Decarbonising Mobility:
TOGETHER, WE DRIVE CHANGE

December 2021
go.shell/DecarbonisingMobility
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Decarbonising the Mobility sector will require co-operation: with governments to help produce regulation that effectively supports decarbonisation; with businesses, such as fleets and vehicle manufacturers; and above all, with customers.

We hope this report will provide you with some new and useful insights. To collect the data, Frost & Sullivan sought the expert opinions of numerous industry executives and used online surveys to gather the views of more than 5,000 customers.

Knowing the thinking of others in the industry – from fleet operators to motor vehicle manufacturers – helps us all to help each other decarbonise.

And knowing the thinking of the customer is vital.

Shell is the world’s leading mobility retailer, with around 46,000 service stations visited by around 30 million customers every day. This scale allows us to offer low-carbon products globally, but if those products fail to attract the customer, they will not work, which is why we must always put the customer first in our decision making process.

We know that the decarbonisation of mobility will require different solutions and different paces across the globe. For example, in some countries, low-carbon biofuels may be a more viable option than electric vehicles.

Therefore, I am particularly pleased that the research reflects the views of customers in 10 key markets around the world.

By gathering the perspectives of these thousands of consumers, and by listening closely to what they have to tell us about their individual journeys towards decarbonisation, I believe this report can help those of us working in the mobility sector provide our customers with the products and services they want and need.

Finally, I am deeply grateful to every one of the industry participants and customers who helped with this report. You’ve all done a great service.
Mobility, the sector encompassing motorised two- and three-wheelers, cars and vans, is a large contributor to overall global emissions. Road vehicles of all kinds account for around 18% of the carbon dioxide emissions from burning fuel¹.

The world must achieve the climate goals of Glasgow and the Paris Agreement and so urgent action is needed to cut carbon emissions from the mobility sector. By capturing the views of Shell’s customers, partners and industry experts, this report seeks to determine how best the mobility sector can decarbonise, meaning get to net-zero emissions. It examines mobility’s efforts to decarbonise, identifying major new trends, obstacles and opportunities.

¹https://www.iea.org/topics/transport

The report has been prepared by consultants Frost & Sullivan on behalf of Royal Dutch Shell Plc (“Shell”). In 2021, Frost & Sullivan conducted online surveys of more than 5,000 motorists and consumers in 10 key markets across the world: Brazil, China, Germany, India, Norway, Poland, Singapore, the Philippines, United Kingdom, and the US state of California.

The researchers gathered opinions and insights from mobility industry professionals, using surveys and interviews with around 50 of Shell’s business partners and customers, including fleet operators and managers. Frost & Sullivan also drew upon the insights of mobility experts and interviewed Shell executives.

All engagements were conducted in a manner that respects competition law boundaries.
The main findings of Frost & Sullivan’s research were:

Customers are serious about reducing their environmental impact: a sizeable proportion of customers are actively seeking to reduce their environmental impact, with more than one in three rating carbon emissions as very important when choosing a new vehicle;

The transition is accelerating: the mobility sector as a whole, at the end of 2021, has made a faster start on the road to net-zero emissions than the executives and experts had anticipated just 18 months ago;

Electric vehicles will play the most important role: there is a global consensus throughout the industry that electric vehicles (EVs), including electric two- and three-wheelers, have a key role to play in helping individuals and businesses to reduce their carbon emissions;
EVs need to be powered with clean energy: customers are aware of that without cleaner power generation, their full benefit is unlikely to be realised;

Infrastructure matters: the adoption of EVs could be slowed by obstacles such as range anxiety (the concern that vehicles’ batteries will run out before they reach their destinations), inadequate charging infrastructure, and a limited choice of models, particularly for vans, also known as light commercial vehicles (LCVs);

We need to avoid a gridlock: as EVs increase in number, the impact of vehicle charging on the power grid will need careful management. Advanced vehicle-to-grid charging systems can help. They allow EVs to communicate with the grid, so charging times and speeds can be adjusted according to overall electricity demand. Vehicle-to-grid (V2G) charging systems also allow EVs to supply electricity to the local power network when supplies are tight, which offers huge opportunity for future energy systems;
China will be the largest EV market this decade: there is likely to be considerable regional variation in how quickly EVs can be adopted. Their current penetration is concentrated in China, Europe and the USA;

Internal combustion engines will be with us for some time: it’s expected internal combustion engines (ICE) will remain a significant part of the vehicle mix in years to come, even if the sale of new ICE vehicles is banned in some markets by the end of the decade. It is important that these vehicles, improved with fuel efficiency gains and emission reductions, are regarded as part of the overall vehicle population when considering the solutions to lower emissions. Biofuels will also be important in decarbonisation, especially in regions where EV adoption is more challenging, including congested metropolises where charging infrastructure build-out will be slower and areas with an electricity grid under-capacity and instability of power supply;

Carbon credits need to play a role: in reducing the net-carbon emissions from mobility, especially in the short term for the benefits of this to be fully realised, the industry and mobility consumers must have greater confidence in carbon credits if options for avoidance or reduction of emissions aren’t available or accessible;

Ride-hailing and car-sharing are likely to help to decarbonise mobility, but not in the short term: According to one study every vehicle that enters the shared transport economy may have the potential to reduce personal car ownership by 11 vehicles², but recent research on ride-hailing suggests emissions are actually higher than for personal vehicle ownership because of the time the vehicle’s engine is running between rides³;

The COVID-19 pandemic has changed mobility habits, and prompted a switch to more personal car use, walking and cycling. Only time will tell whether these changes are permanent or whether people will revert to pre-pandemic patterns;

Governments, customers and companies must work together: The research led us to identify key themes for the future of mobility including the need for governments to drive change through policies and regulations that drive customer choices. It is also clear that it will take governments, companies, customers, and wider society all working together to achieve the world’s climate goals.

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² UC Berkeley’s Transportation Sustainability Research Center (2016), Impacts of Car2Go on vehicle ownership, modal shift, vehicle miles travelled, and greenhouse gas emissions
³ Quartz 2021, Taking an Uber is Worse for the Climate Than Driving Your Own Car
DECARBONISING MOBILITY – A SUMMARY OF OUR FINDINGS
Consumers are looking for ways to reduce emissions from their driving

Consumers around the world want lower-carbon mobility products and services. Of the customers who responded to our online survey*, 80% use an ICE vehicle today, but only one-third of those said they would consider buying a traditional ICE vehicle in the future. The survey group also highlighted the growing importance of environmental factors in their decision-making where 37% rated the importance of vehicle emissions as either nine or 10 out of 10. This was only four percentage points behind price.

The data also highlighted appetite from customers for more understanding of vehicle efficiency and emissions, with 88% of the respondents interested in receiving useful information to influence their buying decisions, including carbon and particulate emissions ratings and information about emissions produced in the manufacturing process.

Consumers in China, Singapore and California showed more appetite for hybrid vehicles than their counterparts in Europe. For EVs there was a more even spread across the globe but a clear preference for EVs over hybrids from India and Brazil.

Consumers believe the entire mobility value chain has an impact on the greenhouse gas emissions that contribute to the warming of the earth and climate change. The research shows 44% strongly agree that the way people travel has a significant impact on climate change. There is also agreement that the mobility industry, including energy providers, car manufacturers, and transport, travel, and logistics companies, should take collective responsibility.

Almost three-quarters of survey respondents thought that while they were making lifestyle changes such as recycling, reducing lighting in the home, and cutting waste, they did not see enough being done by the mobility industry. In Asia, the proportion was higher with 80% believing they are doing enough at an individual level.

*The survey group generally showed a bias towards individuals with a stable income and a comfortable standard of living. The sample had 6.7% fully EV drivers and 13.7% hybrid, which is slightly higher than current market share.
TRENDS IN DECARBONISING MOBILITY
The Importance of EVs – And the Challenges to Resolve

A sample of key industry executives, ranging from FMCG through to automotive and ride-hailing companies, overwhelmingly expect that within the light-duty sector, adoption of battery EVs will be the top mobility trend in their companies over the next five years. Fleet companies agree that EVs, including hybrids and battery EVs, are the future of drivetrains in cars and vans. It is additionally worth noting that, cumulatively, leveraging public transport, new forms of mobility and reducing vehicle mileage also plays a critical role.

Thinking about your company, in your opinion which are the top three mobility trends from the below list that are likely to gain traction in the next 5 years?

- Increase in adoption of battery electric vehicles
- Increase in the adoption of autonomous vehicles
- Increase in shift from private vehicle to public transport usage
- Policies driving the adoption of autonomous vehicles
- Replacing vehicle trips with other modes, such as bicycles
- Replacing the fleet of vehicles
- Pooling vehicles with other companies
- Others

The Need To Ensure The Electricity Comes From Low-Carbon Sources

This issue of how to generate power can be particularly sensitive because in both the OECD and non-OECD world, there are often economic trade-offs for the poorer segments of the populations (ex. Spain, Italy, US). With the increase in energy prices globally, heightened scrutiny should be expected in terms of accessibility to energy vs the affordability of this energy – be it sourced from a fossil fuel or a renewable source. The debate at COP26 between the rich(er) and poor(er) countries has highlighted these potential conflicts. Emerging markets such as China and India will need more energy as their economies grow and their populations increase, urbanise and become more middle class. Balancing the need for accessible and affordable energy alongside the drive to net zero is a challenge. This in turn will affect how much EVs can contribute to decarbonisation despite the growth in new EV sales, which saw a jump of 41% year-on-year, to about 3 million units⁴ in 2020. This looks set to continue with Frost & Sullivan suggesting EVs will constitute 25% of new vehicle sales globally by 2030, with the electrification of fleets, taxis and personal cars placing 140 million EVs on the world’s roads by 2030 and exceeding 400 million by 2040 (only about 10.2 million EVs were in use in 2020)⁵.

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⁴ Frost & Sullivan Analysis, 2021
⁵ World Economic Forum, 2020, How many electric cars are on the worlds roads and which country has the most? https://www.weforum.org/agenda/2021/05/chart-that-is-the-state-of-the-global-electric-car-market/
When industry executives were asked about the barriers for low-carbon mobility products, it became clear that the adoption of EVs is being slowed by a lack of charging infrastructure and the inconvenience of their long recharging time. In fact, inconvenience (including long recharging time) was rated overall as the number one hurdle, followed by life-cycle costs and total cost of ownership, with investments necessary ranked third: the latter being the top issue for North American executives.

Fleet managers see the expansion of EV-charging networks over the next five to 10 years as a key infrastructure need to enable a quicker shift to EVs, specifically to battery EVs in the latter half of this decade.

If the infrastructure is inadequate and there are not enough chargers, potential customers will be put off by range anxiety, creating a chicken-and-egg situation – customers are reluctant to buy EVs because they consider the charging network to be insufficient, but the mobility industry can be hesitant about spending to develop the infrastructure when there are relatively few EVs on the road.

Also, the problem of EV charging infrastructure is not the only factor slowing the adoption of EVs. Customers may also be put off by an EV’s relatively long recharging time compared with how quickly you can fill up a petrol or diesel vehicle. Another issue is the current limited choice of vehicles, especially in the light commercial vehicle sector (i.e., vans).

Technology is likely to help mitigate some of the challenges around charging EVs. Advances in battery technology in the late 2020s will likely see the introduction of solid-state batteries with higher density, reduced weight and quicker charging time. VW aims to be selling these by 2025 and BMW plans to have a solid-state battery ready for mass production by 2030. Vehicle manufacturers play an important role, as demonstrated at COP26 in Glasgow, with 32% of the global passenger vehicle market now covered by commitments to end sales of fossil fuel-powered vehicles, up from a near zero share of the market at the start of 2021⁶.

EV charging infrastructure will also improve significantly if governments and industries work collaboratively to ramp up infrastructure spending. Frost & Sullivan expects to see a compounded annual increase of 28% in installed EV charge points globally by 2030, which would see the total reach 6.4 million (up from 529,000 in 2020)⁷.

Industry executives ranked the top three measures taken by their companies to reduce emissions as follows:

- Using renewable energy
- Switching to low-emission vehicles
- Using green materials
The effects of regional variations in EV sales

The speed at which EVs are being adopted varies according to location.

The World Economic Forum reports that 92% or 9.5 million of the 10.2 million EVs on the world’s roads in 2020 were concentrated in China, Europe, and the USA, with an estimated 750,000 vehicles in the rest of the world.

China’s total of around 4.5 million EVs represents 44% of all the world’s electric vehicles. It is likely to remain the global EV leader this decade with ambitious policy direction backed by government investment in the sector.

Electrification will play an important role in Asia’s two-wheeler market, which includes motorcycles, mopeds, and scooters. In 2020, 74 million two-wheelers were sold worldwide, outnumbering cars by 20 million. Some 2.5 million of these were electric two-wheelers, equating to 3.4% of all two-wheeler sales worldwide that year, according to Frost & Sullivan data. The number is expected to rise to 20 million units a year by 2030.

India has introduced regulation enabling the sale of two-wheelers without batteries. The battery can then be supplied by a subscription-based energy service provider and swapped, once drained, for a fully charged one, significantly reducing the up-front cost of electric two-wheelers, eliminating long charging time, and alleviating range anxiety, further encouraging sales.

Regional differences are expected to grow more pronounced in the coming decades. In countries where the uptake of EVs is slowest, there will be an even greater need for other decarbonisation solutions.

EVs alone will not be enough

The International Energy Agency (IEA), in its report Net Zero by 2050, suggests that all new ICE passenger car sales will need to be halted by 2035 to meet net-zero ambitions. Some European governments are already providing financial incentives to consumers to shift to EVs. Disincentives, such as increased taxes or toll charges for ICE users, could also become more common and may become more acceptable to a wider section of the public as the need to get to net zero becomes even more obvious. However, it is still doubtful that the uptake of electric vehicles will be fast enough for EVs alone to decarbonise mobility.

The IEA’s Net Zero by 2050 report also suggests that by 2030, 60% of worldwide new car sales (compared to a base of just 5% today) must be EVs to meet the goals of the Paris Agreement. Frost & Sullivan has forecast that EVs will still only account for a small proportion of the 2 billion vehicles on the world’s roads at the end of this decade because of the number of used and older vehicles, which will take time to replace.

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9 Frost & Sullivan forecast
10 World Economic Forum (2020), How many electric cars are on the world’s roads and which country has the most? Available at https://www.weforum.org/agenda/2021/05/chart-tracks-the-state-of-the-global-electric-car-market/
TRENDS IN DECARBONISING MOBILITY

Alternative Fuels

Alternative fuels already play a significant role in some markets and could help fill the gap where there remain significant numbers of ICE vehicles on the road.

Biofuels

Biofuels are one of the largest sources of renewable energy in use today, made from organic matter or waste, which can reduce carbon dioxide emissions from mobility and other transport sectors. Biofuels can be blended with traditional fuels such as petrol and diesel and used in conventional ICE vehicles and infrastructure without expensive modification. Many European and US markets limit biofuel blending by policy at low percentage levels, e.g., Europe is limiting Biodiesel blending to 7% and Ethanol to 10%, while countries like Brazil and Thailand allow blends well above 20%. However, vehicle technology is available today to accept even 100% biofuels (e.g., HVO or Bio-LNG). Biofuels will be especially important in hard-to-abate sectors such as trucking, aviation and shipping. This is because liquid fuels provide a lot of energy for a given amount of fuel. Electricity and hydrogen offer solutions over shorter distances today, but the longer the journey, the more important biofuels are.

Currently, most available biofuels are produced from cereals, vegetable oils and sugar cane. From cultivation to use, some biofuels can emit significantly less CO2 when compared with conventional gasoline, but this depends on several factors, such as how the feedstock is cultivated, and the way the biofuel is produced. Other challenges include concerns over labour rights, the amount of water used in the production process, and the competing demands for land use.

Where feedstocks are considered to be potentially high risk from the perspective of human rights, biodiversity, or the release of carbon stock, they can be certified as sustainable by credible sustainability initiatives.

More sustainable carbon dioxide reduction benefits can be achieved through second-generation biofuels, which are produced from agricultural waste. These fuels, often called advanced biofuels, further reduce life-cycle emissions, moderate food-security concerns, and alleviate the environmental impact of agricultural waste products.

As is the case for all alternative energies, biofuels are more costly to produce than petrol or diesel, meaning they may have to be sold at a higher price than the market is used to. Government support may be required to help counter this by incentivising lower carbon alternatives; for example, by establishing feasible mandates that allow the industry to comply, incentivising vehicle manufacturers to develop new engine technologies that can use higher levels of biofuels and introducing time-limited price support for advanced biofuels (such as exemption from fuel excise duty).

Consistent and long-term policy frameworks are critical to developing advanced biofuels because investors need to be confident that they will be able to sell the products at a profit and for long enough to justify investment.
Hydrogen

Hydrogen, produced via electrolysis and renewable power (green hydrogen), is widely regarded as potential solution in the mobility sector. Many in the industry see it as best suited for heavier transport such as trucks and buses, rather than the lighter vehicles that form the focus of this report, due to energy losses in hydrogen production and conversion to electricity in the car. For heavier vehicles, requiring more power and operational time, the fast refueling and the increased range capability of hydrogen vs. battery weight and charging time is considered as the competitive advantage. This would need to be supported by hydrogen refuelling networks along routes often used by heavier vehicles.

Liquefied natural gas (LNG)

LNG can help reduce the well-to-wheel greenhouse gas emissions from heavy duty trucks by up to 16% compared to conventional diesel today. Bio-LNG has a similar chemical composition to liquefied natural gas (LNG) but is made from the process of microbes digesting organic waste. Bio versions of LNG and compressed natural gas (CNG) are already commercially available as a decarbonisation option for vehicles, but currently LNG is used primarily for heavier transport such as trucks.

Synthetic Fuels

Synthetic fuels are not widely available today but could be developed over the longer term. Energy companies are working to produce low-carbon synthetic fuels using green hydrogen produced with renewable electricity, and carbon dioxide from industry processes or captured from air. The advantage of synthetic fuels is that they can be seamlessly blended in the current fuel mix to gradually decarbonise not only new, but also the legacy fleet of vehicles. Given the complexity and cost for the production, synthetic fuels are not expected to spread broadly, but will be more focused on applications like aviation, which are lacking alternative decarbonisation pathways.

1 JEC Well to Wheels Report
The Role of High-Quality Carbon Credits

High-quality carbon credits can play an essential role in decarbonisation where low-emission vehicles and clean fuels are not yet available or accessible. But for this to happen, their use must be made more transparent and verifiable. They also need to be more appealing to mobility consumers and the industry, and their impact should be clearer.

The mobility sector should address concerns over carbon credits and emphasise the important role they can play in decarbonisation. Carbon credits must all be subject to rigorous standards and assurance mechanisms, and their role communicated more clearly to consumers. Concerns around carbon credits can partly be addressed by:

- Proving their additionality – that they have been derived from projects which would not otherwise have been developed without the credits acting as a means for funding.
- Incentivising development of projects that are physically closer to the source of emissions and with near-term impact
- Offering carbon credits which also offer additional benefits such as biodiversity, habitat protection or indigenous employment
- Encouraging customer uptake through clear and compelling communication, which always positions carbon credits in the hierarchy of avoid, reduce, compensate.

The most important factors in shaping this market will be increased focus on credit quality, project type, value chain proximity and the co-benefits beyond pure emission reductions. There is a concerted push in the industry for improved standardisation and transparency measures which will allow for easier comparison of carbon credits. Over the next decade purchasers of carbon credits are likely to favour emissions removal projects and, within these, nature-based projects which offer a more compelling story. High-quality avoidance credits generated from projects which protect natural carbon sinks under threat, will also be critical to meet demand.

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Ride-Hailing, Car-Sharing and The Shared Transport Economy

Shared transport includes services such as ride-hailing, car-sharing, car-pooling and micro-mobility modes such as e-scooters and bike-sharing solutions. Mobile phones have made many of these shared transport options much easier to access and use. As a consequence, they are growing in popularity and it has been estimated that by 2040, three out of four new cars will be part of the shared economy.

Frost & Sullivan forecasts strong growth in vehicles in the shared economy and in the mobility-as-a-service sector. Car-sharing and ride-hailing vehicles are predicted to grow at healthy annual growth rates. Demand responsive transport vehicles, used to meet variable demand for routes and timings, often in areas of low demand such as rural and semi-rural areas, and mobility-as-a-service are forecast to grow particularly quickly.

Frost & Sullivan forecast growth rates in shared economy vehicles and services

<table>
<thead>
<tr>
<th>Service</th>
<th>2020</th>
<th>2030F</th>
<th>Annual Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carsharing</td>
<td>0.3</td>
<td>0.5</td>
<td>16%</td>
</tr>
<tr>
<td>Ridehailing</td>
<td>20</td>
<td>30</td>
<td>85%</td>
</tr>
<tr>
<td>Demand Responsive Transport</td>
<td>0.03</td>
<td>0.41</td>
<td>85%</td>
</tr>
</tbody>
</table>

Forecast for Carsharing vehicles, in millions

Forecast for Ridehailing Vehicles

Forecast for Demand Responsive Transport Vehicles
The pandemic has caused dramatic changes in how we shop and work, with more home deliveries of goods and services and more home-based working and learning. As a result of the increase in home deliveries, it has become even more important to reduce emissions from last-mile delivery, the final stage in a package’s journey to the consumer. Middle-mile and mobility hubs, aggregating local delivery or pick-up points for customers, are part of a wide set of capabilities needed across the mobility sector which will optimise energy efficiencies through scale.

Among the surveyed consumers, up to 34% were using ride-hailing and 22% were using car-sharing services at least once a week. The pandemic has discouraged this to some degree, with the older generation of 61 to 75 years old, in particular, avoiding shared mobility alternatives.

Fewer people are owning cars as more rely on shared transport solutions. On average, 14% of vehicle owners indicated a willingness to use their car less in favour of some form of shared mobility, with the highest incidences in Brazil, India, the Philippines, and Germany.

Share of consumers choosing to substitute car use with shared mobility options

- Germany: 17.2%
- Norway: 10.7%
- Poland: 9.3%
- UK: 11.8%
- USA (California): 7.9%
- Brazil: 20.2%
- China: 14.7%
- India: 17.4%
- Philippines: 17.2%
- Singapore: 11.1%

Data from various sources.
The Growing Role of Technology

Technologies to reduce emissions and promote more efficient driver behaviour can help to improve the efficiency of internal combustion engines.

Telematics enables the gathering and sending of vehicle data, such as location, driver behaviour and engine diagnostics. Some companies in Europe and North America have been using telematics for over 20 years, while their counterparts in Asia are yet to adopt the technology at scale.

Telematics are becoming more sophisticated in data-delivery and the provision of real-time insights. They can be used to support decarbonisation, but particularly in Europe, privacy concerns are restricting the rollout of advanced tracking technologies.

Companies are seeking telematics solutions that can provide support and awareness around decarbonisation without intrusive tracking of employees.

The evolution of internet-connected vehicles is bringing energy efficiency through advances in route-planning, location of refuelling sites, monitoring of driving styles and behaviours, and enabling predictive maintenance. With 80% of new cars sold in 2020 having internet capability, the number of connected cars is forecast to exceed 600 million globally by 2030.

An increasing volume of vehicles with capabilities to connect to smart city solutions could have a positive impact on decarbonisation. Data generated through these solutions may be used to effectively manage traffic flows, optimise routes and reduce congestion in an urban environment, thereby reducing fuel consumption.

Equally important is the availability of tools to measure, record and understand emissions data so that consumers and corporations can accurately and transparently monitor, report, and reduce or compensate their impact on the environment.

Fleet operators and managers are seeking more automated solutions to enable accurate and verifiable measurement as well as automated reporting of fuel consumption and carbon emission reduction from their fleets. For many, this is currently done in a very manual and theoretical way.
Using vehicle-to-grid technology to manage the electricity demand created by EVs

Energy use at home and on the road will work together as part of smart energy infrastructure with bidirectional chargers and software. An integrated energy offer will be different from how consumers purchase energy today. As electric charging networks grow to provide electric vehicle drivers access to a wide and reliable infrastructure, electricity systems will need to be prepared to supply the additional power required.

Intelligent vehicle-to-grid (V2G) charging technologies enable EVs to communicate with the grid through the two-way charger. These advanced charging systems can help ensure the smooth integration of electric vehicles into the electricity system by, for example, adjusting charging times and speed of charge. This can be especially useful for managing variations in wind and solar power. Innovative vehicle-to-grid charging systems allow electric vehicles to supply electricity to the local power network when supplies are tight.

Autonomous vehicles

Autonomous vehicles (AVs) are expected to become an important element within personal mobility in the next decade and beyond – they have the potential to transform mobility significantly. Most fleet operators and managers are not yet considering AVs because of the large investments needed for commercial viability and the fact they are not yet proven. For the time being, they are increasingly demanding advanced driver assistance systems (ADAS), which bring efficiency as well as added safety for drivers and passengers.

Some closed-loop applications, such as within university campuses, on business parks and some leisure park routings, offer easier AV applications. AVs also have the advantage of keeping ageing populations mobile.
How Corporate Responsibility Is Encouraging Businesses to Reduce Their Emissions

Customers and regulators are expecting more action from companies on emissions reduction. Mobility executives who participated in the research said the main driver of efforts by transport fleet operators to reduce emissions was corporate social responsibility (CSR) or environmental, social and governance (ESG) factors.

Large fleet operators and Shell’s business partners highlighted an acceleration in the electrification of their fleets over the past 18 months. In some cases, companies are already switching to lower-emission vehicles despite the poor economics of doing so.

Fleet operators said their corporate customers view fleets as a priority area to meet decarbonisation targets. Most fleet operators expect a switch from ICE vehicles to EVs at the end of the current or next round of three to four-year lease periods.

Reducing emissions is a critical topic

<table>
<thead>
<tr>
<th>Scale</th>
<th>Today</th>
<th>In 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>54</td>
<td>75</td>
</tr>
</tbody>
</table>

This scale is based on 100 as the most critical and 1 as the least critical.
The consumer research shows that the COVID-19 pandemic prompted a marked increase in personal car use, walking and cycling. The use of public transport also increased, but by significantly smaller percentages than personal car use, walking and cycling.

The pandemic has accelerated personal car use relative to alternatives, such as car sharing and public transport, with 46% of respondents indicating an increased use of their personal vehicles. This is reflective in Asia where 50% or more people in China, India and the Philippines want to use their personal vehicles more. Only time will tell whether COVID-19 has caused permanent changes in transport use or whether people will revert to prepandemic patterns. In Europe, 50% of respondents said that they would use their personal vehicle to the same extent as they did pre-pandemic.
The research, though, did reveal what different generations were planning to do. Those aged 61-75 were more likely than any other generation to retreat after the COVID-19 pandemic from options that involved sharing the use of a car, including taxis, hire cars and newer options such as ride-hailing, car-sharing and carpooling.

All generations said that they would use their personal vehicle or walk or cycle to their destinations slightly or significantly more. The consumer research highlighted the younger generations from millennials (aged 26-40) to generation Z (aged 18-25), planned to use a personal vehicle significantly more. This is counter to the usual reporting for these age groups, which tends to show a trend towards shared modes. This could explain why the shift if more significant, as this is being measured from a lower base and the pandemic has therefore had a greater impact.

Only 15% of respondents said they would use their personal vehicle less, which may in part be due to the shift to working from home.

Expected Personal Vehicle Usage After Pandemic

<table>
<thead>
<tr>
<th>Usage After Pandemic</th>
<th>No change</th>
<th>Less</th>
<th>Use more</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>39%</td>
<td>15%</td>
<td>46%</td>
</tr>
</tbody>
</table>

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How COVID-19 affected corporate decision-making

Some companies may delay decisions on decarbonising their fleets until the future of work becomes clearer, particularly as changing patterns in workplace location and mobility have been markedly accelerated by the pandemic.

Companies are starting to offer more flexibility to employees. Younger workers, or those in congested cities, do not find a company car so desirable. Other options such as public transport passes and other methods of transport, are growing in popularity. Industry executives and mobility experts believe that car-sharing, ridesharing, and ride-hailing will gain traction as important modes of mobility over the next five years.

Industry leaders across the globe also noted a significant change in their corporate mobility patterns due to a shift towards work-from-home arrangements.

However, corporate decision making on mobility options cannot be universally applied, partly due to lack of public transport or security concerns with the options available.

The growing importance of last-mile delivery

Passenger and goods movements can be aggregated using data and analytics, including AI, optimising supply and demand, and building demand-response systems. Last-mile delivery efficiency more than offsets all the miles driven by individual consumers and businesses, according to Frost & Sullivan. The prevalence of electronic commerce (e-commerce), with the share of online shopping growing to an estimated 28 percent by 2025, will drive last-mile delivery models to adapt to combat urban congestion and rising transport costs. Delivery vehicles powered by electricity will become the standard for last-mile delivery. Frost & Sullivan predicts this will proliferate with the release of more than 30 new electric light commercial vehicle models by 2023, offering greater flexibility of features for a range of uses. Availability of two- and three-wheelers for last mile delivery, particularly in Asia where governments are encouraging battery electric vehicles, will be important contributors to the sector’s overall decarbonisation.
WAYS THE MOBILITY SECTOR CAN DECARBONISE
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Ways in Which The Mobility Sector Can Decarbonise

This report offers key recommendations for the pathway to decarbonising mobility. Consumers and businesses around the world have the opportunity to take transformative steps to address emissions related to mobility. The choices they make today will impact the progress made over the next three decades and the outcomes of the Paris Agreement and COP26 in Glasgow.

Hard Choices Will Need to Be Made at Every Level

When it comes to mobility, maintaining today’s comfort, convenience, and affordability while also achieving climate change targets will present dilemmas for government, industry and individuals. Working through change and retaining the range of choices available in the mobility market may not be a straightforward journey.

Policy decisions on fuels and infrastructure aiming to achieve net-zero targets may limit consumer choice. Although mobility has the advantage that a significant number of customers are actively seeking to reduce their emissions, any policy decisions must be sensitively handled and communicated.

In particular, challenging choices may need to be made around EV charging. Motorists switching to EVs now may need to compromise on the convenience they experience with their ICE vehicles until there are sufficient charging points available. For its part, the mobility sector will have to collaborate to ensure that investments in roll-out and access to charging infrastructure progress at the pace of demand for EVs.

There is also likely to be controversy around taxes and price support for low-carbon fuels, and such measures may well encounter opposition. Balancing the need for accessible and affordable energy alongside the drive to net-zero is a challenge which will need to be clearly articulated. All these issues will need to be sensitively handled, with the acceptance that it may be impossible to resolve them to everyone’s satisfaction.
A Leading Role for Government

Policymakers should take account of the fact that new technology and supply chains for alternative fuels are expensive and that their commercialisation requires support.

To get projects started, there must be direct financial support through such mechanisms as capital grants, investment tax credits and loan guarantees with a clear policy direction and timeline focused on achieving legislated targets for attainment of net-zero.

The terms for this initial direct support must be sufficiently attractive and sustained in order to achieve policy aims.

Fuel mandates setting minimum amounts of biofuel to be mixed with petrol and diesel could be used to help provide certainty of demand, encouraging investment in the supply of these lower-carbon alternatives. Such biofuel blending mandates already exist in markets such as Brazil, the European Union, the UK and the USA.

Governments can also provide a variety of forms of price support for low-carbon fuels such as biofuels:

- Feed-in tariffs provide long-term purchase agreements for alternative fuels, usually for periods of around 15-20 years.
- Contracts for difference provide financial support equal to the difference in price between an expensive low-carbon fuel and a cheaper petrol or diesel alternative. This allows the low-carbon fuel to be sold at the same price as petrol or diesel.
- Variable tax rates that depend upon the carbon intensity of each fuel.

At the level of the individual consumer, policy which enables carbon-emission labelling is an affordable and easily implemented way of helping customers reduce their carbon footprints, for example, claims on products being certified against industry standard ISO 14067.
Certainty and Co-ordination
Around Government Policies

There must be as much certainty around long-term government policies as possible.

This is because investors need to have confidence that their products can be sold profitably and for long enough to recoup their investment in things such as infrastructure or alternative fuels.

There should be a comprehensive policy framework that encourages the acceleration of demand and the supply of low-carbon mobility products and services.

A mixture of incentives, such as time-limited tax credits or rebates on purchases, as well as disincentives such as higher congestion charges for more polluting vehicles, may be required to encourage consumers to move towards lower-carbon options. These are already being applied in some parts of the world.

These measures must also be properly co-ordinated. Congestion charges, for example, will only work if there are ways for people to access an area without using a higher-emitting personal vehicle.

National and local governments can also help decarbonise mobility by encouraging passengers to move from single-passenger vehicles to public transport or ride-sharing options. This should include improving public transport to make it a more attractive option. This may be a particularly pressing need in many rapidly growing Asian cities where the development of integrated public transport networks has not kept pace with growth. Governments can support the adoption of EVs with policies encouraging the development of charging infrastructure. They should also provide clarity and assistance to energy companies, who at times have found it difficult to navigate legislation, especially at the local level, resulting in delays to the installation of charging infrastructure.

With the help of the mobility industry, local demand for charging infrastructure should be assessed to avoid having areas where there are too few or too many chargers.
Limiting the Impact of Internal Combustion Engine Vehicles

Motorists need certainty over their mobility options. Mandates by governments to end sales of new petrol and diesel ICE vehicles, and restrictions on heavier-emitting vehicles in some cities will differ country-to-country and even city-to-city. In many parts of the world, there is currently no commitment to phase out ICE vehicles.

In the short to medium-term, while the proportion of EVs grows, ICE vehicles can contribute to lower emissions through optimised usage, increased fuel efficiency and hybridisation.

Across value chains, there should be close coordination to ensure the integration of decarbonisation policies, technical standards and guidance for fuels and recharging infrastructure.

Mandates for things such as increased engine efficiency and decreased engine size will impact fuels, infrastructure and ultimately customer choice.

The mobility industry needs clear goals and predictable policies to provide the business case for investment. For example, policy implementation that delivers very low nitrogen oxides (NOx) emissions in modern petrol and diesel cars has led to the development of the Euro 6d and future Euro 7 emissions standards, as well as a subsequent increase in their availability facilitated by energy companies. Car manufacturers and energy companies should work more closely with one another to align on the technologies necessary to introduce higher biofuel blends.

Consumers will not buy alternative fuel vehicles unless they have certainty over refuelling. A sectoral policy framework is needed, consisting of complementary measures to accelerate supply and demand for lower-carbon energies. This will help to provide the necessary infrastructure, incentivise desired consumer behaviours and disincentive current consumption patterns.
Collaboration

The decarbonisation of mobility will require collaborative approaches: across the sector, with other sectors and with governments. Ultimately, this will make the adoption and experience more seamless for customers, which in turn should lead to an acceleration in the adoption of lower-carbon alternatives.

Some of the ways in which governments can support the mobility sector in getting to net-zero have been described above. Businesses can also work collaboratively to help get the mobility sector to net-zero.

Fleet managers are seeking support from across the wider mobility sector, including car manufacturers and energy companies, to increase the choices available to customers. This includes producing more EV classes which are suitable for commuting with one or more passengers, but equally suitable for less frequent, long-distance journeys, like family holidays.

Car manufacturers are working with energy companies to ensure battery recharging points are available at retail stations, in car parks, on streets and at homes. With access to the necessary data, EV charging operators can gain the insights needed to maximise charge-point usage, measure environmental impact and achieve financial sustainability.

Companies should work on sharing data responsibly so customers can benefit fully from the improvements that digitalisation can bring. This includes using digitalisation to make it easier to pay and to find places to refuel or recharge.

Businesses and fleet managers are seeking support from across the sector to measure, report and implement emissions reduction. They want to meet net-zero emission targets but are finding it hard to get the data they need to make informed decisions. For example, they cannot accurately quantify how much carbon they are saving by switching fleets to EVs. Every effort should be made to provide them with the tools and services they need to help them navigate the path to decarbonisation.
WHY PARTNER WITH SHELL?
The experts and industry executives consulted for this report stated that the mobility sector has made a faster start on the road to net-zero emissions than they expected just 18 months ago. This is very encouraging, but if the world is to achieve the climate goals of the Paris Agreement, further acceleration is needed to cut carbon emissions from motorised two-wheelers, three-wheelers, cars and vans.

At Shell, our ambition is to become a net-zero emissions energy business by 2050, in step with society’s progress towards achieving the goal of the UN Paris Agreement on climate change. Our Powering Progress strategy is built around achieving this ambition, but as the final recommendation of this report points out, when it comes to decarbonisation, the best strategy in the world will mean nothing without the mutual support of government, industry and customers. This is why Shell Mobility is eager to form new partnerships, and to strengthen those already in place. It’s this mutual support, above all else, that we are now appealing for.

Given Frost & Sullivan’s findings in this report, the question remains: why should someone choose Shell as a partner in decarbonising the mobility sector? To answer this question, I’d like to begin by sharing some examples of the progress Shell has already made, not only within mobility, but across the entire energy system:

- Today, Shell operates more than 80,000 EV charge points worldwide, a number we aim to increase to greater than 500,000 by 2025. On average, we install a new charge point every 20 minutes.
- In February 2021, Shell acquired ubitricity, a leading European provider of on-street charging. In September 2021, we announced our ambition to increase the size of ubitricity’s UK network – already one of the largest in the UK – from 3,600 on-street charge points to 50,000 by the end of 2025.
- In 2021 Shell announced with Waitrose and Partners in the UK and REWE and Penny supermarkets in Germany to install hundreds of charge points over the coming years.
- Shell Recharge Solutions Europe is the first charge point operator to receive a licence to deliver grid balancing services in the Netherlands. By simultaneously managing the charging speeds of its connected chargers, Shell Recharge Solutions delivers grid balancing services at a megawatt scale, which is equal to the energy consumption of 1,000 households, aggregating individual electric vehicles into a virtual battery.
- In February 2021, Shell extended its long-standing co-operation with Hyundai with a five-year agreement focussed on developing EVs and supporting infrastructure.
- NIO, the Chinese EV manufacturer and charging solution provider, and Shell will work together in China to install 100 co-branded Power Swap Stations at Shell service stations by 2025, additional co-branded Power Swap Stations at Shell EV charging hubs and Shell Recharge fast charging at NIO locations.
- To help deliver more renewable electricity, Shell entered the offshore wind business in 2000, and today, through investments and partnerships, we have more than six gigawatts of wind projects either in our portfolio or in development.
Shell is advocating for clear timelines for the widespread adoption of zero-emission passenger cars and vans and the phase-out of sales of new internal combustion engine vehicles. Although markets will vary in pace, the promotion of investment in infrastructure for electric vehicles, incentives to purchase low and zero-carbon vehicles, the generation of adequate amounts of green power, and incentives to produce alternative and zero- and low-carbon fuels are needed to achieve these outcomes. Shell believes that in the majority of developed countries, this transition should happen in the 2030s.

Launched in 2011 as a joint venture between Cosan and Shell, Raízen operates a cellulosic ethanol plant, producing more than 55.5 million litres to date. When fully operational, it is expected to produce around 35 million litres a year of advanced biofuels from sugar-cane residues. A second plant with twice the capacity is already planned.

In September 2021, Shell announced a final investment decision to build an 820,000-tonne-per-year biofuels facility at the Shell Energy and Chemicals Park Rotterdam, the Netherlands, formerly known as the Pernis refinery. Once built, the facility will be among the biggest in Europe to produce renewable diesel made from waste, and sustainable aviation fuel (SAF).

Through Shell’s Nature Based Solutions program, we’ve invested in a portfolio of nature-based decarbonisation projects around the world such as the restoration of mangrove forests in Senegal, the planting of more than 5 million trees in the Netherlands and reforestation with the Tŝilhqot’in Nation in Canada. All the nature-based solutions that Shell invests in are certified as high-quality under credible and independent carbon credit standards with annual external auditing.

In eight markets, including the UK and the Netherlands, Shell Mobility now offers carbon compensation whereby retail customers can buy carbon credits to help compensate for the emissions generated by the fuel they use.

In 2020, Shell blended around 9.5 billion litres of biofuel in our gasoline and diesel blends worldwide. 99% of our purchased biofuels are either covered by contracted sustainability clauses or certified by independent auditors.

In July 2020, Shell began operations of Europe’s largest PEM hydrogen electrolyser at our Energy and Chemicals Park Rheinland. This facility will produce up to 1,300 tonnes of green hydrogen per year, which will then be used to produce low-carbon fuels and to help decarbonise other industries.

Shell has partnered with Sanofi Turkey to provide a telematics solution to monitor and improve driver behaviour which has helped reduce accidents by 27% and delivered an increase in fuel savings of 4.4% in their fleet of light duty vehicles.

As part of its Innovation Partnership with the Scuderia Ferrari Formula One™ team, Shell is working to define how high-performance fuels can be developed for the future, including advanced sustainable biofuels and synthetic liquid fuels, helping Formula One™ reach its goal of using fully sustainable race fuels by the 2026 season. These learnings and technologies could eventually be used to reduce emissions in hard-to-decarbonise segments of the transport market.

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This list is by no means comprehensive, but what I’d like you to take away from it are three important points.

The first is the diversity of Shell’s business portfolio. We are involved in virtually every aspect of the energy system, from production to distribution to retail sales. Not only that, but when it comes to investment in solutions for decarbonisation, we lead our industry in terms of both diversification and innovation. The reason I have included examples beyond Shell Mobility is that in the context of the energy transition, this integration is an enormous advantage, particularly when it comes to issues such as the provision of green power for EV charging and the production and supply of low-carbon fuels.

The second point is our global scale. With the largest mobility retail network in the world, Shell Mobility serves an average of 30 million customers per day at over 46,000 retail sites in around 80 markets. But it’s not just our retail network that’s important – Shell Mobility is backed up by a global network of cutting-edge product innovation and production, allowing us to deliver products that meet the needs of our customers in each individual market around the world.

Finally, and most importantly, none of the achievements on this list could have happened without collaboration or partnership. It all comes back to this. Our entire industry needs to transform, and for a project of this magnitude, the road to success can only be travelled together.

If you are an existing customer or partner of Shell Mobility, I am asking you to think about how we can strengthen our partnership and do more together. If you are not yet a customer or partner of ours, I am asking you to think about how Shell Mobility might support you. In either case, please do not hesitate to contact us with your ideas or questions.

The decarbonisation of mobility is our industry’s greatest challenge to date. I am confident that it will also be our greatest achievement.

Sincerely,
István