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Clean mobility, time to hit the road

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Editorial

Sustainable Mobility: a clean road to drive on

Salvatore Machì / *Chairman, CESI*
Matteo Codazzi / *CEO, CESI*

First, we hope you and all your loved ones are safe and well. We are living in complex and challenging times. The health emergency has engulfed the whole planet. With COVID-19 being a presence in people's lives all around the globe, at CESI we have clung to our first priority: preserving the well-being of our employees, clients and partners. At the very preliminary signs of the outbreak we put in place rigorous measures to prevent, track, and respond to COVID-19 infections in order to protect the safety of our community members. This is the way in which our Testing, Inspections and Certification "KEMA Labs" Division has remained fully operative throughout the pandemic. That's why, with all the needed precautions, our laboratories and consultants are now at work to guarantee uninterrupted service to our customers. We are fully devoted not to let our clients down when they most need us: when, under extreme circumstances, they must continue to reliably provide electric power to the world economy.

However, working hand-in-hand with our customers doesn't only happen in challenging times at CESI: it is our daily "mantra". It also happened, for instance, when some of our key clients mandated us to assess the best technological solutions for sustainable mobility. Sustainable mobility is the focus of this new issue of Energy Journal. It is a sector in which the future and technology are blending together to develop new scenarios. The market is evolving towards electric vehicles because they drastically reduce CO_2 emissions and their performance is now on par with traditional models. CESI is working side by side with the automotive industry to promote decarbonization by providing its experience and facilities for testing the reliability of electric vehicles (EVs), charging systems and their interaction with the grid on an emerging market in which high, reliable and quality standards will be fundamental.

Electric cars – undoubtedly one of the most efficient answers to the need for mobility with a low environmental impact – are the subject of our Top Story. We describe how the electrification of vehicles makes transport more efficient from an energy standpoint and reduces both the production of greenhouse gasses and our dependence on oil, improving the quality of the air that we breathe. In our Scenario section, we then turn to the evolution in mindset and consumer habits. We focus on the importance and benefits of sustainable mobility, looking beyond EVs as well as to a possible transition with natural gas. An interesting and useful comparative analysis of countries at the forefront of electric mobility (China, Europe, United States) is featured in the Industries & Countries section, which looks at the evolution of sustainable mobility in different parts of the world. A specific article is dedicated to a fact-based comparative analysis of electric and fossil fuel mobility, outlining advantages and critical issues. The interview section presents a virtual debate amongst key figures in the world of mobility and transport: Adina Vălean (European Commissioner for Transport), Henrik Hololei (European Commission Director General for Mobility and Transport), Espen Hauge (President of the World Electric Vehicle Association), Frank Rieck (Professor of Future Mobility at the University of Rotterdam) and Francesco La Camera (Director General, IRENA – International Renewable Energy Agency).

The central section provides an update on CESI activities in the context of electric mobility. The tests conducted in our KEMA Labs facilities embrace the entire landscape of electric performance, safety, mechanical resistance and electromagnetic compatibility. Moreover, those tests validate software communications, protocols, interactions amongst the vehicle and its supply equipment (EVSE), as well as components in the battery management system in case of accidents involving the vehicle. CESI's capabilities, however, are not limited to the vehicle on-board power electronics, but extend also to the charging infrastructure (a key element of EVs), where CESI has been involved as certifying body for different types of charging stations since 2010. Our consultants have also been working with utilities, governments and regulatory authorities across the globe to advise them in planning the charging infrastructure and integrating EVs into the power grid so as to take full advantage of the power system flexibility they can provide to the energy market. We trust this issue of Energy Journal will provide the reader with a broad view of the main implications of sustainable mobility of the future.

The COVID-19 pandemic will undoubtedly act as a catalyst for accelerating the transition to a different mobility paradigm, especially in densely urbanized areas. Big cities will not survive the post-pandemic future if they will not be able to quickly develop a new, sustainable, mobility model.

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"We have to look at alternative technologies of cars such as biofuels or, even more importantly, electric cars."

Fatih Birol, Executive Director of the International Energy Agency








News

Latest from CESI

USA

Chalfont Laboratories joins CESI

On March 20, the transaction of Chalfont (USA) Laboratories' ownership from DNV GL to CESI was finalized. The testing facility in Chalfont is the largest of its kind in the USA. Due to the acquisition, KEMA Labs, the CESI Testing, Inspection and Certification Division, strengthens its position as the world leader for independent testing of advanced technological components for the energy sector. CESI's expertise and assets allow all sector technologies to be experimented with and tested, simulating extreme and complex operating conditions. The KEMA Labs testing and inspections facilities include the world's largest high-power laboratory, with the highest short-circuit power of 10.000 MVA; the world's first laboratory capable of testing ultra-high voltage components for super grids; the Flex Power Grid Laboratory, for advanced testing of smart grids' components. Furthermore, Chalfont facility features 1.000 MVA and 2.500 MVA short-circuit generators; a 1.500 kV impulse generator; a 600-kV power frequency test set; #battery test cells and a 2 MW grid-connected energy storage test lab.

The KEMA Labs testing and inspections facilities include the world's largest high-power laboratory.

Pakistan

CESI's Metering Project in Pakistan

The Government of Pakistan (GoP) has started a major-scale program, financed by the Asian Development Bank (ADB), aimed to introduce the use of Advanced Metering Infrastructure (AMI) in Pakistani DISCOs. The investment program will be implemented in different stages, with the goal of achieving significant AMI coverage across Pakistan's major cities and hubs of industrial activity. CESI has been selected as implementation consultant for two different projects covering the two main Pakistani DISCOs. The first project's goal is to cover 1.8 Million consumers in three circles of Rawalpindi and implement new modern billing system for the entire Islamabad Electricity Supply Company (IESCO). The second project aims to cover 1.8 Million consumers in three circles in Lahore and new modern billing system for the entire company in the Lahore Electricity Supply Company (LESCO). The scopes of works of the assignments extends over four phases of the project: procurement process (only for LESCO project) and preparatory activities; supervision of supply and installation phase of meters and IT systems both related to data gathering and management, and to the billing of power consumption; post installation phase that includes the assistance on works' defects; support during the implementation of Social Information Programs to explain to customers the reasons for the massive change of meters and the targets and benefits they shall get with this new technology.

CESI has been selected as implementation consultant for two different projects.

Global Virus Emergency

CESI's actions to face the global emergency

COVID-19 unfortunately is heavily affecting people as well as social activities around the world. Even the electricity industry is suffering from the impact of this crisis, an essential service that can't afford interruptions, especially in these times. For this reason, we have decided to continue supporting our customers, affirming in the meantime our crucial commitment to health and safety. Following both the WHO's and Local Authorities guidelines, since the end of February, CESI shared and implemented several measures with all its employees, customers and partners, including: working from home, use of respirators and other protective devices for those who are working in our laboratories, maintaining social distance, measuring the temperature at the entrance of our premises, monitoring possible affected employees. We have undertaken most of our services, always considering Country-specific measures for health and safety. Our laboratories in Milan, Arnhem, Berlin, Mannheim, Chalfont and Prague continue to be operational, in order to offer their essential services to our customers. These are not ordinary days and we believe that only with the extraordinary commitment of each of us we can contribute to overcome these turbulent times.

We continue supporting our customers, affirming in the meantime our crucial commitment to health and safety.

KEMA Labs

KEMA Labs' remote services to support reliable power grids during the crisis

Due to the pandemic emergency caused by the COVID-19 disease, the entire world has been subjected to very hard times. The energy sector is no exception: in addition to the need for an ever-greater resilience of electricity grids, the virus crisis makes it increasingly important for the grid to remain safe and reliable. For this reason, the need to test, inspect and certify the grids' components remains crucial. Aware of the crucial importance of fully functioning power grids, KEMA Labs is committed to ensure its clients receive support and service continuity even if they cannot be physically present in our labs for the worldwide lockdown. We have committed to this through the implementation of a pioneering approach: taking advantage of professional video technology that generates a continuous video stream from different angles and perspectives, allowing our clients to remotely witness their tests in our platforms located all over the world.

The virus crisis makes it increasingly important for the grid to remain safe and reliable.

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Top Stories

The Car of the Future is Sustainable, Connected and Autonomous

Amidst the Covid-19 health emergency, the true challenge for clean mobility is to continue guaranteeing the global distribution of sustainable vehicles through the development of charging infrastructure and storage technology. The examples of the Johan Cruijff Arena and Volkswagen's Modular Electric Drive Platform.

Mobility and the transport industry have been heavily disrupted by the Covid-19 emergency, too. Updated analyses indicate that the impact of the Coronavirus on the automotive sector will lead to a short- to medium-term delay in the global transition towards electric mobility caused by the double drop in market demand and industrial production. The Deloitte study that delineates this scenario forecasts that, in 2020, global light vehicle production will drop by ca. 11 million units: from 88.9 million (2019) to 77.9 million (2020). In particular, the production forecast indicates -2219 units for North America and -2956 units for Europe.

Nonetheless, Deloitte affirms that in the medium- to long-term the transition towards electric mobility will not be affected, as is evident through the significant investments made by Original Equipment Manufacturers and institutions (i.e., the 3.2-billion-euro European Battery Alliance Project [EBA] launched in 2017 by the European Union). Although, in the short-term, the ongoing health emergency (and related economic-industrial crisis) could slow down the electrification of transport, progress against carbon dioxide emissions, pollution and climate change will remain unscathed in the medium- to long-term.

Today, with the recession of car markets across Europe highlighting evident and heavy negative numbers relating to global sales, there is only one 'plus sign', which concerns electric and electrified cars: in March, compared to a -85% of sales in the market, electric cars in Italy are growing. In Germany, the UK and France, hybrid and electric registrations increase at double and even triple-digit rates. Amongst the key factors that could propel the growth of the post-COVID-19 EV market, Fabio Orecchini (Professor of Energy Systems and Environment at the Guglielmo Marconi University) underlines three crucial aspects: investment in infrastructures (which, from a technology standpoint, means charging points and digitalization), psychological view (with people yearning for new technological advancements in the wake of the crisis) and environmental impact.

Focusing on Environmental Impact

The **World Business Council for Sustainable Development** has a precise definition for sustainable mobility: "Sustainable Mobility is the ability to meet society's need to move freely, gain access, communicate,

trade and establish relationships without sacrificing other essential human or ecological values, today or in the future." These words describe an ideal transport system that is capable of minimizing the environmental impact of movement and promoting their efficiency, intelligence and rapidity. Many studies and research projects indicate that the traditional system of mobility (driven by fossil fuels) has revealed a long series of diseconomies with issues related to traffic, noise and pollution, especially. The transport sector consumes one fifth of the primary energy produced worldwide, 40% of which is consumed by urban traffic. According to estimates by the **World Health Organization**, 92% of the global population live in areas where air pollution exceeds safety limits and is noxious. Pollutants include **particulates** (PM2.5), **nitrogen dioxide** (NO2) and **ozone** in the lower layers of the atmosphere (O3) that are respectively responsible for 59,500, 21,600 and 3300 premature deaths, in Italy alone, according to the WHO. The situation is serious and requires a new approach to the issue of transport sustainability, one based on new technology, new analyses and monitoring tools, and a new philosophy. In this context, the key concepts of mobility now cover intermodality, carsharing and carpooling and the use of recycled materials by the automotive industry. Various initiatives are underway, but the focus is on the massive global investments made by automotive producers, institutions and private organizations to promote the development and sales of electric vehicles and charging infrastructure.

Exponential Growth

Electric cars are certainly one of the most efficient solutions for mobility with a low-environmental impact. The electrification of vehicles makes transport more efficient in terms of energy consumption, reduces the emission of greenhouse gases and our dependence on oil, and improves the quality of the air we breathe. Moreover, EVs mark a **shift in philosophy, mentality and consumer habits**. Before the Covid-19 emergency, global sales of electric vehicles were accelerating. The **EV Volumes - The Electric Vehicle World Sales Database** reveal that there are over 5.4 million electric vehicles around the globe, 2.1 million of which were sold in 2018 (with the Tesla Model S model leading the market). However, according to **Bloomberg New Energy Finance**, the diffusion of electric vehicles is concentrated in just a few countries: China, which takes first place, followed by the United States, Europe and Japan. Besides the United Kingdom and Germany, in Europe, Norway holds the lion's share; indeed, it is the global leader in terms of market percentages. In comparison to the total number of vehicles circulating worldwide, the percentage of electric vehicles remains extremely low, but research reveals that the number of green vehicles has **increased by a factor of 30 in the last six months**. Thera are currently over 330 electric car models available and about one hundred automotive producers that produce electricity-powered cars.

It is a growing market that no longer looks like just an option for the future. It is an ongoing phenomenon, especially in some countries, thanks to its positive environmental impact. According to studies conducted by **ENEL on data provided by RSE, European Environment Agency, Joint Research Center, Ispra and Deloitte**, electric vehicles are the only technology that allows the complete elimination of particulates and nitrogen dioxide whilst driving. Moreover, recent models guarantee a range that covers average daily drives. According to the **National Household Travel Survey**, 95% of drives do not exceed 200 km., a range that can easily be covered by the electric vehicles currently on the market.

The Development of Charging Infrastructure

The true challenge in order to guarantee the global diffusion of electric vehicles is to develop and provide charging infrastructure. The objective is not only to guarantee the presence of charging stations, but also to **halve the time it takes to charge** vehicles and to **reduce total emissions** both during driving (as already happens) and during charging. As part of the work to achieve "zero emissions," the aim is to accumulate energy in charging stations through the integration of additional batteries that will be charged by photovoltaic panels.

One of the more sustainable novelties concerns the **"second life" of the traction batteries of traditional vehicles**. The latter are usually substituted after 8-10 years (when they reach 80% of their efficiency). Now, they are reconverted to stationary use as energy storage devices charged by solar panels. One of the most exciting international examples of car battery reuse was unveiled during the 2018 inauguration of the **Johan Cruijff Arena** in Amsterdam. The largest European energy storage system in a commercial building was developed in collaboration with Nissan by using both regenerated and new electric car batteries that are charged by solar panels. An inverter system allows the energy to be stored in the batteries and returned to the system when necessary. Thanks to the energy storage system at the Johan Cruijff Arena, Nissan has demonstrated that the storage cells used by 148 Nissan Leaf models could – with the same mechanism – be used to **recharge 500,000 smartphones or power 7000 apartments** for one hour.

One of the most recent projects on electric mobility concerns the development of an **interconnected pan-European network** to allow the mass adoption of electric vehicles in the countries that have been less affected by the e-mobility phenomenon. **Project AMBRA-Electrify Europe** (AMBRA-E), which is coordinated by ENEL X and jointly financed by the EU Commission's Innovation and Networks Executive Agency (INEA) and the European Investment Bank (EIB), calls for the installation of over 3000 EV charging stations by 2020 along seven primary corridors of the trans-European transport network. This includes the main roads connecting urban nodes and the main routes of transport in Italy, Spain and Romania. The charging stations will become part of the public network of ENEL X charging infrastructure and will be equipped with Quick (up to 22 kW AC), Fast (up to 50 kW DC each) and Ultra-Fast charging stations (up to 350 kW DC each). The objective of the project is to reduce charging times for long-distance journeys between Italy, Spain and Romania, to promote cross-border electric mobility and to guarantee long-distance e-mobility.

The Ministry of Clean Energy

From incentives for the purchase of zero-emission vehicles to the development of charging infrastructure and the technological development of batteries, the policies enacted by countries leading the electric mobility revolution are playing a fundamental role. The **Electric Vehicles Initiative** (EVI), which was kicked off in 2010 as part of **CEM (Clean Energy Ministerial)**, is a multi-government policy forum dedicated to accelerating the introduction and adoption of electric vehicles worldwide. Thirteen countries are part of the organization: Canada, France, Japan, Norway, Chile, Germany, the Netherlands, Sweden, China, India, New Zealand, United Kingdom and Finland. In particular, EVI is conducting research on the use of the system of electric vehicles as a distributed energy storage system that can support the integration of renewable energy into grid and off-grid systems. CEM countries have organized the **EV30@30 Campaign, coordinated by the International Energy Agency (IEA)** to accelerate the diffusion of electric vehicles. Based on this scenario, by 2030 at least 30% of all new vehicles sold (ca. 44 million) should be electric. The campaign supports the entire electric vehicle market (including light vans, buses and trucks) and is committed to strengthening the charging infrastructure so that it will meet the demand expected by 2030. According to the **Global EV Outlook 2019**, charging infrastructure is the technology that is making the most progress, also thanks to the growing interest for the "heavy vehicle" sector (buses and trucks). New standards have been developed for high-power charging infrastructure (up to 600 kilowatts [kW]) with enormous battery chargers that could provide up to 1 megawatt (MW) or more (necessary for larger trucks). The study points out that technological progress is providing **increasingly substantial reductions to the cost of producing and managing** electric cars.

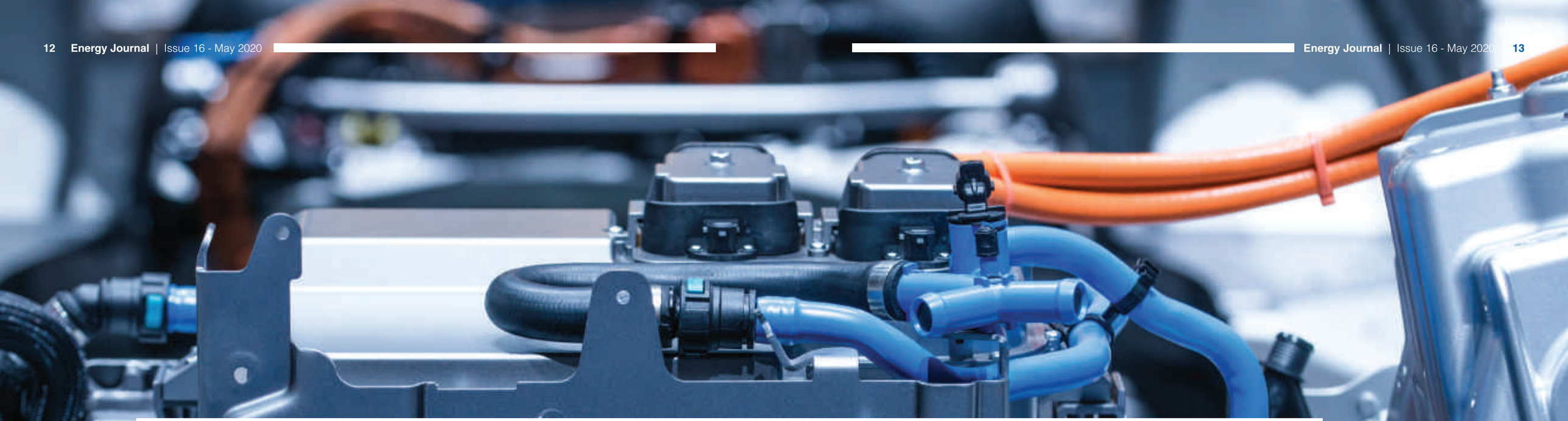
Innovative Platforms

Redesigning vehicle production platforms is the latest technological trend aiming to further reduce the cost of vehicle mass production. **Volkswagen's Modular Electric Drive Matrix**, a German acronym for "Modulare ElektrifizierungsBaukasten (MEB)," is a modular structure platform for designing electric cars. Its flexibility means that it can also be used to design smaller cars and promote the development of electric city cars. The Wolfsburg automotive producer made a strategic decision for the electric car sector. It decided to **opensource MEB to other automotive producers**, allowing them to reduce the cost of developing blueprints and increase production. In turn, this means that it will be easier for producers to electrify their portfolio, just as promised by Volkswagen, which aims to **electrify a quarter of its models by 2025**.

> **Electric cars are certainly one of the most efficient solutions for mobility with a low-environmental impact.**

The German automotive producer has planned investments for **30 billion euro** by 2023 in the electric mobility sector, as part of an overall 44-billion-euro investment plan, which includes digitalization and self-driving cars. Herbert Diess, Volkswagen CEO, points out that "the objective is to make individual mobility CO_2 emission free, besides safer, more comfortable and accessible to as many people as possible."

And this electrification program has not been stalled by the Covid-19 emergency. Volkswagen has communicated that its project for an emissions-free car will continue, notwithstanding the complicated scenario. The message of CEO **Ralf Brandstatter** is clear: "In 2020, we will have to face great challenges, especially in terms of the Covid-19 pandemic. Nonetheless, thanks to last year's good results, we are capable of facing this crisis."



Scenario

The Long History of Sustainable Mobility

The thousand lives of the car from electric motors to gas and steam-driven models and the discovery of alternative fuels that are less polluting and more environmentally friendly.

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The turning point will be in 2030 when it is forecast that electric vehicles will have the same price tag as vehicles with internal combustion engines. Although all economic and industrial forecasts will have to be reviewed once the global Covid-19 emergency is under control, the articles and studies published just a few months ago by MIT and Bloomberg agree on the fact that within a decade the cost of electric vehicle batteries will be halved. In a study entitled *Mobility of the Future* by the **Massachusetts Institute of Technology**, the authors examine various aspects of zero-emission mobility and the cost of batteries, in particular, forecasting that their current value (US$124/kWh) will be halved. Furthermore, a study by Bloomberg New Energy Finance (BNEF) hypothesizes that by 2040 the global market for electric vehicle batteries will reach 942 Gigawatts, requiring an investment of 1200 billion dollars. The rapid decline in the cost of batteries will be key to this boom. According to the study, by 2030, the cost of lithium ion batteries will fall by 52%.

Traditional vehicles will become increasingly less competitive, while the sustainable vehicle sector will continue to grow. The global sale of electric cars is forecast to garner 35% of the market by 2040. Does this seem too far into the future? In reality, it is what happened in the distant past, at the beginning of the twentieth century, when electric vehicles were widespread and considered far more competitive than gas and steam-powered models; in fact, 34% of circulating cars were electric.

Even Carriages Were Electric

Projects for electricity-powered vehicles preceded those for cars powered by internal combustion engines. In fact, the first rudimentary project for an electric carriage was unveiled in the 1830s by Scotsman Robert Anderson. The first project for an electric car dates to the same period. It was developed by Dutchman Sibrandus Stratingh, while the actual car was built five years later by Cristopher Becker.

> **In 1897 the streets of New York witnessed the first entirely electric taxi service.**

Then, a number of studies and experiments conducted in France led to the diffusion of electric vehicles between the end of the 19th and the beginning of the 20th centuries. These vehicles performed better the gas and steam-powered cars of the day. The electric cars were silent, easy to drive, produced fewer vibrations and required less maintenance, while cars with internal combustion engines produced emissions, dark smoke

and unpleasant odours, overheated and were difficult to start up. Soon, **electric cars represented 34%** of all vehicles circulating in **New York, Boston and Chicago** in 1900. Moreover, in 1897, the streets of New York witnessed the first entirely electric taxi service with a fleet of 100 cars. In Europe, Great Britain and France boasted the greatest number of electric cars.

The Success of Town Cars

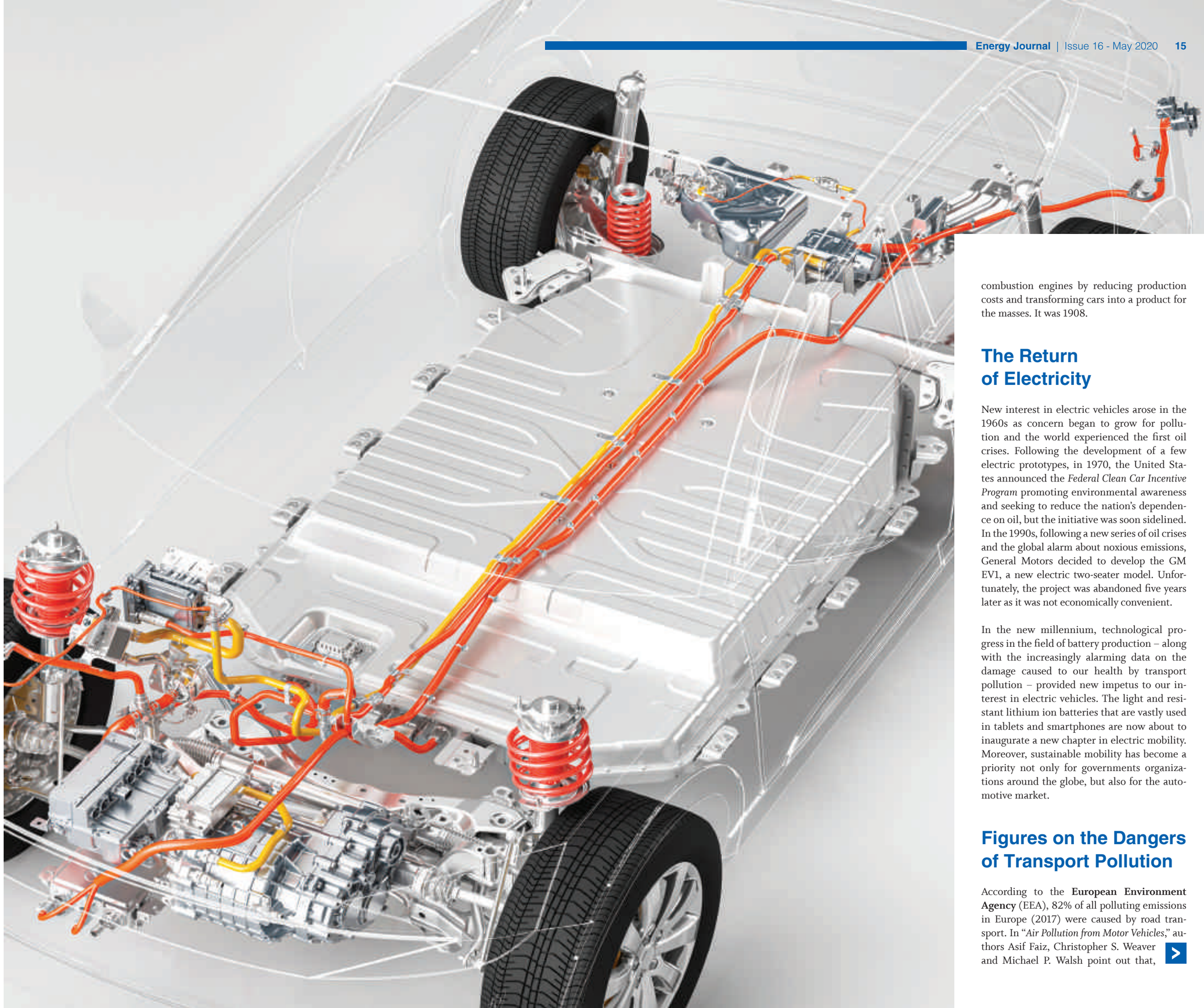
Soon referred to as "town cars," electric vehicles were especially popular in cities where neither their limited speed (ca. 30 km/h) nor range (ca. 50 km) were particularly significant. They were perfect for short distances in urban traffic and very sought after by the richer classes. In fact, the electric automotive producers – Baker Electric, Detroit Electric, Anthony Electric and the Vehicle Electric Company – were the market leaders and faired far better than the producers of vehicles with internal combustion engines.

The First Electric Car-sharing Service and Speed Records

One of the first car-sharing experiments in sustainable mobility also took place at the beginning of the twentieth century. The service provided electric cars that could be shared or hired for a couple of hours, weeks or months. On the track, Belgian race car driver Camille Jenatzy proved that electric cars could reach record speeds. He set the new land speed record at an average of over 100km/h in his La Jamais Contente, a Belgian electric vehicle.

The Decline of Electric Vehicles

After the sudden boom, the interest in electric cars fizzled out for a number of reasons. Firstly, the discovery of vast oil reserves led to a significant drop in the price of gas. Suddenly, gas was more convenient than electricity, which was still expensive and not very widespread. Then, came the improvements made to ICE (Internal Combustion Engine) vehicles. Mufflers reduced their loud sounds; radiators solved the issue of overheating, and electric starters removed the difficulty of starting the cars. **Henry Ford** did the rest. He introduced the mass production of vehicles with internal



combustion engines by reducing production costs and transforming cars into a product for the masses. It was 1908.

The Return of Electricity

New interest in electric vehicles arose in the 1960s as concern began to grow for pollution and the world experienced the first oil crises. Following the development of a few electric prototypes, in 1970, the United States announced the *Federal Clean Car Incentive Program* promoting environmental awareness and seeking to reduce the nation's dependence on oil, but the initiative was soon sidelined. In the 1990s, following a new series of oil crises and the global alarm about noxious emissions, General Motors decided to develop the GM EV1, a new electric two-seater model. Unfortunately, the project was abandoned five years later as it was not economically convenient.

In the new millennium, technological progress in the field of battery production – along with the increasingly alarming data on the damage caused to our health by transport pollution – provided new impetus to our interest in electric vehicles. The light and resistant lithium ion batteries that are vastly used in tablets and smartphones are now about to inaugurate a new chapter in electric mobility. Moreover, sustainable mobility has become a priority not only for governments organizations around the globe, but also for the automotive market.

Figures on the Dangers of Transport Pollution

According to the **European Environment Agency** (EEA), 82% of all polluting emissions in Europe (2017) were caused by road transport. In "*Air Pollution from Motor Vehicles*," authors Asif Faiz, Christopher S. Weaver and Michael P. Walsh point out that,

in urban areas, gas engines are the main source of lead and carbon monoxide pollution, while diesel engines produce particulates. Moreover, gas and diesel, which are the main source of toxic contaminants, also contribute significantly to the emission of nitrogen oxide. In 2018, **Columbia University** published a study revealing that gas stations also release toxic fumes. Gas vapors, as documented in the *Science of the Total Environment Report*, contain toxic chemical substances such as benzene, a carcinogen.

Today, the Covid-19 emergency has kicked off international studies to identify any possible relations between pollution and the onset of the pandemic. In the meantime, the European Space Agency (ESA) has published satellite imagery revealing how restrictions on vehicle circulation, imposed to counter the Coronavirus emergency, have led to a reduction in atmospheric pollution. Based on the data collected by the Copernicus Sentinel-5P Satellite, this phenomenon is particularly marked for nitrogen dioxide (NO2). Indeed, the reduction in smog levels had already been detected by NASA during the Chinese lockdown period. According to a study published by Harvard University, "Exposure to Air Pollution and Covid-19 Mortality in the United States," particulate pollution can increase Covid-19 death rates. In particular, the researchers collected data on the concentration of particulate in 3000 counties over the last 17 years, crossing this data with Coronavirus deaths for each county (up to April 4, data released by the Center for Systems Science and Engineering Coronavirus Resource Center). Complex statistical analyses point to the fact that a 1 µg/m3 increase in PM2 could be associated to a 15% increase in the mortality rate of Covid-19.

Electric Alternatives

In order to fully understand the advantages of electric mobility over gas and diesel engines, at the end of 2018, the EEA published a study entitled *Electric Vehicles from Life Cycle and Circular Economy Perspectives*. The study describes how a car that is fully (100%) battery-powered and recharged with electric energy , produced by the average European mix of fossil fuels (including coal) and renewable sources, reduces emissions by as much as 30% compared to a car with an internal combustion engine. Moreover, the environmental advantage of an electric car is naturally proportional to the quota of renewable sources in the reference mix. If 100% of all electricity were to be produced by renewable sources, the environmental impact of vehicles would practically be erased.

In a Life Cycle Assessment (LCA) perspective, the use of an electric car for urban driving produces 40-55% less CO_2 than a car with a gas engine and 22-40% less than one with a diesel engine. This means that the increase in electricity produced from renewable sources will allow electric vehicles to become increasingly greener than those with conventional engines. Nonetheless, the European Environment Agency underlines how the comparison between electric and gas/diesel engines appears less favorable if we take into account both the impact caused by the extraction of copper, lithium and nickel to ecosystems and the toxic substances used in batteries. Researchers believe that it is fundamental to address these issues by applying the **principles of the circular economy** to the management of batteries: reduce, reuse and recycle. An example of this is the use of batteries regenerated by plants for stationary energy storage.

In terms of the advanced sustainability of battery technology, as part of the May 2018 *Europa on the Move Package*, the European Commission promoted the **Battery Alliance**, a program aiming to mass produce batteries for electric vehicles and energy storage systems. As part of this initiative, France and Germany have presented a joint plan for an initial public-private investment of ca. 6 billion euro. Italy is a project partner too. In terms of giga factories producing super-batteries, Swedish company Northvolt is at the forefront with its project for a massive 32GWh plant that will be erected in Scandinavia by 2023. In the meantime, the European Investment Bank has provided the company with funding for €52.5 million to build a smaller pilot plant to test the new production lines.

Beyond Electric

Researchers and scientists are also actively studying alternative fuels such as natural gas (both compressed and liquid), liquefied petroleum gas (LPG), methanol (produced with natural gas, coal or biomasses), ethanol (produced with grains or sugar), vegetable oils, hydrogen, synthetic liquid fuels derived from the hydrogenation of coal and various mixtures such as diesel. The above-mentioned *Air Pollution from Motor Vehicles* study reveals how, the potential benefits of many of these fuels are often highly overrated, others (in particular, natural gas and LPG) provide considerable advantages in terms of emissions and could become important fuels to use in the transition period to electricity.

Hydrogen deserves to be treated separately. While it is potentially a very green fuel, it is hard to store. Moreover, its production requires significant amounts of energy. In this sector, Italy – and more specifically the Alto Adige Region – inaugurated an important project in 2020. The **LifeAlps Project**, which is part of the European Commission's LIFE Program, aims to extend the hydrogen infrastructure network (along with electric charging) to introduce pilot fleets on the roads and develop zero-emission services (taxi and freight transport). Over the next eight years, the project aims to install 33 new generation fast charging stations and open 5 hydrogen stations for vehicles and buses in Alto Adige and on the A22 highway, a key transport route connecting the north of Italy to Austria.

Sustainable Mobility as a Way of Life

Producers and researchers are at work on sustainable mobility around the globe – especially on the issue of charging infrastructure – to make our cities cleaner and the planet a greener and safer place for everyone. Focusing on the **concept of sustainable mobility** means not only concentrating on the ecological footprint of vehicles, but also that of their use. The diffusion of electric vehicles will make it easier to conceive mobility as a service and integrate public and private means of transport to obtain a homogenous and versatile system for users. The aim is to reduce the number of vehicles in use and provide citizens with a flexible and cheap alternative to public mobility.

Notwithstanding the slowdown caused by the Covid-19 emergency, the transport system will necessarily continue to evolve towards sustainable mobility. The objective is to provide cities with low or zero-impact vehicles, favoring smart electric solutions. This is the only way we will be able to respect the new rules on social distancing without increasing emissions, whilst also providing citizens with a flexible and cheap alternative to public transportation.

Industries & Countries

A Geographical Map of Electric Mobility

Norwegian excellence, Chinese growth, European and American policy promoting the diffusion of green vehicles, the issue of smart charging and charging infrastructure. A review of the state of the art of sustainable transport across the continents.

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The development of electric mobility is being driven by energy security, future export opportunities and the limitation of emissions in countries around the world. Nearly **half of all the electric cars on our planet are circulating on Chinese roads**. In 2018, the global electric vehicle (EV) fleet exceeded 5.1 million units (ca. 2 million were registered in 2018 alone, a 78% increase over the previous year) with no less than 2.3 million EVs registered in the People's Republic of China. The Chinese Government planned (before the onset of the Coronavirus Emergency) to have 4.6 million EVs registered by 2020. Moreover, in 2019, the number of charging stations in China increased by 61.2% over the previous year, reaching 1.17 million units.

The data is clear: the global diffusion of electric mobility is uneven. The Chinese market started out more sluggishly than in **Europe (1.2 million EVs) and the United States (1.1 million EVs)**. However, in 2018, the Chinese market soared with nearly 1.2 million clean energy vehicles sold. The Scandinavian market represents a world apart: per capita sales of EVs are extremely high and **Norway is the global market leader** (new sales of EVs at 46%). This is more than double the quota of the second-ranked market, Iceland (17%), and six times that of the third, Sweden (8%).

This composite geography is the result of exponential growth, especially in China. Indeed, the Asian powerhouse also holds the lead in the motor vehicle, bus, low-speed vehicle (LSV) and the freight transport sectors. Beijing has kicked off R&D projects, **collaborating with key automotive industry players, research institutes and universities**. In terms of infrastructure, the government has financed charging network projects in its main cities and along key traffic routes. This has made China not only the foremost producer of plug-in electric vehicles (PEV), but also the country with the vastest infrastructure (213,900 charging stations in 2017 or one public charging station to every six EVs). In terms of incentives, EV purchases in China are exempt from sales tax, and tax rates on traditional vehicles have been ramped up to discourage their sale.

What about energy consumption? In 2018, the global EV fleet consumed ca. 58 TWh of electric energy (practically, the total energy required by Switzerland in 2017) with China accounting for 80% of the demand. The environmental impact of the global EV fleet was most significant in terms of **carbon dioxide emissions**. In 2018, it produced no more than 38 million tons of CO_2 equivalent (a unit of measure that allows for the comparison of various greenhouse gasses on the basis of their global-warming potential) as opposed to the 78 metric tons of CO_2-eq emissions that would have been produced by a similar fleet of traditional vehicles with internal combustion engines. This means that – in just one year – **electric mobility reduced global CO_2-eq emissions by 40 million tons**.

Policy-based Differences

EV-market differences are mainly caused by different political approaches. When governments and regulatory bodies clearly and timely define charging standards and supply programs, demand is stimulated, and auto vehicle producers are induced to increase the availability of electric vehicles on the market. And This, naturally, also drives the installation of public charging stations.

According to the authors of the **Global EV Outlook 2019**, published by the **International Energy Agency**, the most useful political measure, in this context, is the provision of economic incentives. In particular, this is true not only to bridge the gap between electric vehicles and less expensive internal combustion engine vehicles (ICE), but also to stimulate the rapid diffusion of charging infrastructure, especially in new and renovated buildings and parking lots, as well as in urban networks and on highways. **Economic incentives** are often paired with other measures that increase the value proposition of electric vehicles (including exemptions from restricted-access areas and reduced fees for parking and highway tolls) that are often based on the improved performance of EVs in terms of local atmospheric pollution.

Amongst the policy measures implemented to promote electric mobility in 2018-19, the **European Union** introduced new standards for the reduction of fuel consumption by buses and trucks. Moreover, while the directive on clean energy vehicles encouraged public calls for the adoption of electric buses, new building regulations established minimum requisites for charging stations in both new and renovated buildings. In **China**, the aim is to reduce investments in new plants for the production of ICE (internal combustion engine) vehicles, to lower the average consumption of fuel by light commercial vehicles by 2025, and to provide differentiated incentives for vehicles based on the characteristics of their batteries.

Japan is promoting a cooperative approach amongst all interested industrial parties to reduce the greenhouse gases (GHG) produced by national automotive producers (including exported vehicles). The objective is to reduce emissions by 80% by 2050 through a combination of hybrid electric vehicles (HEVs), BEVs, PEVs and fuel cell electric vehicles (FCEV). Further objectives of the Tokyo Government include the installation of two million charging stations (including 5000 rapid ones) through subsidies to local governments and highway operators and the goal for Japanese companies to achieve a 50% market quota in rechargeable batteries.

The authors of the IEA "Global EV Outlook" also explain that **policy is fundamental to guarantee that electric mobility will have a positive impact on energy systems**. The use of EVs increases flexibility – a characteristic that promotes the integration of variable renewable energy in the energy mix – and this reduces the cost of adapting the electric grid to the increased consumption brought about by green vehicles. Energy markets will have to evolve to include services (i.e., grid balancing mechanisms) allowing the exchange of energy with electric vehicles and minor loads to help satisfy demand through aggregators.

> **In China, the aim is to reduce investments in new plants for the production of ICE vehicles.**

Norway: The Key is Electrification

Let's take a look at excellence. In 2016, the Norwegian Parliament approved a plan to achieve carbon neutrality by 2030, two decades ahead of the planned date. Norway is rapidly converting to renewable energy sources with the objective of **achieving total electric mobility by 2025** (zero-emission cars, minibuses, buses and trucks). Today, Norway boasts the highest global rate of EVs per capita. According to the Norwegian EV Association, there are over 100,000 battery-powered vehicles in a country with a population of 5.2 million residents where EV sales account for 54% of the total market (a figure that reaches 60% by including hybrid vehicles).

While the Norwegian Government provides a subsidy equivalent to €10,000 for the purchase of an electric Tesla (free charging, no circulation tax, minimal insurance) and is working on the creation of a **fleet of electric ships to reduce emissions**, it is also true that Norway – the leading European producer of oil with sales amounting to 45% of its exports and 20% of its GDP – has had to react swiftly to the fall in the price of oil and diversify its energy policy. Norwegian Secretary of State Rikard Gaarder Knutsen has explained that the country will use clean and flexible hydroelectric energy to electrify other sectors: transport, industry and energetic efficiency for citizens.

"By 2025, our country will only commercialize zero-emission cars," explains the Secretary of State. "We are similarly committed to electrifying our maritime sector. By 2022, there will be about 70 new electric ferries on our fjords. Thanks to public financing, we will develop the necessary technology and infrastructure so that, by 2025, we will have nautical accumulators and charging stations in all major ports."

Ampère, the world's first 100% electric ferry service, allows people to travel between Lavik Pier and Oppedal, on the Sognefjord, about a hundred kilometres north of Bergen, in twenty minutes. Thanks to its 1MWh ion batteries, Ampère makes the round trip 34 times a day at an average speed of 10 knots with 360 passengers and 120 vehicles on board. And it's all done without burning any fossil fuel.

The number of electric and hybrid cars is rapidly increasing in **Iceland**, too: from less than 100 in 2014 to over 6000 in 2018 for a country with a population of just 350,000. Moreover, the use of an electric car is particularly convenient in Iceland as, thanks to the **many available sources of geothermal energy**, the state provides free electric energy to all its residents. And thanks to a young female prime minister from the Green Party, politics is also on the ball. The government has not only launched an important investment program to install a vast network of charging stations, but it has also enacted a series of incentives ranging from exemptions on taxes to the annulment of importation tariffs for all those purchasing electric cars.

In **Sweden**, the main issue concerns the limitations of the electric grid. In the first five months of 2019, sales of 100% electric vehicles increased by 253%, reaching 6694 units, thanks to government incentives. And the trend will continue as Sweden aims to become **carbon neutral by 2045**. However, in order to achieve this, it will need at least two million electric and hybrid plug-in cars, which require public and private charging stations. And this clashes with the **structural issues of the Swedish energy grid**. Indeed, after having closed four nuclear plants and shifted to wind energy, the electric system in Sweden will not be able to accommodate the new surge in electric cars. Suppliers have suggested that **Vehicle-to-Grid** (V2G) technology should be incentivized as a solution. V2G technology allows car owners to connect their vehicles to return the energy stored in their batteries to the grid during peak hours. This is an extremely practical strategy, considering that cars are parked nearly 95% of the time.

Sweden is also constructing a **highway that will allow electric cars to be charged whilst driving**. The "Smart Road Gotland" is a 1.6 km stretch (out of a total of 4 km.) between the island airport and the city of Visby. The charging system is based on a system of induction tiles placed on the road surface that are connected to a central station that monitors energy requirements and transmission. The government aims to electrify 2000 kilometers of highways by 2030. The operation will cost of over 3 billion euro and reduce CO_2 emissions by as much as 80%.

Europe: Towards 40 Million Electric Cars

McKinsey has calculated that over two million electric vehicles were sold around the world in 2018. There currently are over five million EVs on our planet, half of which are in China. It has all happened in eight years, considering that only 700 EVs were registered in Europe as of 2010.

Some European countries are making steady progress, but progress is slower in the southern part of the continent, particularly in Italy. An overview of the situation (as of the beginning of 2020) is provided by the **LeasePlan Index, EV Readiness Index 2020** on the development of sustainable mobility in 22 EU member states. According to the study, the Netherlands, Norway and the United Kingdom are best prepared for the transition to EVs, while Italy lags behind. There is, however, consolation in the progress achieved by **Milan, defined tout court as the "Italian capital of electric mobility"** and where one out of four circulating vehicles is ecological (either hybrid plug-in or full electric). In many countries, the increase in ecological vehicles is being driven by the availability of public charging infrastructure (+73%) and an advantageous fiscal system. "The transition to EVs," explains **Tex Gunning, LeasePlan CEO**, "is one of the simplest actions that we can all undertake to contrast climactic change. Everyone should be able to afford an ecological vehicle, but policy makers must cooperate and continue to drive investments in charging infrastructure and incentivize the sale of electric vehicles."

According to a study by environmental organization **Transport & Environment (T&E)**, over the next ten years, Europe will need to ramp up its charging potential by a factor of 15. The aim is to install a total of **3 million charging stations compared to today's 185,000**. This figure is based on the objectives established by the European Union, which aims to achieve zero-emissions by 2050. By 2030, in any case, the emissions-limit for automotive producers (currently set at 130 grams/km) will be reduced by 37.5%. T&E analysts estimate that within the next decade **the number of EVs circulating on the old continent will reach ca. 44 million units**. Public and private subjects will have to **invest ca. 20 billion euro** (about €1.8 million a year) to satisfy the need for new charging stations. Currently, about 3% of the total investment in infrastructure is dedicated to charging stations. These figures have been released just as the EU is publishing its new funding scheme to support sustainable

> **The Netherlands, Norway and the United Kingdom are best prepared for the transition to EVs.**

projects, the so-called ***Green Deal***, that calls for an annual funding of one billion euro. The Transport & Environment study highlights the charging station target for each EU member state. **Germany**, the top-ranked country, will need to install just over 700,000 by 2030 (it currently has ca. 15-20,000), the **United Kingdom** 500,000 and **France** just under 500,000 over the next ten years.

Italy aims to install **300,000 charging stations by 2030**, including both public ones (streets, squares, parking lots) and private but publicly accessible ones (hotels, offices, malls and supermarkets). The country currently has 11,000 charging stations, but they are not homogeneously distributed. Indeed, over half of them are **concentrated in the regions of Northern Italy**. Lombardy is the only region that has over 1000 charging stations. The authors of the T&E study also point out that **70-75% of all charging stations are located in cities and urban areas**. Less than 5% of the total are located outside of urban areas and on highways, while 20-30% are located by "points of interest," especially shop-

ping malls and auto dealers. In order to support the creation of an increasingly efficient and widespread infrastructural network, in 2017, **ENEL launched a national plan for the installation of EV charging stations** calling for the installation of 14,000 new stations, for a total of ca. 28,000 charging points, throughout the country by 2022 through an **investment of up to 300 million euro**. Drawing inspiration from the 5 Business Models of the Circular Economy, Enel X (the group company focusing on digitalization, sustainability and technological innovation) acted as a Booster, a **circularity accelerator**, amongst its ecosystem of suppliers, partners, installers and clients.

United States: Progress Is Slow

In the **United States**, automotive producers are concentrating major investments on the production of 100% electric vehicles – more than on all other electrification options (hybrid, plug-ins, mild hybrids and fuel cells) – but **zero-emission vehicles are not catching on** as they are on other international markets. While the data from 2018 (over 35,000 EVs registered, +79% over 2017) seemed hopeful, EVs only represent **2.5% of the national automotive market** in the United States, a far cry from Norway's 55%. At the end of June 2019, battery-equipped models represented just 1.5% of the 8.4 million light vehicles sold (81% Tesla and 19% divided amongst 19 other battery-equipped models).

And it's not only designers and engineers who are skeptical about the "electric revolution." A survey amongst the 40,000 on-line subscribers of Wards Magazine revealed that nearly two thirds of them had little interest, as consumers, in electric and in smaller cars. This disinterest is caused, amongst other things, by a **lack of adequate information**. Indeed, according to a survey by Ford, 42% of Americans believe that electric cars still require gas.

While we are on the subject of common misconceptions about e-cars: notwithstanding the fact that automotive producers are developing software to manage the power and duration of batteries and ensure optimal ranges, even on snowy roads, the same Ford survey reveals that nearly **80% of Americans would not opt for an electric vehicle to drive in extreme weather conditions**. Compare this to the fact that Norway, one of the European countries with the harshest climates, sold about 35,000 new electric cars last year. There are misconceptions about electric car performance, too. Nearly all interviewed Americans and Europeans (over 90%) did not believe that electric vehicles could **accelerate as swiftly as cars with combustion engines**. This was disproved in 2017 with the introduction of the Tesla S, a model that had a faster acceleration, over a quarter mile, than two supercars like the Porsche 911 and the McLaren 570GT.

The Future Is Smart Charging

In any case, the issue of sustainable mobility is central to the energy transition. And one of the most interesting issues will be that of infrastructural innovation and smart charging – or the impact that the **smart charging** of EVs will have on the entire system. Commenting on the ***Innovation Outlook: Smart Charging for Electric Vehicles*** Report, Dolf Gielen, Director of the **IRENA** Centre for Innovation and Technology, explained that smart charging (which charges both vehicles and the grid) will unlock a virtuous cycle through which the transports sector will become more **sustainable** (electricity produces lower carbon emissions) and electric systems will become more **flexible** thanks to the integration of renewable energy sources.

Smart charging will help to avoid peak demands on the grid and reduce the cost of electricity, a solution that is always handy when infrastructure needs to be reinforced. **Stefano Besseghini**, President of the Italian Regulatory Authority for Energy, Networks and the Environment (**ARERA**), explained in a hearing at the Italian Chamber of Deputies that in order to manage the impact on electric networks – in particular for the low- and medium-tension distribution networks that will power charging stations – EV owners will have to learn to charge their vehicles at the best times and most suitable locations to optimize the efficiency of the electric system.

Nonetheless, technology and a widespread distribution network will not be sufficient to catalyze the e-Mobility Revolution. A **cultural revolution** is necessary to sweep away all the false myths on electric vehicles, beginning with the misconceptions that they pollute as much as traditional vehicles and will have a negative impact on the electric grid. Moreover, what we must really overcome is the **fear of their limited range**, the fear that we may be stranded before we locate a charging station. In the future, this fear will be increasingly less founded in view of the **global economic and technological drive to achieve a green planet** through silent, clean and sustainable means of transport.

Future & Technology

CESI Technology and Testing for Electric Mobility

Thanks to its state-of-the-art testing tools and laboratories, CESI certifies the reliability of electric vehicles, charging systems and their interaction with the grid, helping sector enterprises to expedite the launch of new models.

According to the Boston Consulting Group, by 2030, electric cars and trucks will compose 25% of the global vehicle fleet and represent 50-60% of new vehicle sales. The BCG also estimates that the electrification of infrastructure will produce an added value of US$3-10 billion for medium-sized utility companies (2-3 million clients). In fact, utilities will become the main partners of governments and automotive producers in this new entrepreneurial challenge addressing the **upgrade of electric charging infrastructure and smart sensors to avoid surcharges, as well as new tariff plans and promotions to incentivize the use of EVs**. While in 2009 each kWh produced by a battery for a hybrid or full electric vehicle cost US$700, by 2017 the cost was reduced to US$150 and, by 2030, it will cost no more than US$90.

We already have a wide range of applications for the mobility of the future: interconnected vehicles, self-driving vehicles, electric vehicles, remote diagnostics systems, remote control systems, artificial intelligence, smart grids, vehicle-to-grid, car sharing, V2V communications and smart home integration. In addition to these technological aspects, many of our daily habits will change in the coming years, too. According to a report by Goldman Sachs, urban populations will increase by 50% over 2010-2025 and this will have an effect on our quality of life. In order to limit congestion issues and property management costs (vehicles are unused 95% of the time), analysts have been emphasizing the benefits of a model based on the sharing economy. **Sharing electric vehicles could lead to a cleaner and more sustainable world**, especially considering that transports currently account for one fifth of all greenhouse gas emissions. Moreover, in the coming years, the automotive market will remain stable in industrialized countries, but developing nations will account for 70% of all new sales by 2025. This means that everyone will be able to afford the newest, most efficient and lightest models.

Italy is entering this new era of more sustainable and efficient mobility, too. Technological evolution, the need to reduce the impact and effect of traditional mobility on human health in megalopolises around the world, new policies, and massive investments by automotive producers are all converging on a turning point for the sector. **Electric mobility will be fundamental for the progressive decarbonization of our economy** and could represent a national opportunity for development. Electric vehicles produce 50% fewer emissions than vehicles with internal combustion engines (with reference to the average CO_2 emissions level of internal combustion engine vehicles in EU member states vs. the average emissions produced

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to generate electricity). Even batteries, after being used to power electric vehicles, will be used as energy storage devices for non-dispatchable renewable energy sources (photovoltaic panels) or disassembled to recycle precious elements (lithium, nickel and cobalt) as part of the circular economy.

Certification Tests at KEMA Labs

In this scenario, in which the future and technology are blending together to create tomorrow's sustainable mobility, CESI is working on electric mobility. It is working side by side with the automotive industry on decarbonization, providing its experience, competences and cutting-edge testing facilities for the final, critical step: testing new products before they are commercialized. After acquiring KEMA, **CESI now has all the latest generation tools and laboratories for testing electric mobility**. In the KEMA Labs, our experts test the reliability of electric vehicles (EVs), charging systems and their interaction with the grid on an emerging market in which high, reliable and quality standards are fundamental.

Speaking at a conference on sustainable mobility organized by WEC Italy, CESI Consulting, Engineering and Environment Division Director **Gianluca Marini** described how CESI is concentrating on the significant impact that electric vehicles will have on the country, both in terms of electric consumption and electricity transmission issues. According to the National Integrated Energy and Climate Plan (PNIEC), the 6 million vehicles expected to be circulating on Italian roads by 2030 could represent an additional energy demand of 18-24 TWh (7% of the total energy demand in Italy). "This," points out Marini, "will lead to further challenges: from the need for adequate charging infrastructure to the possibility of using vehicles as a resource for network services. Moreover, the concrete diffusion of renewable sources could be facilitated by electric mobility, improving its flexibility and storage options."

Understanding the strategic importance of a wide network of reliable and easy-to-use charging stations, CESI has been active as a certification agency for various types of charging stations - from household wall boxes to high-power public charging stations - since 2010. **The tests conducted at the KEMA Labs** address the full panorama of electric safety, mechanical resistance and electromagnetic compatibility. Moreover, the tests evaluate communications, protocols, interactions amongst vehicles and electric vehicle supply equipment (EVSE), as well as components in the battery management system for vehicle safety in case of accidents. The laboratory tests simulating interaction amongst vehicles, EVSE, battery and network storage systems provide precious data on the real operational conditions of vehicles for clients and allow system operators to optimize design phases and accelerate EV market launch schedules. "We have been working as technical consultants with the main actors in this sector: utilities, governments and regulatory authorities," points out CESI CEO **Matteo Codazzi** at an event promoted by Motus-E. "In this phase," he explains, "the objective is to help our partners with the transition to electric mobility and recommend new ways of integrating EVs into the grid. In fact, their use in dispatchment market services could provide a benefit of ca. €150 million a year by 2030."

Sustainable Approach and V2G Technology

Stimulating electric mobility amounts to taking a sustainable approach for an increasingly cleaner urban environment. With the objective of providing the market with the environmentally friendly benefits of charging stations, **CESI has been analyzing the entire lifecycle of this infrastructure**: not just its electric performance, but also its individual impact on the environment during every phase of the its lifecycle. The CESI approach is based on a thorough analysis of the carbon footprint of every installed charging station, followed by an evaluation of the recyclable and removeable raw materials, and the disassembly process necessary to promote efficient ecological disposal. Indeed, this is the new challenge facing charging station producers and service providers. At CESI, we also evaluate new technology based on the transferal of inductive power and automated connection of cables between cars and charging stations. This is an important process that allows EVs to be charged via automated systems even during extended parking stays. Moreover, thanks to V2G technology, the power flow can be inverted, using the car batteries to feed the electric network. This contributes to the stability of the electric network and the growing development of non-dispatchable energy sources such as photovoltaic. The entire charging station infrastructure can be designed to fuel EVs and become an important tool for distributed energy generation. In this context, electric car owners provide services to the grid and, in return, enjoy returns amounting to 30-100% of annual charging costs based on specific cases (household or company user, remuneration in only energy or capacity, too, etc.). In fact, this is an element that in many North European countries softened the initial barrier represented by the high cost of purchasing an EV. In terms of system service supply for electric vehicles (and the opportunities to integrate EVs and the grid), in 2019, CESI presented a study on the current panorama of grid services in Italy with the objective of evaluating the possible technological and regulatory impact of so-called "**Vehicle Grid integration**." Using batteries as a distributed energy storage system and aggregating them via a management platform with a range of flexible resources transforms unidirectional (V1G) and bidirectional (V2G) charging infrastructure into the real gems of this innovative revolution. And in order to reduce the costs of grid operation and full exploit the opportunities introduced by vehicle-grid integration, the system-level analyses (and case studies on the evaluation of EV cluster impact on transmission and distribution networks) conducted by CESI are fundamental for system operators (struggling with the new regulations and sustainable business models), market analysts, investors and, more in general, with all e-mobility actors.

> "CESI has been analyzing the entire lifecycle of this infrastructure."

Supporting Enel X

To integrate public lighting with charging infrastructure, Enel X has developed **JuiceLamp**, a smart LED lighting system that not only guarantees high efficiency and remote management but also charges two vehicles simultaneously (up to 22kW each) either via digital app or through credit card payment. The JuiceLamp system also provides video surveillance, air quality monitoring and fiber or Wi-Fi urban connectivity services.

The Enel X **JuicePole** is a 22-kW charging station that can quickly recharge up to two vehicles thanks to its innovative system. The system includes a 10-inch high-definition high-contrast monitor, an iconic and custom-tailored design (which allows it to be integrated into any urban or geographical context) and a network connection (that can be activated via smartphone or credit card for contactless payments).

CESI supported Enel X on the JuicePole project, in order to address its technological complexity. The tests conducted at our laboratories measured the performance levels of the JuicePole 2.0 to identify any critical issues caused by high operation temperatures. Testing addressed the natural cooling design and the ergonomics of the stations, two fundamental factors that preceded the campaign for the installation of the new JuicePoles by Enel X.

MOTUS-E

MOTUS-E is the first Italian Association representing industry operators, the transport sector and its entire supply chain, academia, consumers and advocacy groups that aims to promote the transition towards a more sustainable concept of mobility in a context in which technology and digital transformation play a fundamental role.

“MOTUS-E unites and represents all those of us who are interested in the success of electric mobility,” explains **Francesco Venturini**, MOTUS-E President. “The objective is to create a common platform on which all actors - from infrastructure managers to builders - can participate. The aim is to promote a transition towards the future of mobility in Italy, too, as is happening in other countries around the world.”

MOTUS-E Association
https://www.motus-e.org/

Opinions

Will the Only Car of the Future be Electric?

In this issue of Energy Journal, we have dedicated this section to a virtual debate, reflecting also the scenario determined by the Covid-19 emergency, showing points of view of some of the most important players involved in deciding on mobility and transport. The debate is based on extracts from their interventions in publications and events.

Adina Vălean

From Romania is the European Commissioner for Transport. Ms. Vălean has been a Europena MP since 2007. In 2019, the became President of the Commission for Industry, Research and Energy. Moreover, she also served as Vice President of the European Parliament (2014-2017) and President of the Commission for the Environment, Public Health and Food Safety (2017-2019).

Henrik Hololei

Is the European Commission Director General for Mobility and Transport. Henrik is an economist by training and holds degrees from Tallinn Technical University and Aarhus University in Denmark. He held various positions in the Estonian Government Office between 1995 and 2004.

Espen Hauge

President of the World Electric Vehicle Association [WEVA] and the European Association for Electromobility (AVERE). He has been engaged on the EV scene for 15 years. His career also includes project management, engineering, and research and development, with management experience from the oil and energy industry, and in construction, working for global companies such as ABB and GE, as well as for the City of Oslo.

Frank Rieck

Professor of Future Mobility at the University of Rotterdam, in a study conducted for the Faculty of Applied Sciences. Is currently, responsible for the research & innovation regarding Future Mobility. And is chairman of Dutch-INCERT a national network of knowledge centres regarding eMobility and is representing the Netherlands as vice president of EU organization AVERE.

Francesco La Camera

Is the Director-General of the International Renewable Energy Agency (IRENA). He brings more than thirty years of experience in the fields of climate, sustainability, and international cooperation. Previously, Mr. La Camera served as Director-General of Sustainable Development, Environmental Damage, EU and International Affairs at the Italian Ministry of Environment, Land & Sea since 2014.

1 ***With the new European Green Deal, the automotive sector is once again in the commission's firing line. The current objective is to reach 95gCO_2/km by 2021. In addition, more ambitious goals are set for 2030 and 2050. Reducing 90% of CO_2 emissions by 2050 is a key objective. Do you think it is feasible achievement? What are some of the initiatives, currently in place, working in that direction?***

EU Commissioner Adina Vălean: "We must ensure the free circulation of freight in the EU and promote coordination amongst member states in this period of health and economic emergency caused by the coronavirus. The transport sector has been heavily disrupted by the emergency in all sectors: air, road, rail and maritime. And it's not only the companies that are suffering, but all passengers, workers and the economy as a whole. This is why it is important to coordinate as many decisions as possible amongst EU member states. In any case, when it comes to future scenarios, the strategy on sustainable and intelligent mobility will lead us towards a transport sector aligned with a clean, digital and modern economy. When it comes to future scenarios, the strategy on sustainable and intelligent mobility will lead us towards a transport sector aligned with a clean, digital and modern economy. In this respect, the European plan certainly guarantees that transport will drive climate neutrality by reducing 90% of emissions by 2050, as per the European Green Deal". In addition, according to Commissioner Vălean, "in terms of climate neutrality, there is a strong need for cleaner vehicles and alternative fuels for road, maritime and aviation. I strongly believe that, in order to improve transport efficiency, it will be necessary to increase the use of rail and inland waterways as well. Moreover, green options must be incentivized for consumers, as well as providing solutions for low- and zero-emission solutions, including infrastructure".

Source: "EU strategy for mobility and transport: measures needed until 2030 and beyond"

https://www.europarl.europa.eu/doceo/document/CRE-9-2020-01-29-INT-1-403-0000_EN.html

Espen Hauge, President of the World Electric Vehicle Association [WEVA] and the European Association for Electromobility (AVERE): "A recent study carried out by the European Alternative Fuels Observatory, underlined that we already have 1.2 million electric cars in Europe and nearly 200.000 public charging points. In addition, the main motorways across the continent will soon be equipped with ultra-fast charging points, according to recent reports. This highlights how the objectives set by the European Green Deal are feasible."

Source: Les Echos, "D'ici quatre à six ans, la part de marché de l'électrique atteindra 50% dans plusieurs pays européens"

https://www.lesechos.fr/thema/articles/espen-hauge-dici-quatre-a-six-ans-la-part-de-marche-de-lelectrique-atteindra-50-partout-en-europe-1013826

Henrik Hololei, Director-General for Mobility and Transport at the European Commission: "Transport accounts for one quarter of all greenhouse gas emissions in Europe, which is why it is necessary to provide incentives for industry decarbonization. Initiatives in this department are, in fact, in line with the new EU strategy to accelerate the transition towards a low-carbon-emission, as per the Paris Agreement on Climate Change. At the same time, sustainable mobility is a fundamental element to improve the quality of life of all European citizens. As The European Commissioner for Transport Vălean has already pointed out, "the transport sector is already taking the first step towards a low-carbon economy. The objective by 2030 is to reduce emissions by 30% compared to the levels of 2005: this is a feasible achievement, but it requires a diverse and collective effort".

Source: The Parliament Magazine, "Investment in smart mobility keeps EU's economy moving"

https://www.theparliamentmagazine.eu/articles/opinion/investment-smart-mobility-keeps-eus-economy-moving

2 ***Aside from the impact on air pollution and CO2 emissions, sustainable and electric mobility are bound to play a crucial role, in broader terms, in the lives of million Europeans. What do you consider as the primary benefits for European citizens regarding green mobility?***

Frank Rieck, Professor of Future Mobility at Rotterdam University: "The European objectives in terms of sustainable mobility can certainly contribute, in broader terms, to a more sustainable ecology and a new economy for the whole system, in which investments for mobility will be more efficient in terms of time and money for the entire community. It's evident to everyone that we are facing new challenges. We know that the use of traditional means of transport have a huge impact on climate change and, indeed, we may wonder whether cars are still necessary. Nonetheless, global auto mobility continues to grow and global road transport (motorcycles, cars, trucks and buses) could double, reaching 80 trillion kilometers by 2050".

Source: Will Automotive Be the Future of Mobility? Striving for Six Zeros

https://www.mdpi.com/2032-6653/11/1/10/html

Henrik Hololei: "Such policies will make Europe more competitive, as long there is cooperation at all government levels: local, national and European. If we want to strengthen our economy, then the savings we can make by investing in smart and sustainable mobility can play a significant role. Active travel boosts our physical activity, which could save the EU over €80bn a year in healthcare costs. Conversely, traffic congestion costs the EU €100bn per year. In fact, introducing and promoting new measures in favor of low-emission vehicles, because smart and sustainable mobility will give our economies a huge boost. Investing in smart and sustainable mobility contributes to job creation and growth in Europe: to give an example, the number of jobs in the cycling sector could reach one million if we double the number of people riding bicycles; currently, 650.000 Europeans have a full-time job in this sector. Overall, investments in smart and sustainable ways of transport in our cities does not only have economic advantages, but also improves our quality of life".

Source: The Parliament Magazine, "Investment in smart mobility keeps EU's economy moving"

https://www.theparliamentmagazine.eu/articles/opinion/investment-smart-mobility-keeps-eus-economy-moving

Adina Vălean: "I am 100% committed to leaving no one behind as we embark on this green and digital transformation. The Just Transition Mechanism will be key here: it will mobilize 100 billion euros to address the social and economic effects of the green transition, focusing on the region's industries and workers who will face the greatest challenges. The connectivity provided by transport is fundamental to freedom of movement in the European Union. It should go without saying that, while we must embark on a significant reduction of emissions from transport and harness digital opportunities for the sector, safety and security will continue to come first. Our strategy will incorporate measures for maintaining the highest safety and security standards in the world of transport".

Source: "EU strategy for mobility and transport: measures needed until 2030 and beyond"

https://www.europarl.europa.eu/doceo/document/CRE-9-2020-01-29-INT-1-403-0000_EN.html

3 ***In order to achieve such ambitious goal, it is important to improve the technology utilized in the mobility sector. In this respect, what are some of the most important digital innovations?***

Henrik Hololei: "The main elements of our strategy include making the most of digital technologies, speeding up the deployment of advanced biofuels and renewable electricity and moving towards zero-emission vehicles. The implementation of ICT solutions is key in promoting smart and sustainable mobility, and also serves to demonstrate that investing in smart and sustainable mobility contributes to job creation and growth in Europe".

Source: The Parliament Magazine, "Investment in smart mobility keeps EU's economy moving"

https://www.theparliamentmagazine.eu/articles/opinion/investment-smart-mobility-keeps-eus-economy-moving

Frank Rieck: "Today, the automotive market is still growing, but its future depends on its ability to adapt to the needs of modern society. Our vehicles may evolve from family cars into micro-cars or larger multi-person vehicles. Thanks to modern technology, we are not just more aware of these developments, but we are starting to see them as feasible in the short term. The first signs of these transformations are already visible in our cities and urban areas."

Source: Will Automotive Be the Future of Mobility? Striving for Six Zeros

https://www.mdpi.com/2032-6653/11/1/10/html

Espen Hauge: "In many ways, EV technology is already superior to that of traditional cars. Green cars are more silent and more reactive. In this respect, a study we carried out at AVERE reveals that nearly 92% of EV owners are satisfied with their cars and would never go back to a car with an internal combustion engine. Thanks to the efficiency of electric motors, cars consume 50-80% less energy than a car with an internal combustion engine. Electric mobility is, of course, a friend of intelligent networks and plays a big role in the deployment of renewable energy. Indeed, cars are parked about 80-90% of the time and can be recharged in a fraction of that time. This allows great flexibility in the use of intermittent renewable energy sources such as wind or sun".

Espen Hauge: An interview with AVERE & WEVA

https://www.electrive.com/2019/05/10/espen-hauge-an-interview-with-avere-weva/

Adina Vălean: "The implementation of ICTs technology is, undoubtedly, a crucial factor in the effort to achieve our objectives. Digitalization, in fact, allows us to increase traffic efficiency through artificial intelligence and it benefits from services for shared and efficient mobility such as car sharing. This will require accessibility, convenience and connectivity, as well as security and protection to ensure the highest global transport safety and security standards. Therefore, it is necessary to continue investing in research and innovation, working side by side with industry."

Source: "EU strategy for mobility and transport: measures needed until 2030 and beyond"

https://www.europarl.europa.eu/doceo/document/CRE-9-2020-01-29-INT-1-403-0000_EN.html

Francesco La Camera: "The increasing diffusion of artificial intelligence and big data, the Internet of Things and storage systems are key factors to achieve (by 2050) the production of over 60% of global energy from wind and photovoltaic sources. Clearly, a systemic approach combining technology with new business models will be necessary to achieve this. Moreover, these solutions will have to be implemented coherently through careful planning and an intelligent development of policy. The good news is that we already have many of the tools that we need to decarbonize the economy."

Source: "Renewable Technology Innovations in Focus at IRENA Innovation Day in Bangkok

https://www.irena.org/newsroom/articles/2019/Sep/Renewable-Technology-Innovations-in-focus-at-IRENAs-Innovation-Day-in-Bangkok

4 ***Speaking of technology innovation, what are some of the most cutting-edge developments that could bring relevant transformations in the mobility sector?***

Frank Rieck: "In my recent research Will Automotive Be the Future of Mobility? Striving for Six Zeros, I underlined how disruptive technology such as electrification, automation and connectivity can make mobility more sustainable by pursuing six so-called 'zero objectives': zero emissions, zero energy, zero congestion, zero accidents, zero empty and zero costs. Now, it is the perfect time to drive this change for the better by concentrating on the 'six zeroes'. In this paradigm shift, we still expect the car to be the main vehicle for mobility in the future. The type of car we want to rely on, however, is the question we need to answer as a community in order to decide whether the future will be green and sustainable or not."

Source: Will Automotive Be the Future of Mobility? Striving for Six Zeros

https://www.mdpi.com/2032-6653/11/1/10/html

Espen Hauge: "According to Bloomberg New Energy Finance, by 2030 the electric vehicle market will reach 30 million sales a year and there will be 500.000 circulating electric vehicles before 2040, which accounts for one out of every three cars on the road. It's a staggering prediction that shows how European citizens and industries are, finally, embracing the key role of e-mobility. The main trends concern the rapid decrease in the cost of batteries by about 10-30% a year and, within four to six years, the price of electric battery vehicles that will be the same as that of cars with internal combustion engines. At this point, I trust that electric vehicles will reach a 50% market quota in various European countries. I'd even venture to say that, after 2025, purchasing a non-electric car will not be the best investment. As we wait for the prices to level out, government incentive policies are fundamental to drive sales. Furthermore, not only are batteries becoming cheaper every year, but they are also becoming more efficient, lighter and quicker to charge. I would like to remind that, only fifteen years ago, a 3.6 kW battery could only power a vehicle for 100 km after charging overnight. Now, we have 100 kW batteries that can drive vehicles over 300 km. after a short 30-minute charge. Basically, we can drive for three hours and just need a half an hour coffee break to recharge our electric vehicle".

Espen Hauge: An interview with AVERE & WEVA

https://www.electrive.com/2019/05/10/espen-hauge-an-interview-with-avere-weva/

Henrik Hololei: "I wanted to add that, as demonstrated by the European Mobility Week, European cities are encouraging the transition to cycling, walking, public transport and the use of low-emission vehicles. Furthermore, local shared mobility services such as bike-sharing and car-pooling are now well established. Last year alone, 5.657 permanent measures were implemented by 799 local authorities. This is the right path, we just need to continue on it. These habits must be promoted at all levels of government, amongst local administrations and all the other parties that are involved in urban mobility, from civil society organizations to local media, to schools and academic institutions".

Source: The Parliament Magazine, "Investment in smart mobility keeps EU's economy moving"

https://www.theparliamentmagazine.eu/articles/opinion/investment-smart-mobility-keeps-eus-economy-moving

> **"Research and innovation are vital to keep improving the technologies and reduce the costs for sustainable energy."**

Francesco La Camera: «While the current crisis has undoubtedly underlined global interconnections and strengthened the vision of a more resilient society at national and regional levels, it has also highlighted the vast differences in countries' circumstances and capacities. International cooperation is needed to tackle deeply embedded shortfalls and vulnerabilities, and crisis responses must reflect global co-dependency. Investments must be directed everywhere they are needed, including to the most vulnerable countries and communities. In the creation of future infrastructure, energy solutions aimed at scaling up renewables provide a safe and visionary strategic investment choice. Recovery measures could help to install flexible power grids, efficiency solutions, electric vehicle (EV) charging systems, energy storage, interconnected hydropower, green hydrogen and multiple other clean energy technologies. With the need for energy decarbonisation unchanged, such investments safeguard against short-sighted decisions and increased accumulation of stranded assets […] Research and innovation are vital to keep improving the technologies and reduce the costs for sustainable energy. This is especially true in end-use sectors like transport, heating and cooling, as well as for enabling technologies such as energy storage and green hydrogen. Governments must embrace these forward-looking options to ensure that public policies and investment decisions reflect the true potential for low-carbon economic development».

Source: Staying on Course: Renewable Energy in the Time of COVID-19

https://www.irena.org/newsroom/pressreleases/2020/Apr/Staying-on-Course-Renewable-Energy-in-the-time-of-COVID19)

One on One

Electric models VS Fossil fuel

The analysis of data on emission levels allows us to compare mobility with electric and internal combustion engines.

For further information on this topic, please contact:
Alessandro Bertani, Services & Smart Technologies Director – CESI
alessandro.bertani@cesi.it

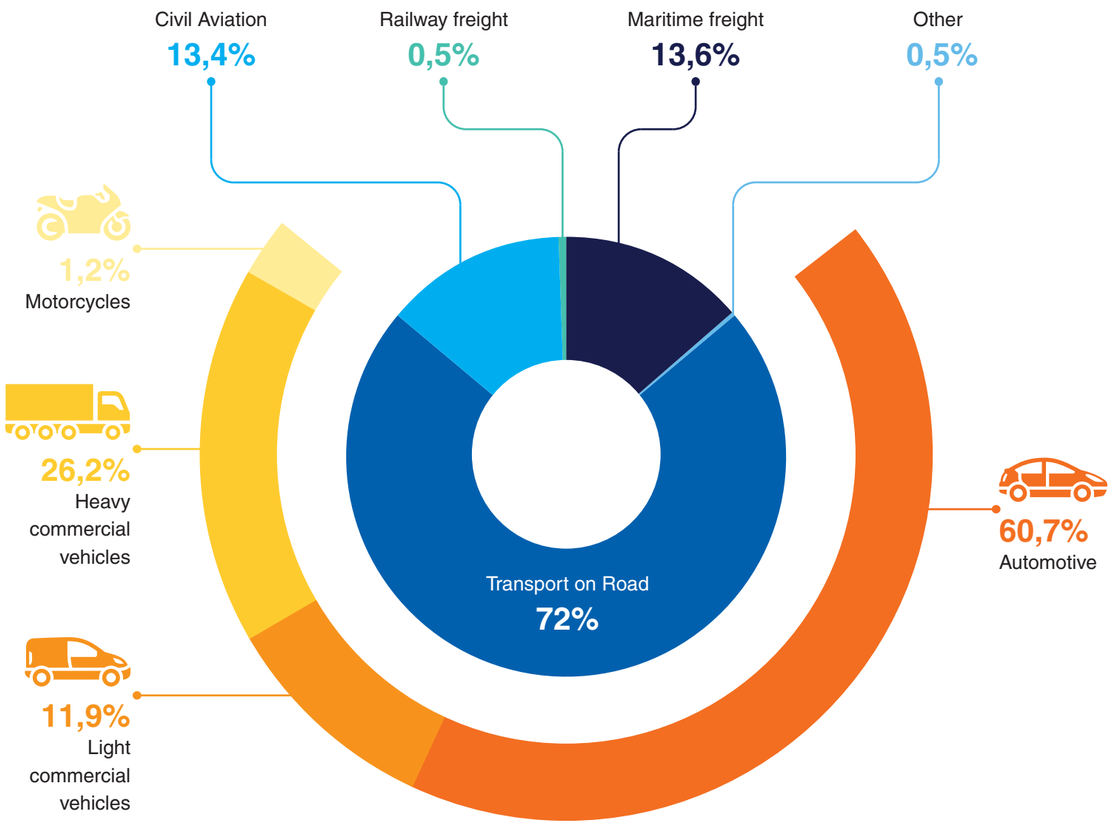
The transport sector (road, rail, air and maritime) is responsible for 30% of all CO_2 emissions in Europe, and nearly 72% of this 30% is produced by road transport.

The aforementioned digits have been revealed by the official data published in 2019 by the European Union, which has pledged to reduce transport emissions by 60% by 2030 (compared to the levels of 1990).

Transport Emissions Are on the Rise

It's not an easy objective to achieve. The constant increase in mobility has led to greater CO_2 emissions by the transport sector, while other sectors (energy, industry, residential, agriculture) have witnessed a decreasing trend. A few distinctions must be made in regard to the passenger transport sector. CO_2 emissions vary significantly depending on whether we analyze road, rail, air or maritime transport. Motor vehicles are amongst the most polluting means of transport on European roads. They account for 60.7% of the total CO_2 emissions. Therefore, environmental policy is called to investigate on the potential reduction of CO_2 emissions that could be produced by substituting ICEVs (Internal Combustion Engine Vehicles) with BEVs (Battery Electric Vehicles).

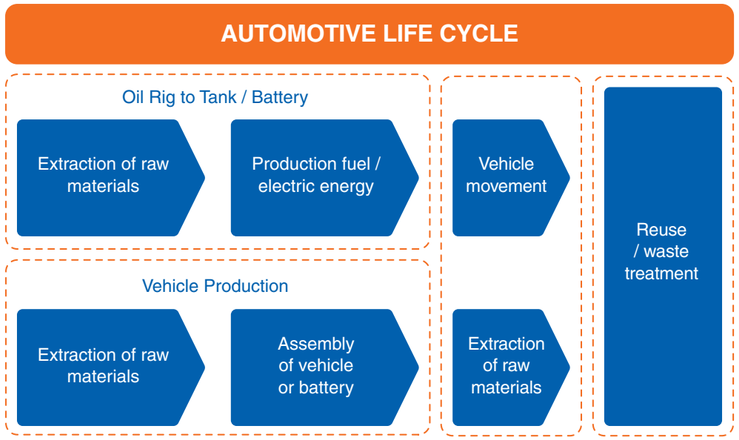
Emissions caused by type of transport (2016)



Source: European Environment Agency

The Lifecycle Analysis

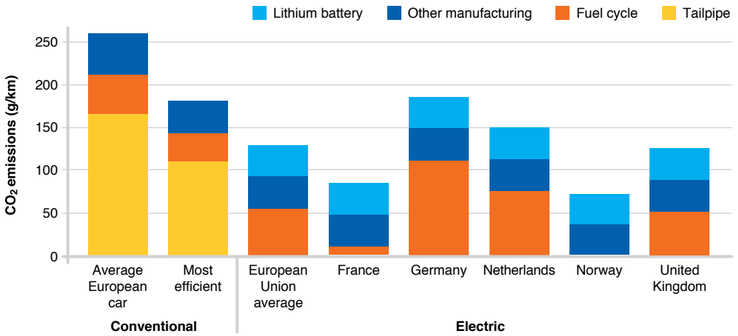
CO_2 emissions caused by BEVs and ICEVs depend on numerous factors. Indeed, a sound analysis must address the entire lifecycle of a vehicle, as well as its fuel type, to produce what is referred to as a *lifecycle analysis*. This type of analysis addresses the CO_2 emissions produced during various phases: extraction, refinement and distribution of fuels necessary to power ICEVs or to produce electric energy; production and transmission of electric energy; production of vehicle and battery components and their assembly, reuse and/or treatment as waste; CO_2 emitted to move a vehicle.



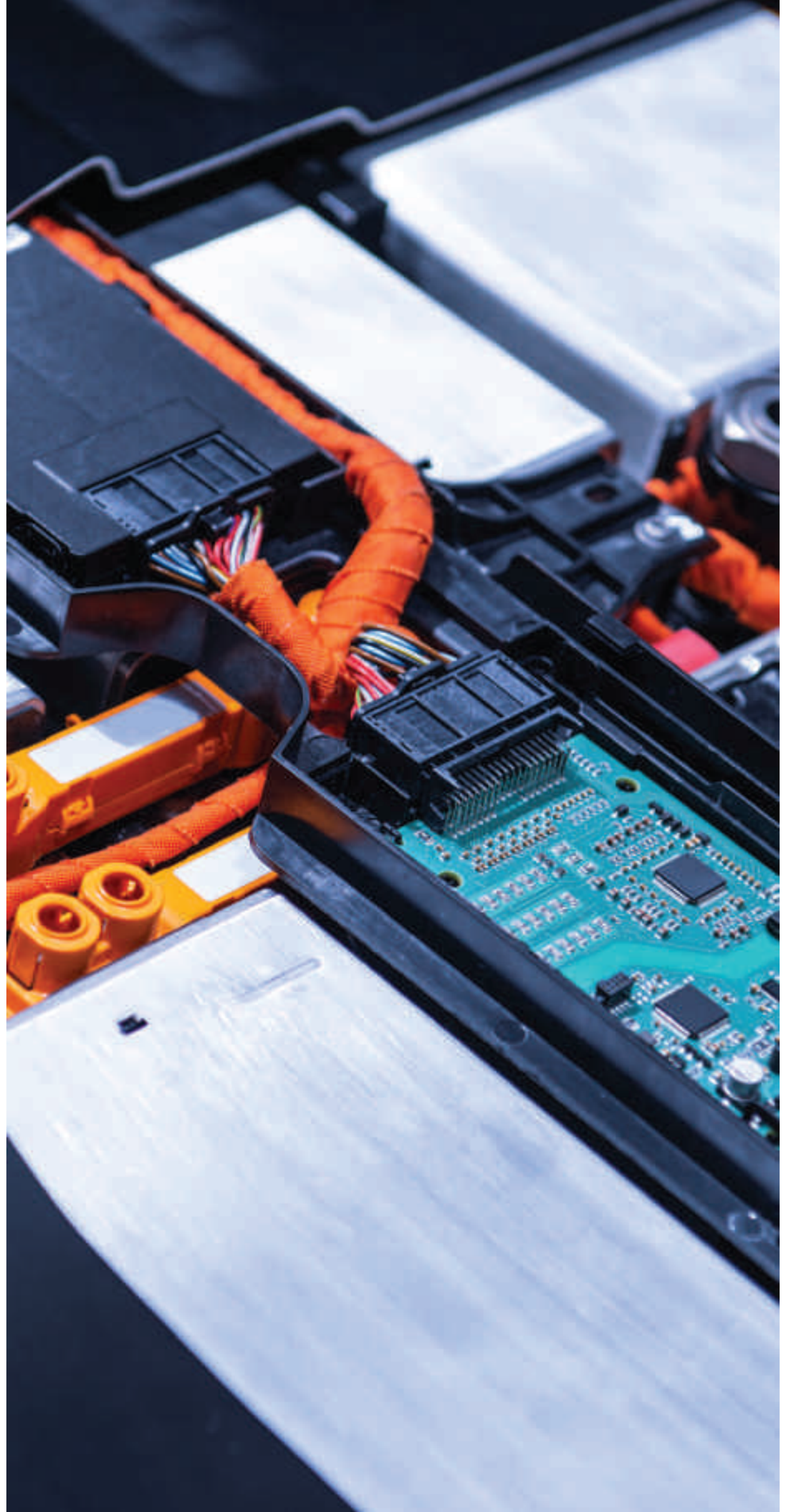
Schematic representation of automotive life cycle.

According to the "**Life Cycle Analysis of the Climate Impact of Electric Vehicles**" Study produced by Transport & Environment (T&E), the CO_2 emissions produced by an electric car throughout its lifecycle (calculating an average lifetime driven distance of 200,000 km, an energy mix equivalent to the European average and a 30 kWh battery) are less than half of those produced by a diesel car of the exact same size.

This trend is confirmed by the "**Effects of Battery Manufacturing on Electric Vehicle Life-cycle Greenhouse Gas Emissions**" study, published in 2018 by ICCT (International Council on Clean Transportation). The study indicates that greenhouse gases (GHG) measured throughout the lifecycle of electric vehicles is 50% less than those produced by vehicles with internal combustion engines, even when taking into consideration the significant amount of toxic emissions caused by battery production, based on a lifetime driven distance of 150,000 km. The table below shows how, compared to endothermic engines, electric cars produce 28-72% fewer emissions, based on the sources of local electricity generation.

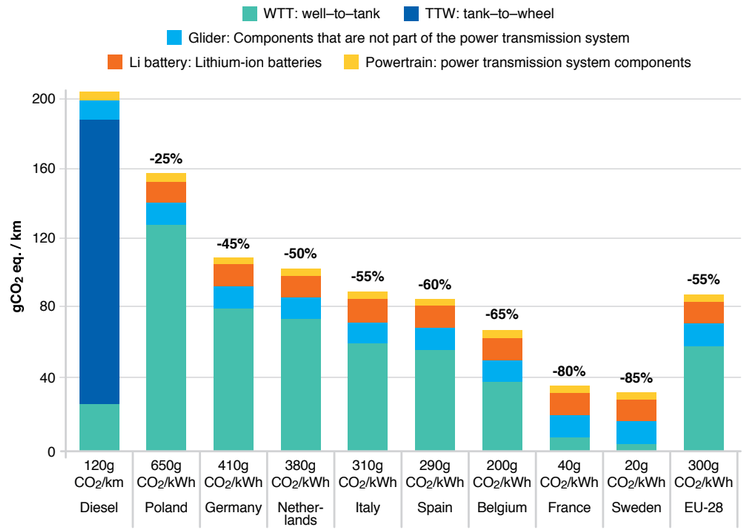


Life-cycle emissions (over 150,000 km) of electric and conventional vehicles in Europe in 2015.



Influence of Various Energy Mixes on the Environmental Impact of Electric Vehicles

The energy necessary to drive electric vehicles is produced from a wide range of sources. The use of oil and coal, as opposed to renewable energy, has significant repercussions on the environmental impact of these vehicles. However, according to recognized studies carried by the European Environment Agency, the superiority of electric vehicles is not affected by this issue. In fact, the only (and rather unlikely) case against electric vehicles would concern a scenario in which the electricity was produced entirely through coal. This is the sole case in which an electric car would produce more GHG than either gas or diesel cars. The results, which only differ slightly from the ICCT study, reveal that even in Poland, where 70% of the energy mix is produced through coal and lignite, electric cars still pollute less. In Italy, where 37% of the energy mix is produced from renewable sources (and 40% from gasses), the advantage is evident. In Germany, where the mix includes coal and lignite, the difference with diesel is reduced. In France and Sweden, on the other hand, where the energy mix uses little fossil fuel and is mainly based on renewable sources and nuclear energy, electric cars are very popular. On average, in the EU28, CO2 emissions are currently equal to 300 gCO2/kWh and are forecast to decrease to 80 gCO2/kWh by 2050.



Influence of energy mixes on the environmental impact of electric vehicles.

Impact of Batteries on Electric Vehicle LCA

Today, ca. 70% of the environmental impact of EVs comes from the electricity generation mode, while the remaining 30% may be attributed to battery and vehicle component production. However, as revealed by the aforementioned studies, this ratio is destined to increase progressively as electricity gets produced from renewable sources. The impact of battery production, which is destined to become increasingly significant, could be further reduced by using renewable sources also to provide the electric energy required for their production. Furthermore, even battery recycling would reduce the impact by lowering the amount of raw materials required to create new batteries. In fact, the extraction process that provides the materials necessary for battery production causes significant pollution and consumes a lot of energy.

The use of recycled materials, together with the reliance on renewable energy for battery production, could reduce the original impact of batteries by 35%.

Future Scenarios

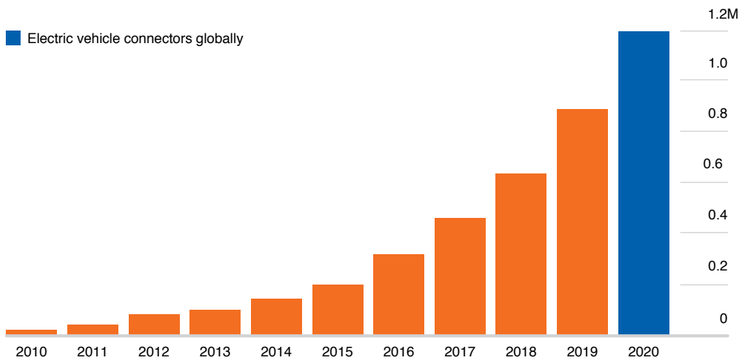
The decrease in emissions caused by the production of electric energy, the improvement of productive processes and the increase in the energy density of batteries will not only determine an **increase in the autonomy** of electric cars, but it will also lead to an increasingly lower environmental impact in terms of CO_2.

According to forecasts by analysts at BloombergNEF (BNEF), whereas China has been the greatest protagonist of electric mobility to date, in 2020 Europe will take the global lead in terms of zero-emissions cars. In the **EV and New Mobility: Trend to Watch in 2020** Report, BNEF estimated that, in 2020, 2.5 million electric cars would be sold globally, a 20% increase over 2019.

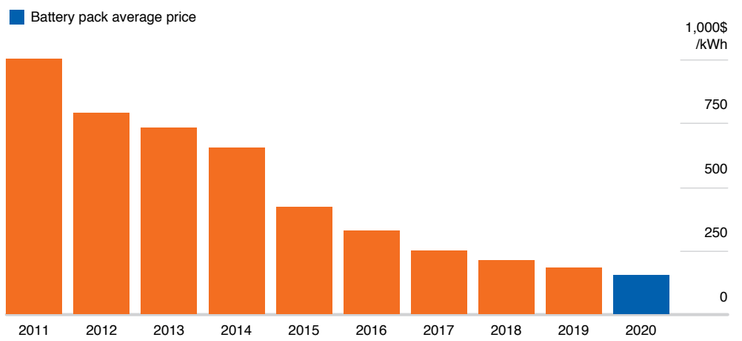
Furthermore, Chinese sales will slow down due to the reduction of government incentives on the purchase of a zero-emissions cars. And this will make Europe the main market for the first popular electric models like the Volkswagen ID.3.

The decrease in the cost of lithium ion batteries is one of the main factors that will influence the diffusion of electric vehicles. The average cost of 1 kWh was US$135 in 2020. This is 13% less than in 2019 and 89% less than ten years ago. The consequence is that cheaper and more efficient batteries will contribute to the progressive reduction of the final cost of electric vehicles, which will grow increasingly more competitive than gas and diesel vehicles, even in terms of sales.

The BNEF study also addresses research infrastructure. In Europe, the number of charging stations will increase significantly from the 880,000 installed at the end of 2019 to 1.2 million in 2020. Moreover, besides EU policy and that of its member states, there will also be significant investments in charging infrastructure made by energy companies as they prepare to face the new needs raised by eMobility.



Source: BNEF



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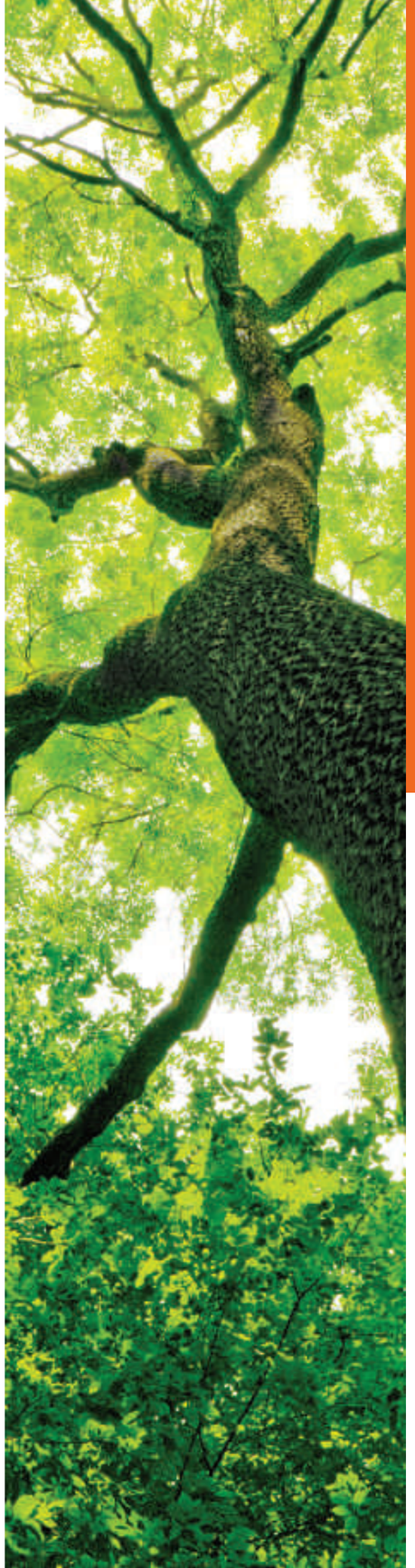

Title: Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future

Author: Daniel Sperling
Publisher: Island Press
Year of publication: 2018
https://www.springer.com/gp/book/9781610919067

Vehicle automation, shared mobility and the electrification of automobiles are the greatest changes affecting the transport sector. The governments of various countries are called upon to foster this potential and initiate an age of green mobility. Author ***Daniel Sperling*** *explains how to implement these changes immediately. Daniel Sperling is the Founding Director of the Institute of Transportation Studies at the University of California, Davis (ITS-Davis); Professor of Civil and Environmental Engineering; Professor of Environmental Science and Policy; and Faculty Director of the Policy Institute for Energy, Environment, and the Economy at the University of California, Davis.*

This book has been defined as mandatory reading for governments and companies committed to ushering cities into a sustainable future.

Review

The Three Revolutions of Sustainable Mobility

Daniel Sperling – who, since 1981, has written over 200 articles and 12 books on the innovation of mobility – believes that our leaders must start from an important assumption: the technological revolution alone will not lead us towards lesser environmental impact.

Three Revolutions precisely outlines the strategies that governments need to implement in order to inaugurate an era of green mobility. No one can ignore the three revolutions that are taking place in the transport sector: the automation of vehicles, shared mobility and the electrification of automobiles. The time has come to provide an answer to the most important question: what are the potential benefits and the negative impacts that these innovations could set in motion? Together with seven other opinion leaders from the mobility sector, Daniel Sperling describes possible future scenarios based on research, data, reports and best practices. The founder of the Institute of Transportation Studies and Director of the Policy Institute for Energy, Environment and the Economy at the University of California (ITS-Davis) examined the most innovative projects, the most proficient collaborations between the private and public sectors and highlights the strategic role that policies must play in different countries. According to the author, governments need to place the transport sector at the center of public interest. This will transform citizens into "informed protagonists" of the very behavior necessary to promote environmental sustainability and green mobility. The objective is to improve the quality of life of all individuals so that these revolutions will not only lead to a more enjoyable and sustainable future, but also to a fairer one. There are many factors that could influence the outcome of such important changes, starting from the choice of individuals who abandon the idea of privately-owned vehicles and share their means of transport. The elements that will most significantly influence the distribution of electric vehicles includes the decrease in price of batteries and fuel cells, automation, and the ability of companies to introduce further innovations to the electric vehicle sector.

Three Revolutions connects recent global developments in the transport sector to technological innovation and economic and urban planning trends. The Mayor of Sacramento (California), Darrell Steinberg, points out the practical value of this publication: "*Three Revolutions is essential reading for anyone interested in how technology and mobility will shape our communities and our lives. This perfectly timely book helps to inform the various decisions we need to make as these new technologies emerge. In Sacramento, we are implementing some of the innovative ideas in this book in an effort to lighten our environmental footprint and become technology leader. Our cities need to define their own destiny as new opportunities emerge. This book shows us how.*"

Three Revolutions acts not only as a reference textbook, but also provides material for reflection and inspiration for all policy, enterprise and industry sectors that intend to pursue sustainable mobility. Daniel Sperling identifies the exact mix of business, politics and markets necessary to implement every possible change that may lead to a green, more informed and sustainable future.

Shaping a Better Energy Future

CESI is a world-leading technical consulting and engineering company in the field of technology and innovation for the electric power sector. In particular, through its Division KEMA Labs, CESI is the world leader for the independent Testing, Inspections and Certification activities in the electricity industry. With a legacy of more than 60 years of experience, CESI operates in 40 countries around the world and supports its global clients in meeting the energy transition challenges. CESI also provides civil and environmental engineering services.

The company's key global clients include major utilities, Transmission System Operators (TSOs), Distribution System Operators (DSOs), power generation companies (GenCos), system integrators, financial investors and global electromechanical and electronic manufacturers, as well as governments and regulatory authorities. In addition, CESI works in close cooperation with international financial institutions such as, among others, the World Bank Group, the European Bank for Reconstruction and Development, the European Investment Bank, the Inter-American Development Bank, the Asian Development Bank.

CESI is a fully independent joint-stock company headquartered in Milan and with facilities in Arnhem, Berlin, Prague, Mannheim, Dubai, Rio de Janeiro, Santiago de Chile, Knoxville (USA) and Chalfont (USA).

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