

## Avant-garde technology is a wind of change

Power2 means massive reductions in fuel consumption and oxides of nitrogen (NOx) in engine exhausts. The technology has now moved out of the test phase and into the market. ABB Turbocharging is more convinced than ever that Power2 will be not only a success, but also a new standard in turbocharging.

Text: Tiziana Ossola Auf der Maur, Photography: Alex Spichale



Power2 two stage turbocharging on the test beds at ABB Turbocharging in Baden, Switzerland

Christoph Rofka, ABB Turbocharging's Senior General Manager of New Turbocharger Sales, is confident of the relevance of Power2 technology for today's market. As one who got into the project at the ground floor and saw its development run its full course until a series production was introduced onto the market, Mr. Rofka should know.

Power2 constitutes nothing less than a quantum leap in turbocharging technology for large engines. ABB Turbocharging initiated this two stage turbocharging system and is driving it forward at full power. It is synonymous with substantial reductions in fuel consumption and NOx emissions. "There is scarcely another technology capable of achieving both at the same time," Rofka notes.

### Partners on board

The system has now moved beyond the development phase in the lab. The first two stage turbocharging systems have been introduced as a series production into the high

speed gas market. A cornerstone of Power2's further development is an intensive cooperation between ABB Turbocharging and its potential customers, the engine builders. "This is an indispensable part of the process," Rofka says. "And must remain so until at least the moment of readiness for series production." The classic customer – supplier relationship for off-the-shelf products is not how things work in technological step changes of this stature. Two stage turbocharging has to be applied in a different form on every engine according to the applications involved and it has to go along with engine development to get the best out of the overall system. "That means that we have a lot to do in terms of application engineering." Rofka explains.

Emphasizing the difference between selling a standard "plug and play" product and a turbocharger for a large engine, each turbocharger and turbocharging system in ABB Turbocharging's portfolio is capable of covering a range of engines, but has to be specifically adapted to the engine and its application. Furthermore, engine concepts and its main parameters need to be carefully reviewed with the engine developer to finally ensure the best match. "This is what we mean by application engineering. It involves not only working out how to physically fit the turbocharger onto the engine, but also how to best design and utilize the turbocharging system to get the performance the engine builder is looking for in terms of power, fuel consumption, emissions and operation flexibility. For both of these processes, we draw on an inventory of interchangeable parts, or if necessary, design new parts, and always look into advanced ways how to drive turbocharging technology further in general and for specific engine applications and programs."

Rofka adds, "Our customers are confident and that is important as the foundation on which we can build. At ABB Turbocharging, we believe that two stage turbocharging will someday be part of the furniture on ships and power stations. And we also believe that it will be an integral part of the main engines and generator sets on ferries and cruise liners and both industrial and utility power and cogeneration plants.

## The market as a driver of technology

At the start of the Power2 development process, it was clearly evident to everyone that single stage turbocharging was reaching its technical limits. ABB Turbocharging was thus convinced on a critical point: It was absolutely essential to make the technological leap from single stage turbocharging, a technology whose effectiveness had been repeatedly demonstrated for decades, to two stage turbocharging.

As on diesel engines, Power2 technology is being used as an enabler of the Miller Cycle. The term denotes an ingenious method of cooling an engine's combustion air. On four stroke engines, the cooling effect is achieved by shortening the opening period of the inlet valve and reducing the time during which air can enter the cylinder on the engine's induction stroke. The earlier end of induction

promotes expansion, and hence cooling as the air continues to expand in the cylinder. The higher charge air pressures offered by Power2 compensate the shorter time available for intake of the cylinder charge during the shorter inlet valve openings, allowing engine power output to be maintained or bettered.

On the very latest gas engines, high pressure turbocharging systems fulfill a new efficiency and power enhancing role. As a result, ABB's Power2 two stage turbocharging technology had its premier on gas engines from a leading manufacturer, where it contributed to an excellent electrical efficiency of almost 49 %. Several first generation applications for power plants are now in operation, where fuel efficiency is a critical factor for ensuring the most kilowatts for the least fuel.

This leap of faith has already begun to translate into real business, thanks in great part to recent developments that have made for a more challenging market. In particular, the rapid, steep increase in fuel prices has increased companies' motivation to explore technology that will help reduce fuel consumption.

Furthermore, it seems likely that companies will continue to consider new options for technology that maximizes fuel efficiency. Given that the global demand for power is expected to increase 47% by 2035, the future looks bright for the power plant sector. ABB Turbocharging is thus confident that Power2 technology will continue to gain in relevance in the global market as the demand for power – and power plants – grows.

## Political developments as another technology driver

And Power2's relevance does not end with applications in power plants. Indeed, this technology also holds great potential for the marine industry, as well.

Global marine legislation has brought new considerations for ABB's evaluation of the usefulness of Power2, because new regulations from the International Maritime Organisation will come into force in 2016. The third bundle of limitations from IMO, known as IMO Tier III, demands an 80% reduction in emissions of oxides of nitrogen (NOx) from ships when they operate in Emission Control Areas, also known as ECAs. These are areas of dense population or environmental sensitivity close to important seaways such as the Baltic, the North Sea and the English Channel. Likewise, the designation to ECA status of the Mediterranean is under discussion and the entire East and West Coasts of the USA and Canada are due for nomination.

These strict emissions regulations represent a new challenge for the maritime sector. New technological solutions were rapidly required in order to meet these ambitious targets. "We saw this in a positive light. We have always been a strong driver of technological progress and this legislation promotes progress," notes Rofka in retrospect.

In fact, two stage turbocharging has existed for a long time, but its time had not yet come. Now the concept has been revived and new concepts devised. It has been transformed from a sleeping beauty to avant-garde. “Via the emissions regulations, the full potential of two stage turbocharging can be brought into play,” Rofka observes. “Against the background of strict emissions reduction, the technology started to make eminent sense.” The elegance of the two stage solution also derives from it not making necessary a great deal of engine development on the mechanical side. According to the concept, it does not create inordinately higher stress in-side the engine.

The legislation dictates technological development and creates a completely new industrial culture. “This is novel,” Rofka notes, “and good for us.” The IMO rules, especially IMO Tier III are a huge engine development incentive. “Previously, every engine builder could decide what the next engine development moves would be. But now there are strict requirements and a strict timetable. They have triggered in-depth development activity at all engine builders at the same time.” \

## Series readiness

ABB sees advantages in this race to IMO Tier III. Of course, for engine builders and end users alike, the question of cost arises. But Rofka and his team are convinced that the higher capital costs will be compensated by lower operating costs. As he states, “The fuel savings potential will be significant.” This factor will be essential for making the final verdict on the concept, in particular for cruise ships and freighters, where fuel consumption represents the largest item of lifetime expenditure. “And anyway,” Rofka comments in an aside, “it’s high time that fuel economy became a stronger driver in the engine industry. To date that was only partly the case.” Interest from engine builders and engine end users is large. “Next on the agenda is defining the Power2 product portfolio.” Currently, only some specific engine configurations are covered in the whole global spectrum of four stroke engines.

Rofka explains that in the case of dual-fuel engines, the future of two stage turbocharging is becoming more and more relevant. “There is a lot of engine development work needed in order to even start to estimate the effects of two stage turbocharging in this area.” ABB Turbocharging regards dual-fuel engines as fairly interesting with regard to IMO Tier III. For example, ships could use a low emissions gas mode in ECAs and switch to diesel on the high seas. Amid all this potential, one thought has guided, and will continue to guide, ABB Turbocharging as it moves forward, as Rofka notes, “We constantly have to go back to basics: Do we have the right products, and what is the right time to go two stage?”

## This is Power2

In the new engine turbocharging concept, two turbochargers are arranged in series to generate increased air pressure, airflow and a superior turbocharging effect. This results in a turbocharging efficiency rating of up to 76%, which is extremely high. The increased air pressure, combined with advanced engine technology, improves engine output and power density by up to 10%. At the same time, fuel consumption, CO<sub>2</sub> and NO<sub>x</sub> emissions are greatly reduced.

Published in Greece: Oct 2012