
PODCAST

Turbocharging will become more important

ABB Decoded

The CEO of Accelleron (formerly ABB Turbocharging) Daniel Bischofberger discusses the critical role of turbocharging in the changing landscape of energy industries. He shares insights in the significant impact of turbochargers today and tomorrow

Reiner Schoenrock: Hello, and welcome to a new episode of ABB Decoded, the podcast that tries to press pause on our fast-moving lives and shine a light on the technology and trends that are reshaping our world. I'm your host, Reiner Schoenrock and in this episode, we will be discussing how turbocharging technologies help to accelerate industry transformation towards a more sustainable world.

Turbocharging was invented more than a century ago, with the sole purpose of improving efficiency of combustion engines and thus, reducing environmental impact with less fuel, less emission. This is the DNA of our business, and it is ever more important in our world today, as sustainability is the main driving force in industry transformations. Today, I'm here with Daniel Bischofberger, the CEO of Accelleron (formerly ABB Turbocharging). Hello Daniel, it's nice meeting you. You have just taken up this role recently. Could you please share some information about yourself for our listeners here.

Daniel Bischofberger: Hi Reiner, also nice meeting you. Thanks for inviting me. It's a pleasure and an honor to take part of this renowned podcast series. I joined ABB Turbocharging as of March 1st, so a little bit more than two and a half months ago. Before I joined ABB, I was six years with Sulzer, where I was a member of the executive committee and head of the service division with 1.2 billion Swiss franc revenues and 5,000 employees. However, I'm not a new kid in town in ABB. Before Sulzer, I worked 21 years in ABB and associated companies. I have extensive experience in power generation, power transmission and, oil and gas industries. Over the last 30 years, I developed a deep understanding of service business and high-tech products in the mechanical, electrical and automation space. In all my previous jobs, I succeeded in supporting and empowering the leadership teams to deliver sustainable performance and profitable growth.

Reiner: Oh, that sounds great, Daniel. And I guess with your broad knowledge, you are the right guy to ask one easy question, what is a turbocharger? What does it do?

Daniel: Okay. Turbocharging was invented more than a century ago with the sole purpose of improving efficiency and so, reducing environmental impact with less fuel, less emission. In a nutshell, I would say,

turbocharger is a key component for combustion engine. The turbocharger functions as the ventilator. I would say it legalized doping for the engine. It gives the engine an extra boost in performance.

The combustion engine with a turbocharger delivers four times more power. That means if the turbocharger fails, the engine loses 75% power. Further benefits, 10% higher efficiency, 10% less CO2 emissions and up to 60% less NOx emissions. In economic sense, it helps saving of up to \$3 million USD annual in fuel costs for large vessels, when using conventional fuel, even more when using more expensive alternative fuels.

Hey, quite impressive, isn't it? I guess it becomes a bit even more impressive when you hear the following figures.

The largest ever built two-stroke engine for marine has about 100,000 horsepower. That's the equivalent of about 1,000 Volkswagen Polo and the weight of more than 2,300 tons. The corresponding three turbochargers required have a combined weight of 30 tons. That means slightly more than 1% of the total weight, but this 1% weight makes it possible that the power of the engine is increased from 25,000 horsepower to 100,000 horsepower. I guess now you understand why I'm talking here about legalized doping.

Reiner: Yeah, yeah. Those are great examples, Daniel. So, can you share with us where turbochargers are being used? You already mentioned vessels, but probably there are way more. Let me guess, how about locomotives?

Daniel: There are two fields of application. They call it on-highway and off-highway. On-highway means passenger cars and trucks. Who doesn't know the Porsche Turbo and would like to drive one? Me too, by the way. On the highway application means standardized turbochargers in high volumes, but that's not where we are playing. We are in the off-highway segment. This heavy duty segment consists of the sub-segment marine, power and other such as diesel locomotives, as you mentioned, mining trucks. Marine represents more than 50% of our business and covers cargo vessels, oil and energy tankers, bunkers and cruise ships with gross tonnage of up to 300,000 tons. Power plants are another 30% of our business. Here, combustion engines are used mainly for base load application for small and remote grids or as backup emergency power for hospital, data centers and nuclear power plants. They are all mission critical applications, that means reliability is everything. We talk here about small series and customized turbochargers, that's where ABB Turbocharging is playing. That's where our leadership in technology and reliability, as well as our extensive service network are key.

Reiner: Can you explain how turbocharging, which relies on internal combustion engines, remains a relevant technology when the world is moving towards electrification and electric motors?

Daniel: I'm really happy that you asked this question. There's obviously a misperception in most people's minds that the net zero world and combustion engines do not go together. It might be surprising, but turbocharging in our segments marine and power, will become even more important in a net zero world. But let me explain, it's all about energy storage. In a world powered by wind and solar, energy storage is vital to balance time and location mismatch between power production and demand. Batteries are seen as the energy storage solution. No doubt, batteries are an excellent solution for energy storage but they have their limitations, especially when you talk about storing large amount of energy in the gigawatt hours range.

Let's have a closer look at our main market, marine. A large cargo vessel from Shanghai to Europe is consuming 40 gigawatt hours of energy. 40 gigawatt hours is equal to 2 days energy produced by nuclear power plant Leibstadt, the largest power plant in Switzerland. All the annual electricity consumption of 10,000 four-people households in Switzerland. So, the weight of the battery to store such an amount of energy would be more than 200,000 tons, exceeding the load capacity of most of the ships. So, the ship would become a submarine, which definitely is not the purpose of a ship.

But not doing anything is not an option either. If maritime industry were a country, it would be the world's 6th largest CO2 polluter, with one billion tons of annual CO2 emissions, or 3% of global

emissions. So the annual fuel consumption of the marine industry is equivalent to about three billion barrels of oil. This is 50% more than the annual fuel consumed by the aviation sector.

So, what is the way forward? Short term, efficiency improvements. Midterm, transition to natural gas. Natural gas emits 30% less CO₂ than compared to marine diesel and/or blending of fossil fuel with sustainable fuels. So long term, e-fuels. E-fuels that means synthetic fuels produced with renewable energies. Though combustion engines adapted for new fuels will continue to be vital for the marine segment, in all those fields such as upgrades, combustion engines run on gas or e-fuels, ABB Turbocharging is the undisputed leader, thanks to its turbocharger superior efficiency.

Just to give you another example, the vessel MSC Oscar, with a load-capacity equal to the 1100 Boeing 747 is equipped with our state-of-the-art ABB turbochargers, which have 2% to 3% higher efficiency compared to competitor's turbocharger. This higher efficiency results in annual fuel savings of 200 ton, or \$100,000 USD and CO₂ reduction of 620 ton.

Reiner: Oh. Daniel, that is very impressive. Thank you for those insights. Now, your business case for the marine seems to be clear, but how about another market you mentioned earlier, the power sector?

Daniel: Global renewable power production, solar and wind, has tripled over the last decade to 3,000 terawatt hours per annum. But these 3,000 terawatt hours still only account for 12% of the electricity produced in the world. The more renewable power, the better for the environment, but power grid stability will become a challenge. Renewable power generation is intermittent. It isn't always windy or sunny, or like today in Switzerland, it's raining. So decentralized reliable backup power will continue to be a required to avoid potential grid blackouts.

Thermal power generation plants, hence, have a role to play at peak times and when there is a draft in renewable power production. Just take regions with cold winters like here in Switzerland, electricity production with photovoltaic is highest in summer, while demand due to electrical heating pumps will peak in winter. Hence, thermal power plants might be one of the solutions to balance the seasonal mismatch. It goes without saying that these power plants will also ultimately be using sustainable fuels, sustainable fuels produced during time of excessive electricity production from renewable.

The key word here is power 2X. An example is the first hydrogen fueled power plant in operation in 2020, in Germany with INNIO engines, a renowned gas engine OEM. And of course, ABB Turbochargers, 100% carbon neutral, a carbon-free thermal power plant. This shows that net zero world and combustion engines do get together.

Reiner: Oh, that's really interesting, Daniel. Can you please provide some further insights about these sustainable fuels?

Daniel: Technology for sustainable fuel production is available. It's all about industrialization and scaling of production. The challenge will be the sheer amount of sustainable energy required. For example, today, biofuel production stands at 1,000 terawatt hours per annum. These however would only cover one quarter of the fossil fuel consumed by marine only, let alone biofuel consumed or to be consumed by many other segments. However, this is only a drop in the ocean compared to the total amount of fossil fuel consumed. If you want to replace 100% of all fossil fuels, that means oil, gas, coal, with renewable energy, you'll have to increase the electricity production from solar and wind by 4,000%. I repeat, 4,000%. That this will happen is clear, it's a must. We have no other choice. It's not a question of whether, it's a question of when. And until then, we are relying on fossil fuel, whether we like it or not. But we have to do our utmost to burn less and less oil and gas. Important to note is that alternative fuels will be significantly more expensive than fossil fuels. Biofuels are at least three times more expensive.

Fuels made from renewables are more in the range of 10 times. Although these prices will come down thanks to economy of scales, they will still be higher than today's fossil fuel prices. In a nutshell, firstly, most combustion engines for off-highway applications are here to stay, especially in the marine and power sector. Secondly, efficiency becomes even more important. Already today, to reduce consumption of fossil fuels and subsequent CO₂ emissions. Even more tomorrow, due to higher sustainable fuel

prices and our common duty for future generations to reduce the world energy intensity. And efficiency is ABB Turbocharging's most competitive edge.

Reiner: Great Daniel, thank you. So that makes it perfectly clear that the ABB Turbocharging will play a significant role in the future. But can you tell us how ABB developed the expertise in this technology? So what were the most important development steps so far?

Daniel: First of all, that ABB Turbocharging is the undisputed leader is a combination, of personally, I would say, initial luck, and more than 100 years of continuous investment in technology. It started at the beginning of the 20th century, to be precise, 1904. Alfred Büchi, a Swiss engineer, filed a patent for turbocharging. From 1909 to 1919, Alfred Büchi worked for Sulzer, a Swiss engineering company, to further develop turbocharger concept for marine application. In 1915, Alfred Büchi started discussions with BBC, one of the founder companies of ABB, about setting up a corporation. It took almost four years for both companies. In 1925, turbocharging found its first successful industrial application in the marine sector. The turbochargers design by Büchi, and now important, were built by BBC, not by Sulzer, under the supervision of Büchi. That's why I said it's a little bit initial luck.

Thanks to the turbocharger, the power output of the combustion engine was increased from 1700 horsepower to 2500, according to Wikipedia. So a shy increase of 40% far away of today's 400%. But you know, all great things start small. Over the next 80 years, focus was on improving performance of the turbocharging. In 2004, the world's most powerful turbocharger for marine application, with 35,000 horsepower, so the power of about 350 Volkswagen Polo, was unveiled by ABB. In 2015, a Wärtsilä engine equipped with our two-stage turbochargers achieved Guinness World's Records for the most efficient four-stroke medium speed engine for marine. Moving forward, we will be focusing our development efforts on carbon neutral fuels such as hydrogen, ammonia, methanol. We are in several pilot projects with engines, engine OEMs working with these fuels already today.

Reiner: Okay Daniel, how does your factory and service landscape look like?

Daniel: We have four production sites and sourcing sites in Switzerland, but also in China, India and Japan. These four sites are complimented with more than 100 service stations in more than 50 countries, covering our global markets and being very close or at the doorstep, of our customers. Thanks to our extensive service network, we are able to respond within 24 hours to any service needs from our customers around the globe. Our state-of-the-art spare parts center in Baden delivers within 48 hours, spare parts to any airport in the world. We have worldwide, more than 600 service engineers trained to the highest level. We produce about 10,000 turbochargers per annum, and we handle more than 100,000 auto service lines annually.

Reiner: Thank you, Daniel. Now, let's shift technology, because so far, we were talking about hardware in turbocharger itself. But the world is driven by computer, by digital. So how far is your business already impacted by this transformation?

Daniel: We see potential and opportunities for us. There are three fields where digitalization will play a major role in our business. One, internal process automation, improving our operational efficiency and transparency. Two, smartly enabled services. We are offering service contracts such as paid by the hour flat rate services including warranty between drydocks, et cetera. These service contracts are made possible thanks to our digital solution called Turboanalytics. Turboanalytics is a digital twin, with online data from the ships and based on physical modeling and enhanced with artificial intelligence.

Number three of our digital offering, our software has a service offering called Tekomar XPERT, consisting of three modules. Module optimizing engine performance for marine. Module two, monitoring and reporting and forecasting emissions for ships. And last, but not least, module three, providing recommendations for hull and propeller cleaning to improve performance. These three modules combined can result in up to 20% fuel savings and emission reductions. Tekomar XPERT is currently in use on more than 2,000 vessels and 6,000 engines and growing.

As Peter Terwiesch mentioned in his previous podcast on digitalization, 96% of business leaders see digitalization as essential to sustainability. And this will be a strong focus of our portfolio moving forward.

Reiner: Thank you, Daniel. We are coming to the end of the podcast, but I have to ask you one more question. Your division was recently renamed Accelleron. And on the weekend, I watched the Formula 1 race, and I saw advertisement of Accelleron. So, what can you tell us about your collaboration with the Sauber Group Formula 1 team.

Daniel: It's really a cool partnership, I tell you. The, the best thing is first time my son, and even my daughters, are really interested in what I'm doing. Not really that they care about turbocharger but I think, they think it's cool to be in Formula 1. So the partnership has two goals. First, technology collaboration and second, leveraging Formula 1's one billion fan base as a platform to create awareness and brand visibility for our new brand, as you said, Accelleron.

This technology collaboration is a first in the field of turbocharging, and we'll see the continual exchange of ideas, expertise and innovations across both teams. We'll be working on several joint projects such as computation of fluid dynamics, additive manufacturing techniques and advanced material technology.

Furthermore, the Alfa Romeo cars are such beauties. Even my wife confirmed, especially with the Accelleron logo on the front wings, isn't it? By the way, did you know that Formula 1 cars are driven with gasoline containing 10% renewable ethanol? Formula 1 is aiming to field a generation of engines by 2025, and the championship wants that the engine to be powered by 100% sustainable drop-in fuel, designed to help Formula 1 achieve its goal of being net zero carbon by 2030. So, Formula 1 will be as green as Formula E. Oh, okay. But of course, only when the batteries of the Formula E cars are charged with renewable energy. So we are looking forward to more exciting races in the coming months. Stay tuned.

Reiner: Thank you Daniel, and thank you for all your insights and compelling examples.

Daniel: Thanks Reiner, it was really also pleasure on my side.

Reiner: Now, we all better understand what a turbocharger is and what kind of impact it has on the transformation of industry to become more sustainable. If you enjoyed this episode of ABB Decoded, why not like, share or subscribe wherever you get your podcast. Until next time.