The Future of Sustainable Mobility

ABB provides groundbreaking solutions for clean e-mobility in cars, buses, trains, cable cars, vessels and planes.

As a pioneering leader focusing on digital industries, ABB accelerates the development of sustainable e-mobility solutions with its state-of-the-art, digital range of products.
Dear journalists,

For over 130 years ABB has stood for the development and implementation of revolutionary traffic solutions. Our founding fathers laid the cornerstone for the electrification of European rail traffic, thereby opening up new population areas. Electric trains, trams and cable cars directly led to new opportunities and new freedoms in society. One of the main reasons for our generation’s prosperity is the pioneering spirit of this age.

But it is more than just progress when we equip trains, cable cars and ships with revolutionary electrical drive systems today and our leading charging solutions help bring about a practical global e-mobility infrastructure for road traffic. It is nothing less than an effort to avert a global climate catastrophe. Last year ABB was recognized for this commitment by being counted among the ten most important global companies ensuring positive change in the world.

For us this is an honor but also a responsibility. In this booklet we have assembled a selection of our multifaceted activities aimed at shaping the transportation infrastructure of the future. The pages that follow explain where we are today and where we are headed in the future – in line with our motto: Running the world without consuming the earth.

Sincerely yours,

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For more information on the contents and further information about ABB’s offer and the global evolution of electromobility please visit: new.abb.com/sustainable-mobility.

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Energy revolution
in road traffic

Clean air and quiet cars that do not endanger the planet: As a leading supplier of charging solutions for electric vehicles, ABB plays a decisive role in shaping the future of sustainable transportation.

Previously a “problem child”, now transportation has become a beacon of hope in the battle against climate change. Cars, trains, vessels and planes are currently responsible for a quarter of the world’s energy consumption and contribute roughly the same share to environmental pollution. And cars consume more energy than all freight transports combined – including trucks, vessels and trains. Therefore, switching to clean means of transportation would not only drastically reduce the amount of greenhouse gases contributing to global warming, but also slash carbon monoxide, sulfur dioxide and other substances that cause lung damage and cancer. Against this backdrop, the debate among experts has long since moved from whether electrically powered mobility will gain traction to how long this shift will take. In the meantime, more and more countries, including the UK and France, have announced that it will no longer be legal to sell new cars with combustion engines beginning in 2040. Germany has similar plans for 2050. Switzerland and Austria have not made any definitive statements regarding their plans as of yet. The industry has responded accordingly and is currently investing billions in production facility conversions. VW plans on manufacturing around ten million electric vehicles between 2020 and 20267 – and Volvo has even announced that starting in 2019 only hybrid or full-electric cars will be rolling off of its assembly lines.7 GM plans on offering over 20 new electrically powered models by 20238 and wants to double its research capacities in the coming years. Analysts assume that electric vehicle production will surpass production of conventional models as early as 2040. With over ten years of experience in the electric vehicle charging market, ABB is a part of these developments because they offer tremendous potential for improving our climate.

Electric cars in the fast lane
Rising investments in mass production of electric cars are already benefiting consumers today: The latest generation models offer the same performance and amenities of their fossil-fuel predecessors and – above all – thanks to falling battery prices – cost virtually the same as conventionally powered vehicles. Average prices of electric cars are expected to fall below those of fossil-fueled vehicles by 2025.9 They are already unrivaled when it comes to the cost of operation. Electric cars already perform better over lifetime both ecologically and economically than fuel or diesel-powered vehicles. The ever-denser network of charging stations worldwide has played a major role in this development. Thanks to this, “range anxiety” – once a major obstacle to universal acceptance of electric vehicles – is now beginning to dissipate. Just as the appeal of electric cars rises with each charging station that is added, every electric vehicle sold makes investing in additional charging stations even more appealing. This networking effect benefits everyone – and above all the environment. In pioneering countries such as Denmark there are already more charging stations than conventional filling stations10 and around the globe more than 136,000 charging stations keep electrically powered transportation running smoothly (last updated: January 2019).11 ABB has sold some 10,500 of these – more than any other manufacturer – in 73 countries. 1,200 of those sold are fast charging stations, which eliminate yet another obstacle to e-mobility. ABB’s top model Terra HP charges car batteries with up to 350 kilowatts, delivering enough energy for a range of 100 kilometers in just four minutes. In addition, weather-resistant Terra DC charging stations can handle temperatures from -35 °C to +55 °C degrees, which is why the Terra 53 DC is used at the world-famous Jaguar “Ice Academy” in the Arctic Circle, for instance. To accelerate the transition to sustainable forms of transportation, ABB is working with public institutions and renowned car manufacturers on the successive expansion of the global infrastructure. One example of this is Electricity America, the largest e-mobility infrastructure project in the US to date, which will also use ABB charging stations. In Europe, ABB was selected by IDONITY, a joint venture between the BMW Group, Daimler AG, Ford Motor Company and the Volkswagen Group, as its main technology partner and supplier for the construction of a network with 400 fast-charging stations in 24 countries. And Porsche Japan will install ABB high power chargers in Porsche centers and public facilities throughout the country in time for the market launch of the 600-HP Taycan electric sportscar.

The first cars were electric
Electrically powered cars are not a 21st century invention. In the early 20th century, only 22 percent of cars on US roads had a combustion engine; 40 percent were powered with steam and 38 percent were electric.12 Combustion engines began to take over the market around 1900 because the higher energy density of fuel made it possible for cars to travel longer distances. But throughout history electric cars have always been on par with if not superior to their combustion-fuelled counterparts. In 1867 the electrically-powered Baker Toledo was the first car in history to reach a speed of over 100 mph (160 km/h), for example. And today’s acceleration record is also held by an electric car, the Tesla Model S P100D: From 0-60 mph (96 km/h) in 2.27 seconds was the fastest acceleration speed ever measured by world-renowned Motor Trend Magazine.13
Global transition
At the same time, many countries are now investing directly in the expansion of e-mobility. South Korea, for example, rewards electric vehicle buyers with bonuses equivalent to 20,000 euros, making it the most generous state-sponsored program in the world.26 China also has a monetary incentive system. Moreover, electric car consumers receive preferential service when applying for license plates along with access to faster traffic lanes.27 New registrations for electric cars more than doubled from 2015 to 2017 in response to this.28 With an additional jump of 114 percent in the first half of the past year, China already boasts the largest fleet of electric vehicles worldwide.29 Meanwhile, in Europe, Iceland’s government-sponsored incentive program is considered exemplary. The result: While there were only 90 electric vehicles on the entire island in 2014, today there are more than 6,000. In Norway, where electric car owners pay less vehicle tax and can take advantage of free parking, toll road or ferry service and complimentary charging stations in parking garages, 39 percent of the cars sold in 2017 were electric.30 More than one in five vehicles is electrically powered. Germany is also setting its sights on sustainable forms of transportation as part of its energy transition policy, which leads the way in Europe.31 The country plans to reduce greenhouse gas emissions by 40 percent by 2020 and expand this even further to 55 percent by 2030 (the base year for the comparison is 1990). To achieve these numbers, Germany has no alternative but to expand its e-mobility infrastructure. Instead of the nearly 200,00032 electric vehicles on the road today, plans are underway that would see up to eight million such vehicles on German roads by 2030. Many charging stations will need to be installed in order to achieve this goal. For example, autobahn service area operator “Tank & Rast”, which ABB has already supplied with 177 stations, wants to have just as many rapid charging stations as conventional pumps in the near future.33 There are currently 18,000 electric vehicles in Austria. The trend is rising considerably. While in 2015 only 0.9 percent of new car registrations were for electric cars, the share had already jumped to over 2.5 percent in 2018.34 By 2050 the entire transportation sector is expected to be largely climate neutral.35 To this end the government and automotive industry put together a 93-million-euro “e-mobility package” designed to create incentives for purchasing electric cars and building charging stations. Switzerland36 is also implementing a roadmap to promote e-mobility starting this year. This roadmap was signed in December 2018 by representatives from the automotive, electricity, real estate and vehicle fleet industries along with the federal government, cantons, cities and municipalities. One of the objectives is to increase the share of electric vehicles in new registrations to 15 percent by 2022.

E-mobility: the sustainable alternative
In ideal circumstances, electric cars could cut CO₂ emissions in the transport sector by more than two-thirds.

It all starts with a vision. “The city car of the future will be small, electric, shared by multiple individuals and eventually drive autonomously.” This is how in 2017 the German Federal Environment Agency presented its vision of automobile traffic in the “City of Tomorrow.”37 This is a hopeful sign. After all, the Paris Climate Agreement’s guidelines show that at least 20 percent of all cars on the road will need to be electrically powered by 2030 in order to achieve the defined climate objectives.38 Skeptics note that, while electric cars do not produce emissions during operation, manufacturing the batteries is an energy-intensive process that is associated with its own form of environmental pollution. Moreover, in most cases the power generated to operate these vehicles is also not produced in a climate-neutral way. Thus, current studies answer the question as to whether electric vehicles are actually more environmentally friendly than their fossil-fueled predecessors with a cautious “Yes, but…”. “Yes” because electric cars boast unrivaled efficiency. While combustion engines do not even convert 50 percent of the energy used into movement, electric motors utilize over 90 percent.39

Another “Yes” because they are already much easier on the environment even with the current electricity mix. For instance, in Germany 489 grams of CO₂ was released to produce one kilowatt hour of electricity in 2017.40 Translated into consumption figures for a modern compact electric car, this results in about 90 grams of CO₂ emissions per kilometer. A comparable gasoline-powered car provides almost double the load – when the emissions produced in the fuel production and transport process are included in the calculations. The “But” that puts these figures into perspective is due to the fact that this is far from exhausting the potential of electromobility. If an electric car is operated solely using electricity from renewable sources, then CO₂ emissions are actually reduced by more than two-thirds when viewed over the entire life cycle.41

This is why ABB has made it its mission to push ahead with the integration of electricity from hydro-power, wind and solar energy. The efficiency of the wind turbine generators manufactured by ABB has increased 200-fold in the past 30 years, ensuring that unevenly generated wind energy can be fed into the grid with stable voltage. In addition, ABB supplies innovative electrical and process control systems for photovoltaic power plants and solar-thermal plants. However, the main problem facing renewable energy sources is that they are often located outside of metropolitan consumer centers and a considerable share of the sustainably produced power is lost in transport. It was not until ABB’s pioneering work on the development of high-voltage direct current transmission (HVDC) technology that it was possible to transport electricity across many hundreds of kilometers with virtually no loss. Today over half of the HVDC connections used around the world are made by ABB.
E-mobility beyond the road

From trains to cable cars to vessels, buses and even planes – ABB is a name that has stood for continuity in solutions for the electrification of transportation for more than 130 years.

Tram
In 1888 Maschinenfabrik Oerlikon (MFO), a predecessor to ABB, delivered all of the technical equipment for the first, 10.5-kilometer-long electric tram line in Switzerland from Vevey to Chillon via Montreux.

TOSA Bus
The TOSA buses on the 23 line have connected the city of Geneva with the airport since 2013. ABB developed the technology that charges the batteries with 600 kilowatts at selected bus stops in 20 seconds flat – while passengers enter and exit the bus. This provides enough electricity to power the bus for up to eight kilometers without interruption. The TOSA buses cut CO₂ emissions by around 1,000 tons annually and plans are underway to begin using them in the city of Nantes soon, too.

OppCharge Buses
OppCharge, the fast charging system for buses ABB introduced in 2014, is already being used worldwide. The fast-charging stations located in terminals can fully charge a bus battery in just four to six minutes.

Zugspitzbahn
The funicular railway on Germany’s famous Zugspitze mountain is powered by 800 kilowatt motors from ABB and holds a total of three world records: It has the highest steel support (127 meters), the largest height difference (1,950 meters) and the longest span (3,213 meters from the valley station to the peak). The cars glide at a speed of 10.6 meters per second across this stretch of mountain, where inclines can reach up to 104 percent.

Stoosbahn
The Swiss town of Stoos has operated the steepest funicular in the world (110 percent incline) since December 2017. Two 1.2-megawatt motors from ABB transport 1,500 passengers on the 1.7-kilometer route per direction of travel and hour.

First Electric Locomotive
In 1899 the first electric standard gage locomotive in Europe was used for the 40-kilometer route from Burgdorf to Thun. The project was realized by Brown, Boveri & Cie., one of ABB’s predecessors.

Gotthard Base Tunnel
After ABB’s predecessor had already electrified the Gotthard Tunnel at the dawn of the 20th century, the new, 57-kilometer long Gotthard Base Tunnel opened in 2016. The longest and deepest railway tunnel in the world, it was equipped with ABB electrical systems including light and ventilation.

Allegra Trains
The drive packages ABB supplied for the Allegra trains, a centerpiece of the Swiss Rhaetian Railway (RhB) connecting Davos, Klosters and other cities in the region, are specially designed to meet the tough demands of this rugged mountain region. The drives generate power through recuperation when the trains are valley bound and can remove ice from cables with artificial lightning.

Azipod Drive
The Azipod Drive developed by ABB uses propeller cars that can swivel 360 degrees and are mounted under the hull of a ship. This enables ships to maneuver in ports or on difficult routes (such as tight fjords) in an effective, environmentally friendly way. The drive has been in use since 1990 and reduces consumption of fossil fuels by more than 40 percent.

Electric Aircraft
In 2016 the Solar Impulse, an airplane powered solely by the sun’s energy and piloted by world-famous adventurer Bertrand Piccard, was the first to circle the earth without using fossil fuel. The solar power generated during the day kept the four electric motors running through the night. Now this technology, which ABB helped develop, makes it possible to fly for even longer without fuel than with.

ABB Formula E
Fun and excitement paired with energy efficiency and practicality – the ABB FIA Formula E Championship offers all this and more. It is the first fully electric FIA motorsport racing series in the world (read more on page 10). ABB, the title partner to the series since 2018, uses it as a platform for developing and testing e-mobility related solutions.
Pole Position for ABB

The ABB FIA Formula E Championship shows that electrically powered motorsport can be just as sustainable as it is suspenseful. ABB develops future e-mobility technologies.

The new Gen2 racers: Batteries with twice as much power and just 20 percent more weight.

Gripping wheel-to-wheel battles, spectacular passing maneuvers around tight corners, a line of cars taking on hairpin curves, top speed on the straights, charismatic drivers – the ABB FIA Formula E Championship offers everything motorsport has to offer – and much more.

Races are held in areas where e-mobility is taking hold: in the middle of urban centers. City circuits planned for Formula E races in metropolises like New York City, Rome, Paris, Hong Kong, Mexico City or Bern not only enable fans to experience the races close-up, they also allow for interactive participation. Fans can give their favorite drivers a “Fanboost” via an online voting platform, ensuring even more high-speed battles on the tracks. (see box “Motor-sport Interactive”, page 12)

“The Formula E is a ground-breaking series,” sums up 2016 Formula 1 Champion Nico Rosberg and ABB FIA Formula E Championship investor. “It brings the sport of racing to the people. Formula 1 could learn a lot from the Formula E series.”

Established by Alejandro Agag, a former politician and entrepreneur from Spain at the suggestion of FIA President Jean Todt in 2014, the ABB FIA Formula E Championship is creating excitement around the globe in its fifth season. The regulations intentionally focus on putting driving performance and tactical skills at the forefront. All Formula E teams have identically designed race cars and uniform tires. This gives every team the same opportunities and strengthens the role of the driver, confirms BMW Motorsport Director Jens Marquardt: “Piloting a Formula E race car is much more complex than driving a conventional race car.”

Today more factory teams are represented in the first fully electric racing series in the world than in any other comparable championship racing series. They all want to try out new technologies under the harshest possible conditions and transfer the knowledge they gain in motorsport to series production.

More Power than Ever

The speed at which new technologies are progressing is evident in the latest developments in the 2018/19 season: Second-generation vehicles, also called “Gen2”, are bringing a new organization with tremendously enhanced performance to the track for the first time ever.

The carbon fiber chassis with covered front wheels and rear spoilers above the rear wheels is built by Italian motorsport supplier Dallara.

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“...”

During qualifying four groups compete with five drivers each. Each group has six minutes to complete a lap at top speeds. The five fastest drivers from the group phase then battle it out for the pole position. All of the other positions in the starting line-up are determined based on the drivers’ times in the group phase.

Points are awarded to the ten best-placed drivers in each ePrix: 25 for the winner, 18 for second and 15 for third place. Three additional points are awarded for pole position, along with another point for the fastest lap in the race.

The championship is broken down into driver and team standings.

2018/19 Regulations
McLaren applied Technologies delivers the lithium-ion batteries. They weigh 374 kilograms and have almost double the utilizable capacity of their predecessors with 52 kWh, despite weighing just 20 percent more. This clearly shows the direction in which e-mobility is headed overall.

At maximum power of up to 250 kW (335 hp) the Gen2 cars can hit top speeds of up to 280 km/h (174 mph). Race regulations call for a peak power limit of 200 kW (270 hp). But top speeds are not the decisive criterion on tight city circuits with short straights anyway. Instead, battles are decided based on the enormous acceleration power of the electric motors and an intelligent energy management system. Former Formula-1 driver Nick Heidfeld had this to say about the series: “I like the fact that there is so little room for error.” Naturally, driver safety is the number one priority. This season drivers will be wearing biometric gloves for the first time. The gloves record vital signs and, in the event of an accident, can give rescue teams crucial information. Additional elements reminiscent of computer games bring even more suspense to the races. Alongside the “Fanboost”, the series is also implementing “Attack Mode” this season. Drivers and teams can decide to use this mode based on the racing situation (see box “Motorsport interactive”).

Fun elements like these bring the thrill back to racing, which the ABB FIA Formula E Championship hopes will attract new target groups and an increasingly young crowd to the race tracks. The ePrix events are usually sold out weeks ahead of time. And now media interest in the series has skyrocketed. The races can be viewed on free TV channel Eurosport. German broadcasters ARD and ZDF are also airing the events live on TV and the Internet, as is the SRG Group in Switzerland. Austrian fans can follow the excitement on ORF Sport+.

ABB and Formula E

ABB, the title partner to the series since early 2018, plays a key part in the ABB FIA Formula E Championship. Involvement in the Formula E series was a logical next step for the global technology group to enhance the company’s role as a leading supplier of e-mobility charging solutions. With more than 10,500 charging stations sold in 73 countries, ABB not only has the largest installed base worldwide, but has also brought a steady stream of new advances to the field, opening up new horizons in the development of electrically powered transport. For example, the newest peak performance model, the Terra HP fast charging station, ensures that “stopping to charge” an electric car is virtually as fast as stopping at a conventional pump. The DC chargers charge cars batteries with up to 350 kilowatts, delivering enough energy for a range of 100 kilometers in just four minutes. To continue expanding its leadership role, ABB also uses the ABB FIA Formula E Championship as a competitive platform for testing and further developing future charging technologies. In addition, it also tests support systems for wireless video monitoring or uninterrupted power supply on the tracks.

For more information on the ABB FIA Formula E Championship visit new.abb.com/formula-e

Motorsport interactive

Fanboost: Fans can support their favorite Formula E drivers: Votes are cast online before every race. The five drivers with the most votes can take advantage of the “Fanboost”

Fanboost:

Motorsport interactive

Attack Mode: in order to engage Attack Mode, the driver must pass through a defined activation zone placed off the racing line. The driver activates Fanboost or enters into Attack Mode.

The future of sustainable mobility

In the ABB FIA Formula E Championship the fans don’t come to the races – the races come to the fans. All ePrix races are held on circuits located in the heart of major metropolises. The competitions are each held during the course of a single day. Practice sessions in the morning, qualifying around noon and the race in the afternoon.

March 23, 2019

Sanya (China), City Circuit

Lap distance: 2.28 km, 11 curves

April 13, 2019

Rome, Circuit of the Classics

Lap distance: 2.84 km, 21 curves

April 27, 2019

Paris, Circuit des Invalides

Lap distance: 1.9 km, 14 curves

May 11, 2019

Monaco, Circuit de Monaco

Lap distance: 1.765 km, 12 curves

ABB Formula E development platform

ABB reduced the size of the Terra DC fast charger by 30 percent for the racing circuit.
ABB announced its realignment plans in late 2018. Now the company is focusing on digital industries and shaping megatrends such as e-mobility, automation, digitalization and renewable energy sources.

The former copper and iron company has become a technology leader in digital Industries. Today the Swiss company is setting new benchmarks with its cross-sector software portfolio, ABB Ability™. It has also redefined cooperation between people and machines with the collaborative robot, Yumi. Moreover, its innovative technologies have made it the world’s number one digital power grid supplier and a leading vendor of fast charging solutions for electric vehicles. In December 2018 the company announced the largest restructuring since ASEA and Brown Boveri & Cie. merged in 1988. ABB marked the beginning of the group’s new organization as a technology leader in digital industries with the sale of 80.1 percent of its Power Grids Business to Hitachi. Focusing and simplifying the business will ensure that the technology leader can respond to the rapidly changing demands of its customers in the future with even more individually tailored solutions as the Fourth Industrial Revolution progresses, and will be able to supply innovations powered by the latest technologies – such as artificial intelligence – even more quickly.

Effective April 1, 2019, ABB divided its operations into four customer-centric, entrepreneurially managed Businesses, each of which is ranked number one or two in its respective market.

Robotics and Discrete Automation
This business joins unique solutions for machine and factory automation with the broadest portfolio of robotics applications on the market. The digital range of hardware and software was enhanced by the acquisition of B&R Automation Solutions played a key role in making this possible.

Electrification Products
This business offers a full range of innovative products, digital solutions and services from the sub-station to the point of consumption. With some 10,500 charging stations for electric cars sold in 73 countries, ABB is also leading the way in e-mobility. This prompted “Fortune Magazine” to rank the company among the top ten most important businesses in its “Change the World” list. With wind turbine generators, photovoltaics and solar thermal components, the business is helping develop renewable energy sources and crafting solutions for data centers and smart buildings. Impressive constructions equipped with ABB technology include the Burj Khalifa, one of the tallest buildings in the world, the Elbe Philharmonic in Hamburg and Europe’s first sustainable soccer stadium, FC Austria Vienna’s Generali Arena.

Industrial Automation
Innovative solutions from this business enable customers to manufacture products in a secure, energy efficient and increasingly autono-mous way. Smart technology makes it possible to monitor and control company locations from a single head office. Measurement and analysis technologies like ABB’s revolutionary smart sensors enable requirements-based maintenance thanks to continuous machine data monitoring, thus cutting downtime and maintenance costs. The business focuses on companies in the chemical, cement, oil and gas, paper and cellulose, minerals and mining and metal sectors. And when the first ever remote-controlled ferry travels through the Port of Helsinki, you can be sure that ABB’s Drive and Automation Solutions played a key role in making this possible.

Motion
The business has the largest global installed base and offers customers a comprehensive range of electric motors, generators, drives and innovative services. Electric motors from ABB pull cable cars on the highest mountains, can be found on superfreighters and cruise ships and provide a reliable supply of potable water at pumping stations. ABB drive systems propel intercity trains and ABB generators produce electricity for their environmentally friendly operation in wind power plants. The innovative drive systems are enhanced with automation and digitalization solutions.

ABB Ability™
The four businesses offer digital solutions tailored to customer requirements thanks to the cross-sector digital portfolio of ABB Ability™, which helps create even more value for customers. ABB Ability™ builds on novel technologies such as industrial artificial intelligence to address the growing demand for digital solutions in the rapidly changing world of industry.

You will find more information on the new ABB at: www.writing-the-future.com
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Test. Refine. Revolutionize. As the leader in charging infrastructure, ABB has made its partnership with Formula E a rapid incubator for the technologies accelerating the e-mobility revolution. Join us for the new season to see electric racing pushed to new limits. Let’s write the future. Together. abb.com/formula-e