequent steps for further ramp-up were discussed at the charging infrastructure summit at the beginning of December with representatives of the energy industry and charging infrastructure operators. The BMVI also announced four billion euros for the development of private and public charging infrastructure over the next few years.

Significant regulatory progress is also being made with autonomous driving.

At international level, Germany has already proposed the expansion of the level 3 regulation for uniform requirements for type approval via the United Nations Economic Commission for Europe (UNECE). The first draft of a bill on the operation of level 4 vehicles is expected to be presented in Germany in 2021.

## EXTRAORDINARY EFFECT OF COVID-19 PANDEMIC

The COVID-19 pandemic made its mark on the year 2020. By March, the spread of the coronavirus and the accompanying measures to control the COVID-19 pandemic were having an impact on politics, the economy and our society. In particular, the necessary lock-down restrictions to control the pandemic led to a hitherto unprecedented economic slump, but also to a significant decrease in $CO_2$ emissions. The consequences of the pandemic affected almost all areas of mobility. Like many other areas of the economy, the entire industry was put under severe strain – especially the automobile and supply industry, the travel and tourism industry involving air and sea transport and public transport. Many people, fearing that they would catch the virus, fell back on using cars or, in the cities especially, bikes, even though the transport companies have largely maintained public transport with buses and trains despite a significant slump in passenger numbers.

7 Federal Ministry for Economic Affairs and Energy (BMWi) (2020): „Die Nationale Wasserstoffstrategie“ [The National Hydrogen Strategy]. URL: https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/die-nationale-wasserstoffstrategie.html [Last revised: 16.11.2020].

The consequences of the temporary shutdown in goods and vehicle production, the interruption to supply chains caused by the global border closures and a significant decrease in sales figures with corresponding sales collapses were and are only gradually becoming apparent. The extent to which the COVID-19 pandemic may be responsible for the reduction in jobs and value networks in Germany and Europe remains to be seen. Permanent job cuts have so far been prevented through effective rules on short-time working and unbureaucratic stopgap assistance in all areas. However, many small and medium-sized businesses have got into financial difficulty and only in the coming months will they know the extent to which the impending risk of insolvency can be averted. There is also the question of whether and when companies will make enough profit again to be able to make the necessary future investments.

In view of this, as a response to COVID, the Federal Government launched a package of measures worth 130 billion euros to revive the economy and equip Germany for the future. The package is geared to climate change mitigation and to promoting technologies that will be important in the future and is socially equitable. The package supports local authorities and strengthens public transport. Hydrogen technologies and electromobility are also supported. The Federal Chancellor's talks with ministers and representatives of the mobility industry including the NPM as part of ***Concerted Action for Mobility*** (KAM) were also dominated by the COVID-19 pandemic.

In addition to controlling the pandemic, economic recovery has top priority both in Germany and at EU level. Innovations guarantee sustainability. Climate change mitigation and digitalisation are what drive them. During the pandemic, the latter in particular has shown what huge opportunities for the economy and society come with it.

## SPECIAL ASSIGNMENTS FOR THE NPM

With the adoption of the economic stimulus package and out of the KAM talks in September, the NPM was asked to investigate the optimum electric efficiency of plug-in hybrid vehicles and the market ramp-up of alternative fuels.

### OPTIMUM ELECTRIC EFFICIENCY OF PLUG-IN HYBRID VEHICLES (PHEV)

The coalition committee adopted the economic stimulus package on 3rd June 2020 to combat the consequences of the COVID pandemic. This included the assignment for the NPM to discuss the issue of the optimum electric efficiency of the electric drive in plug-in hybrid vehicles. A task force employed for this purpose then developed recommendations for action based on the themes of vehicle technology, charging and grid infrastructure and user behaviour. The objective of the recommendations for action is to facilitate PHEV to be used in electric mode for at least 50 % of mileage. A recent study has shown that this value is currently well below that, especially for PHEV company vehicles, unlike private vehicles.[8]

**PHEV as a future-proof trailblazer**

PHEV acts as a trailblazer for electromobility and can help introduce customers to electromobility gradually and without concerns about short ranges. At the same time, they benefit the climate with sufficient use of the electric driving mode and can be a part of the drive portfolio of the future in connection with the use of alternative fuels.

Furthermore, they ensure a socially acceptable transformation as they have a positive effect on employment in the automobile and supply industry, stretching out the decrease in staff over time.

*Report from the PHEV Taskforce*

***Recommendations for optimum electric efficiency of plug-in hybrid vehicles***

8 Bieker et al. (2020): "Real-world usage of plug-in hybrid electric vehicles – Fuel consumption, electric driving, and CO2 emissions". In: ICCT White Paper, September 2020.

**Optimising the percentage of use in electric mode in a targeted way**

In the area of vehicle technology, the NPM recommends aiming for e-ranges for PHEV of approx. 80 to 100 km across all models. The charging capacity should be increased to 11 kW at the same time. It is also recommended to enable services such as the automated switch to the e-mode in defined zones or the digital display of data on consumption or the next charging station in the vehicle or via the app.

From the point of view of the charging and grid infrastructure, the most important factors are the expansion of the charging infrastructure at home and in workplaces, as this is where 85 to 90 % of the charging events for PHEV take place. When it comes to charging privately at home, an accompanying funding programme for private charging infrastructure for example can support the expansion. The expansion of the charging options in workplaces can be accelerated by creating tax incentives for employers to set up charging points.

In terms of user behaviour, the focus is especially on company vehicles, as this is where there is the greatest need for action due to the low percentage of use in electric mode. A company car policy that focuses on using the electric drive is a step in the right direction towards a more appropriate use of PHEV. Employers can also assume the charging costs for private and company journeys and introduce a charge card for company car users. Optimised sales and usage advice for fleet operators and users can also help select suitable drive concepts.

When it comes to drive mechanisms and funding instruments, adjustment of the environment bonus and the innovation premium as well as making company car tax more dynamic are tools to be examined in order to increase the percentage of use in electric mode. This requires a monitoring process to be initiated without delay. This process would involve comprehensive collection and assessment of data on the use of PHEV. Adjustments to the funding instruments and other measures can be undertaken on the basis of the monitoring process.

**PHEV with significant benefit for the environment with optimum electric efficiency**

Calculations made by scientific experts have shown that the increase of the percentage of use in electric mode for PHEV is accompanied by a significant $CO_2$ savings potential. A percentage of use in electric mode of 65 % for private PHEV and 55 % for company cars would account for a reduction in direct $CO_2$ emissions of approx. 2.5 to 2.9 million tons of $CO_2$-equivalent in 2030.

The following illustration summarises the recommendations for action given by the PHEV taskforce to optimise the electric efficiency.[9]

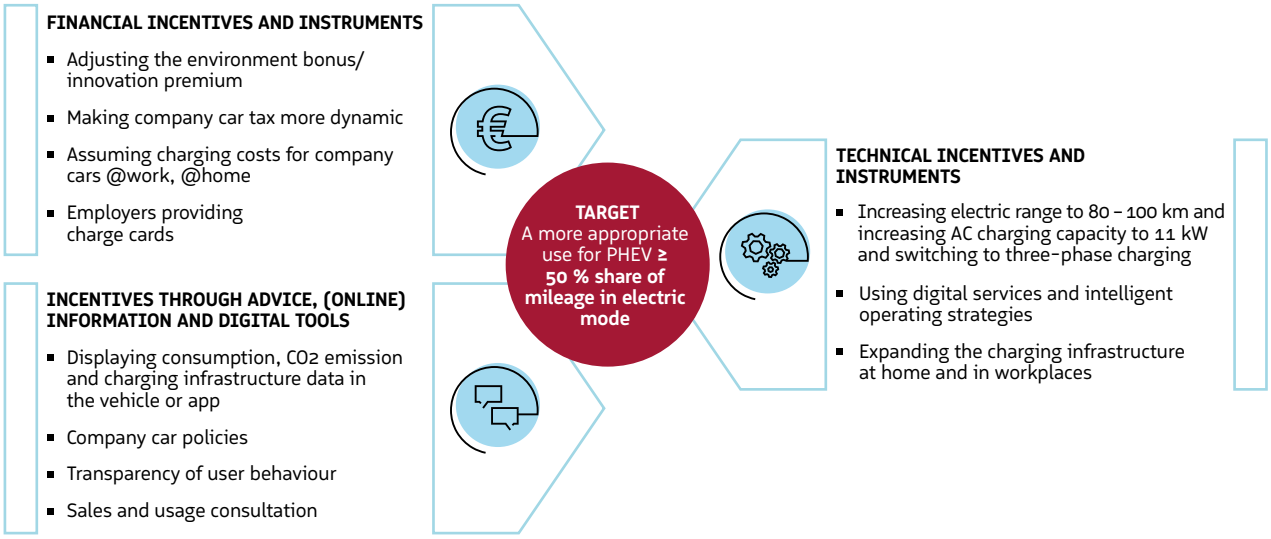



*Figure 1: recommendations for action to optimise the electric efficiency of PHEV after prior monitoring (own illustration)*

9 No agreement could be reached within the taskforce about the timing of the adjustments.

## MARKET RAMP-UP OF ALTERNATIVE FUELS

During the ***Concerted Action for Mobility*** meeting in September, the WG 1 "Transport and climate change" were asked to further develop previous knowledge from the NPM on alternative fuels and, building on that, present recommendations for action for the use and market ramp-up of alternative fuels, paying particular attention to the fact that in principle there are very different views as to the amount and in which areas alternative fuels can or should help to reduce $CO_2$ in the transport sector. Both electricity-based (Power-to-X, PtX) and advanced biomass-based fuels were considered and the different manufacturing procedures examined in terms of marketability and production capacity.

### Working on technological hurdles

Both with single technologies and the integration of individual processes (for example electrolysers and direct air capture), there needs to be urgent work done on technological maturity. The forecasts of manufacturing costs for electricity-based fuels in 2030 vary significantly between 1.00 and 4.50 euros per litre (without taxes and duties). There is agreement about the fact that the costs of alternative fuels will turn out to be significantly higher than those of fossil fuels. According to current assessment of the technological feasibility, and with a view to the duration of planning procedures, a ramp-up of industrial-scale production is not expected until the second half of the decade. The production and use of advanced biogenic fuels cannot be increased at will either due to the limited availability of primary materials and competition for use.

### Reliable and predictable regulatory framework necessary

PtX can only be produced on an industrial scale if there are additional government instruments at national and international level. Subsidies, quotas, tenders and a $CO_2$ price, as well as the design of the tax and levy system could be an incentive for investment decisions for a ramp-up of alternative fuels. In order to trigger the necessary investments of amounts in the tens of billions, the instruments must be reliable and predictable over a period appropriate to the investment. The discussion about a suitable set of instruments was controversial in WG 1, resulting in different combinations of instruments being favoured depending on the basic position.

### Necessary steps for the market ramp-up

Recommendations are being made to immediately formulate and implement ambitious, long-term and binding sustainability criteria for the production of electricity-based and advanced biogenic fuels. Research should be specifically geared to supporting the scaling up of technologies, including their short-term cost reductions. A market launch programme for larger plants of the 10,000 tonne class per year is also essential for the ramp-up of electricity-based liquid fuels (Power-to-Liquid). In addition, international cooperation and partnerships are to be politically supported and encouraged. The global expansion of additional renewable power generation capacities is a prerequisite for the climate change mitigation effect of PtX fuels. The rapid national implementation and enforcement of the outstanding legislative acts on the electricity purchasing criteria and the greenhouse gas calculation methods for alternative fuels within the framework of the EU Renewable Energy Directive II/RED II is necessary to ensure security in investing in PtL plants. Having a discussion going beyond the transport sector about the supply, requirements and provision of the limited amount of alternative fuels available in order to achieve the climate goals in the sector – also in terms of the EU discussion about climate neutrality – is also recommended.

*WG 1 Workshop Report*
*Alternative fuels*

# 2.2 SHAPING TRANSFORMATION WITH INNOVATIONS

The COVID-19 pandemic is not yet under control and there remains uncertainty as to how the situation will develop in terms of health and the economy. In addition to the serious economic consequences, the pandemic has also, however, triggered a boost in the digitalisation of our working and living environments. Home offices, cloud computing, online shopping and online events are booming[10] and are here to stay. Born of necessity, reality has shown within a few weeks that working from home actually works in many companies and institutions. And the vast majority are finding these new ways of working mostly positive and are accepting the diverse range of options for digital collaboration.[11] According to the Fraunhofer Institut für Arbeitswirtschaft und Organisation (IAO) [Fraunhofer Institute for Industrial Engineering], the COVID crisis has brought digital collaboration forward by at least 15 years.[12]

Politicians, economists and citizens alike share the conviction that innovations benefit society.[13] Not only can innovations like in the field of digitalisation be an important lever for economic recovery but are a prerequisite for future viability and progress and not just in the transport sector.

For the mobility system, digitalisation is what enables platform-based intermodal networking and corresponding travel chains. The intelligent interaction of ideally all mobility service providers, mobility data providers and the mobility infrastructure is the basis for this. The implementation of mobility innovations in new products, new business fields, new business models and therefore new markets involves large investments. Defining norms and standards across industries creates investment security and drives the implementation of new technologies.

Decarbonising the transport sector will not succeed without technological and social innovations. By laying down specific measures and operational steps it must be shown how the defined climate targets can be achieved by 2030. The commercial vehicle sector turns out to be particularly challenging. Openness to all the different kinds of technology available remains absolutely imperative for developing and introducing alternative drives and fuels. However, there must be a realistic assessment of technologies in terms of when they become available on the market. This also applies to linking the energy and transport sectors. For a successful transition to sustainable transport, electromobility and alternative fuels need suitable charging and refuelling infrastructures.

In the following, the NPM working groups give an insight into the mobility issues that formed the focus in 2020, highlighting the activities that show great innovation potential for the transport sector, with which transport is not only able to meet its climate goals but can also play to the strengths of the German economy and science in research and development to be able to be at the forefront of mobility in the future.

**10** Bitkom Research: „Corona führt zu einem Digitalisierungsschub" [COVID boosts digitalisation]. https://www.tcs.com/de-de/digitalisierungsschub-durch-corona [Last revised: 16.11.2020].

**11** Fraunhofer FIT: „Homeoffice Studie, Erste Ergebnisse" [Home office – initial results] (07.05.2020). URL: https://www.fit.fraunhofer.de/de/presse/20-05-07_fraunhofer-umfrage-homeoffice-erste-ergebnisse.html [Last revised: 16.11.2020].

**12** Handelsblatt: "Fluch oder Segen? Das Experiment Homeoffice" [Blessing or curse? The work from home experiment] (25.09.2020). URL: https://www.handelsblatt.com/karriere/management-fluch-oder-segen-das-experiment-homeoffice/26211388.html [Last revised: 16.11.2020].

**13** Federal Ministry for Economic Affairs and Energy (BMWi): "Transferinitiative: Mehr Ideen – mehr Erfolge" [Transfer initiative: more ideas – more successes] (2020). URL: https://www.bmwi.de/Redaktion/DE/Dossier/transferinitiative.html [Stand: 16.11.2020]; Zimmermann, V. (2020): „Innovationen in der Corona-Krise: Not macht erfinderisch" [Innovations in the Corona crisis: Necessity is the mother of invention]. In: KfW Research Fokus Volkswirtschaft, No. 295. URL: https://www.kfw.de/KfW-Konzern/KfW-Research/Innovationen.html [Last revised: 16.11.2020].

## MOBILITY OF THE FUTURE: DIGITALISATION AS A DRIVER OF INNOVATION

The mobility landscape in Germany is undergoing profound change. Digitalisation, networking and automation are increasingly finding their way into people's living environments, raising the population's expectations and requirements for the mobility of the future. Citizens want one-stop shop mobility that is simple, available at all times, affordable and convenient. One solution could be platform-based intermodal mobility that enables the availability and use of different means of transport that is demand-orientated, available at any time and if necessary able to be combined within one route.

Digitalisation and networking are significant trailblazers of change and provide huge opportunities to make the mobility of the future customer-friendly with new mobility services.

**Vision: consistent range of services from the intermodal mobility chain**

In order to achieve flexibilisation of individual mobility, digitalised mobility must be considered holistically. In addition to networking across means of transport, other services such as digitalised parking space management should be enabled and integrated into a comprehensive platform offering to ensure seamless travel chains for customers – this is because 20 to 30 % of urban traffic can be attributed to people driving around looking for a parking space. A mobility data ecosystem is needed for an efficient organisation of mobility, enabling an open and secure exchange of data between vehicle manufacturers, mobility providers and infrastructure providers to transform the current "hotchpotch" of isolated solutions into a user-friendly mobility experience.

It should be possible to plan, book and bill for a journey, or in logistics a transport volume, within one application from start to finish. Customers should be able to choose the carrier according to their preferences (time, costs, how climate-friendly they are, convenience, social interaction etc.). In addition to booking travel chains, other services are required that offer users flexibility in mobility. Combining it with cheap and time-efficient alternative options offers added value insofar as intermodal mobility platforms optimise the travel chains for customers through intelligent networking of transport means (for example by taking into account the timing, shortening of the waiting times). As well as different mobility options and services, efficient organisation of mobility needs to be closely connected to the transport infrastructure. The exchange of data between transport infrastructure and mobility service provider helps to achieve an intermodal mobility network and manage mobility according to need and increase utilisation of existing capacities to minimise the volume of traffic overall.

**How can an intermodal service environment be implemented?**

It is necessary for mobility providers – who have equal rights and equal obligations – to be able to provide mobility services for users in a meaningful way for society as a whole while safeguarding their own business interests. Non-discriminatory participation for all transport service providers should be ensured here through the use of available mobility data while safeguarding data sovereignty and economic interests. The creation and further development of the market for mobility services should be accelerated through incentives or targeted regulation.

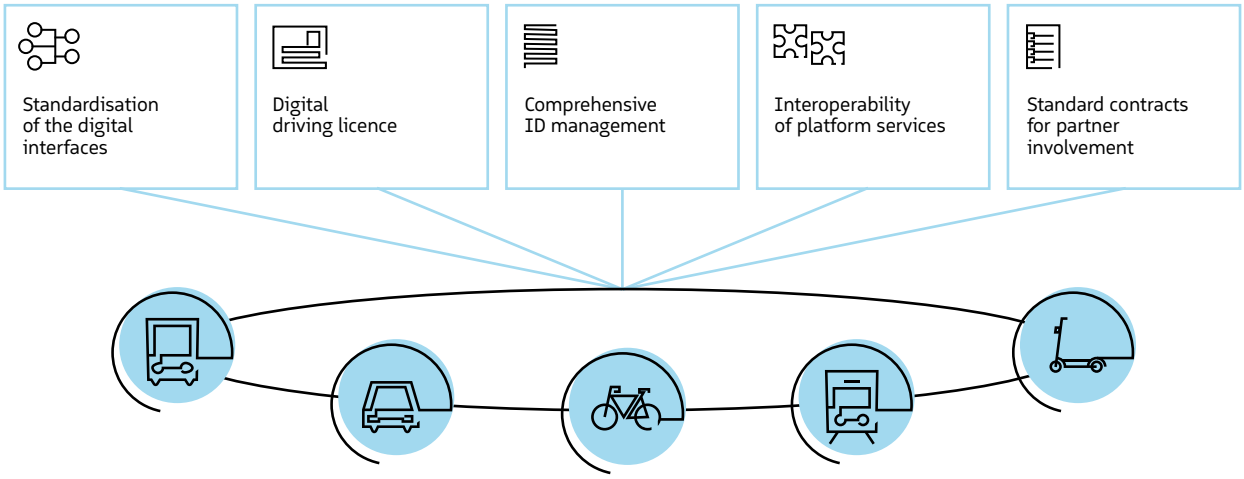



*Figure 2: requirements for the implementation of digital mobility platforms (own illustration)*

**Requirements for the implementation of digital mobility platforms**

Non-discriminatory participation for all transport service providers in the platform service and the provision of basic services for mobility services should be made possible and overarching governance principles for data exchange, ID management, security architecture and interoperability and liability and arbitration issues must be defined as quickly as possible (see illustration). The implementation of a continuous service offering is being tested in the real-world laboratory in Hamburg, the test room for innovations in digitalised mobility (see chapter 2.4 for further details).

*WG 3 Interim report*

***Platform-based intermodal mobility and recommendations for action on data and security***

## NEW MARKETS: STANDARDS AND NORMS ACCELERATE THE IMPLEMENTATION OF INNOVATIONS

For innovations to actually be ready for the market and companies to invest in new technologies, there needs to be internationally agreed standards and norms. They guarantee that the products are high quality, safe, interoperable and useable and at the same time secure for investment. To accelerate the transformation in the mobility sector, the normative and regulatory framework must be created through the combined efforts of people involved in industry and the economy, society, science and politics.

Important groundwork is being done within NPM to identify the need for standardisation and determine appropriate recommendations for action for the future of mobility. Individual focus roadmaps address the normative requirements of key innovation topics. In electromobility, the intelligent load management important for the integration of the mobility and energy sectors has been identified as a key element of successful implementation.

**Smart control is a prerequisite for achieving stability of the power grid**

The increasing charging events as a result of the market ramp-up of electromobility will become more and more noticeable in the power grid. These foreseeable, especially isolated loads on the power grid must be balanced out in such a way that the power grid remains stable. This assumes that the charging infrastructure can communicate with the vehicles and the power grid in all directions and can be intelligently controlled.

The “Intelligent Load Management” focus roadmap (see the chapter on sector integration) provides the first forward-looking overview of how and where standardisation and norms can help achieve a seamless interaction between electromobility and the power grid.

*WG 6 Focus roadmap*

***Intelligent Load Management***

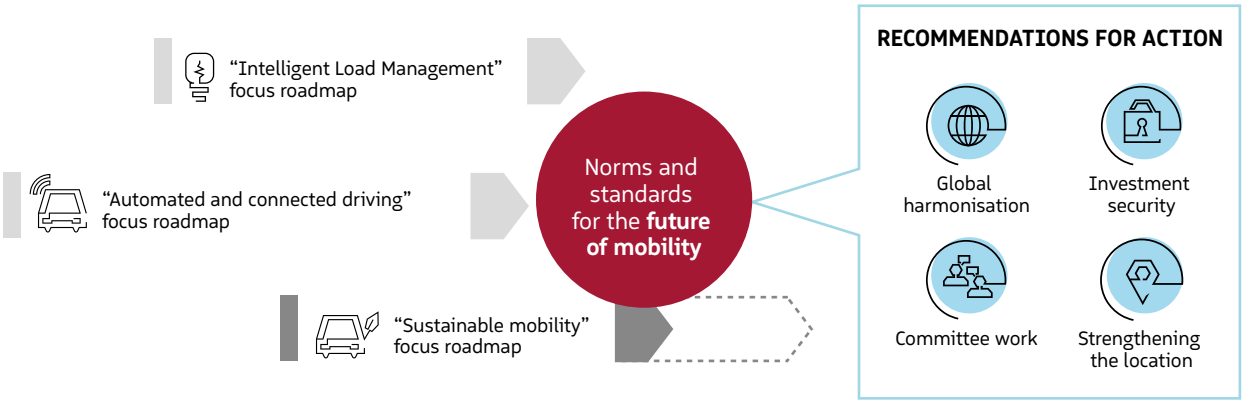



***Abbildung 3: Norms and standards for the future of mobility (own illustration)***

**Digitalisation and automated driving bring new challenges**

Another key area where action is needed is the further development of automated and connected driving. This makes the product, the requirements for interoperability and the infrastructure more complicated. The “Automated and connected driving” focus roadmap has been used to develop a strategic framework for needs-based further development of standardisation activities in this area.

The restructuring of type approval and certification processes in the automotive sector is also associated with this. Technical developments and digitalisation mean that products or their function are already able to be altered today during their useful life. The currently valid processes for registration, type approval and periodic monitoring must ensure that in the future these changes do not affect road safety and that the environment will continue to be protected.

*WG 6 Focus roadmap*

***Automated and connected driving***

**Boosting marketability of innovations for sustainable mobility**

The topic of sustainability and compliance with nationally and internationally agreed climate goals is a key challenge of the entire mobility system of the future. The question as to what contribution standards and norms can make to creating a sustainable transport system provides the general framework for further work on this issue. As well as looking at technical aspects, an overarching, holistic look at the topic of sustainability is also required. The "Sustainable mobility" focus roadmap complied with this aspect. Standards and norms making sustainability measures assessable and comparable and enabling their transparency is especially important here.

Accounting provides great leverage. It is an essential component for transparency in a sustainable mobility system. An international harmonised standardisation and norms enable accounting according to globally standardised criteria. This is especially significant for globally distributed value chains as are used in vehicle construction for example.

*WG 6 Focus roadmap*
*Sustainable mobility*

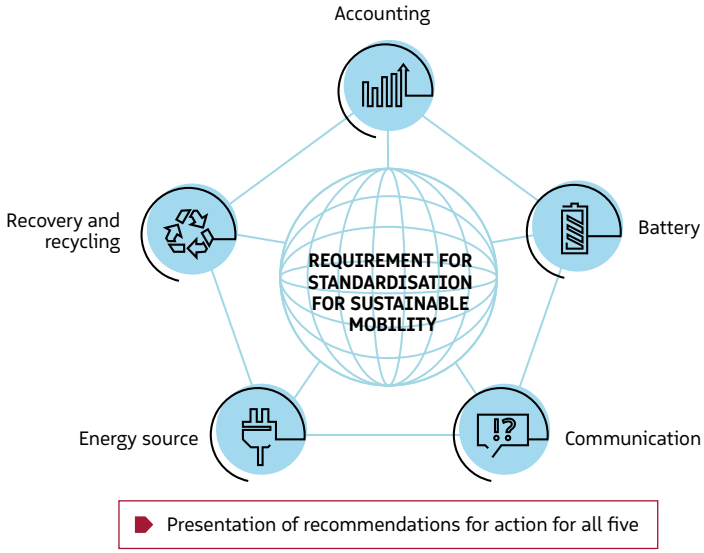



*Figure 4: "Sustainable mobility" focus roadmap (own illustration)*

The goal of accounting must be to develop a uniform system where the transport providers can be compared depending on their use and taking into account the framework conditions (for example long-distance and local transport) and the associated emissions. In order to achieve this for the overall mobility system, standardisation activities are necessary to establish an accounting framework and create a standardised ICT architecture and organisation.

Another key area where action is needed is the reuse and recovery of materials. To achieve a sustainable life cycle assessment of a vehicle, the recyclable materials must be able to be reused or recycled. Because of the complexity of a vehicle with numerous materials and substances used, an integrated life cycle management is needed that already relies on sustainably recoverable materials, their long life and later reuse or recycling in the product design. The standardisation activities to increase the transparency of supply chains are of particular importance here.

The creation of a sustainable added-value chain (see also chapter 2.3) for batteries, including a circulation system, is another important area where action is needed. However, many questions still need to be answered, including the development of standards for the second-life use of batteries, a standardised recycling process to increase the recycling efficiency or a standardised determination of the $CO_2$ footprint of batteries.

Overall, it can be seen that the further development of standards and norms supports and boosts the marketability of innovations enormously. Standardisation projects provide the opportunity to bring new technologies on the roads and implement sustainable innovations in the market.

## ACHIEVING $CO_2$ TARGETS FOR TRANSPORT: ELECTRIFICATION OF HEAVY COMMERCIAL VEHICLES

With the passing of the Climate Change Act in December 2019 and the setting up of the climate action programme 2030 (CAP 2030), the Federal Government has laid important groundwork in reducing the $CO_2$ emissions in the transport sector by 42 % by 2030 compared to levels in 1990. However, two reports from the Federal Government giving estimates of the overall mitigation effect of CAP 2030 have revealed that the operative measures already implemented are not enough. The NPM's WG 1 "Transport and climate change" has therefore been asked to analyse the report and in all areas where action is needed show concrete ways as to how the climate target can be achieved. There is a significant area where action is needed especially in the commercial vehicle sector to which WG 1 first dedicated itself. The required integrated overall review of all areas where action is needed will take place in 2021.

### Great sense of urgency with commercial vehicles to achieve reduction in $CO_2$

The commercial vehicle sector makes up around one third of the total emissions in the transport sector. Heavy commercial vehicles used in long-distance transport are especially responsible for over half of the commercial vehicle emissions. As evidenced by the above-mentioned reports – taking into account the political framework conditions that were decided upon or are specifically foreseeable as of January 2020, – the $CO_2$ emission reduction targets of 17 to 18 million tons of $CO_2$-equivalent aimed for in CAP 2030 for the commercial vehicle sector cannot yet be achieved because there remain significant hurdles in the electrification of heavy commercial vehicles especially.

### Several technology approaches are being followed in parallel

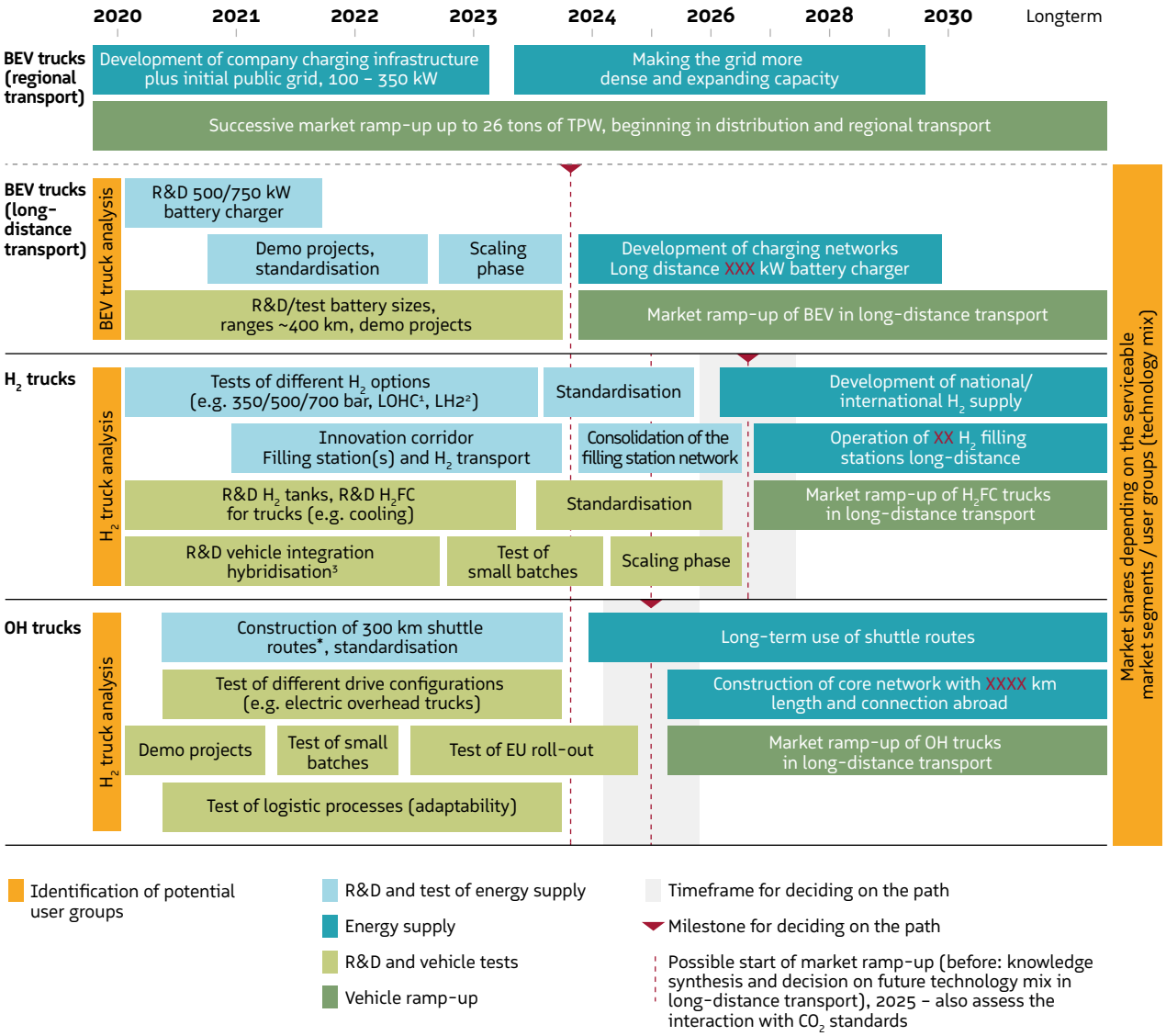
While battery electric concepts are already ready for the market for light commercial vehicles, when it comes to heavy commercial vehicles, especially for use in long-distance transport (>26 tons of total permissible weight (TPW)), some of the multiple technology options for electrification (battery (BEV), fuel cell ($H_2$FC) and overhead line (OH) HGVs) are still in the testing phase. The transport and logistics industry is also subject to enormous international competitive pressure and very much driven by costs when choosing new technologies. Other systemic criteria such as global logistics chains and route flexibility, but also issues of refuelling, charging and service infrastructure should also be considered.

### Ways of achieving one third of electric mileage in heavy commercial vehicles

A possible roadmap was developed for structured analysis of the available technology options – BEV, $H_2$FC and overhead line HGVs. This presented the three technology paths, their marketability and infrastructural framework. This possible roadmap shows:

- The successive ramp-up of **BEV trucks used in regional transport** (up to 26 tons of TPW) begins as of 2020 above all in distribution. At the same time, the focus is on setting up company charging infrastructures (100 kW) and the public grid (350 kW) by around 2023, with the grid becoming more and more dense.
- **BEV trucks used in long-distance transport** (>26 tons of TPW) are in the R&D and demo stage in terms of the actual vehicle until around the end of 2023. When it comes to charging infrastructure, the first phase should be used to develop a first nationwide charging infrastructure based on the existing standards. The expansion of public, nationwide fast-charging networks designed for commercial vehicles and the market ramp-up of vehicles will be carried out from around 2024.
- **OH trucks** are in the R&D and demo stage until around the end of 2023 both in terms of the actual vehicle and also in terms of charging infrastructure (electrification of shuttle routes), with simultaneous expansion of an extended test grid of about 300 km. Long-term use will be made of shuttle routes from around 2024. With positive results in practice, the development of the overhead core network and the market ramp-up of vehicles could take place from around 2025.

- The R&D phase with $H_2$FC trucks both for vehicles and in refuelling infrastructure is scheduled to run until around 2026. Then, if there are positive developments here too, there will be development of a national and international $H_2$-supply, the operation of a filling station network in long-distance transport and the market ramp-up of $H_2$FC trucks.




1 LOHC = liquid organic hydrogen carrier
2 $LH_2$ = liquid hydrogen
3 $H_2$ICE are also tested but are not listed here as no electric powertrain is used
* Not endorsed by all members of the WG

*Figure 5: presentation of different technology options and necessary steps to market ramp-up: a possible roadmap to achieve the goals of the CAP 2030 (own illustration)*

**Key findings and recommendation for action**

Calculations made on ramp-up curves, total cost of ownership (TCO), economic $CO_2$ avoidance costs and consideration of other decision parameters (cross-border compatibility, existence of charging infrastructure at home and abroad) have shown that at present no focus on a single technology path can be recommended. However, it may **make sense** to have a **technological focus in the medium-term** to achieve technical feasibility and a reduction in the total investment volume. According to the iterative approach, an overall review of the stage of development of the three technologies should be carried out again in 2023.

**The calculations also showed that there are significant opportunities for influencing the situation through government instruments and they should be used.**

Different recommendations for action have been put forward for all three technology paths:

- The funding of acquisition costs of electrically operated commercial vehicles.
- The rapid expansion of the refuelling and charging infrastructure for BEV and $H_2$FC trucks and the overhead line infrastructure for OH trucks with different drive configurations.
- Funded practical tests for OH trucks on a larger scale (shuttle routes).
- Intensification of research & development to attain the necessary technological maturity of $H_2$FC trucks and for cost degression (innovation corridors).
- Accelerated clarification of unanswered questions on standardisation.
- Use of effective regulatory levers: $CO_2$-based toll and the influencing of energy costs (EEG reallocation charge, taxes, $CO_2$ price etc.)

Despite the various recommendations for action, a high degree of speed and consistency is required to make one or more technology options marketable by the mid-2020s from a technical, organisational, socially acceptable and economic point of view. This is a necessary requirement to rapidly scale alternative drives in the commercial vehicle sector in the second half of the decade and achieve market integration. It is essential to scale technology options on a European scale.

**Other approaches to decarbonising heavy goods transport**

The analysis of the possible roadmap to achieve electrification options reveals that only a low number of vehicles >26 tons of TPW will be available on the market, especially in the first half of this decade. Therefore, approaches to decarbonising heavy goods transport that deliver results in the short term will also be considered, including:

- Optimising truck equipment components and trailers,
- Promoting modal shift and combined transport (CT), increasing of CT capacity and reducing mileage through among other things digitalisation and
- using gaseous fossil fuels (LNG/CNG17) and biogas.

*WG 1 Workshop report*

*Switch to alternative drives for commercial vehicles*

## KEEPING AN OPEN MIND: THE FUTURE BELONGS TO A COMBINATION OF MULTIPLE TECHNOLOGIES

Alternative drive and fuel types are already widespread today and central to sustainable and $CO_2$-reduced mobility of the future. The focus is on technological electromobility concepts, hydrogen and fuel cells and alternative fuels for internal combustion engines. These form the greatest potential for $CO_2$ reduction, regardless of technology, and at the same time ensure individual and economic mobility needs. Figure 6 shows the interactions between the different drive and fuel technologies and shows possible scenarios for use.

*WG 2 Short report*

*Possible uses under real conditions*

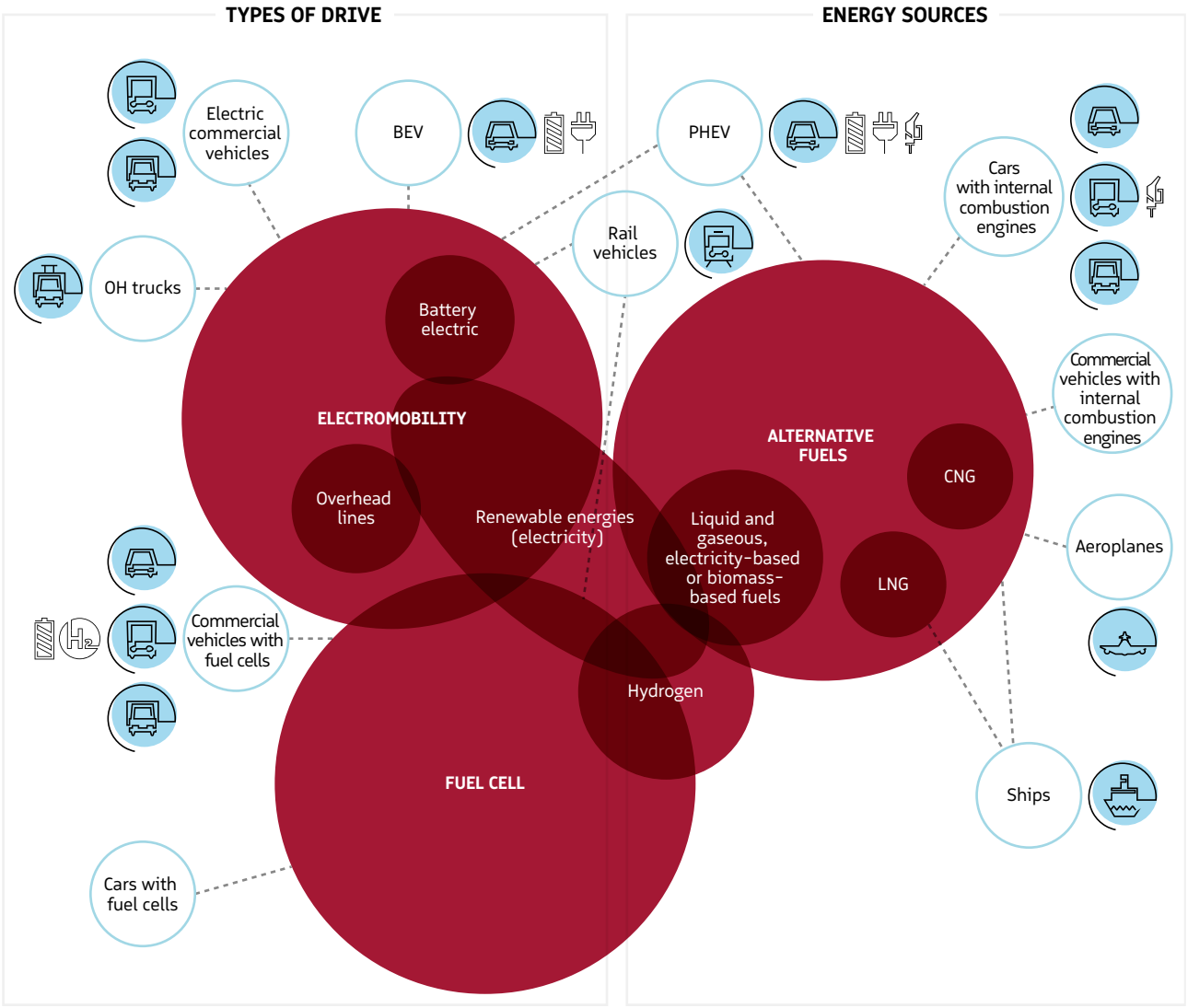



*Figure 6: The interaction between the different drive and fuel technologies (own illustration)*

**Technological electromobility concepts**

From a technological point of view, battery electric mobility currently offers the most sophisticated solution for $CO_2$ reduction, where electric vehicles are, by definition, rated $CO_2$-free for the transport sector. They therefore offer significant potential for a rapid reduction in $CO_2$ emissions. However, this does not mean that in the entire life cycle assessment electric vehicles will be operated completely emission-free as the production of battery cells is energy- and cost-intensive. Falling battery prices are anticipated due to technological improvements and scale effects in production. This means that electric vehicles can be provided even more cheaply in the future. Technical improvements are also reflected in the reduction in energy intensity in the production of battery cells so that not only costs but also the use of resources and therefore $CO_2$ emissions can be reduced.

For there to be acceptance of electric vehicles in society and for them to be user-friendly, further expansion of the charging infrastructure is needed. Both public and private charging infrastructure should be considered to achieve the number of charging points needed that can be based on the expansion of

the vehicle fleet and the charging capacity of vehicles and infrastructure. With a growing number of electric vehicles, the scaling of charging infrastructure locations in long-distance transport and in suburban neighbourhoods must be kept in mind early on. There must also be renewable energy to charge the battery because then electric vehicles can leverage their environmental benefits in the lifecycle analysis.

**Hydrogen and fuel cells**

Hydrogen can be produced using various methods. Today it is mainly generated from carbonaceous sources such as natural gas (grey hydrogen) or through electrolysis from water using electricity. For water electrolysis there therefore needs to be a sufficient supply of renewable electricity to provide emission-free green hydrogen. If during water electrolysis renewable electricity is used, the hydrogen obtained is described as "green". This is how renewable energy is transformed into storable forms of energy.

The fuel cell installed in the vehicle converts hydrogen and oxygen into electric energy and feeds it to an electric motor. However, there are currently only a few vehicle models on the market and the number of these vehicles on the roads is correspondingly small. Among other things, this is due to the high acquisition costs. As soon as batch production of fuel cell vehicles is established, the costs will come down to about the level of comparable vehicles with internal combustion engines. However, hydrogen generation and distribution and fuel cell drive systems are today already ready for the market in terms of function. The infrastructure for hydrogen distribution must not only be based on market penetration of fuel cell vehicles, but also constantly expanded with regard to the other fields of application of the energy source hydrogen.

**Alternative fuels for internal combustion engines**

Technology options for alternative fuels are mainly identified as being based on biomass-based or electricity-based fuels, today already covering five percent of the fuel requirement via biomass fuels, from cultivated biomass such as food and raw materials for feed (first-generation biofuels). Due to the high proportion of vehicles operated by internal combustion engines in the existing fleet and the currently positive market development of plug-in hybrid vehicles, the use of alternative fuels can reduce $CO_2$ emissions.

Second-generation biomass-based fuels, also called advanced biofuels, mainly process waste and residual material.

However, there are currently only pilot and demonstration plants available to make this type of fuel.

There are two manufacturing methods for electricity-based fuels. The production of hydrogen and methane through power-to-gas already shows a high level of technical maturity. Liquid fuels such as synthetic gasoline, diesel and kerosine are synthetised using the Fischer-Tropsch process from hydrogen and $CO_2$ from air. However, for these electricity-based fuels there are currently mainly pilot plants, requiring the construction of large production plants. The expansion of renewable energy to make electricity fuels is also crucial.

An appropriate framework must be created for second-generation electricity-based and biomass-based fuels to accelerate market launch and market ramp-up.

**The interaction of technologies**

The future of mobility belongs to a combination of multiple technologies. The NPM will establish in the next step what a sustainable mixture of drive and fuel technologies can look like.

## INFRASTRUCTURE FOR A SUCCESSFUL TRANSITION TO SUSTAINABLE TRANSPORT

Alternative drives and an economically operable charging and refuelling infrastructure designed for them are important components of a successful transition to sustainable transport. The "charging infrastructure" master plan has defined important measures, especially for the development of a charging infrastructure, for which the NPM has developed a variety of suggestions with the "Charging infrastructure 2019 emergency package" to advance the ramp-up of private and publicly accessible charging infrastructure. The master plan has taken up many of the measures put forward by the NPM, the initial implementation of which in 2020 contributed to positive market development despite the difficult circumstances brought about by the COVID crisis.

In addition to a funding program for private charging infrastructure, the Residential Property Modernisation Act (Wohneigentums-Modernisierungesetz – WEMoG) was passed and

*WG 5 report*

*Charging infrastructure 2019 emergency package*

the Building Electromobility Infrastructure Act introduced. The agreed talks between automobile manufacturers and BMVI were also started in order to discuss the development in the next few years in more detail and in this way support the development of charging infrastructure that is more needs-based. The National Centre for Charging Infrastructure also started working as central coordinator and among other things announced the tendering of 1000 funded locations for DC fast-charging infrastructure. There are important outstanding issues especially when it comes to increasing space availability and accelerating funding and approval procedures and the availability of devices for the fast-charging area compliant with calibration law.

**Charging infrastructure needs as "moving target"**

It is currently difficult to operate public charging infrastructure economically due to too little utilisation. This makes it clear that new approaches to determining needs and their economic viability are needed for sustainable expansion of the charging infrastructure. Contrary to previous understanding that charging infrastructure and electric vehicles are to be viewed as being in a fixed relationship, the dynamic NPM model for determining needs clearly establishes that the number of charging points required is a "moving target". This is not only dependent on the number of electric vehicles but also on the charging capacity of both vehicles and charging points, and the proportion charged in a public space. Depending on the weighting, it is therefore possible for there to be a corridor spanning 180,000 to about 950,000 required charging points for 2030 with a target number of 10.5 million electric vehicles as set out in the master plan. The degree to which the individual charging points are used is always critical for economic operation. Although the aim is to make the charging infrastructure cost-effective for 2025, it is currently unclear whether this can be achieved nationwide. Therefore, there must be clarification as to how uneconomical locations can still be financed.

**Expansion of fast-charging locations in long-distance transport**

A nationwide charging infrastructure is central to a successful transition to sustainable transport. In an initial survey of the status quo for nationwide coverage in long-distance transport, it becomes clear that fast-charging infrastructure has currently already been set up, especially at motorway service areas and truck stops along the motorway. Overall, in April 2020 61 % more fast-charging points were available than in the same period in 2019. While in some regions the expansion is already well advanced, there are some longer stretches without any fast-charging facilities along the main road axes. The NPM therefore recommends a distance corridor of 30 km to 50 km between fast-charging locations for long-distance transport by 2025 and as a first step equipping all serviced motorway service areas and truck stops with fast-charging infrastructure.

*WG 5 report*

***Needs-based and economical public charging infrastructure***

*WG 5 report*

***Nationwide charging infrastructure***

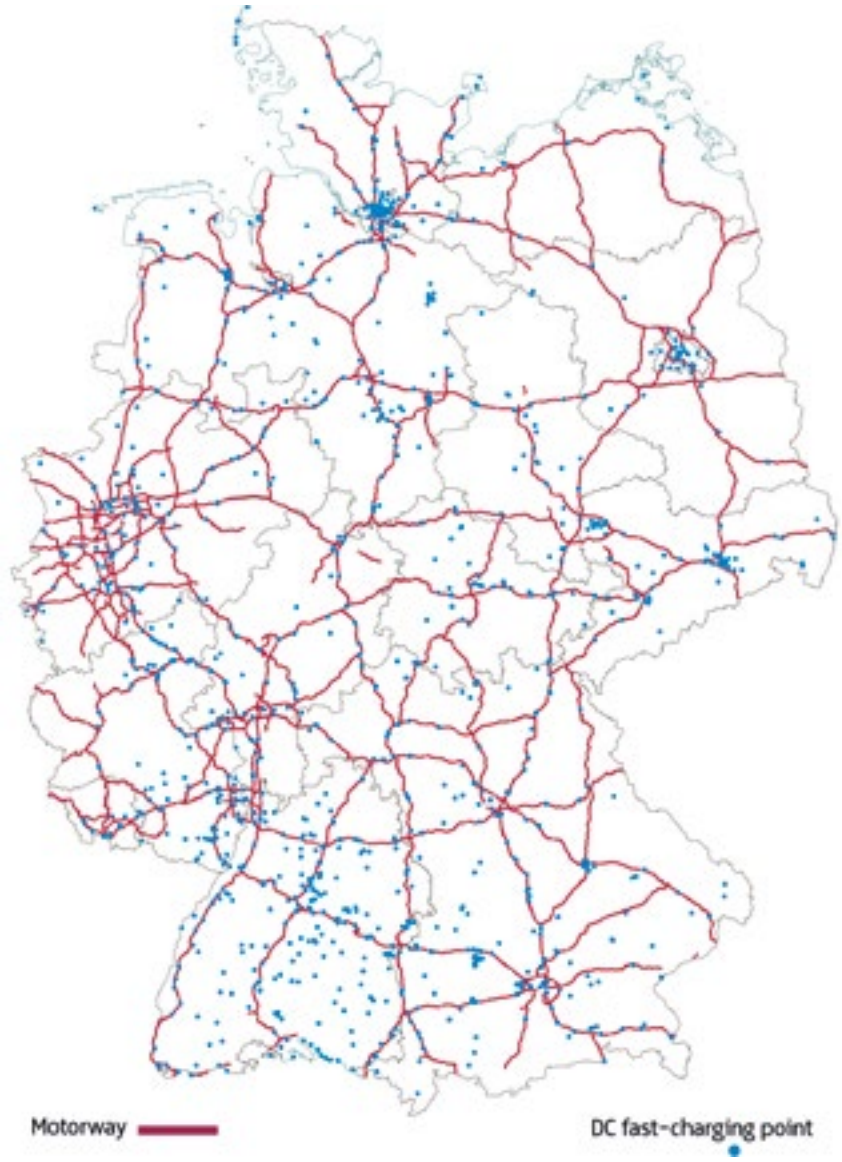



*Figure 7: fast-charging points along the motorway (as of April 2020)*
*(Source: BDEW analysis; analysis of the charging infrastructure based on data from the BDEW [Federal Association of Energy and Water Management] charging point register (April 2020), source map: EasyMap)*

**Innovative solutions for successful grid integration**

Another key component for ramping up the charging infrastructure is a successful grid integration that enables intelligent integration of electric vehicles into the energy economy, for example as part of bidirectional charging. This is because more electric vehicles and therefore more charging events increasingly affect the local power grid. Innovative solutions for a needs-based infeed and outfeed of electricity in and out of the vehicle battery (vehicle-to-grid, V2G) are therefore required to ensure grid operation. To create a common basis for classifying these new approaches, there needs to initially be a common understanding of the term "grid integration".

*WG 5 report*

*"Vehicle2Grid" Factsheet*

*WG 5 report*

*Grid integration of electromobility – Basis for a successful sector integration*

**Customer-friendly charging infrastructure and new charging solutions with plug and charge**

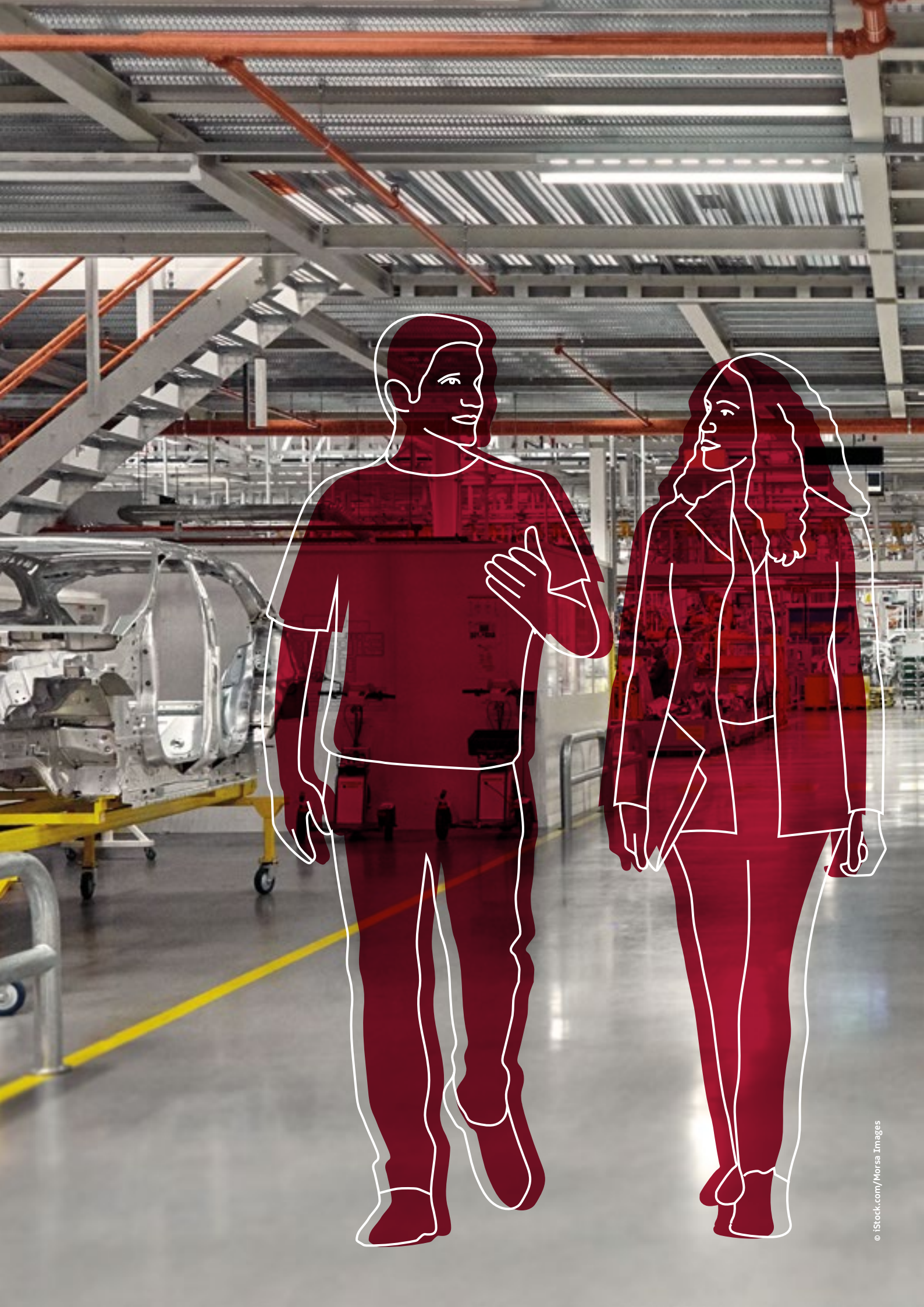
Customer-friendly charging is also an important aspect for developing public infrastructure. In addition to precise regulatory framework conditions and incentives through funding programs, competition between the market participants is central to the development of innovative solutions with the greatest benefit for consumers. These innovative solutions include for example plug and charge, i.e. starting, ending and billing a charging event just by connecting or separating the charging cable using stored contract certificates in the vehicle. In addition to technical implementation issues, the non-discriminatory use of the functionalities by users and market participants above all must be clarified and ensured.

**New requirements for charging infrastructure for commercial vehicles**

In the light of a rapid reduction in emissions in the transport sector, the development of electric commercial vehicles is especially highly relevant, bringing with it other requirements for the development of charging infrastructure. The ramp-up of hydrogen mobility also raises new questions for the provision and expansion of appropriate refuelling infrastructure. Both topics require innovative and dynamic solutions in equal measure, to which the NPM will devote itself in 2021.

*WG 5 report*

*Customer-friendly charging – Focus on public charging infrastructure*



# 2.3 SECURING GERMANY AS A PLACE FOR MOBILITY

There are only a few countries which, like Germany, produce and export vehicles on a large scale. The mobility sector plays an important role for the industry and business location that is characterised not only by strong links with other industries but on which hundreds of thousands of jobs also depend.

Germany has the opportunity to build new industrial value networks through mobility innovations and by developing and industrialising key technologies and therefore securing production in Germany and Europe. The accompanying extensive changes in employment must be recognised and proactively shaped. For this purpose companies must be provided with tools so that they can manage this change. Ultimately, political leaders are challenged to assist the transformation nationally and internationally with an active industrial policy so that structural change can be designed in such a way as to be socially acceptable, involving all stakeholders.

## IN FOCUS: ADDED VALUE AND EMPLOYMENT

The mobility industry switching to vehicles with alternative drives signifies a fundamental change of structure – a huge task for the entire business location. The sales figures for electric vehicles are increasing continually, the sales of vehicles with internal combustion engines are decreasing, with production and primary material costs for electric vehicles also being higher due to currently lower production numbers, meaning the profit margins are significantly lower. This means that the industry faces a double challenge: while sales and earnings are decreasing, companies must at the same time manage future investments and the development and expansion of production plants for electric drive concepts and train their employees to use the new technologies.

The massive slump in sales in the last few months has meant that many companies now lack the financial means to future-proof their business models and employees and invest in new technologies. As a result of the crisis, other companies are accelerating the adjustment of their business models, which often results in a notable restructuring or reduction in jobs.

**Developing closed value cycles for the mobility of the future**

The challenge of structural change is for Germany as a business location to have complete value chains. Only then does it remain competitive. To maintain prosperity and employment, most of the added value in the production of vehicles must also continue to take place in Germany. However, to date key components such as battery (cells) have been for the most part imported. A calculation of the possible effects of electromobility on employment from January 2020 underlines the urgent need for action: if the competitive position of Germany's electromobility industry does not improve in the coming years and the need for imports of battery cells and electric vehicles continues to grow with the market ramp-up, the effects on employment structures would be considerable. Therefore, supply and production structures for these components of electric vehicles that are stable and meet needs must be built on an industrial scale as quickly as possible.

**Developing new value cycles**

However, it's not just the value networks for production, but also for the recycling of batteries and electric machines from old electric vehicles that have to be built and expanded on a large scale. For production of electric vehicles in Germany and Europe, there are huge challenges in the supply of battery cells, critical primary materials for the production of lithium-ion batteries and the supply of rare earth elements for the production of electric machines. In terms of sustainability and security of supply, the value networks for these important key components of electromobility must therefore be considered as closed cycles from the beginning. It will be years

*WG 4 report*

*Qualitative consideration of the value network battery recycling*

*WG 4 report*

*Electric machine – Status quo, outlook and need for action for the German economy*

before larger quantities of old batteries and electric machines can be recycled. However, the necessary structures must be set up today so that in the future batteries and components will have a meaningful second use and valuable primary materials can be recovered and recycled on a large scale sustainably and competitively. This also includes the setting up of a suitable collection system. At the same time, uniform standards for battery recycling and certification for recycled materials should be developed and adopted across Europe.

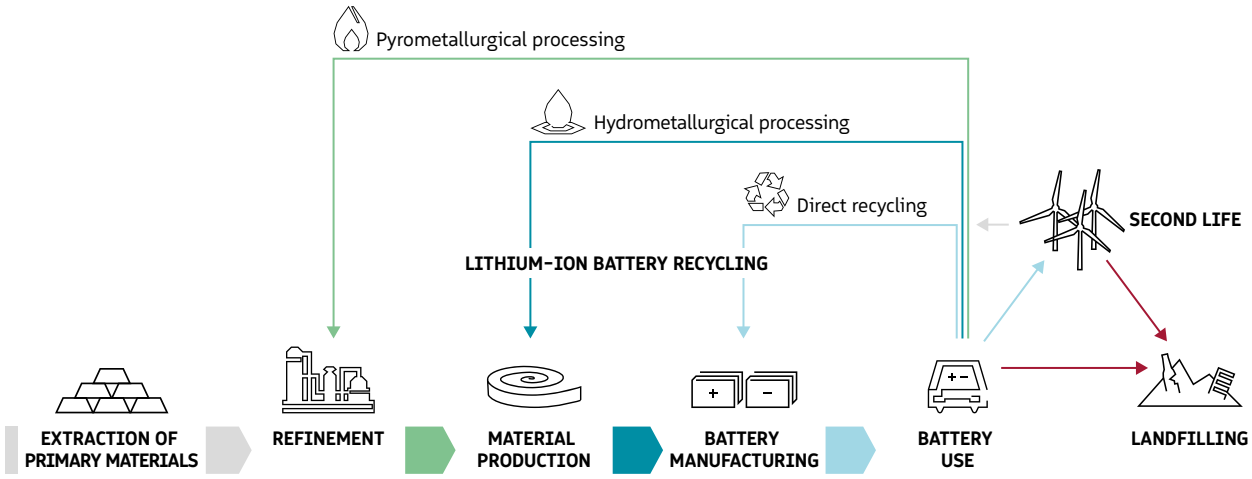



*Figure 8: closed-loop circulation of traction batteries from electric vehicles (own illustration)*

The setting up of value networks for the building of fuel cells or the production of e-fuels could bring further opportunities. Within these value networks, there are new opportunities for adjacent industries, such as machine and plant construction.

**Recognising changes in employment and the increasing importance of professional training, implementing strategic human resources planning**

With the transformation of mobility towards alternative technologies, the requirements for employees and the respective human resources needs are changing fundamentally in some cases. This transformation must be identified in good time and proactively shaped. However, employee qualification in the transformation, however, cannot be provided by individual companies alone. Rather the strengths of companies, politicians and social partners need to be pooled, preferably in the affected regions (clusters). The respective regional stakeholders (in the sense of joint action) are most likely in the position of recognising what is needed and developing solutions.

**A software tool to support small and medium-sized businesses**

Small and medium-sized companies in particular must be provided with tools for them to recognise and understand their future staffing needs and be able to introduce specific measures to secure and increase their competitiveness and employability. To that end, the NPM is developing a software tool specifically for companies in the automobile sector. This uses simulations to make clear what consequences any changes specific to the company and those which are external (such as changes in legislation) have on personnel and where gaps in staffing and overcapacities might occur.

**Regional competence hubs**

Since production structures in Germany differ by region, regional competence hubs should also be set up in which all relevant stakeholders work out collectively the future job profiles for the respective regions and define and communicate suitable qualification measures for the employees. The first pilot hubs are currently being used in Baden-Württemberg, Hesse and Lower Saxony. Insights from the pilot hubs can then be used to adapt the concept for different regional circumstances and make it usable throughout Germany.

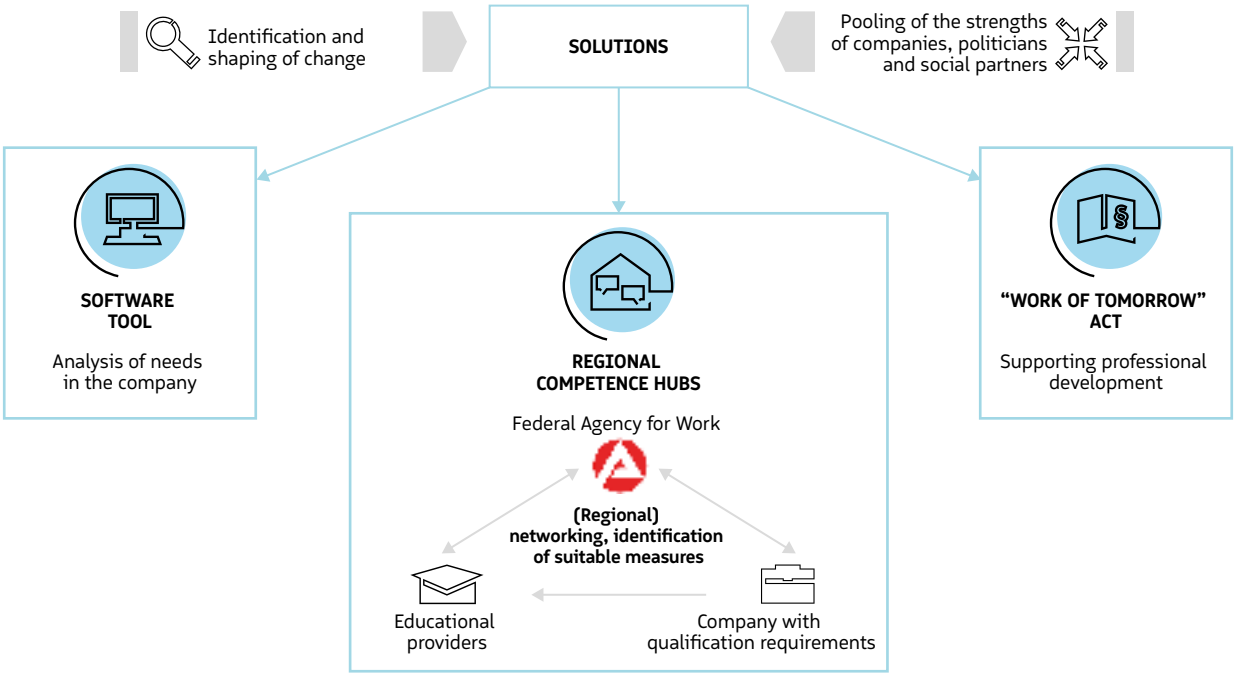



*Figure 9: future-orientated changes in employment (own illustration)*

The companies receive financial support for implementing further qualification measures from the Federal Government, among others. With the "Work of Tomorrow Act", short-time work was opened up more for qualification in spring 2020, meaning that qualification measures in the short-time working periods caused by structural change and crises can now be given greater support. This makes an important contribution to maintaining employment and ensuring employability through future-orientated training.

Research and development of disruptive technologies such as new battery generation or power electronics must also be continued across companies and supported and promoted by political leaders.

# 2.4 PASSING THE REALITY TEST – FUTURE OF MOBILITY

The mobility system has always changed and developed over time. However, the current upheaval and the accompanying transformation process are taking place at an unprecedented scale and speed. The coming together of climate protection, transition to sustainable energy, the switch to alternative drive and fuel types, digitalisation, automation and networking is having a knock-on effect that will realign the entire mobility system. Openness to all the different kinds of technology available remains a key issue for the future, especially if one keeps in mind climate protection, sustainability and economic viability. Planning and investment security for technologies, production capacities, qualified staff and infrastructures are also essential requirements for the transformation to be successful.

However, many questions on the mobility of the future will only be answered as time goes by. The consequences of digitalisation, the assessment of technology leaps and the influence of social developments are only partly predictable. It is all the more important for forward-looking concepts and technologies to be discussed and tested as early as possible in everyday life with all involved in order to validate the associated opportunities and identify and clear any stumbling blocks.

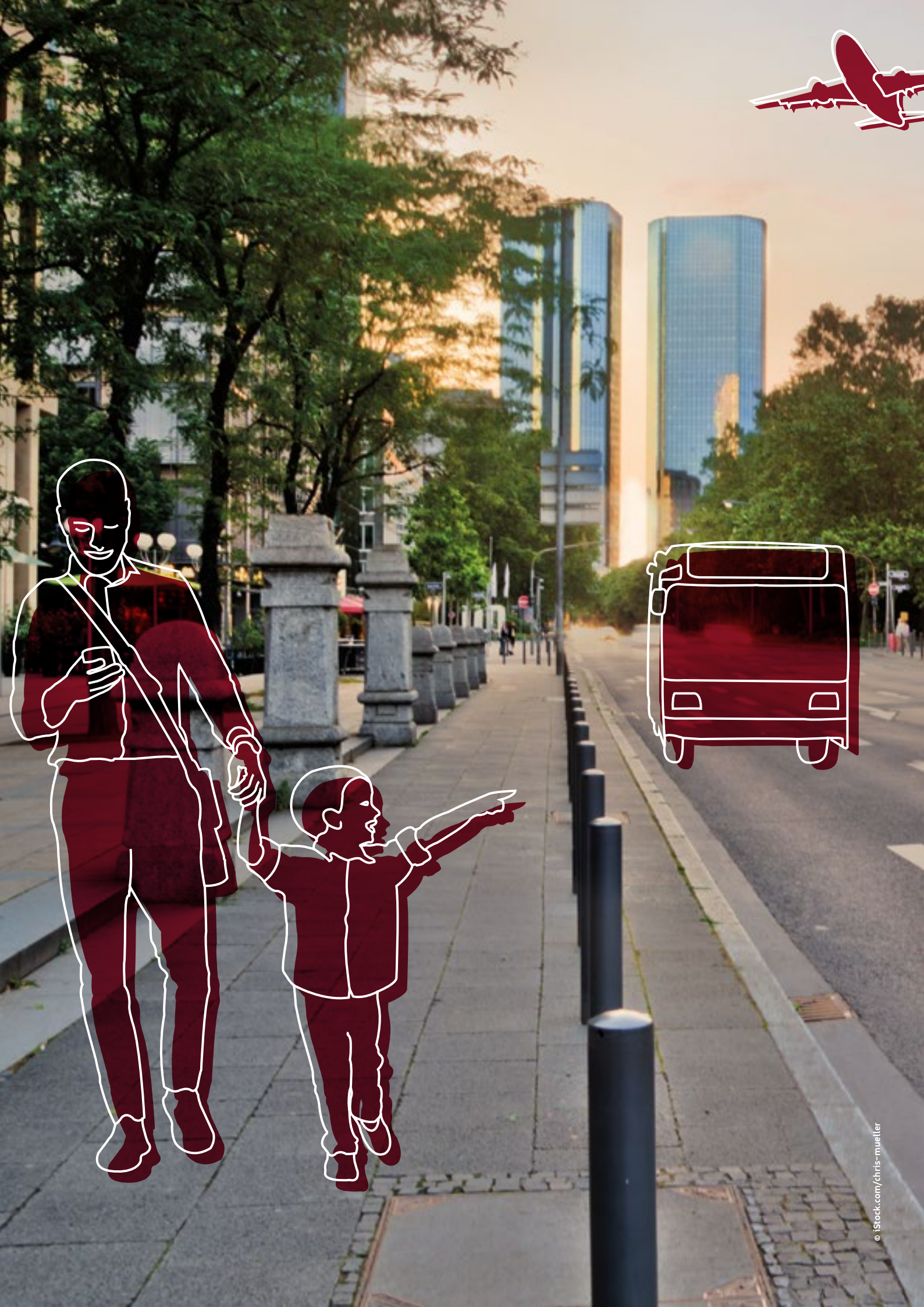
There is acceptance and success when new mobility forms and solutions meet the everyday reality and needs of the users. Spatially concentrated test and demonstration environments in laboratories known as “real-world laboratories” make a significant contribution at this point to achieving successful and nationwide practical applications from technologies.

## REALLABHH, THE REAL-WORLD LABORATORY FOR DIGITAL MOBILITY

The real-world laboratory in Hamburg (RealLabHH), which was initiated by the National Platform Future of Mobility, is where the mobility of tomorrow is to be tested in the here and now of a metropolis and, based on this, a blueprint for the digital mobility of the future is to be created. The social debate about digital mobility services will be at the centre of the project in order to provide important insights into which approaches will stand the test in practice. The digital developments in the mobility sector cannot be viewed in isolation from the social changes.

How can digitalisation shape the transport system so that it is more sustainable, safer, more convenient and more reliable? About 30 project partners in a total of eleven subprojects should help to better answer this question. This applies equally to passenger traffic and goods traffic, be it in rural areas with their specific mobility requirements or in an urban setting. The subprojects range from mobility budgets to the creation of a provider-independent mobility platform and solutions for particularly vulnerable participants in road traffic. The continuous and comprehensive involvement of citizens is envisaged. Residents can try out what’s on offer themselves and participate actively in participation and dialogue events.

RealLab Hamburg



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# 3 AN OUTLOOK FOR 2021

Many processes initiated or new legal regulations introduced in 2020 will only take effect in 2021 and later. At the same time, the COVID-19 pandemic has changed the ground rules and called into question previous approaches. The pandemic has exposed the vulnerability of our social subsystems in the mobility sector too. We must continue to build resilient structures to prepare for further shocks and contend successfully with a crisis.

With the measures adopted in the economic stimulus package, the Federal Government has made it clear, in addition to direct financial aid for the economy and consumers, that sustainability and innovations are vital for economic recovery. The long-term climate goals for 2030 and 2050 and extensive digitalisation serve as innovation providers. This is also reflected at European level.

Technologies that prove to be suitable for advancing decarbonisation and digitalisation for transport must be developed into marketable products, rolled out and scaled for an accelerated market ramp-up and with a view to competitiveness and export. Quick action and a will to implement are essential for transforming the mobility system – across industries and in close collaboration – because the different tools often only take effect after a delay of several years. Added to this are the changes in consumer behaviour as a result of technological and social innovations. This must be monitored on an ongoing basis and also taken into account through unbureaucratic and prompt adjustments on the road to transformation. It has already become apparent that the future of mobility will be a topic for the upcoming federal election in September 2021, since in Germany the topic remains closely linked to the country as a place of industry, and also to performance and jobs in the mobility industry.

The NPM is initially set up until the end of 2021. The NPM will present a summary of their extensive work at the World Congress for Intelligent Transport Systems (ITS) in Hamburg as one of the world's largest industry events. Hamburg is not only the host, but the city and metropole region will become the test and demonstration field for the digital mobility of the future as part of the event. The NPM and their members will not only present the theory of innovative mobility, but also above all its practical implications.

In all activities that help to shape a sustainable mobility system, it is important that they are set up sustainably and consider economic, ecological and social aspects in a balanced way. The focus must always be on people and their needs. Then the future mobility system will successfully deliver what it promises to be: high-quality, safe, climate-friendly and affordable.

# 4 NPM PUBLICATIONS

## 2020

| | |
|---|---|
| 12/2020<br>Interim report | **„Gesellschaftliche Dialog- und Beteiligungsstrategie zur Gestaltung digitalisierter Mobilität“ [“Social dialogue and participation strategy for shaping digitalised mobility”]**<br>Working group 3 – Digitalisation for the mobility sector |
| 12/2020<br>Interim report | **„Maßnahmen zur Digitalisierung der Verkehrsinfrastruktur“ [“Measures for digitalising the transport infrastructure”]**<br>Arbeitsgruppe 3 - Digitalisierung für den Mobilitätssektor |
| 12/2020<br>Interim report | **„Werkstattbericht Antriebswechsel Nutzfahrzeuge – Wege zur Dekarbonisierung schwerer Lkw mit Fokus Elektrifizierung“ [“Workshop report on the switch to alternative drives for commercial vehicles – ways to decarbonise heavy vehicles with a focus on electrification”]**<br>Working group 1 – Transport and climate change |
| 12/2020<br>Interim report | **„Werkstattbericht Alternative Kraftstoffe – Klimawirkungen und Wege zum Einsatz alternativer Kraftstoffe“ [“Workshop report on alternative fuels – climate effects and ways to use alternative fuels”]**<br>Working group 1 – Transport and climate change |
| 12/2020<br>Interim report | **„Roadmap zur Implementierung einer standardisierten Kommunikation zwischen Fahrzeug und Ladepunkt entsprechend der ISO 15118“ [“Roadmap to the implementation of standardised communication between vehicles and charging points as per ISO 15118”]**<br>Working groups 5 – Connecting mobility and energy networks, sector integration and 6 – Standardisation, norms, certification and type approval |
| 10/2020<br>Interim report | **„Schwerpunkt-Roadmap Nachhaltige Mobilität – Standards und Normen“ [“Focus roadmap on sustainable mobility – standards and norms”]**<br>Working group 6 – Standardisation, norms, certification and type approval |
| 10/2020<br>Interim report | **„Factsheet Vehicle to Grid – Kundennutzen und Netzintegration“ [“Factsheet Vehicle to Grid – Customer benefit and grid integration”]**<br>Working group 6 – Standardisation, norms, certification and type approval |
| 10/2020<br>Interim report | **Flächendeckende öffentliche Infrastruktur“ [“Nationwide public infrastructure”]**<br>Working group 5 – Connecting mobility and energy networks, sector integration |
| 10/2020<br>Interim report | **„Positionspapier Elektrische Maschine – Status Quo, Ausblick und Handlungsbedarfe für die deutsche Wirtschaft“ [“Position paper on electric machines – status quo, outlook and need for action for the Germany economy”]**<br>Working group 4 – Securing Germany as a place for mobility, production, battery cell production, primary materials and recycling, training and qualification |
| 10/2020<br>Interim report | **„Positionspapier Qualitative Betrachtung des Wertschöpfungsnetzwerks Batterierecycling“ [“Position paper on qualitative consideration of the value network on battery recycling”]**<br>Working group 4 – Securing Germany as a place for mobility, production, battery cell production, primary materials and recycling, training and qualification |

| | |
|---|---|
| 10/2020<br>Result report | **„Empfehlungen zum optimierten Nutzungsgrad von Plug-in-Hybridfahrzeugen“ [“Recommendations for optimum energy efficiency of plug-in hybrid vehicles”]**<br>PHEV taskforce |
| 07/2020<br>Interim report | **„Plattformbasierte intermodale Mobilität und Handlungsempfehlungen zu Daten und Sicherheit“ [“Platform-based intermodal mobility and recommendations for action on data and safety”]**<br>Working group 3 – Digitalisation for the mobility sector |
| 07/2020<br>Short report | **„Netzintegration von Elektromobilität – Basis für eine erfolgreiche Sektorkopplung. Eine Definition“ [“Grid integration of electromobility – basis for successful sector integration. A definition”]**<br>Working group 5 – Connecting mobility and energy networks, sector integration |
| 06/2020<br>Short report | **„Einsatzmöglichkeiten unter realen Bedingungen“ [“Possible uses under real conditions”]**<br>Working group 2 – Alternative drive technologies and fuels for sustainable mobility |
| 06/2020<br>Report | **„Schwerpunkt Roadmap Automatisiertes und vernetztes Fahren“ [“Focus roadmap on automated and connected driving”]**<br>Working group 6 – Standardisation, norms, certification and type approval |
| 04/2020<br>Report | **„Kundenfreundliches Laden – Fokus öffentliche Ladeinfrastruktur“ [“Customer-friendly charging – focus on public charging infrastructure”]**<br>Working group 5 – Connecting mobility and energy networks, sector integration |
| 04/2020<br>Report | **„Bedarfsgerechte und wirtschaftliche öffentliche Ladeinfrastruktur – Plädoyer für ein dynamisches NPM-Modell“ [“Needs-based and economical public charging infrastructure – plea for a dynamic NPM model”]**<br>Working group 5 – Connecting mobility and energy networks, sector integration |
| 04/2020<br>Report | **„Schwerpunkt Roadmap Intelligentes Lastmanagement“ [“Focus road map on intelligent load management”]**<br>Working group 6 – Standardisation, norms, certification and type approval |
| 03/2020<br>White Paper | **„Handlungsempfehlungen zur Typgenehmigung und Zertifizierung für eine vernetze und automatisierte Mobilität“ [“Recommendations for action on type approval and certification for connected and automated mobility”]**<br>Working group 6 – Standardisation, norms, certification and type approval |
| 01/2020<br>Interim report | **„Zwischenbericht zur strategischen Personalplanung und -Entwicklung im Mobilitätssektor“ [“Interim report on strategic personnel planning and development in the mobility sector”]**<br>Working group 4 – Securing Germany as a place for mobility, production, battery cell production, primary materials and recycling, training and qualification |

## 2019

| | |
|---|---|
| 12/2019<br>Interim report | **„Handlungsempfehlungen zum autonomen Fahren“<br>[“Recommendations for action on autonomous driving”]**<br>Working group 3 – Digitalisation for the mobility sector |
| 12/2019<br>Progress report | **Fortschrittsbericht der Nationalen Plattform Zukunft der Mobilität<br>[Progress report from the National Platform Future of Mobility]** |
| 11/2019<br>Short report | **„Elektromobilität. Brennstoffzelle. Alternative Kraftstoffe – Einsatzmöglichkeiten aus technologischer Sicht“ [“Electromobility. Fuel cells. Alternative fuels – possible uses from a technological point of view”]**<br>Working group 2 – Alternative drive technologies and fuels for sustainable mobility |
| 10/2019<br>Interim report | **„Zwischenbericht zur Wertschöpfung“ [“Interim report on added value”]**<br>Working group 4 – Securing Germany as a place for mobility, production, battery cell production, primary materials and recycling, training and qualification |
| 10/2019<br>Report | **„Roadmap PtX“ [“PtX roadmap”]**<br>Working group 5 – Connecting mobility and energy networks, sector integration |
| 10/2019<br>Report | **„LNG- und CNG-Strategie im Schwerlastverkehr“<br>[“LNG and CNG strategy in heavy goods transport”]**<br>Working group 5 – Connecting mobility and energy networks, sector integration |
| 9/2019<br>Report | **„White Paper Aktuelle Entwicklungen und Herausforderungen zur Zukunft der Mobilität“<br>[“White paper on current developments and challenges for the future of mobility”]**<br>Working group 6 – Standardisation, norms, certification and type approval |
| 03/2019<br>Interim report | **„Wege zur Erreichung der Klimaziele 2030 im Verkehrssektor“<br>[“Ways to achieve the 2030 climate goals in the transport sector”]**<br>Working group 1 – Transport and climate change |
| 03/2019<br>Report | **„Sofortpaket Ladeinfrastruktur 2019“ [“Charging infrastructure 2019 emergency package”]**<br>Working group 5 – Connecting mobility and energy networks, sector integration |
| 03/2019<br>Report | **„Red-Flag-Bericht 10 % EV-Neuzulassungen“<br>[“Red flag report 10% electric vehicle registration”]**<br>Working group 5 – Connecting mobility and energy networks, sector integration |
| 02/2019<br>Interim report | **„Digitalisierung für den Mobilitätssektor“ [“Digitalisation for the mobility sector”]**<br>Working group 3 – Digitalisation for the mobility sector |

*All reports only reflect the opinions of the experts involved in the NPM.*

*2020 and 2019 reports*

*National Platform Future of Mobility*

# 5 TABLE OF FIGURES

# CHAIR AND MEMBERS OF THE NPM STEERING COMMITTEE

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# IMPRINT

## AUTHOR

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## EDITORIAL SUPPORT

acatech – Deutsche Akademie der Technikwissenschaften [German Academy of Science and Engineering]
ifok GmbH

## MEMBERS OF THE EDITORIAL TEAM

Dr. John Erik Anderson (DLR)
Kai Bliesener (IG Metall)
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Dr. Jan Strobel (BDEW)
Johannes Thiele (acatech)
Amelie Thürmer (BDEW)
Alexander Vetter (acatech)
Simona Wieser (acatech)

## TYPESETTING AND LAYOUT

Warja Rzepka (ifok)

## PROOFREADING (GERMAN VERSION)

Nikola Klein – e-squid text konzept lektorat

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