Turbocharging – for our customers
Activity Report 2015
As we anticipated, the year of 2015 presented challenges across all industry sectors, but also a time for us to reflect on our heritage. The story of our business began 110 years ago when the patent for the very first industrial turbocharger was granted with early support from ABB. Since then, significant advances in turbocharging technology have hugely improved performance and power output of reciprocating engines. Highlights of our own recent technology developments are documented over the following pages.

Along with our peers in the industry in 2015 we faced the hurdle of falling fuel prices, heavily impacting all markets, and compounding the dramatic dip in merchant marine newbuildings. Weakening of the EUR and JPY against the USD brought additional dynamics to the market. In the context of this, a further milestone has also caused us to review what was possible in 2015; the 125th anniversary of ABB Switzerland, one of the two roots of the ABB Group.

We continue to believe that bringing our business together with engine builders is the key to new application-specific products and technologies in greater alignment with the needs of end customers. One example of this in 2015 was the market penetration of the second generation of Power2®. This two-stage turbocharging technology will be applied on the world’s most efficient four-stroke diesel engine. The year also saw a Valve Control Management (VCM®)-enabled pilot engine in field operation. We fully anticipate further progress on this in 2016 with key development partnerships now in place. In our Service Business, transitioning from our spare-parts-centric model toward a customized approach with new maintenance concepts and upgrades offerings has generated a strong market response, redefining our role as an OEM.

Many other achievements in 2015 were made possible due to such relationships, shaping the future of our offering. In 2016, new product developments closely influenced by our customers’ insights will be presented to the market.

Looking forward, working closely with engine manufacturers and end customers will continue to be essential to ABB Turbocharging as we see industry adjustments and realignment on the horizon. We thank suppliers, partners and employees for supporting this vision and we thank our customers for continuing to choose us. Your trust in our employees and our many years of technical expertise and industry knowledge enables us to continually push the boundaries of turbocharging innovation.

Oliver Riemenschneider
Highlights

1. Supplier awards received from Caterpillar and GE Jenbacher. 2. Customer satisfaction at a level of 92 percent. 3. Study published identifying 1.4 MUSD savings and 64 percent ROI for power plant upgrades. 4. 20 percent year-on-year increase in service partnerships with customers. 5. Launch of world’s largest container ships from CSCL and MSC, powered by ABB-designed turbochargers. 6. ABB turbochargers on engines of the latest vessel from world’s top cruise operator. 7. Launch of Power2 800-M on the Guinness World Record-holding most efficient medium-speed engine. 8. Inauguration of world’s largest internal combustion engine power plant in Jordan with 76 TPL-C turbochargers. 9. ABB turbochargers on first dual-fuel low-speed engine in China. 10. ABB Turbocharging celebrated 110 years since the first turbocharger patent.

ABB Turbocharging extended Management Team in 2015.
For our High-Speed product line, against the backdrop of a challenging year for European high-speed engine builders, we continued to focus on stronger, deeper partnerships with our customers, successfully prolonging supply agreements with a number of major engine builders. We identified a trend toward project-based ordering, in some cases resulting in relatively large unit orders. For example, projects to provide GE Jenbacher J920 engines with the first generation of our two-stage turbocharging solution: Power2 550-M. This solution is capable of delivering turbocharging efficiency approximately eight percentage points higher than a single-stage turbocharger and of enabling an estimated seven percent improvement in fuel consumption.

In 2015, we also introduced to the market new platforms and applications for the efficiency gains and operational flexibility that we know engine builders and operators are seeking. Products tailored to new customer applications were commercially released. In one case this resulted in increased engine power of more than ten percent compared to the previous solution for the application, and the customer was still able to achieve engine thermal efficiency of 43.7 percent. This is just one such example of adding value through our sustained drive toward more innovative, segment-specific products.

New technologies
The advancements with Valve Control Management (VCM) were a key highlight of 2015, enabling flexibility of applications to take an engine from idling to full load in half the time. We will now work closely with key engine builders for further development activity of this technology.

Market presence
In order to better serve the high-speed diesel and gas engine market, we have in 2015 strengthened our presence in the United States, where the majority of the large high-speed engine market is located, including the two main players Caterpillar and Cummins. To truly align our deep knowledge of turbocharging technology with the current and expected future market profile, it is important that we bring not only know-how, but product development and assembly to the US.

New products
During this year also the TPS44-H was introduced, a new robust and compact platform with high power density enabling small gas engines in the 500 kW class to achieve highest efficiencies but at the same time long maintenance intervals, which will ultimately deliver lowest total cost of ownership for our customers.

In 2015, we continued to focus on developing relationships with major engine builders and introduced new applications and platforms for operational flexibility and efficiency.
Our business focus on closer collaborations with customers has led to the phase-in of innovative products and technologies, currently with seven customers in the medium-speed market, to support their new engine development platforms.

MaK and Caterpillar have markedly increased their footprint in China for state-of-the-art medium-speed engines. This is also creating new opportunities for our own penetration of this market.

**Latest products**
The A100 series of turbochargers has remained in demand for both medium-speed and low-speed applications presenting new opportunities with customers including Rolls Royce, Wärtsilä, Hyundai, Daihatsu, Yanmar and Caterpillar.

Adding to the A100 family, last year we introduced the first A100-M axial products delivering two A170-M turbochargers to the Norwegian navy for a supply vessel and ten A175-M units ordered for application on spark ignited gas power plant engines. The A170-M and A175-M were designed specifically to meet demand for higher compressor ratios with single-stage turbocharging, and to match the special requirements of each diesel or gas engine. Their release underlines how our latest turbocharging solutions are developed to be key technology enablers, in this case, resulting in highest pressure ratios and efficiency, and maintaining or even improving the trade-off between NOx emissions and specific fuel consumption.

In addition to demand for innovations in turbocharging technology, there remains a sustained requirement for power and efficiency combined with reduced fuel consumption and lower emissions. Always central to our product offering, this is illustrated by first delivery of the predecessor to the A100 series, the TPL-C, to Hyundai Heavy Industries for their largest produced diesel engine the H46/60V in application on a Korean Navy supply vessel.

**Two-stage turbocharging success**
The last 12 months also saw key developments announced in two-stage turbocharging technology. In June, selection of ABB’s latest generation two-stage turbocharging system, Power2 800-M was announced for the new Wärtsilä 31 engine, recorded in the Guinness Book of Records as the world’s most efficient four-stroke diesel engine. With the highest turbocharging efficiencies and pressure ratios and the potential for six-figure savings on fuel costs, Power2 800-M is now leading the way in two-stage turbocharging technology. The first application of Power2 on this new engine will be on a state-of-the-art new generation icebreaker vessel to be built in 2016.

**Customer collaboration**
As the year ended, the opening of our newest Service Station in Amman, Jordan, demonstrated the full collaboration between ABB’s turbocharging product and service offerings, with an engine manufacturer. The world’s largest power plant based on reciprocating engines, located in Jordan was inaugurated in 2015 equipped with 76 TPL-C turbochargers. One of the first power plants of its type, it will eventually operate on natural gas, thanks to the flexibility of its 38 engines. The new ABB Service Station will support the enabling of uptime to be maximized for the 600 MW plant, and also the smaller power plant IPP4.

Combining our turbocharger expertise with our customers’ engine knowledge has allowed us to develop innovations that deliver highest pressure ratios and efficiency.
Early in 2015, the success of our latest-generation turbochargers was recognized with the A100-L on the engine of the “world’s largest container ship,” the 19,000 TEU China Shipping Container Lines’ Globe. The A185-L design was fitted to the main engine with ABB-designed turbochargers also on the auxiliary engines. By spring 2015, MSC had launched a vessel with even larger capacity, also equipped with ABB-designed A180-L turbochargers. Altogether, since market launch in 2009, 2,050 A100-L turbochargers have been delivered or specified.

The contribution of ABB turbochargers to increasing efficiency of container ships over the last five years has enabled savings of $231 million in fuel costs for our customers, saving 1.7 million tons of CO₂, as well as reducing HFO output by half a million tons, for ships over 8,000 TEU.

Customer focus
The selection at the end of 2015 for ABB turbocharging products to be supplied on a major project with the world’s largest container ship operator, AP Moeller Maersk underlines our strength in this market. Since 2010, ABB turbochargers have been delivered to at least 50 percent of all diesel engine powered container ship newbuilds over 8,000 TEU.

Several further examples from 2015 illustrated our resolve to create stronger cooperations with manufacturers of low-speed engines: the first specification of ABB turbochargers on a MAN GI engine, the two-stroke gas injection dual-fuel engine that first entered service in 2015; and the specification of ABB turbochargers on the very first dual-fuel low-speed engine in China, built by WinGD. ABB turbochargers are now applied on all WinGD dual-fuel engines.

With 800 A200-L turbochargers in the market since the product was launched in 2013, another milestone for this latest-generation turbocharger was the success of the A270-L on the first W6X7DF engine from WinGD, representing our focus on supporting engine builders with solutions for increasing operational flexibility to comply with ever-stricter emissions regulations.

Industry innovations
In striving to increase the performance of our products, working with customers to find ways to save energy is important. As part of a project for MSC to deliver a power turbine generator (PTG) system, the largest that ABB has been involved with, the ABB PTL 3200 power turbine was delivered. Through converting waste energy to electricity, the system enables ships to recover up to four percent of fuel energy, at the same time allowing fuel consumption and emissions to be reduced. Demonstrating innovation from ABB’s marine expertise, this first proven operation of a stand alone waste heat recovery system in “island mode” permitted the auxiliary engines to be switched off while the PTG continued to supply full electrical power to the vessel.

Latest generation products
As we continue to extend the performance offered by the A100 series of turbochargers, we launched at Marintec 2015 in Shanghai the A160-L, the smallest, lightest and most compact of the series. Developed based on market requirements for small-bore two-stroke diesel engines, it is highly efficient and with a pressure ratio of up to 5.0, it is truly a smart performer that also enables IMO Tier III NOₓ emissions compliance. Listening to our customers’ requirements to maximize uptime, this product was developed for easier maintenance, with longer service intervals so operators can be assured of their turbochargers’ reliability, literally from dry dock to dry dock.

New market offerings
At the same time, ABB unveiled an air outlet silencer, unique in being the first product available to the market to reduce noise emissions for turbochargers on low-speed marine engines. It reduces the noise level of compressed air leaving the turbocharger and is a key element in ABB’s noise reduction packages, now available for A100-L and A200-L turbochargers. The abatement of noise emissions aboard ships has taken on new significance with the 2014 introduction of new International Maritime Organization SOLAS regulations, and now ABB offers a package specifically to support operators in meeting these regulations.

The success of our latest-generation turbochargers was further recognized in 2015, while we also presented to our customers new product innovations reducing emissions and delivering higher levels of efficiency.
Rail product line

Highlights

For the rail product line, 2015 was a critical year for standardization of our Variable Turbine Geometry across the market. In China, the first locomotive with VTG was tested at altitude for passenger trains and for double section locomotives. With VTG as the standard turbocharging offering for long-haul applications, we now offer to the Chinese market increased fuel economy by around two percent and higher flexibility with no compromises in a country with large variation in ambient conditions. In the second half of the year, Kolomna Diesel Mash officially presented their new 12D500 engine configuration. It is equipped with two ABB TPR 56-F turbochargers with a VTG feature. This engine will become the “working horse” for the future long-haul TMH DE double sector locomotive to be deployed in far eastern Siberia.

Rail operators in India seeking constantly to lower fleet operating costs, also plan to adopt the VTG turbocharging system for their long-haul DE locomotives, with hardware testing planned for 2016.

Two-stage turbocharging continued to be a major highlight in 2015 across multiple industry sectors, and for rail this meant the phase-in of our first two-stage turbocharging system for commercial application. In China, the first firing of a locally designed high-speed engine equipped with Power2 336-H showed positive results, including increased power density at extremely high altitudes.

Despite the advances in two-stage turbocharging, single-stage turbocharging will remain viable, and over the past year, we have introduced to the rail sector high specific flow capacity on a single-stage turbocharger. This enables existing locomotives to be upgraded. The advantages of this are three-fold: improvement in application reliability, reduced operational costs by extended durability and reduced investment required in fuel costs. Examples of upgrades completed are from VTC to TPS and VTC to TPR.

The popularity of the TPR prevails and we continue to develop in line with market needs. Field qualification of the latest, TPR56FV66 will be in 2016, providing higher pressures up to a pressure ratio of 5.8.

Market acceptance of Variable Turbine Geometry as the standard turbocharging offering for long-haul rail applications was our focus in 2015, with significant developments in the Chinese market.
Service Business Highlights

**Product life cycle care**
The general trend of outsourcing the maintenance of industrial equipment to service providers has reached the market for turbocharger service. Through listening to and tuning into our customers’ requests in 2015, we were able to bring more flexibility into our maintenance and service offerings, designed to more clearly and comprehensively address customer needs.

With a 20 percent year-on-year increase in the number of turbochargers maintained under our service agreements, we have made good progress toward our goal of better supporting customers with their cost management while maximizing the performance of their products, allowing them to focus more on their own business issues. In addition to our well-known Maintenance Management Agreement and Operation Performance Package, we have also launched the Fixed Rate Service Agreement designed for tailored scope of support and tailored payment intervals, which customers are telling us, can be a better way for them to work with us.

As with our Product Business, in our Service Business we are also engaging more than ever before with engine builders, to more fully support engine maintenance concepts. The objective of this is to move toward a “one-stop shop” for customers; enhancing simplicity and reducing complexity for our current and future customers.

**Service network**
As ever, we constantly review our global footprint to ensure the best availability of our service engineers for the installed base of 200,000 ABB turbochargers. In 2015, we opened new service facilities in Uruguay and Jordan, and we enhanced our service facilities in Australia, China, Japan, South Korea, Turkey and the USA.

The success of our Service Business is, of course, determined by those who choose to work with us. In actively seeking feedback, we have had confirmation that technical support and service ability are two areas of our overall business where customers rate us the highest.

**Turbocharger upgrades**
Interest in turbocharger upgrades increased by more than 40 percent in 2015 compared to the previous year. Despite modest fuel oil prices, the main incentive for our customers to upgrade their turbochargers was still the overall efficiency of their power installations. But also increased operational flexibility, higher power output and lower maintenance costs were reason enough to invest in newer and improved turbocharger and engine technology.

A report commissioned by Forrester Consulting in 2015 found that ABB turbocharger upgrades further improve engine performance and reduce fuel consumption, identifying a 64 percent return on investment for a specific power plant case study analysis. While the bulk of our upgrades work was in power plants, further upgrades of marine applications took place, with benefits demonstrated.

Faced with strong retrofit competition, it proved once again indispensable to cooperate closely with the engine OEM to deliver a tailored and valuable solution to our customers. We have initiated several similar cooperations and will continue to do so.

**Changing markets**
Looking ahead, the cooling of the global economy, overcapacities in merchant marine and the low oil price is expected to change the shape of the market for service, presenting some further challenges. Close ties with application operators and engine builders will remain central to our growth in 2016 as we look to better serve their specific needs when it comes to optimizing their power installations over the life cycle. Continuing our heritage of innovation, further work on developments with integrated data solutions is planned, providing the opportunity to back up our current offerings to customers.

Close ties with application operators and engine builders will remain central to our service offerings in 2016.
TPL turbocharger service on a container ship, Hamburg, Germany.
Technology development
Highlights

In technology, we have three different directions: developing new functionalities and solutions and thus adding value to our customers’ business; product cost reduction; and R&D productivity.

The first of these is illustrated by advancements in Valve Control Management in 2015. This came as a result of an increased number of customer development partnerships. A key highlight of the year was the first VCM-equipped pilot engine going on stream. It is an application for combined heat and power generation and runs continuously, providing significant gains in efficiency and flexibility. This is the first field test VCM installation aiming for serial qualification of our VCM technology. To develop the technology further, we will continue to look for opportunities to widen the scope of applications.

Another focus area is energy recovery. ABB continues to work on development of an electric turbo compounding system, offering customers reduced fuel consumption and carbon emissions, while maximizing power density.

The Internet of Things offers great potential to improve the serviceability of industrial technologies by connecting sensors for the extraction of operational data. ABB Turbocharging is exploring the potential of digital sensor technology to enable the remote monitoring of turbochargers for improved maintenance and service offerings to customers.

R&D productivity
In order to make a step change in R&D productivity, we launched an initiative, aiming to double productivity in development and qualification of new turbocharger platforms.

Another highlight demonstrating our commitment to pioneering R&D was to receive the Best Paper Award at the 2015 ASME Turbo Expo, the leading global conference for turbomachinery. The paper was titled “The Matching of a Vaned Diffuser With a Radial Compressor Impeller and Its Effect on the Stage Performance”.

With more than five percent of revenue from ABB Turbocharging global invested in R&D, it remains a key focus to enhance functional performance and cost efficiency whilst increasing reliability of our products.

Our objective moving forward is to push the boundaries of our turbocharging technologies, as well as further investing into testing and simulation technology.

Developments in our VCM solution with key partners was significant in 2015 as were the further steps taken in new technology areas with enhanced performance and increased reliability for our customers remaining central to our offerings.

Close-up of the Jungfrau test bed, where the Power2 two-stage turbocharging system was tested.
Supply and Value Chain Excellence

Highlights

Last year, we focused on setting the base to optimize the whole value chain, defining how to further improve our supplier performance for customers. Optimization was supported with the planning and implementation of key projects, to once again align our business with the shape that the market is currently taking.

Foremost was the planning and execution of investment projects for new manufacturing technology to shorten throughput times and lead times, and to further increase flexibility, enabling us to react faster to customer requirements. To offer competitive products, in manufacturing attention was given to a number of areas for increased productivity. Similarly, across supply management further major cost savings were achieved. We have implemented an Integrated Business Planning Process in order to improve and stabilize planning over the entire value chain. Anticipating the months ahead, we must be able to act proactively to meet changing market demands.

We also plan to significantly improve performance concerning on-time delivery and quality. This will be encompassed by our new “Zero Defects” initiative. Also, following on from the 2015 productivity program, a new initiative will be implemented in 2016 covering the entire value chain, from design, through supply management and production to product application. As markets and expectations shift, we believe the cornerstones are in place for our business to adapt to these changes.

In 2015, value chain optimization, planning, and implementation of projects were in focus to further improve our performance. Delivering competitive products faster will enable us to more flexibly meet customer requirements.
Meeting customers at Marintec 2015 in Shanghai.
Focusing on customers

Highlights

In 2015, feedback was received from customers in 75 countries, with 92 percent satisfied and 65 percent proactive promoters of ABB Turbocharging – an increase year-on-year of four percent.

As an OEM, feedback on the quality of our products and our service is truly what defines us as a market leader. This is becoming increasingly important as we move towards another year of increasing competitiveness.

ABB Turbocharging uses a standardized method to measure customer satisfaction. In 2015, feedback was gained from customers in 75 countries, with 92 percent satisfied and 65 percent proactive promoters from their experience of working with us, an increase year-on-year of four percent.

More detailed analysis reveals that the area of our business that customers rank the most highly is technical support with service quality and on-time delivery also ranked highly. In addition, high scores were given for our lead times and knowledge of the industry and applications. This information is essential for us to know that customers value and can benefit from our experience and understanding of the markets in which they operate. We welcome this information, seeking to improve the results each year.

We also welcome any less positive feedback and suggestions as these can help shape our business for the benefit of many customers. Our approach is always to conduct a detailed review process to resolve any issues and to provide a satisfactory response to the customer.

Another way in which we are able to measure the success of our efforts in 2015, is through the supplier awards received. For the third consecutive year, as part of their operation excellence initiative, Caterpillar Marine Power Systems (MaK) in Kiel awarded a gold level Supplier Quality Excellence Process (SQEP) award to ABB Turbo Systems Ltd in Switzerland. Caterpillar Inc. USA, awarded gold level SQEP to ABB Turbo Systems Ltd following a bronze award in 2014. For the third consecutive year Caterpillar Inc. USA also awarded their highest level (platinum) to ABB Inc. BU Turbocharging US. In addition, our long-time relationship as a supplier to GE Jenbacher was rewarded with “A” level for quality and “B” level for total supply excellence, incorporating criteria such as quality of products and performance, sourcing operations and fulfillment and commercial aspects.

Highly valued, these awards are a testament to the years of developing strong reciprocal relationships, which we aim to replicate with all of our customers. Into 2016 and beyond, we will continue to draw on these successes and analyze all feedback to live up to our market-leading reputation across the industry.
Looking ahead to 2016

We now operate in an environment where OEMs more than ever balance risk, opportunities and investments against possible returns. This, we anticipate will drive industry realignment.

Oliver Riemenschneider  
ABB Turbocharging

Commemorating the milestones of 110 years of turbocharging and then 125 years of ABB Switzerland highlights the deep foundations of our business, which has given us the platform from which we continue to grow.

Urs Gribi  
ABB Turbo Systems Ltd, Switzerland

Developing new approaches and offerings in close cooperation with customers to generate value over their products’ life cycle is the best way to support them through challenging market conditions.

Axel Kettmann  
Medium-, Low-Speed & Rail

Working with engine builders to deliver turbocharging solutions that add outstanding value to their applications is essential for us going forward.

Rolf Schweizer  
Product Group High-Speed

Our focus last year on new turbocharging product development has positioned us well for introducing a competitive new offering to the marine engine market in 2016.

Roland Schwarz  
Product Group Marine Auxiliary, and  
ABB Turbocharging Japan

Through our service network we will focus on increased engagement to drive productivity in meeting fresh challenges that will come from converging market pressures and M&A.

Herbert Müller  
Service

As 2015 closed, very sadly we learned of the untimely death of our colleague, Maurizio Boschetti, Vice-President and Head of BU Turbocharging Supply & Production Network.

Maurizio Boschetti  
(1969 – 2015)
As China makes even greater efforts to revive both its economy and environment, we see the huge opportunities opening up for us.

Allan-Qing Zhou Wang  
ABB Jiangjin Turbo Systems Co., Ltd, China

Evolution 3+: The next level of ABB Turbocharging is shaping up to continuously deliver customer value and secure our success.

Clemens Sager  
Finance and Controlling

Going beyond the scope of turbochargers, our advanced technologies will enable engine builders to offer even better engine solutions.

Christian Roduner  
Technology

A focus on new production, manufacturing and supply initiatives across the entire value chain will be significant in remaining competitive as markets change shape.

Markus Mühlethaler, a.i.  
Supply and Value Chain Excellence

Interpersonal relationships are key to our success. We, as business leaders encourage flexibility and adaptability from our people to support our customers in growing their businesses.

Peter Schmid  
Human Resources

With his sudden passing following an accident in December 2015, we have lost a highly dedicated, well respected and liked colleague. Maurizio spent his entire career of 26 years working for the ABB Group, joining ABB Turbo Systems in 2008. Throughout these years Maurizio always showed great commitment, drive and leadership, contributing significantly to the advancement of the global Turbocharging business.

He will always be remembered professionally and personally across the business as an open and honest character, and a great team player who will be missed very much by all.
Contact

ABB Turbo Systems Ltd
Bruggerstrasse 71 a
CH-5401 Baden/Switzerland
Phone: +41 58 585 7777
Fax: +41 58 585 5144
E-mail: turbocharging@ch.abb.com
www.abb.com/turbocharging

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