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125 YEARS OF ABB IN SWITZERLAND

# **Entrepreneurship and pioneering achievements** from 1891 into the digital future

# ABB: 125 years of technical progress and pioneering innovation

Dear readers,

ABB can look back on 125 years at the forefront of technical progress and ahead to a brilliant future. For that, we have to thank our visionary predecessors, our enthusiastic customers around the world, and our shareholders and employees. The company had not even been entered into the commercial register when, thanks to the technical expertise of its founders, it received its first order to electrify the city of Baden.

Because of its innovative strength, the company now known as ABB evolved to become a global market leader in its industries. This is because it has always remained young and inventive at heart. Its predecessor company, BBC, pioneered and shaped the world of electrification from the outset, and then later shaped automation, and now, as ABB, it is a digital champion, touching many areas of life. Yet it would not do to laud only the achievements of our engineers in this retrospective and forward-looking publication. After all, to keep succeeding against strong rivals in over 100 countries you also need a learning organization, a culture of performance, and passion. Digitalization, automation, and energy efficiency are megatrends that will shape the decades to come. And we will be at the forefront – as we have been for 125 years.

HISTORY AND THE FUTURE: PETER VOSER AND ULRICH SPIESSHOFER STANDING NEXT TO AN ELECTRIC-VEHICLE CHARGING STATION. 125 YEARS OF INNOVATION LIE BETWEEN THIS FACILITY AND THE HISTORIC ABB BUILDING.



**PETER VOSER**  
CHAIRMAN OF THE BOARD  
OF DIRECTORS, ABB LTD

**ULRICH SPIESSHOFER**  
PRESIDENT AND CHIEF  
EXECUTIVE OFFICER, ABB LTD

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AND CHARLES  
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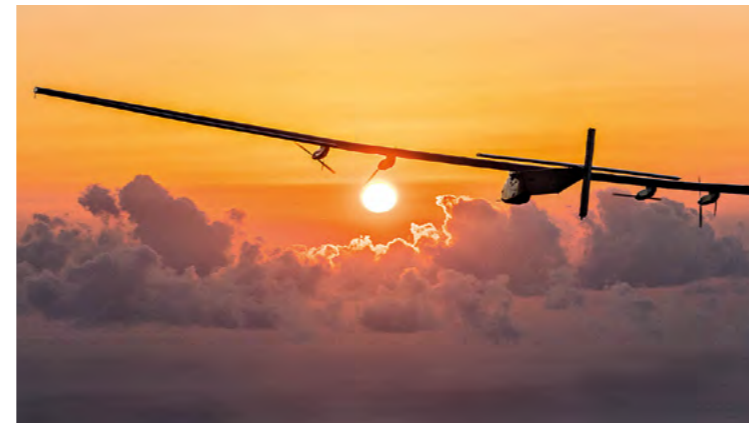
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SOLAR IMPULSE 2 –  
FLYING AROUND  
THE WORLD  
BY THE POWER  
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I'M YUMI, PLEASSED TO MEET YOU.

# 125 years of experience on the road to the future

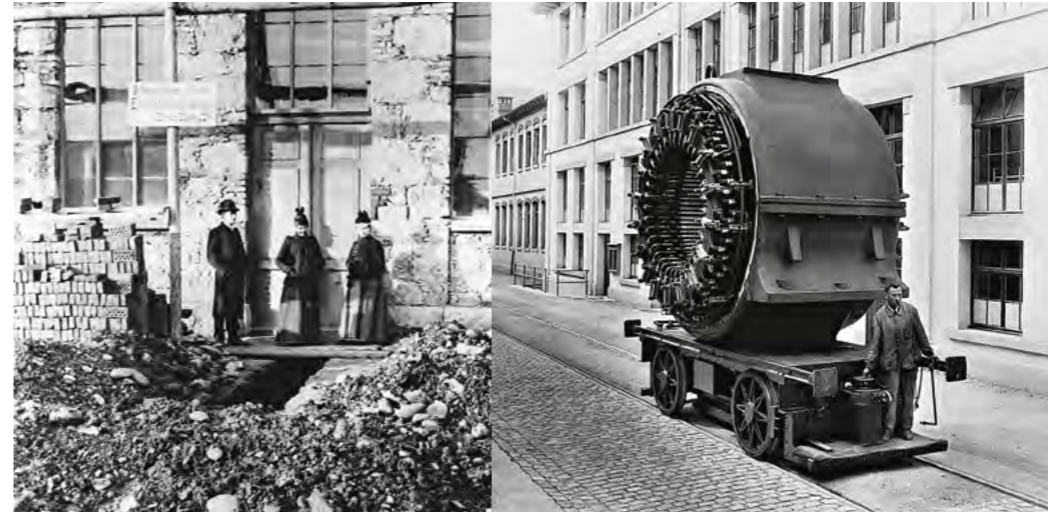
A start-up founded by two young engineers in 1891 continues to write industrial history today



— SUCCESS TO BE CELEBRATED: BBC DELIVERED ITS THOUSANDTH GENERATOR IN 1895, JUST FOUR YEARS AFTER IT WAS FOUNDED. THE ENTIRE WORKFORCE GATHERED FOR A GROUP PHOTO.

When great inventions leave the laboratory and begin to transform people's lives, we talk of an industrial revolution. There have been four such revolutions. They began with the mechanization of textile manufacturing by means of water power and steam-driven machines – which, in Switzerland, took place in the early 19th century. The end of that phase marked the beginning of the breakthrough in electrical engineering, which opened up completely new possibilities in power generation, distribution, and communication. Two engineers were involved in the genesis of what came to

be known as Industry 2.0: Charles Brown and Walter Boveri. They got to know each other at the Oerlikon Engineering Works (MFO), or more precisely in its newly formed electrical engineering department, which was led by Charles Brown. The atmosphere there was similar to that of the incubators of today's entrepreneurs as they strive to develop and capture new fields of business. In 1888, Brown and Boveri built an eight-kilometer-long direct current line between Kriegstetten and Solothurn, which boasted what was at the time a remarkable efficiency level of



— BUILDING BLOCKS OF THE FUTURE: ABOVE, WALTER BOVERI (LEFT) AND HIS WIFE VICTOIRE INSPECT THE CONSTRUCTION OF THE FIRST BBC FACTORY HALLS IN 1891 TOGETHER WITH A FRIEND. RIGHT: A GENERATOR COMPONENT BEING TRANSPORTED IN BADEN AROUND 1915.

75 percent. The early collaboration between these two young men was therefore one of technical excellence, practicality, and efficiency. But they soon ran into obstacles at MFO since the company did not recognize the potential of this disruptive technology; nor did the two men have the money to go it alone: 500,000 Swiss francs, equivalent today to over ten million. An annual salary at the time was around 3,000 Swiss francs. Banks and private investors in Switzerland and Germany were unwilling to put up so much money. And yet the first major order was already on the table: The Pfister Brothers, Baden-based merchants who had become enthusias-

tic about electricity at the World Exposition in Paris in 1889, wanted to electrify the town of Baden with two generators, transformers, and an entire distribution network covering the town, and they wanted the 23- and 25-year-old men to help them. At the same time they were offering an attractive property for the construction of a factory for 43,000 Swiss francs.

The decision was made in 1890. Walter Boveri became acquainted with Zurich silk industrialist Conrad Baumann, who took an interest in the two pioneers. And Boveri himself took an interest in that man's daughter Victoire, whom he married soon after. Boveri and Brown signed a contract of association in December. Boveri's father-in-law granted the two engineers a generous loan of 500,000 francs. It was a high-risk investment which would later pay off handsomely.

The company founders chose Baden as the headquarters of Brown, Boveri & Cie. (BBC), which was set up on October 2, 1891 as a limited commercial partnership. They began operations with 100 workers and 24 salaried employees, but before even doing so they received an order to electrify the town of Baden. It was the perfect start for Industry 2.0.

The founders complemented one another. Brown was the technician, Boveri the numbers man. Their compa-

ny built ever-larger power generating systems in Switzerland and abroad. In part because he was connected to so many Swiss electricity companies, Walter Boveri became not only a pioneer of the Swiss electrical industry, but also one of its founders. BBC also diversified by moving into areas such as the electrification of railways. And it was a success: by 1900, the company (by then a joint stock corporation) was employing 1,300 workers and 235 salaried staff. Boveri proceeded to build up BBC into a large international conglomerate.

But then crisis came in the shape of World War I. Raw materials, including the copper so necessary to electrical engineering, became more and more expensive. Dividends were not paid out between 1921 and 1924. And Boveri's initial attempts to gain a foothold in the USA proved fruitless in that difficult market. The founders, who had become so accustomed to success, grew apart. They both died in 1924.

The period following World War II saw the beginning of an unparalleled economic upswing. A wide range of solutions for the production of electricity, information technology, motor and drive technology, electrical rail transport, industrial electronics, and automation were welcomed by hungry markets. BBC continued to write the success story of its founders – and today's ABB still carries their genes. It is now part of the evolution of Industry 4.0 – digitalization, automation, and information technology – following the emergence of computers in the 1970s, which represented Industry 3.0. Today, 125 years on, the order of the day is networking, creating the Internet of Things, Services, and People to achieve a previously unimagined level of productivity. ABB has been a pioneer of technical progress from the outset, creating a better world. This unconditional curiosity, combined with a way of doing things that entails economic good sense and social solidarity is the legacy and DNA of ABB's founders, which it carries to this day. ABB is a pioneer now as they were pioneers in their time.

— The genes of ABB's founders Brown and Boveri live on in the company today.

# Electrifying founders

They were young – just 26 and 28 – when they founded what would become a global enterprise. They had ideas, they had energy – and they had courage

## Walter Boveri

### VISIONARY ENTREPRENEUR

He graduated from high school at 17 and was a qualified mechanical engineer by the age of 20: born in Bamberg in 1865, things moved quickly in the life of Walter Boveri. He got to know Charles Brown at Oerlikon Engineering Works and they became close friends.

It was on trips abroad that he discovered his own interest in business, and together with Brown he drew up a business plan, but nobody wanted to invest the 500,000 Swiss francs they needed.

Nobody, that is, except silk manufacturer Conrad Baumann, who granted

Boveri not only the loan but also, in 1891, the hand of his daughter, Victoire. So when married life began, so too did Boveri's business with Brown, the latter on October 2, 1891. Boveri was a visionary merchant who worked tirelessly in the cause of electrification and became a Swiss citizen in 1893. Later came the

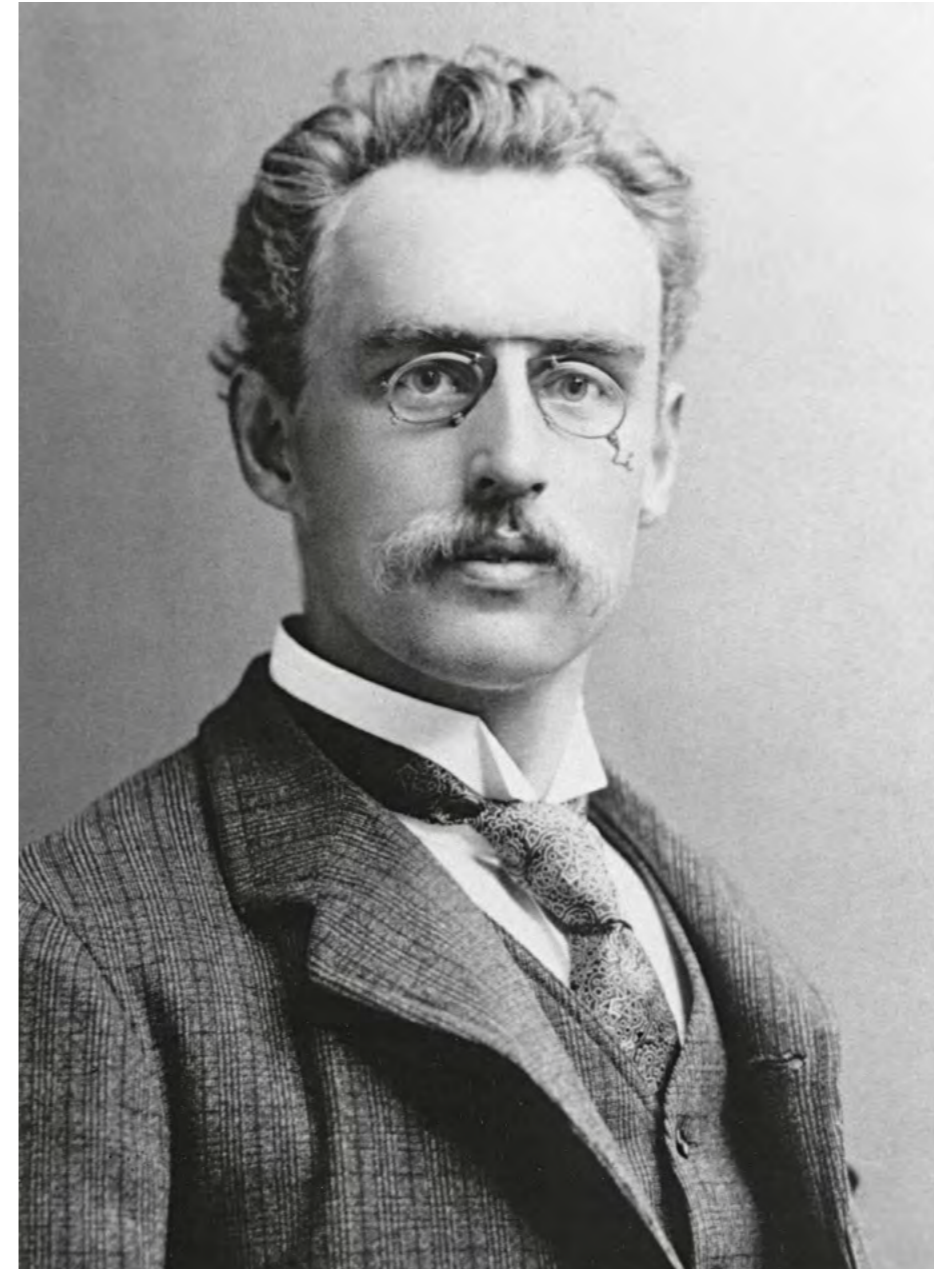
crisis of World War I and economic misfortune in the USA, and Boveri sadly died in a car crash in 1924. He was only 59. But his work lives on.



## Charles Brown

### THE BOY WONDER

Born in 1863, Charles Eugene Lancelot earned his degree at the age of 19. At the age of just 21, he moved together with his father and brother to Oerlikon Engineering Works where he was put in charge of its electrical department at the age of just 21. His technical achievements made headlines: he laid an eight-kilometer-long direct current line and succeeded in transmitting electricity at a remarkable efficiency level of 75 percent. He was already working with Walter Boveri by that time; Brown researched and developed alternating current equipment. In 1891 Brown and Boveri founded their company for the "manufacture of electrical machinery." It was the pioneering Brown in particular who drove the development of the technology. But, in 1911, the two founders fell out. The city of Baden acknowledged their technical and business achievements in 1916 by awarding them the freedom of the city. Charles Brown died of a heart attack in 1924.



# The way things go

Building-blocks of success: technical innovation and pioneering projects have been shaping ABB for 125 years

## 1944

### HIGH-SPEED LOCOMOTIVE

BBC develops the first high-speed locomotive with a direct drive system. It increases efficiency and reliability, as well as the way the interior space is used.



## 1939

### GAS TURBINE

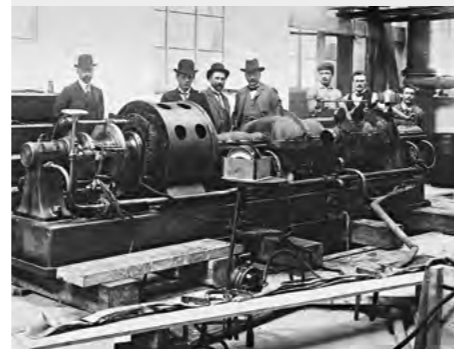
BBC installs the world's first market-ready gas turbine at a power plant in Neuenburg.



## 1901

### STEAM TURBINE

BBC becomes the first company in Europe to build a steam turbine.



## 1889

### THREE-PHASE SYSTEM

Jonas Wenström (1855–1893) invents the three-phase system for generators, motors, and transformers.

## 1899

### ELECTRIC LOCOMOTIVES

Europe's first electric standard gauge locomotive featuring two motors marks the beginning of a new era for electric railways, improving acceleration and passenger comfort.



## 1891

### BBC

Charles Brown and Walter Boveri establish BBC in Baden, and it becomes the first company to transmit high-voltage alternating current.

## 1897

### HIGH-VOLTAGE OIL CIRCUIT BREAKER

BBC develops the first high-voltage oil circuit breaker. It forms the foundation of ABB's expertise in the field of switching equipment and substations.



## 1893

### THREE-PHASE POWER

ASEA builds Sweden's first three-phase electrical system, which transports energy from a hydroelectric plant at 50 kilovolts (kV) over 13 km. This technology is still used mainly to supply power to large electrical motors.



## 1953

### INDUSTRIAL DIAMONDS

ASEA becomes the world's first company to produce synthetic diamonds.

### DATA TRANSMISSION

BBC performs the first data transmission using a carrier frequency, opening up new possibilities in the transfer of speech, control data, and protection signals for power network management.

## 1954

### HIGH-VOLTAGE DIRECT CURRENT TRANSMISSION

ASEA supplies the world's first high-voltage direct current (HVDC) transmission system: a 100 km underwater cable that supplies the island of Gotland with 20 MW of power.



## 1969

### GEARLESS MILL DRIVE

BBC develops the first gearless mill drive system, increasing safety, reliability and efficiency in the mining and cement industries.



## 1971

### 1,300 MVA TRANSFORMER

BBC manufactures the world's most powerful transformer, which can handle 1,300 MVA.



## 1974

### ELECTRICAL INDUSTRIAL ROBOT

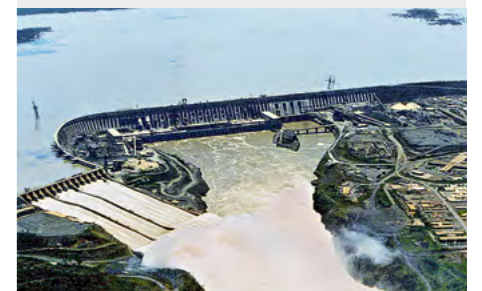
ASEA presents the world's first fully electric industrial robot equipped with a microprocessor. ABB has since sold more than 300,000 robots.



## 1984

### ITAIPÚ

ASEA and BBC supply generators, transformer stations, and transmission systems for what will long remain the world's largest hydroelectric plant: Itaipú, between Brazil and Paraguay.



## 1988

### FUSION

Switzerland's BBC and Sweden's ASEA join together in what is up until this point the biggest merger in industry, creating ABB. Zurich is chosen for its headquarters. At the time of their merger the two companies employed around 160,000 people worldwide.

## 1990

### AZIPOD

Development of the Azipod drive, which makes cruise liners, ferries, icebreakers, and other vessels more maneuverable and energy-efficient.



## 1991

### THYRISTOR SWITCH FOR SERIES COMPENSATION

ABB develops the world's first thyristor switch for controllable series compensation, and has since been a leader in this technology.



## 1998

### FLEXPICKER

ABB launches the IRB 340, the first robot to be developed specially for sorting and packaging small, light objects.



## 2000

### SHORE-TO-SHIP ELECTRICAL SYSTEMS

In Gothenburg, Sweden, ABB installs the world's first "shore-to-ship" power supply system. It allows vessels to shut down their diesel generators when in port and reduce emissions.



## 2002

### UNDERGROUND ALTERNATING CURRENT CABLE

"Murraylink" connects the alternating current networks of the Australian states of Victoria and South Australia. This 177-kilometer-long cable made by ABB has a capacity of 220 megawatts and is laid beneath the ground for conservation reasons, making it the world's longest subterranean high-voltage link.

## 2012

### DIRECT CURRENT CIRCUIT BREAKER

As a result of years of research, ABB develops the world's first circuit breaker for high-voltage direct current transmission. This circuit breaker combines a fast-acting mechanism with power electronics. It can interrupt direct current outputted by a large power plant in just five milliseconds – 30 times faster than the blink of an eye.



## 2010

### ULTRA-HIGH-VOLTAGE DIRECT CURRENT TRANSMISSION

The world's first UHVDC connection (ultra-high-voltage direct current) transmission is commissioned. This  $\pm 800$  kV connection made by ABB has a rated power of 7,200 MW. It carries electricity from Xiangjiaba hydroelectric plant in the south-west of China to Shanghai, around 2,000 km away. The new transmission line can serve the electric demands of 24 million people.

## 2009

### FULLY AUTOMATED HARBOR CRANE

ABB supplies the first fully automated grab-type ship unloader for the first unmanned bulk cargo terminal.

### ULTRA-HIGH-VOLTAGE SWITCHING SYSTEM

ABB commissions a gas-insulated, ultra-high-voltage switching system rated at 1,100 kV and establishes new efficiency records in the long-distance transmission of electricity.

## 2008

### HIGH-VOLTAGE DIRECT CURRENT UNDERWATER LINE

ABB commissions the world's longest and highest-performing underwater high-voltage direct current transmission line. It covers a distance of 580 kilometers and links the power networks of Norway and the Netherlands. Its transmission capacity, which can be utilized in both directions, is 700 megawatts.

## 2005

### HVDC LIGHT

ABB launches HVDC Light, which allows electricity to be transported from the mainland to offshore drilling rigs.

## 2004

### AUTOMATED SUBSTATIONS

ABB supplies the first manufacturer-neutral automation system for substations which complies with the new international standard for monitoring and protecting station equipment.

### 800xA AUTOMATION SYSTEM

ABB launches the world's first fully integrated industrial automation system: 800xA.

## 2015

### COLLABORATIVE ROBOT

ABB develops YuMi, the first collaborative, two-armed robot for small parts assembly. YuMi offers unique features, which bring many new possibilities to automation. The robot was developed for a new era of automation in which people and robots will work hand-in-hand on joint tasks. The design is entirely safety-based: YuMi is inherently safe. That means protective fencing is superfluous in many applications.

## 2016

### GOTTHARD BASE TUNNEL

At 57 kilometers long and 2,300 meters deep, it is the longest and deepest rail tunnel in the world and, as part of its 100-year partnership with SBB, ABB played an important part in it. ABB installed the power supply and drives for the world's most powerful ventilation system (15.6 MW). The entire ventilation control system also comes from ABB. A total of 899 medium-voltage bays, 300 transformers, and over 500 protection and control units supply energy to the tunnel's infrastructure.



# Beginning of a beneficial friendship

— He's called YuMi, he has two arms, and he is a robot. He is set to permanently change the way people and machines work together.

Man and machine are not irreconcilable opposites and it is not a matter of either-or. The working model of the future will be one of natural collaboration. Machines can do some things better than people can, such as monotonous routine work, which can be tedious and even dangerous. That gives people the space and time we need to dedicate ourselves to more interesting tasks. "Automation raises our standard of living," says scientist Roland Siegwart, who teaches robotics at the renowned ETH or Swiss Federal Institute of Technology (see interview on page 17).

The robot called YuMi represents a major step in human-machine collaboration. YuMi – from "you and me" – is the result of ten years of development by specialists at ABB. In the past, people and robots did their work separately in industrial manufacturing, where clumsy machines were big and "insensitive" and threatened people's safety.

But YuMi not only looks friendly,

it is sensitive to touch and works so accurately with its two arms that it is able to thread a needle. It works hand-in-hand with humans. For instance, YuMi can do some of the work involved in assembling mobile phones. But if processes requiring more sophisticated fine-motor skills and demand the human touch, then people can step in. The robot is equipped for its share of the work with a powerful controller, flexible gripper hands, and a visual system that enables it to reliably recognize the different parts it needs to assemble.

#### Flexible colleague

This two-armed robot was especially developed for assembling small parts in the electronics industry – parts in products like watches, tablet computers, and mobile phones. This area of industrial production is growing at a remarkable rate and demands a high degree of flexibility. Rapid growth and ever-shorter product life cycles (think smartphones) pose challenges for

— BEST OF BOTH WORLDS: YUMI IS MODELED PARTLY ON THE HUMAN ARM. THANKS TO ITS SENSORS ITS "HANDS" CAN WORK WITH AS MUCH DEXTERITY AS OUR FINGERS CAN.







— HELPING THE NEW ARRIVAL: RESEARCH, DEVELOPMENT, AND PRACTICE GO HAND-IN-HAND. YUMI IS PATIENT, BUT SCIENTISTS AND ENGINEERS WILL HAVE TO BE BOTH PATIENT AND INQUISITIVE AS THEY DEVELOP THIS NEW PARTNERSHIP BETWEEN MAN AND MACHINES.

manufacturers. That is why a flexible, mobile, highly developed robot is a very welcome coworker indeed.

YuMi allows manufacturers to produce equipment more quickly, more efficiently, and of a higher quality. Improved automation means less waste produced and higher flexibility. In short, manufacturers get more for their money. But YuMi is intended not only as an economic growth stimulator. YuMi makes work safer and more enjoyable for the people with whom it works, while for consumers this man-machine collaboration ultimately results in products of higher quality and greater durability.

An examination of the approximately hundred-year history of industrialization shows that automation, of whatever kind, has not deprived people of work. On the contrary: the steam locomotive may have ousted

horse-drawn vehicles, but today there are more and more train and truck drivers and there is work for an increasing number of people. Life expectancy has more than tripled since 1800, and prosperity is many times greater in today's Western Europe than it was at the onset of industrialization and automation.

#### Time to reflect

Machines have gradually relieved people of certain types of work, giving us time to reflect on how to make life better for everyone. Robots do not rob us of work, they simply do the things they should have done long ago. Take transport, for example: people become tired, they get distracted by thoughts, and so they make mistakes. Computers may not be entirely free of faults but they can be much more reliable than people. ETH researcher

Siegwart cites the example of radar and camera systems in cars that can recognize pedestrians, other vehicles, traffic signs and safety lines – and do so very consistently. These functions make our lives as drivers, pedestrians, and cyclists easier and above all safer.

In terms of the history of the industrial revolution, a robot like YuMi represents a single chapter, which has only just begun. Today, these rugged and robust machines perform much more than simple, dull and menial tasks such as hammering, soldering or welding. Our new, computer-controlled colleagues are reliable and sensitive partners. As in every good marriage each allows their better half to employ its strengths to the full. Sure, there might be conflicts, but human-machine partnerships will make the world a better place – or the world of work at the very least.

# “Robots cultivate fields better”

— ETH researcher Roland Siegwart talks about where machines are ahead of people – and where they are not.



— ROLAND SIEGWART, 57, IS PROFESSOR OF ROBOTICS AND CODIRECTOR OF WYSS ZÜRICH AT ZÜRICH'S FEDERAL INSTITUTE OF TECHNOLOGY.

**Mr. Siegwart: Robots who do our work for us make people anxious. What do you say about that?**

These machines are not very intelligent. They can do simple, repetitive tasks – not usually the kind of work people like to do. That's why automation raises our standard of living. Working in mines several miles below the ground is not

something humans should have to do. Robots should do it instead.

**What will robots still not be able to do better than us for the next hundred years?**

Computers can collect and analyze data, but doing creative things with it? That remains the gratifying task of humans.

**How far has research progressed?**

We're trying to make robots more autonomous so that they can get along in daily environments – in autonomous vehicles, for instance. This makes traffic significantly safer because computers always pay full attention. The ability to learn is also a major field

of research. A computer in an autonomous vehicle has to be able to differentiate between the image of a person and that of an animal or a post.

**You know ABB's YuMi from your laboratory. What kind of robot is it?**

YuMi belongs to the next generation of robots that are able to emerge from their sheltered production facilities and enter our day-to-day environments where they can work together with people. This robot, for example, can attach certain parts in the assembly of smartphones and watches. But whenever the human touch is needed, humans take over.

**Is there a robot you would like to invent?**

The first question is, what do we find tiresome? An automated system which could do our laundry or clear the table would be quite nice. The other question is: what do we really need? We need things like more food for a steadily growing global population – that's one thing. Robots can cultivate fields better: drones fly over arable lands, analyze them, and then are able to sow, irrigate, fertilize, and harvest more precisely.



— IT NEVER GETS BORED, IT NEVER GETS TIRED, AND IT NEVER MAKES MISTAKES: YUMI RELIEVES PEOPLE OF ROUTINE ACTIVITIES.

# 125 years of pioneering expertise

Technology drives the world. ABB is a driver of technological progress. Including the mega-trend digitalization

**Mr. Voser, as the Chairman of the Board of Directors of ABB, which is now approaching its 125th anniversary, what is the most moving aspect of this milestone for you?**

**Peter Voser:** Every day, it delights and fascinates me to see the innovative powers developed by what was BBC, and is today ABB, since the company was founded in 1891. Since its founding in Baden, the company has been actively involved in three industrial revolutions, in many cases in a leading position. Charles Brown and Walter Boveri were the visionary founders of an enterprise that we would today call a start-up.

**Mr. Spiesshofer, Mr. Voser, what do you think Charles Brown and Walter Boveri would say to the current corporate strategy?**

**Ulrich Spiesshofer:** Today's strategy is built on precisely the same entrepreneurial spirit that characterized the two founders. We continue to write new chapters in the history of our company as a leading pioneer in the technology sector. We are ideally positioned to take full advantage of the opportunities offered by Industry 4.0, the fourth industrial revolution. That is

also the target of the third phase of the Next Level Strategy we presented at the beginning of October this year.

**Could you explain that in more detail?**

**Ulrich Spiesshofer:** Essentially, the objective of the strategy is to transform the four divisions of ABB into independently active business units. This expressly includes the transformation of our highly successful Power Grids division under the umbrella of ABB. At the same time, we will be exploiting our digital potential to the full, maintaining our clear focus on operational excellence. We will also be strengthening the awareness and perception of our global brand. The objectives of this next phase of our strategy are to accelerate our growth and generate more value for our customers and shareholders alike.

**Peter Voser:** We have done our homework in recent years and are now significantly better positioned in both operational and financial terms. ABB is now more customer-oriented and much less complex than before. This places us in an excellent position to act, together with our customers and partners, as a motor for progress in the

— We will continue to write new chapters in our history as a leading pioneer in the technology sector.

Ulrich Spiesshofer  
Chief Executive Officer, ABB Ltd



— THE FUTURE IS IN GOOD HANDS: PETER VOSER AND ULRICH SPIESSHOFER ARE IN CHARGE OF ABB. EVERYTHING BEGAN WITH ELECTRIFICATION. A STRONG CULTURE OF INNOVATION IN THE COMPANY HAS MADE IT ONE OF TODAY'S LEADING PLAYERS IN THE WORLD OF DIGITALIZATION.

— THE FITNESS TRACKER FOR ELECTRIC MOTORS: ABB'S SMART SENSOR MONITORS THE STATUS OF ELECTRIC MOTORS AND CAN REDUCE DOWNTIMES BY UP TO 70 PERCENT.

digitalization of power supplies, industry and in the transportation and infrastructure segments. In this way, we strengthen the competitive capabilities of ABB and, in turn, the economy of Switzerland, the home of our concern.

**Mr. Spiesshofer, you have identified digitalization as one of the key value drivers for ABB. Isn't that simply a buzz word?**

**Ulrich Spiesshofer:** Certainly not. Digitalization will radically change traditional business models.

Fundamentally, it enables connectivity between machines, processes, services and people. Being a pioneer in the past does not automatically guarantee that we will remain so in the future, especially if the signs of the times are overlooked and the opportunities they bring are missed. ABB has identified the signs and is actively exploiting the opportunities they offer.

**What concrete measures have been taken in the course of digitalization?**

**Ulrich Spiesshofer:** Today, ABB is already a digital "hidden champion". With more than 70 million devices installed in machines and factories around the globe, no other concern rivals us in our ability to establish connectivity between the physical and digital worlds. Our products and services not only connect machines with one another, they also make it possible to analyze the resulting data to ultimately create concrete benefits. The enormous potential of digitalized industry is shown where people interact with machines in integrated scenarios. For instance, the extremely

— We strengthen the competitive capabilities of ABB and, in turn, the Swiss economy.

**Peter Voser**  
Chairman of the Board of Directors, ABB Ltd

sophisticated sensors of our YuMi two-armed robots make them a workmate with a particularly delicate touch for their human colleagues on the assembly line for small components. Our entire portfolio of digital solutions and services is now being brought together in ABB Ability™ to serve all customer segments. This confirms and consolidates our position as a leading protagonist in the fourth industrial revolution. We are particularly pleased to have been able to get Guido Jouret, a pioneer of the Internet of Things, on board as a driving force for the realization of our digital strategy.

**Mr. Voser, do you see the fourth industrial revolution as a threat to some jobs?**

**Peter Voser:** Every one of the four industrial revolutions has been accompanied by reservations and fears. When

emotions are set aside, these have never stood up to closer scrutiny and have never become realities. Quite the opposite: each of these technological revolutions has brought enormously increased productivity and wealth. They significantly improved standards of living, and not just in the industrialized nations, and created more jobs than ever before. Admittedly, the employment landscape changed and brought new jobs in other sectors.

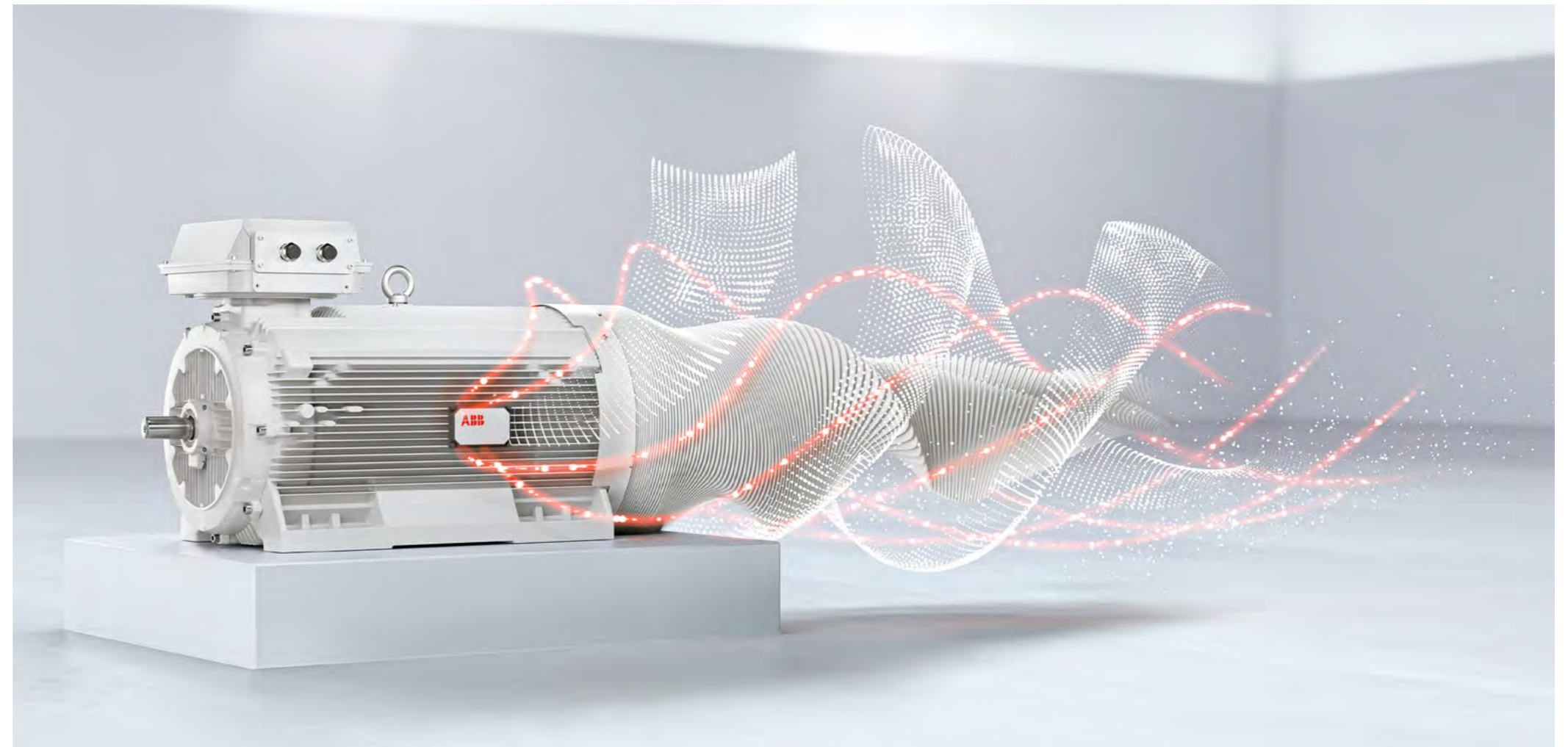
**You were born in 1958. So you didn't grow up in the digital world and can't really call yourself a "digital native". How do you see these changing times?**

**Peter Voser:** The way I see it, enthusiasm for new technologies has nothing whatsoever to do with age. I have been accompanied by constant change throughout my professional life and I'm pleased to be able to say, with

absolute conviction, that I have been able to play my part in it at various stages along the way. Digitalization now offers even more opportunities and more access points for shaping the future. Today, Silicon Valley is not the sole source of innovation and ideas – any number of Swiss valleys, highlands, and lowlands can do the same. Our strategic partnership with Microsoft is a groundbreaking example of this.

**What exactly does this partnership involve?**

**Ulrich Spiesshofer:** This strategic partnership with the world's largest software concern is built on many years of successful collaboration. We are working together on the creation of one of the world's biggest industrial platforms in the Cloud. Our partnership bundles the global strengths of ABB



and Microsoft, and will bring unique benefits for our customers – true to our brand promise: Let's write the future. Together.

**Today, ABB has around 135,000 employees and maintains a presence in more than 100 countries around the globe. How much Switzerland can still be found in ABB?**

**Peter Voser:** A lot, and it's going to stay that way! Switzerland is an important pillar of strength for us, and the home of our headquarters. We will continue to invest here, too. For example in research and development and in increasing productivity. Namely in activities with high value-creation potentials and correspondingly higher margins.

**ABB is obviously becoming more of a global concern. Will ABB remain**

**a Swiss company?**

**Peter Voser:** For us, as a global concern, Switzerland offers so many advantages. We feel perfectly at home here, and not just at our headquarters. Our Swiss subsidiary also does a wonderful job. It's an innovation machine that regularly brings new products with enormous benefits for our customers to the market at very short intervals. It's also doing very well indeed.

**Could this have something to do with your now being Swiss yourself, Mr. Spiesshofer?**

**Ulrich Spiesshofer:** (with a smile) No, of course not, although I do take pride in now having Swiss nationality. Switzerland has become a second home for me and my family. I don't speak Swiss German yet, but my children speak it like natives.

# Research that pays off

ABB is big on research. That is why the company operates seven of its own Group research centers. One of them is the Dättwil Research Center, and we paid a visit.

— THIS POWER ELECTRONICS COMPETENCE CENTER IS LOCATED IN SWITZERLAND. A HIGH-PURITY ROOM AT DÄTTWIL.



ABB invests around a fifth of its total research and development expenditure in Switzerland. One of its Group Research Centers is in Baden-Dättwil. A team consisting today of 220 employees from 40 different countries has been shaping the future in fields such as power electronics, industrial automation, and materials science since 1967. Over 120 students and degree candidates also work at the institution each year.

## A PRODUCT IN JUST SIX MONTHS

Their mission is to make tomorrow's world even more efficient with inventions and intelligent applications. One example is a new series of

switching concepts for even more powerful photovoltaic systems. These systems convert sunlight into electricity and are part of today's energy revolution, but they also supply consumers autonomously. The power of such a system increases with increased system voltage, which has risen from over 110 V to 1,000 V and is on its way to 1,500 V. This allows more power to be transmitted at the same strength of current. An ABB inverter can transform DC into AC voltage from 15 instead of just 10 solar modules.

But at these higher voltage levels there is a critical range of medium current strength which is difficult or expensive to switch, for physical

reasons. That may sound like just a technical detail, but it has immediate effects on the cost and overall efficiency of systems. At Dättwil, a project team was appointed to solve this demanding configuration of technical and economic challenges. Researchers there had already worked on power electronics solutions before, which gave them something of a head start in developing a concept using standard components. Experts at ABB SACE in Italy used this concept and converted it into a marketable product in just six months: the world's first low-voltage circuit breaker incorporating hybrid technology. It was yet another piece of research that paid off directly for both ABB and its customers.



— DÄTTWIL RESEARCH CENTER: 220 STAFF FROM 40 COUNTRIES LAY THE FOUNDATIONS HERE FOR TOMORROW'S PRODUCTS.



— THE ONLY DIFFERENCE BETWEEN THE FIRST ENERGY-INDEPENDENT APARTMENT BUILDING AND OTHER MODERN RESIDENTIAL ARCHITECTURE IS THAT ITS WALLS ARE SO THICK BECAUSE OF THE VERY GOOD INSULATION. IT IS SITUATED IN BRÜTTEN, SWITZERLAND.

# What the future looks like!

— A home that needs no external power supply: it was officially opened in the middle of this year. Here's how it works



— BRIGHT, COSY, AND SPACIOUS – THE LOUNGE, WHICH LOOKS LIKE MANY NEWLY BUILT APARTMENTS.

— AN ISLAND OF CUPBOARDS LINKS THE KITCHEN WITH THE DINING AREA, ENABLING COOKING AS A SOCIAL FUNCTION.



— EVEN AN ENERGY-INDEPENDENT HOUSE CAN HAVE FAMILIAR COMFORTS IN THE KITCHEN.



When Edwin L. Drake first struck oil in America in 1859, he tapped into a source of energy which still powers the world to this day. Switzerland meets around half of its total energy needs from the woodlands which, over millions of years, became the black substance which now powers our cars and heats our homes. But oil reserves are limited and using them harms the environment. Fortunately a rethinking process is well underway. In Switzerland, as in other countries, the proportion of electricity generated by renewable energies such as wind and solar power is growing. Last year it was already 23 percent. These sustainable sources are also available to private houses, which still consume a quarter of Switzerland's total energy – and four-fifths of that is for heating and hot water.

The world's first energy-autarkic apartment building was inaugurated in mid-2016 in Brütten, a town of 2,000 inhabitants in the Winterthur district. It approaches sustainability from three different angles and with previously unheard-of consistency: the generation of electricity, its

energy storage, and its power consumption. Furthermore, the nine families who live there use only the power generated on the building's property. "Just one hour of sunshine is enough in summer," says Roger Balmer, head of the pioneering project, "to cover the energy needs of all of its occupants for a whole day." That is only possible with the consistent use of the latest intelligent technology. But first things first.

The building came about as a project of Umweltarena Spreitenbach which, since 2012, has been an innovative platform on which companies can showcase their resource-saving projects and products in action. The importance of this concept has been highlighted by numerous accolades, such as the "European Solar Award." The energy-independent building achieves two aims simultaneously. Firstly, it gives examples of technologies which can be used to operate a project of this kind. Secondly, it is not merely a design study, it is a real place in which to live and feel at home. The building's technology gathers together all kinds of leading ecofriendly energy concepts.

Its roof and facade play a key role, being fitted with types of solar cells that are optimized in different ways for the generation of electricity. Together they supply up to 127 kilowatts, which is converted using 26 ABB solar inverters and fed into the building's own network. Any energy not immediately needed is stored for the short- and long-term. The latter is especially difficult: electrolysis is used firstly to produce hydrogen, which is then stored at 27.5 bar in two large pressure tanks containing a total of 120,000 liters. On overcast winter days it flows from there into fuel cells which convert it back into electricity. The 60°C heat produced is used for heating and hot water.

Geothermal energy is also part of the energy mix. A downhole heat exchanger converts the temperature difference between an almost constant 11°C spring water and the outside temperature into a choice of heat or cooling using heat exchangers and a heat pump. All of these and many other modules communicate with each other

electronically, which is the only way to combine the supply of energy with its use by occupants in a highly efficient manner. Wall and floor heating, and an ingenious ventilation system, produce pleasant interior conditions at all times. Power-saving lighting and energy-efficient household appliances help keep the building self-sufficient from a consumption point of view. This permits us to look into a future which may soon be everyday reality. A tablet can be used to control lighting, sockets, and blinds. The ABB-free@home system used to this end controls lots of other features as well (see following page). The pioneering Brütten project sets new standards in future residential construction. Its nine families are currently discovering what it feels like to live there on a daily basis. Their initial feedback is encouraging in terms of pursuing the vision of self-sufficient buildings. And they are providing suggestions about how to make this future even more comfortable to live in.

## Energy-independent – a sunny outlook

The meaning of the word “autarkic” lies somewhere between “independent” and “self-sufficient.” An autarkic building is both. Firstly, it does not draw any electricity from external lines, instead producing it all itself using solar and geothermal energy.

Furthermore, the building is frugal in the consumption of that energy. All of that is sustainable and it requires sophisticated technology at every level, on every floor, from the roof, right down to below the basement. But a building of this

kind is far from being a soulless habitation unit. Its interior climate is regulated so that all of its occupants feel comfortable in every season – and not only physically. The feeling of being part of progress is thrown in for free.



THE BUILDING'S ENTIRE TECHNOLOGY CONVERGES ON A DISPLAY WHERE IT CAN BE CONTROLLED AND MONITORED – INCLUDING REMOTELY, USING A SMARTPHONE.



## It's in your hands

The intelligent ABB-free@home controller automates and optimizes energy consumption and more

A house is a complex structure entailing countless functions, especially if it is optimized for energy efficiency. Things can quickly become impossible without an automation system such as that provided by ABB-free@home for new buildings, and for retrofitting in existing buildings. This system provides a common platform for almost all technical housing systems. It is clearly presented on a device such as a tablet, from which the systems can be controlled and monitored intuitively, even away from home. This is how it gives occupants more time, comfort, safety, and customization. The system permits the control of blinds, lights, heating, air conditioning, and doorway communication. It makes saving energy child's play. For example, the ideal and most comfortable temperature can be selected for each and every room. An eco-feature can reduce the temperature overnight if required.

Blinds open and close automatically to prevent rooms from heating up in summer or cooling down in winter, whenever occupants are absent. The lighting also makes for a feeling of wellbeing. All of the lamps are networked and separately dimmable, and can be set to create atmospheric lighting scenarios at the touch of a button. Whether reading, eating, or watching television, occupants can control lighting in the palms of their hands. Previously memorized routines can be reproduced by the lights and blinds to simulate the presence of occupants. This means better security during vacations.

### More comfortable and safer

Networked smoke detectors make the building safer still; not only do they warn acoustically, they also switch on all the lights in the apartment automatically and open all of the blinds. Video doorway communication makes things even safer, showing an image of whoever rings the doorbell. Even landing lights come on when the doorbell rings. ABB-free@home makes a building smarter, more comfortable, and safer. The additional cost over a conventional electrical installation is minimal. The system is also ready for the future because it can be updated. It has proven its worth in many private households since 2014; since then occupants have been saving energy and enjoying safety and comfort.

# Next stop: charging station

—  
Geneva is now home to unique TOSA electric buses, which can “fill up” in just 15 seconds using a ground-breaking quick-charging system made by ABB

Anyone who owns an electric car knows that it requires a different mobility mindset from vehicles with fuel tanks. You have to plan, think ahead, and schedule in times to charge up the batteries. If you drive an electric vehicle privately then planning is, to a certain extent, part of getting around and also what makes it appealing. But when it comes to public transport, timetables, a far-reaching infrastructure and the very rhythm of the city, all depend on trouble-free processes.

That is why vehicles like the fully electric bus that runs on Line 23 in Geneva, connecting the suburbs and the expanding city to the airport, cannot be left standing with empty batteries, otherwise people would not get to their flights on time, arrive punctually at work, and enjoy free-flowing traffic. In Geneva, the TOSA buses (Trolleybus Optimisation Système Alimentation) made by ABB in conjunction with Swiss manufacturer, Hess,



—  
EASY DOES IT: EVEN GETTING INTO THE NEW TOSA ELECTRIC BUS IS SMOOTH AND SAFE.



—  
THE FUTURE ARRIVES ALMOST SILENTLY. THIS TOSA ELECTRIC BUS OFFERS THE LATEST IN TRAVELLING COMFORT FOR UP TO 133 PASSENGERS.

do not arrive late – at least not because their batteries haven't been charged.

#### “MILESTONE FOR THE FUTURE”

These buses are fitted with ABB's ground-breaking quick-charging on-board technology, which enables their batteries to be charged in seconds using what is known as flash-chargers. This is how it works: the batteries that drive these articulated buses on Line 23 are installed on the roof. When the vehicle arrives at a stop equipped with a charging station some meters above the ground, its power supply line connects with the battery's charging terminal in seconds. The bus's battery is charged with 600 kW in just 15 seconds – enough power to light up ten thousand 60 Watt light bulbs for the same time. ABB's TOSA technology, meanwhile, allows the articulated bus to recharge fully at its terminus in just four to five minutes. In your own electric car you can take a break, eat something, and have a drink while it charges up, whereas Line 23 will, from 2018 onwards, shuttle to and fro every ten minutes at peak traffic times carrying 10,000 passengers a day – up to 133 per vehicle – all of whom will be expecting to arrive on time at the stops of their choice. The benefits of this new kind of quick-charging infrastructure are obvious: there is no need for expensive

overhead lines, which limit the flexibility of bus routes, and they enable fully electric buses to be used instead of the previous diesel-powered vehicles, saving up to 1,000 tons of carbon dioxide per year. Luc Barthassat, State Councilor for Transport and Environment in Geneva, sees it like this: “The deployment of TOSA on Line 23 is the result of joint efforts by public and private partners aiming to achieve a vision. This innovative project is a milestone for the future of urban mobility because it enables sustainable and eco-friendly transport and therefore contributes to the well-being of our community.” In Geneva ABB will equip twelve TOSA buses with the necessary technology and provide flash charging stations at 13 out of 50 stops, three charging stations at termini, and another four stations at depots.

Political vision and the possibilities offered by technology have combined in an eminently practical fashion on Geneva's Line 23. This is based on ABB's Next-Level Strategy in which energy-efficiency and sustainable mobility – subways, electric cars, electric buses – play a major part in the company's philosophy. And the technology, developed by engineers in Switzerland, also provides an insight into the future. If it's good for bus passengers in Geneva today and tomorrow, then it may soon be benefiting electric car owners everywhere.

—  
CLEAN AND FAST: THIS IS WHERE TOSA IS CHARGED WITH 600 KILOWATTS IN JUST 15 SECONDS. TO DO THAT, A POWER SUPPLY LINE EXTENDS AUTOMATICALLY FROM THE ROOF OF THE BUS.



—  
MARCO GRUNAUER, 37, HAS BEEN WORKING AT ABB SCHWEIZ AG SINCE 2007 AND IS RESPONSIBLE FOR QUICK-CHARGING INFRASTRUCTURE FOR ELECTRIC CARS.

## “Quality of life and emotion”

—  
The success of electric vehicles is dependent, among other things, on charging infrastructure. ABB's Marco Grunauer is responsible for ensuring that electric vehicle owners can charge up quickly and easily

**Mr. Grunauer, there are gas stations on almost every corner, but it takes a bit longer to find a charging station for an electric car. Would you agree with that?**

A powerful, reliable charging infrastructure such as the one ABB can offer is a precondition for the success of electric mobility. Switzerland has what is, by European standards, a close-knit quick-charging infrastructure and is keeping up with other countries. The infrastructure is steadily being expanded.

**How many charging points are still needed?**

There will be around 100 ABB quick-charging systems installed in Switzerland by the end of 2016. They will allow all standard electric vehicles (EV) to charge up. Around a third of the stations will be operated privately and won't be publicly available: these will be at factories, banks, insurance companies to give just a few examples. This is unlike the Netherlands, Denmark and Norway, where there are large-scale operators of EV

charging networks; in Switzerland, operators are usually local and run smaller networks. This makes it more difficult for drivers to work out where charging stations are. So it's not about the number of charging points, it's more about networking existing points effectively.

**So the problem is not the lack of infrastructure that many people talk about?**

In the end it is a question of quality. For example, Swiss retailers and shopping centers already offer quick-charging stations. In reality, electric vehicle owners don't go there just to charge up. First and foremost they go to shop and charge up their cars at the same time. After that they park their cars somewhere else, not having to depend on charging infrastructure at particular parking spaces. A quick-charging station is therefore shared by hundreds of users and provides a lot of freedom.

**Do you yourself drive an electric vehicle?**

Of course. ABB maintains a fleet of electric cars.

**And how do you find it?**

Anxiety about the range of the vehicle is all in the mind and worries are unfounded so far. Networked electric vehicles help travel planning and always get me safely to my destination. An electric vehicle's combination of quietness and power is an amazing experience. I really enjoy being part of something that can positively change our environment and maybe even the world.

**What will the future of the automobile bring?**

Cars are like telephones, typewriters, audio storage media, televisions, cameras, and many other major achievements of the 20th century. Technologies are being used in new ways and making everyday life easier. Electric vehicles are driving further and the options available are growing while prices drop – and that is already happening. Nobody really knows what the future will look like, and that is precisely what drives people to help shape it.



**A PASSION FOR ENGINEERING**

Songlin develops groundbreaking technology for ABB in Shanghai, China. He and his team are responsible for creating robotic applications that demonstrate their robot products' latest features. Sounds complicated? Not at all. In fact it's "cool," says Songlin. And when he talks about YuMi, the first collaborative, two-armed robot, he gets really enthusiastic. "YuMi can solve Rubik's Cube and even make a café latte." Songlin describes his job as "very technical, but still creative." And he enjoys it when his work achieves something. He began working for ABB in Beijing in 2013 after completing his master's degree. His international team members come from China, Sweden, India and Germany. Their next goal? "To change the world."



— SONGLIN, RESEARCH & DEVELOPMENT, SHANGHAI, CHINA.

# Success is achieved by people

— Specialists, engineers and inventors throughout the world enthusiastically pursue ABB's vision. With a clear aim in sight, they never cease to enjoy tinkering and discovering. Here are just some of their stories

— CLAIRE, CORPORATE RESEARCH, VÄSTERAS, SWEDEN, WORKS WITH HER TEAM TO DEVELOP PIONEERING ENERGY-RELATED MATERIALS.



**TEAM PLAYER OF THE HIGHEST CALIBER** The best ideas always come from the Far North. Claire manages a team of 22 researchers working in the field of electrical insulation and material technology in the small Swedish town of Västerås. It was eight years ago that she first brought her expertise in nanotechnology to ABB. She and her team have since been developing futuristic materials for a series of ABB products. As a recognized academic she also strengthens the link between ABB units and university research. Claire especially enjoys working in a team. Asked about what motivates her, she replies that above all it is "the people I work with." What fascinates her about her work? "Every member of the team has a different way of thinking and a different personality, but they are all so committed."

**EXPERT IN STEEL CABINETS** Craig likes best to talk about his great passion – transformers. “Even after 35 years I’m still fascinated by a thing that can’t move,” jokes Craig. “But so much happens inside these little steel boxes.” Craig began working in the electrical transmission and distribution sector in 1979. Today he is the Director of Business Development and Technology at ABB North America’s Transformer Remanufacturing and Engineering Services. “So much has changed and is still changing,” says Craig, “the methods we use to analyze the performance of transformers, the development of materials, and the way electricity is generated and distributed. These are things I really get a lot of pleasure out of.” Sounds electric...



CRAIG, BUSINESS & TECHNOLOGY LEADERSHIP, ST. LOUIS, MISSOURI, USA.

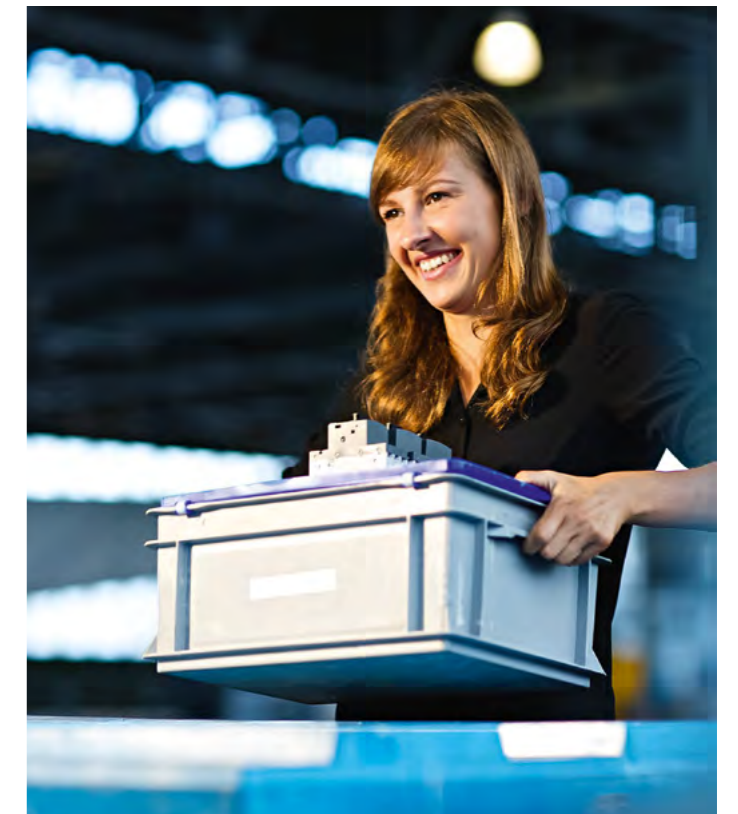


TOBIAS, RESEARCH & DEVELOPMENT, TURGI, SWITZERLAND.

**SPECIALIST IN ENERGY** Tobias currently manages a team of 12 engineers who are responsible for developing software for frequency converters used in the generation and distribution of electricity. The vision behind this is a lofty one: to provide renewable energy more efficiently to the European electrical grid. Tobias is especially proud of a frequency converter developed for the Grimsel 2 storage station in Switzerland. It is the most efficient used in a hydroelectric power plant anywhere in the world. “I really enjoy watching it working,” says Tobias, “because I know what’s gone into it.” Tobias began working at ABB Switzerland in 2007 as a systems engineer. Since 2012 he has been managing the R&D Control Software unit. What makes him happy? “The fact that my team and I are contributing to a sustainable energy future.”

—  
People who make our dreams and their own come true.

**ENGINEER WITH VISION** As a student, Tamara helped to develop a mobile phone charging station based on solar power. “And just two years later,” she reports, “I’m part of one of the most exciting projects ever – Solar Impulse.” When this exclusively solar-powered aircraft became the first plane to fly around the world without fossil fuel, she was responsible for the mobile hangar at the start and finish of each stage. The hangar can be folded up, carried to the landing site, and set up again. She made sure that there was enough electricity to operate the hangar. “Working together with pilots, astronauts and wonderful people from all sorts of different backgrounds was a source of motivation for me,” says Tamara. To her, Solar Impulse was not only a technical challenge but a human one, which she found thrilling.



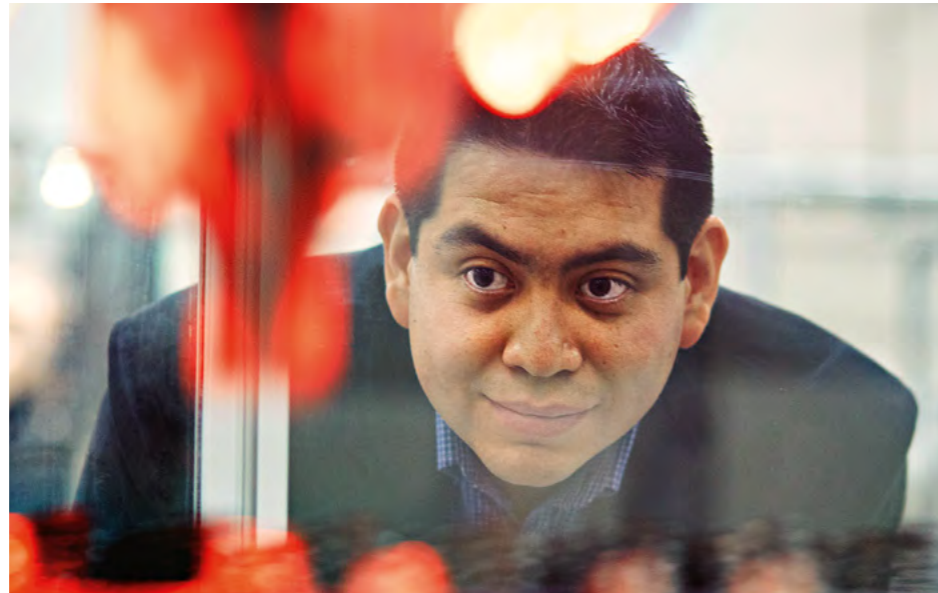
TAMARA, DESIGN & ENGINEERING, TURGI, SWITZERLAND.



— HANSON, MARKETING & SALES, SHANGHAI, CHINA.

#### EXPERIENCED PROBLEM SOLVER

David knows everything about industrial robots, down to the last detail. Together with his team of 12 he solves his customers' technical machine problems by remote maintenance. He and his team provide support around the clock, which requires research and intuition. "We know our robots inside and out," says David, "and we talk of nothing else all day long." He arrived at ABB in Mexico eight years ago as a trainee. Today he heads a call center in the United States. He sums up his work: "Helping someone to solve a problem gives me immense satisfaction."



— DAVID, TECHNICAL SUPPORT, AUBURN HILLS, USA.

**DOOR-OPENER FOR NEW MEDIA** Hanson has had an exciting year. He has been responsible for moving his division into eCommerce, thereby initiating a completely new approach to the digital marketing of ABB products. Hanson's career has been as exciting as his ideas. He was a junior buyer at ABB in Xiamen in 2005, after which he moved to Italy and then to England. He returned to China with renewed energy and now heads up the eCommerce Initiative for low-voltage products. His motto is: "We have to look ahead and do things differently." Because one thing is clear: "Moving our product sales into the digital world is a radical step in our sector." Courage and confidence are needed for it to work. "Sometimes I feel a bit like a superhero," he says, with tongue in cheek.



## Big idea for little geniuses

— The success story of ABB's childcare centers began 50 years ago. They were modern then and are still modern now.

**THE BEST FOR CHILDREN AND THEIR PARENTS.** It was no less than half a century ago that the company then known as BBC opened Switzerland's very first child day nursery. The company was fulfilling its social responsibility towards guest workers from Italy and Swiss society: a piece of active integration. ABB built heavily on this idea. Professional, caring, facilitative care is now a major factor in attracting people to work at ABB, which is constantly on the lookout for highly qualified employees. It is also a flexible answer to the multiple challenges presented by a society that needs to accommodate working parents.

# On the right track

Electricity is an environmentally-friendly way of powering transportation. And there is a long tradition of it at ABB. In 1890, ABB's Sécheron center produced the first electric streetcar



RARELY SEEN: THIS TRACTION TRANSFORMER USED IN THE DESIRO SERIES OF LOCOMOTIVES CONVERTS THE HIGH VOLTAGES OF OVERHEAD POWER LINES INTO VOLTAGES FOR ON-BOARD APPLICATIONS.

— NO HORSE DROPPINGS, NO SMELL, NO NOISE: THE ELECTRIC STREETCAR WAS BOUND TO SUCCEED FROM THE OUTSET. AUTOMOBILES ARE NOW FOLLOWING THE SAME TREND.



— THE LOK 2000 IS THE SWISS NATIONAL RAILWAYS' TRUSTY LONG-DISTANCE LOCOMOTIVE, AND IT IS AN EFFICIENT ONE THANKS TO ABB TECHNOLOGY – SEEN HERE ON THE GOTTHARD RAILWAY LINE.

Each Swiss citizen travels almost 2,500 kilometers every year on the national railways, placing them at the top of the world's rankings for this environmentally-friendly mode of transport. And they have done much in the past to make things that way, literally laying the tracks for the future. ABB Sécheron is closely connected to the evolution of rail, and its history is as complex as a railroad yard. It all started in Geneva's Sécheron district where Alfred de Meuron opened a small electrical appliance workshop in 1879. His company grew and by 1890 had produced its first electric streetcar. This was the birth of today's ABB Sécheron center.

Innovation, high quality, and an ever-flexible business policy allowed this company to become what is today: one of the world's leading manufacturers of power supply systems for trains and rail infrastructure.

#### Every kilogram counts

One of Sécheron's innovative products was the traction transformer, which converts high voltages from overhead power lines into low voltages needed for on-board applications. It is the high voltage that allows lighter-weight power supply lines to be built, but weight also matters on trains. The lighter and more compact

a transformer, the faster and more energy-efficiently the train. It is this, as well as their reliability and ability to adapt to all kinds of different situations, that has convinced demanding clients in China, North America, Malaysia and, of course, rail-mad Switzerland itself. The transformers are manufactured not only in Geneva but also, in many cases, nearer to the customer, whether in China or Russia. In Turgi, ABB Sécheron also manufactures power electronics and medium-voltage drive systems. These, too, make modern locomotives more powerful and more economical, even though ABB itself has not built locomotives for around 20 years now.



— AEROSPACE ENGINEERING? NOT QUITE, BUT ABB SÉCHERON'S PRODUCTION FACILITY IN GENEVA ALMOST LOOKS THAT WAY.

# View to the future – all over the world

As ABB sees it, technology means progress for humanity. And technology that really works has to be close to humanity in every sense of the word.

**2,900 TRAINS** pass daily through Zurich Central Station, which is frequented by almost half a million passengers on weekdays. Since it was opened in 2015, the Durchmesserlinie city railway line has helped take the pressure off the Central Station and made travelling quicker for many users. ABB not only planned and renewed the power supply system in the station and its shops, but also supplies power to operate the new tracks. That is how the trains stay on the move – for the benefit of passengers.

Take a look around. Wherever you see modern technology, reliable power supplies, efficient road transport, and remarkable rail solutions, you're likely to be looking at ABB technology. Not that it's always visible. Most of it is at work inside buildings and vehicles, where it drives progress. And a lot of progress happens quietly. It saves energy. It is as flexible as it is convenient. The future we envisage is already a reality in many projects and places. It makes our cities more livable and our transport more attractive, and it strikes a better balance between what people want and the needs of a sustainably developed environment. That is what ABB is building towards all over the world. And, quite naturally, some outstanding examples of this can be found in Switzerland.

**RECREATION IN THE MOUNTAINS** is becoming ever more spectacular, thanks to safer cable cars and mountain railways. ABB technologies connect the two winter sports areas of Arosa and Lenzerheide to create the biggest skiing region in the canton of Graubünden. Cableways fitted with ABB's energy-efficient drive systems span the heights of 1,700 meters and 70 meters between Hörnli and Urdenfürggli without a single mast, carrying 150 holidaymakers in each gondola.



**A ZURICH TRADEMARK** – the Prime Tower, which was completed in 2011. This architectural showpiece is 126 meters high and comprises 36 stories. Behind its glass facade lies the latest ABB technology, such as ultra-modern power supply systems, which bring electricity safely and efficiently to every room. That is because ABB products reduce energy losses by up to 30 percent along the entire energy chain.

**FIFTEEN SECONDS** is all the TOSA fully electric bus needs to replenish its batteries. It can recharge using pivoting contacts on its roof during a regular stop. It drives without emissions and without noise. The TOSA can carry 133 passengers; it connected Geneva Airport to the Palexpo exhibition center from May 2013 to the end of 2014 – to the delight of passengers and operators. Geneva's Line 23 is now being equipped with TOSA buses.



**THE GOTTHARD BASE TUNNEL** is the world's longest railway tunnel. The latest energy-efficient technologies from ABB provide it with ventilation and power supply for its infrastructure and for over 10,000 orientation lights. Our company helps in many other ways to ensure that Switzerland, a country famous for its railways, keeps setting international standards. That includes locomotives as well as infrastructure, and encompasses maintenance, upgrades and retrofitting. The EC250 high-speed train, which is due to launch in 2019, will be yet another railway pioneer, and will incorporate ABB converters.





HAWAII LIES AT THE END OF THE EIGHTH STAGE: 8,942 KILOMETERS ACROSS NOTHING BUT OCEAN OVER FOUR DAYS, 21 HOURS AND 52 MINUTES – A WORLD RECORD FOR SOLO PILOT ANDRÉ BORSCHBERG.

# Around the world by sun

Solar Impulse 2 flew 40,000 kilometers around the world powered by the sun alone. It was an endurance test for everyone

### LIKE A JULES VERNE STORY

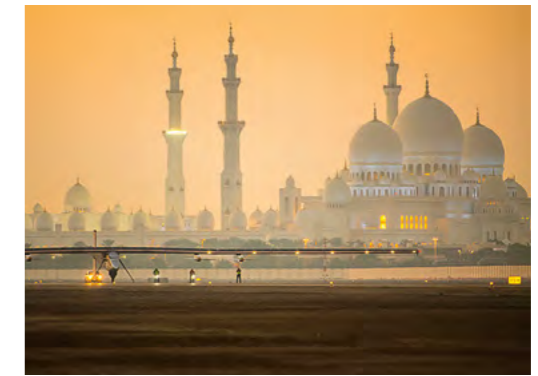
That was how Bertrand Piccard's idea sounded: to fly around the world in a solar-powered plane without a drop of fuel. He spent 12 years together with a 60-man team of partners to prepare for the 17-stage flight. To circle the globe he alternated with André Borschberg as the pilot of Solar Impulse 2, landing 505 days later in Abu Dhabi where he had set out on the record flight. Four twin-bladed tractor propellers were driven by solar power, which was collected during the day by 11,628 photovoltaic cells affixed mainly to the 63.4-meter-long wings. The current was converted by an ABB microgrid, which also controlled its highly efficient distribution and storage in rechargeable batteries, from which the high-wing plane was powered at night. This high-flying dream provides very real evidence of what renewable energies can achieve when used intelligently – by courageous people, it should be added.



The dream of flying with clean energy becomes a reality



SAN FRANCISCO WAS THE DESTINATION OF THE NINTH STAGE, WHICH HAD STARTED AT HAWAII. THE GOLDEN GATE BRIDGE IS IN THE FOREGROUND, AND BEHIND IT THE CENTER OF THE CITY.



ABU DHABI IS IN THE MIDST OF A SUCCESSFUL TRANSFORMATION IN WHICH RENEWABLE ENERGIES ARE REPLACING FOSSIL FUELS SUCH AS OIL. IT WAS AN APPROPRIATELY SYMBOLIC START AND FINISH FOR SOLAR IMPULSE 2.



MANDALAY IN MYANMAR WAS THE FIFTH STOP ON THIS TRIP AROUND THE WORLD. THE AIRCRAFT WAS SERVICED IN ITS INFLATABLE HANGAR IN PREPARATION FOR NANJING, THE NEXT STOP.

NANJING WAS ONCE THE IMPERIAL CAPITAL OF CHINA. AT THE EDGE OF THIS URBAN MASS OF 5.5 MILLION PEOPLE, A TEAM OF EXPERTS PREPARES THE NEXT STAGE TO NAGOYA IN JAPAN.



# Staying power

The turbocharger: invented over 110 years ago, today it helps increase efficiency all over the world

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ALFRED BÜCHI USED THE HEAT GIVEN OFF BY AN ENGINE AND INVENTED THE TURBOCHARGER.

How can diesel engines be made more efficient? This was the question posed to ETH engineer and Sulzer employee Alfred Büchi. He answered in 1905 at the age of 26 by registering a patent for a “combustion machine consisting of a compressor, a piston engine, and a downstream turbine.” This marked the invention of today’s turbocharger which was the first device to employ otherwise unused exhaust gases as they were discharged from a combustion engine. Büchi contacted BBC in 1915 to develop the patent. But it was not until he moved from Sulzer to Howaldtswerke shipyard (Kiel) in 1918 and then returned to Switzerland in 1919 that he was able to develop his invention in a consortium involving BBC and the Schweizerische Lokomotiv- und Maschinenfabrik (SLM, Swiss Locomotive and Machinery Works). The first high-performance turbocharger left the BBC plant in 1924. The company kept on researching this technology and gave it its own development department in 1949. Büchi became the director of SLM in 1926, founded his own engineering office in 1935, and was given an honorary doctorate by ETH in 1938. He later became a member of Switzerland’s National Council and died in 1959. His invention lives on in products like the ABB 800-M turbocharger, which helped the Wärtsilä 31 engine to earn a place in the Guinness Book of World Records as the most efficient four-stroke diesel engine.



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A TURBOCHARGER LEAVES THE ABB TURBO-CHARGING PLANT IN FREDERICIA, DENMARK.

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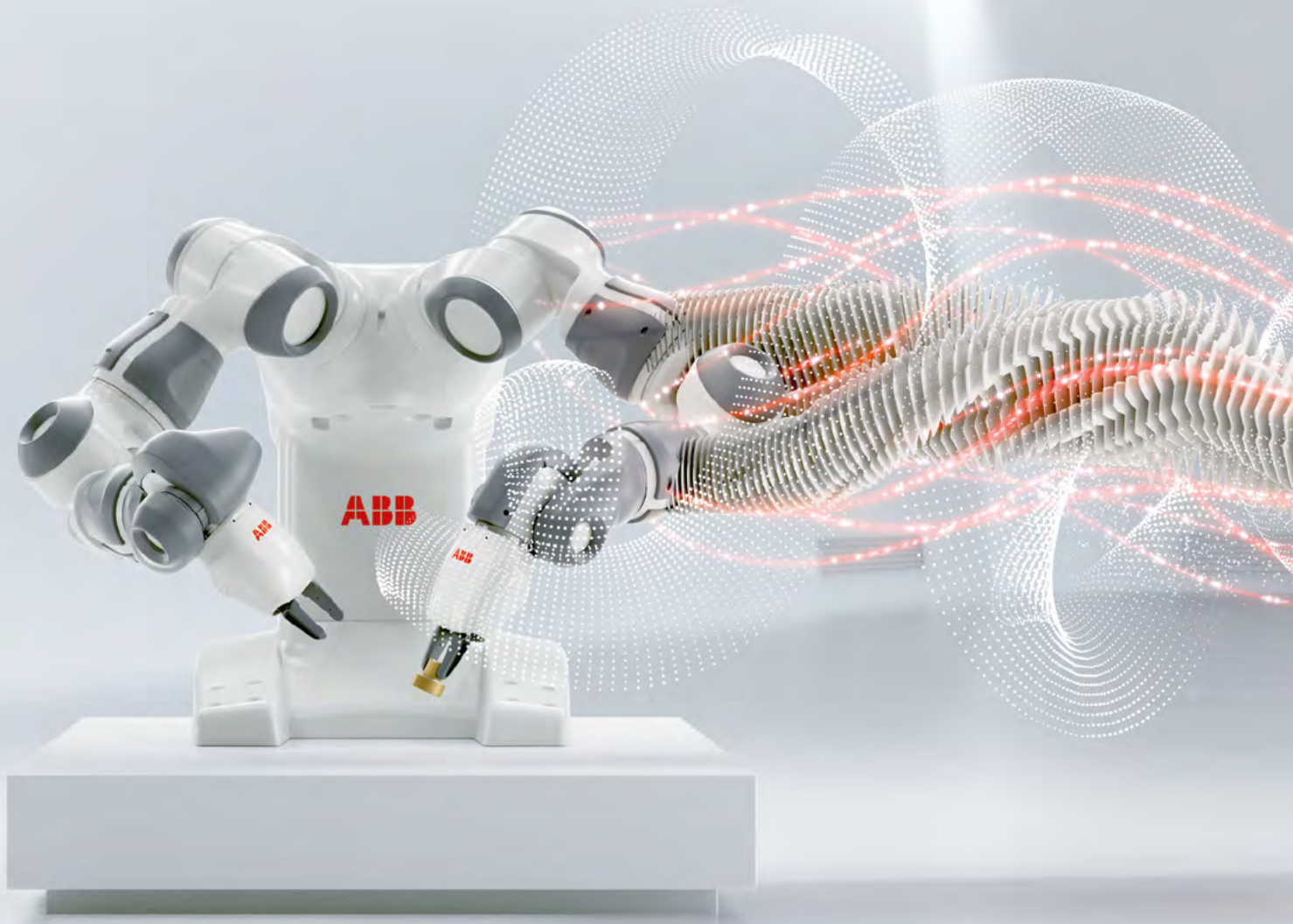
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