Media information

System changeover to e-mobility

Berlin, March 2020

Note: this media information and further information, images and films on e-mobility can be found on the Internet at www.volkswagen-newsroom.com.

All the information on equipment applies to the German market.

ID.3* = This vehicle is not yet available for sale in Europe.

ID.4* = The vehicle is a near production concept car.

Golf Life 1.5 TSI ACT OPF 96kW/130 PS 6-speed = fuel consumption (NEDC), l/100 km: urban 6.2 /extra urban 3.9 /combined 4.7, CO2 emissions, g/km: 108 (combined); efficiency class: A

Golf Life 2.0 TDI SCR 85 kW/ 115 PS 6-speed = fuel consumption (NEDC), l/100 km: urban 3.8 /extra urban 3.1 /combined 3.4, CO2 emissions, g/km: 89 (combined); efficiency class: A+

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At a glance

System changeover to e-mobility

- **System changeover:** 2020 will be the key year for the system changeover to e-mobility.
- **Electric offensive:** Volkswagen is forging ahead – as the driver in the system changeover to e-mobility. 75 new electric models are planned up to 2029.
- **Timeframe:** Volkswagen is moving forward to schedule with its electric offensive. The ID.3 will appear on the roads in the summer.
- **The battery has the edge:** battery electric cars represent the best approach in economic and environmental terms. Hydrogen is no alternative for passenger cars.
- **Ready for the breakthrough:** battery electric drive systems are available, affordable and to make the greatest contribution to climate protection.
- **Affordable e-mobility:** in terms of total cost, the ID.3 is at the same level or even below the level of comparable internal combustion models.
- **Sustainable mobility:** following the ID.3, the ID.4 from Zwickau will also be produced with a neutral carbon balance.
- **Safety:** electric cars are just as safe as conventional vehicles with internal combustion engines.
- **Charging infrastructure:** public charging will become increasingly important. The expansion of public charging infrastructure must be drastically accelerated.
- **Sprint program:** by 2025, more than 300,000 public charging points will be needed in Germany.

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The future of mobility is electric

2020 will be the key year in the transformation of the automotive industry. With the ID.3, Volkswagen is bringing the "Golf of the electric era" onto the market. Many other models will follow. The ranges and charging performance of these vehicles are fit for everyday use. The charging infrastructure is ready. And there is a new situation with regard to costs. With the ID.3, the electric car will be just as inexpensive as or even less expensive than a comparable internal combustion model for the first time. The electric car is finally moving into the center of society.

With e-mobility, Volkswagen is making a substantial contribution to climate protection. The Group is committed to the goals of the Paris agreement under which global warming is to be limited to significantly less than two degrees up to 2050. In order to achieve this objective, it will be necessary to make mobility entirely CO_2-free. Volkswagen is therefore doing everything in its power to ensure that electric cars are both produced and used sustainably.

In the passenger car sector, hydrogen is no alternative. In comparison with the battery, the technology is expensive, insufficiently mature and inefficient. On the basis of the state of the art, the battery electric car is considerably superior to the fuel cell and also to synthetic fuels and will be successful in establishing itself over the next few years. Those who make different assertions are only contributing to uncertainty on the part of customers and raising obstacles to the traffic transition that is so urgently needed.

The system changeover to e-mobility is well underway. Over the next five years, the Volkswagen Group will be investing about €33 billion in e-mobility, including €11 billion to be invested by the Volkswagen brand alone. Among other efforts, we are building a battery cell production facility in Salzgitter together with the Swedish company Northvolt. By 2029, Volkswagen intends to launch up to 75 all-electric models and to sell about 26 million electric vehicles.

It will now be crucial to bring these vehicles onto the roads at long last. Experience shows that people who have already driven an electric car no longer want to go back. The models in the ID. family are real alternatives to the conventional internal combustion engine. Long ranges, fast charging and a rapidly developing charging infrastructure are making e-mobility fit for everyday use. They are now the better choice even in terms of prices. To sum up, the electric car is ready for its breakthrough.

Electric offensive: Volkswagen's system changeover to e-mobility

Group. No other automaker has adopted such a comprehensive approach to the dawn of the electric age as Volkswagen. Over the next few years, the Group intends to become the world market leader in e-mobility and is investing a total of €33 billion for this purpose up to the end of 2024. Volkswagen is electrifying all segments of its product portfolio. By 2029, the Group intends to launch up to 75 all-electric models and to sell 26 million electric cars. By the end of the decade, about 40 percent of Volkswagen Group vehicles sold in Europe and China are to be all-electric cars.

Brand. The brand will invest €11 billion, or about one third of the funds planned by the Group as a whole. Volkswagen Passenger Cars is bringing e-mobility to the mass market. With the ID.3, the first electric car fit for everyday use and affordable for millions of people, will come onto the roads. This will be followed rapidly by a number of other models. In 2025, the Volkswagen brand expects to produce 1.5 million cars in the new ID. family.

MEB. The modular electric drive toolkit (MEB) is the technical and economic backbone of the electric offensive. About 20 million of the electric vehicles planned by the Group up to 2029 will be based on the electric platform developed by the Volkswagen brand. This vehicle architecture conceived especially for electric drive systems offers long ranges of up to 550 kilometers, spacious interiors and outstanding performance. The scalable battery system allows all customers to select the battery capacity that best suits their needs. Fast charging capabilities at up to 125 kW are a crucial advantage, especially for long-distance trips.

ID. family. The Volkswagen brand is launching the compact ID.3 as the first electric car based on the MEB. Following the Beetle and the Golf, the ID.3 will usher in the third major chapter in the history of the Volkswagen brand. Market introduction throughout Europe is planned for the summer of 2020. Series production at the Zwickau plant is already underway. This year too, the ID.4, the brand's first all-electric SUV, is due to follow. By 2022, Volkswagen will be offering electric models based on the MEB in all major vehicle segments.

Electric vehicle production. By 2022, Volkswagen is to build a total of eight plants for the production of MEB vehicles. The Zwickau plant is playing a pioneering role in the transformation. The plant is being converted entirely to e-mobility for €1.2 billion. By 2021, up to 330,000 electric cars per year will roll off the production line there. In future, the Emden, Hanover and Dresden plants will also produce electric vehicles. In addition, it is planned that Mladá Boleslav will become a European electric car plant. In China, two further MEB plants, which are to start production this year, are being built at Anting and Foshan. The US plant at Chattanooga, Tennessee, is also being changed over to the MEB.

Germany as a production location. With its resolute entry into e-mobility, Volkswagen is making an important contribution to climate protection and thereby creating long-term perspectives for some 100,000 employees at its German plants. A strong cluster for EVs will emerge in Germany in the coming years. This will also include the

component plants at Brunswick, Kassel, Salzgitter and Wolfsburg. They will produce key components such as the electric motor and the battery system. Volkswagen is also cooperating with Northvolt to set up a major battery cell factory in Salzgitter.

Training. The production of electric cars calls for different skills in some cases. At Zwickau, all 8,000 employees are therefore to be trained for electric car production. About 3,000 people are receiving special training in the installation of electrical components and about 1,500 employees will acquire a "high-voltage license". In total, the team at Zwickau is to complete about 13,000 days of training up to the end of 2020.

Key year. 2020 will be a key year for the transformation of Volkswagen. The market launch of the ID.3 in the summer will make the start of the brand's electric offensive tangible on the road. In addition, further members are to be added to the ID. family. The brand's first all-electric SUV, the ID.4, will celebrate its world premiere in the course of the year. Production is due to start at the electric car plant in Zwickau in 2020. At the same time, preparations will start for the planned changeover of the Emden plant, where the ID.4 will also be made from 2022 onwards. At the international level, preparations for the start of production of the ID. family are well underway in China and the USA. Pre-production of the ID. family has already started at the Chinese plant in Anting.

The alternatives: battery vs. hydrogen and e-fuels

Focus on the battery. Battery electric or hydrogen? In Germany, this discussion shows no signs of coming to an end. Volkswagen has made its decision. In view of the facts, the automaker is clearly focusing on battery electric vehicles. The reasons are obvious: the technology is tried and tested, ready for production in large series and affordable for the vast majority of drivers. However, what is most important is the fact that the battery electric vehicle is far superior in terms of climate protection to the fuel cell electric vehicle and internal combustion engine models with synthetic fuels. This assessment is supported by a large number of scientific studies carried out by bodies such as the Fraunhofer Institute and Agora Verkehrswende.

Efficiency is a key factor. Efficiency is the key factor in assessing the various alternative drive systems. The power required for hydrogen production is enormous. A hydrogen vehicle needs between two and three times as much power for the same journey as a battery electric vehicle. The efficiency of a hydrogen vehicle is about 35 percent and e-fuels only reach 15 percent. In contrast, a combination of battery and electric motor converts the primary energy used most efficiently. Depending on the model, the efficiency is between 70 and 80 percent

	Battery	Fuel cell	e-fuels
Efficiency with 100% green power (%)	75	35	15

Source: "Klimabilanz, Kosten und Potenziale verschiedener Kraftstoffarten und Antriebssysteme für Pkw und Lkw" by Martin Wietschel et al. Fraunhofer-Institut für System- und Innovationsforschung ISI, September 2019.

Scarce green power. Why is efficiency so important? It is really quite simple – because power is scarce and this applies especially to green power. In Germany, there will be a shortage of indigenous green power in the long term. This means that all types of waste must be avoided. Scarce green power must be used as efficiently as possible. In the case of passenger cars, hydrogen would therefore be a dangerous detour. The battery is by far the better alternative. Hydrogen technology will become established in other areas – especially in industry and in heavy goods traffic as well as aviation and shipping. The prediction of Berlin hydrogen expert Prof. Volker Quaschning is clear: "The normal car for average use will very probably be a battery electric vehicle in the future. There will be no environmental disadvantages as a result."

Fitness for everyday use. In addition to environmental aspects, the battery also has quite practical advantages over hydrogen. Although a hydrogen car can, in theory, the re-fuelled as fast as an internal combustion model, the infrastructure required is not yet available. The development and installation of refueling infrastructure would result in costs running into the billions which could scarcely be financed at the same time as the development of charging infrastructure. More important is the fact that the hydrogen car will be significantly more expensive than a comparable battery electric vehicle for the foreseeable future – not least because of the high power requirement.

As a result, there are only a few models on the market and demand is very limited. At the beginning of 2020, only 507 hydrogen cars were registered in Germany. For the vast majority of car drivers in Germany and Europe, the battery electric vehicle will therefore be a better and more attractive option, especially since ranges and charging capacities are now entirely fit for everyday use.

Source: https://www.isi.fraunhofer.de/content/dam/isi/dokumente/cce/2019/klimabilanz-kosten-potenziale-antriebe-pkw-lkw.pdf

Sustainability: the sustainable EV

Green mobility is possible. The battery electric vehicle has the best climate balance of any drive system. This is the result of a large number of scientific studies conducted by bodies including the Fraunhofer Institute, the Federal Ministry for the Environment and the Agora Verkehrswende think tank. Volkswagen is going one step further and will be delivering the first models of the ID. family in Europe with a 100 percent neutral carbon balance. The vehicles will therefore make a key contribution to the decarbonization of the transport sector and will play a pioneering role on the way to clean mobility. This development will be ushered in by the compact ID.3, followed shortly afterwards by the ID.4, the first SUV in the new electric car generation manufactured with a neutral carbon balance.

Avoid, reduce, offset. With the ID. family, Volkswagen is targeting the entire life cycle of the electric vehicle – from raw material extraction via production through to recycling. The Group is following a clear principle. Wherever possible, CO_2 emissions are to be avoided. If this is not entirely possible, the emissions are to be reduced to the greatest extent possible. Emissions which are currently still unavoidable are offset by investments in climate protection projects. In addition, as regards the vehicle utilization phase, Volkswagen offers a number of possibilities of charging electric cars with climate-friendly power. With this approach, Volkswagen is following the recommendations of many scientists who are calling for a broader view of the climate balance of individual mobility.

Own climate protection projects. In order to compensate for emissions which are still unavoidable, Volkswagen is developing its own climate protection projects. In addition, Volkswagen supports existing climate protection projects such as the Katingan Mataya Forest Protection Project of Permian Global in Borneo. The project is located in central Kalimantan and safeguards 149,800 hectares of forest on carbon-rich peat soils. All the projects are certified to the most stringent international standards "Verified Carbon Standard" (VCS) and "Climate Community and Biodiversity Standard" (CCB) or "Gold Standard".

Efficient production. Within the framework of its environmental mission statement "goTOzero", Volkswagen is reducing the environmental footprint of its production throughout the Group. By 2025, the plants intend to reduce emissions per vehicle produced by 45 percent compared with 2010. The Zwickau vehicle plant is among the forerunners. All the power purchased from external sources is Volkswagen Naturstrom from renewable sources. There is also a high-efficiency compact cogeneration plant which is to be powered using carbon-neutral gas in the long term. The buildings and equipment are subject to a continuous energy optimization process, for example through the use of frequency-controlled fans and pumps. This way, the consumption of power, water and heat is continually reduced.

Sustainability in the supply chain. Green power is also used for energy-intensive battery cell production by suppliers. Since July 1, 2019, Volkswagen has reviewed its suppliers on the basis of a global sustainability rating. The Group expects its suppliers

to ensure the maximum level of transparency and to provide the maximum level of information on compliance with the agreed sustainability standards. In 2019, about 12,000 suppliers were checked and 1,300 sustainability audits were carried out. However, due to the complexity and global orientation of the company, with more than 40,000 suppliers, compliance with environmental and social standards along the entire supply chain is a task that even a major industrial group cannot master alone. This is why Volkswagen also participates in cross-sector initiatives such as Drive Sustainability or the Global Battery Alliance which are working on shared standards for sustainable raw material extraction.

Charging with green power. About half the emissions of an electric car charged using a conventional power mix are produced during the utilization phase. With green power, these emissions can be reduced almost to zero. Volkswagen offers a number of options for charging electric cars with green power. Volkswagen Naturstrom is available for charging at home and the fast charging parks of the IONITY joint-venture along the highways use 100 percent eco-power. Volkswagen also operates the charging stations as its plants using green power.

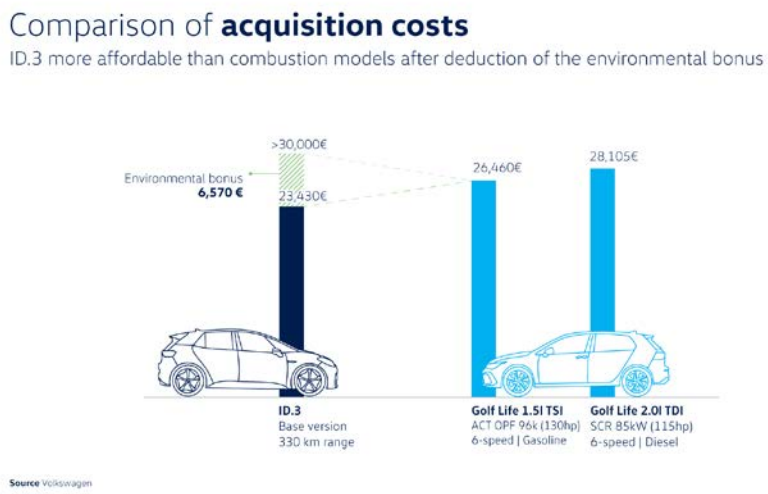
Battery recycling. At the end of the vehicle life-cycle, the battery can be reused in second-life concepts or processed as a valuable source of raw materials by established recycling procedures. At the center of excellence in Salzgitter , a pilot plant for battery recycling is already being built and is due to start operation in the course of 2020. In future, up to 1,200 tonnes of batteries per year are to be recycled there. Apart from the recovery of aluminum, steel and copper, the main focus is on reusable nickel, manganese and cobalt. At the plant, established processes are tested to verify their technical and economical scalability. The objective is to reuse as many raw materials as possible when large quantities of end-of-life batteries become available at the end of the 2020s.

Cost: comparison of electric motors and internal combustion engines

Competitive. Cost will play a decisive role in the breakthrough of e-mobility. To date, electric cars have been considerably more expensive than comparable models with internal combustion engines. That is now changing. With the ID.3, the electric car will be fully competitive in terms of cost and can also match comparable internal combustion models. The main reasons for the improved cost levels are high economies of scale, more efficient production, falling battery costs, state purchase incentives and the fact that electric power is relatively inexpensive compared with gasoline or diesel.

Cost of ownership. For a genuine cost comparison between electric cars and models with internal combustion engines, it is not sufficient simply to compare the sales prices. The total cost of acquisition and operation must be taken into consideration. In Germany, depending on the model variants, the ID.3 has a cost level that is similar to or even lower than comparable internal combustion models. With the basic version, customers can easily save several thousand euros. The model variants with larger batteries will also be competitive with internal combustion models.

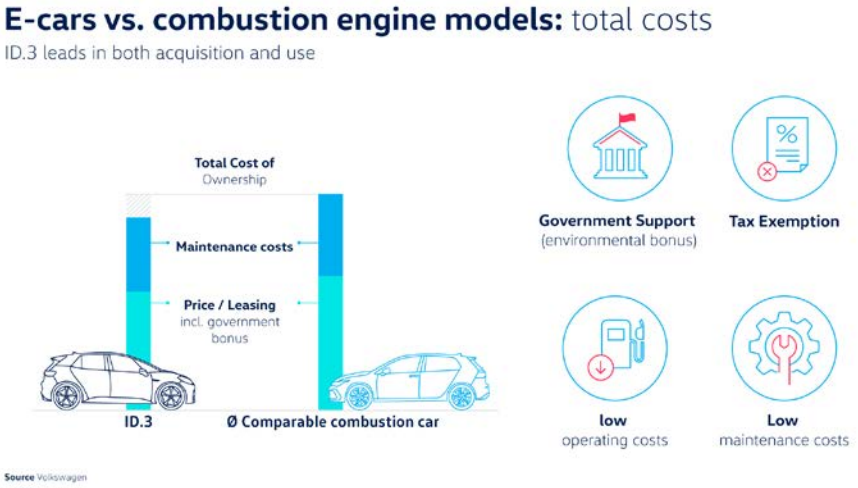
Purchase price. The basic version of the ID.3 with a range of 330 kilometers costs less than €23,430 in Germany, following deduction of the environmental bonus. It is therefore less expensive than comparable models such as the Golf Life 1.5l TSI or the Golf Life 2.0l TDI. The ID.3 with the medium-sized battery and a range of 420 kilometers has a basic price of less than €28,430 following the deduction of the environmental bonus – also a price level that is very competitive.



Environmental bonus. State purchase incentives and tax concessions play a key role in the cost of ownership analysis. The German government has recently significantly increased its subsidy for all-electric vehicles and extended it until 2025. For basic

models up to a net list price of €40,000, the higher subsidy rate of €6,000 applies. This is shared equally by the manufacturer and the state. For models with a net list price up to €65,000, the lower subsidy rate of €5,000 applies. The share of the manufacturer in this bonus is also paid including value-added tax, which adds €570 to the higher subsidy rate. In total, an environmental bonus of €6,570 must therefore be deducted from the purchase price of an electric car such as the ID.3 in Germany.

Operating expenses. In terms of operating expenses, ID.3 drivers in Germany save about €70 per month or €840 per year with reference to comparable gasoline models. Up to 2030, no road vehicle tax is payable for battery electric vehicles in the first 10 years from initial registration. In addition, electric vehicles do not need oil changes; the maintenance expenses for an ID.3 are therefore between 30 and 40 percent lower than those of an internal combustion model. Scheduled visits to the workshop are only necessary at intervals of about two years – irrespective of the distance driven. The ID.3 is also assigned to a less expensive insurance class in Germany. With class 17 for fully comprehensive insurance, the ID.3 is about three classes less expensive in terms of insurance than a comparable internal combustion model. And energy costs are also normally lower – especially if customers charge their vehicles at home or at work or optimize their costs using the appropriate WeCharge tariff for public charging.

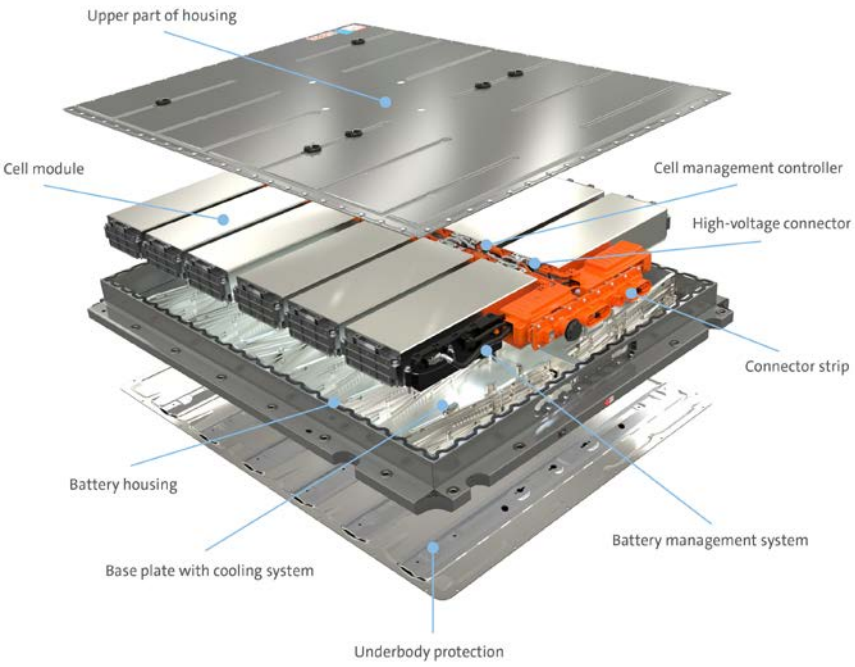


Outlook. With the ID.3, the electric car will become financially attractive. Thanks to the environmental bonus, the total cost of electric cars in Germany will be at the same level as or even lower than comparable internal combustion models. In the long term, the electric car will also be competitive without state subsidies. On the one hand, the cost of electric cars will fall as market penetration rises. On the other hand, internal combustion models will become more expensive in the years to come as a result of more stringent emission regulations.

Battery: safety and durability

A key component of the electric car. Batteries and battery cells are key components of the electric car. Within the framework of its electric offensive, the Volkswagen Group will have an annual demand for batteries with a capacity of more than 150 gigawatt-hours from 2025 in Europe alone – and about the same figure in Asia. In order to meet this demand, Volkswagen is cooperating with partners including LG Chem (South Korea), SK Innovation (South Korea) and CATL (China). In addition, Volkswagen is building its own major battery factory in Salzgitter together with the Swedish company Northvolt AB. At the beginning, the production facility will have an annual capacity of 16 gigawatt-hours; production is due to start in 2024.

Variable high-voltage battery system. The models in the ID. family were developed around the battery. The high-voltage battery system is positioned in a flat configuration in the floorpan of the vehicle between the axles and has a similar shape to a bar of chocolate. Each battery system consists of a variable number of battery modules, each of which is built up from individual battery cells. This modular design allows maximum flexibility. The longer the range required by the customer, the more modules are installed in the battery system. Up to 12 modules may be installed on an ID.3. However, the basic structure always remains the same.



System, module, cell. The battery system consists of the aluminum battery housing with a crash frame, integrated battery cooling system and a connection box for the high-voltage and low-voltage vehicle electrical systems. The modules with the

individual battery cells are installed in the battery housing. The cell controllers (which monitor voltage, currents and temperature) and the cell balancing system (which ensures equal loading of the cells in everyday operation) are installed in the longitudinal member of the battery housing. The battery electronics, which form a further control unit, are integrated in the rear part of the battery system. The battery housing has a lid at the top which can be easily removed for any maintenance.

Volkswagen installs lithium-ion cells on its models. These are highly durable and have no memory effect. They can also be installed in a "pouch" or "prismatic" configuration. This allows considerable flexibility in cooperation with cell suppliers.

Durability. As a general principle, Volkswagen batteries are designed for the entire lifetime of a car. Volkswagen guarantees a minimum battery capacity of 70 percent for eight years or 160,000 kilometers – irrespective of charging behavior. Considerable efforts have been made to ensure this durability. The batteries are actively cooled or heated and the battery management system distributes the load between the individual cells. This means that the battery is always used in the best possible operating range.

Safety and fire protection. The risk of fires and electric shock have been minimized by special safety systems in the case of the ID.3. In the event of an accident, the power from the battery is immediately interrupted. The battery system of the ID.3 is protected by a special crash frame. For the first time on a Volkswagen, fully enclosed, solid underbody protection is installed.

Tests by the ADAC have repeatedly shown that the risk of fire is just as low in the case of an electric car as with an internal combustion model. In its current recommendation, the German Fire Brigade Association writes: "Certified electric vehicles largely present comparable fire risks to vehicles with other drive systems (fuel, gas). Fire tests have also shown that the fire intensity of vehicles of the same size and generation is comparable irrespective of the drive system used." In the event of a fire, water can be used to extinguish the batteries.

Battery research. Volkswagen has grouped its battery competence together at the center of excellence (CoE) in Salzgitter. The CoE bears responsibility throughout the Group for the development, procurement and quality control of battery cells. The center also carries out research on the next generation of batteries. Lithium-ion batteries are currently the best technology available and will continue to hold this position for at least the next 10 years. The next quantum leap will probably be the solid-state battery. Volkswagen is carrying out intensive research into this technology together with its partner QuantumScape. Solid-state batteries will provide an energy density up to 50 percent higher than that of the present lithium-ion batteries and will therefore allow a longer range. In addition, they will be lighter and less expensive as well as allowing shorter charging times. However, it will take some time before these batteries are suitable for widespread industrial use.

Charging infrastructure: simple everyday charging

Charging as a key factor for the success of e-mobility. Fast, simple and convenient charging is a key factor for the success of e-mobility. Charging an electric car must become just as easy and normal as charging a smart phone. Everything must be just right, the vehicle, charging services and the infrastructure. This is why Volkswagen has a holistic commitment to charging, going beyond the car itself. Volkswagen is investing in the charging and energy ecosystem consisting of hardware and software related to the car and in the infrastructure.

More public charging. In contrast to refueling, charging is an operation that can take place in the background where the car is already standing – at home, at work, in front of the supermarket or by the roadside. Volkswagen currently estimates that more than half of all charging operations are completed at home. As the market penetration of e-mobility grows, charging operations will be transferred more and more to public spaces. Three out of four inhabitants of Germany live in conurbations and the possibilities of private charging are restricted in urban areas. More than half of the population is employed and therefore potentially has the possibility of charging batteries at the workplace. This is why charging facilities in public spaces must be considerably expanded.

Sprint program. At the beginning of 2020, there are already about 24,000 public charging points in Germany and the number is growing every day. Supermarkets, hotels and car park operators are installing charging stations for their customers as are many companies for their employees. However, the expansion of charging infrastructure will need to be significantly boosted to ensure the breakthrough of e-mobility. The German government has made charging infrastructure a key element in its climate protection program. By 2030, the target is to have a million publicly accessible charging points. Specific measures have been defined in the charging infrastructure masterplan, which provides for investments of more than €3 billion. The decisive factor will now be the sprint program. Over the next five years, about 300,000 public charging points will need to be installed.

Volkswagen's commitment. Together with partners, Volkswagen will be installing 36,000 charging points throughout the Group in Europe – including 11,000 charging points to be installed by the Volkswagen brand. Elli, a Volkswagen company, offers affordable wallboxes for charging at home via the Group brands. With the entry-level ID.Charger, the Volks-Wallbox for €399, customers can call upon charging capacity of up to 11 kW. Throughout Germany, Volkswagen Naturstrom® from renewable sources can also be ordered. In time for the market launch of the ID.3 in mid-2020, Elli will be offering private customers, companies and fleet operators a broad portfolio of charging solutions – with smart power tariffs, IT-based energy management and charging cards for convenient digital invoicing.

IONITY. In order to make e-mobility fit for widespread use on long journeys, Volkswagen is developing a pan-European network of fast charging stations together with industrial partners under the umbrella of IONITY. By the end of 2020, 400 of these HPC (high-power charging) stations are to be installed along highways throughout Europe – every 120 kilometers, with charging points for more than 2,400 vehicles.. IONITY offers charging capacities of up to 350 kW und and will be operated with green

power throughout Europe. The charging network is also available to all users, including drivers of brands which do not form part of the joint venture. In addition to the IONITY stations, other suppliers have planned more than 2,200 new HPC facilities.

We Charge. Together with the ID.3, Volkswagen is also launching its We Charge charging service. The charging card offers access to about 150,000 public charging points throughout Europe and makes charging on the road a reliable option. We Charge customers can also access the IONITY fast charging network at attractive conditions: depending on the tariff package selected, prices start at 30 cents per kWh.