Flexible fuel gas turbines meet airports' power needs for today and tomorrow

Despite the financial and operational challenges brought to bear by the global pandemic, the aviation industry reaffirmed their global commitment to Net Zero at COP26 Transport Day.

Airport Milano Malpensa, Italy. Image credit: SEA Energia

One of the areas that attention is being focused on is the aviation industry. As hubs of the sector, airports are under increasing pressure to reduce their operations' carbon footprint.

Within Europe, the European Green Deal sets the objective of making Europe the first climate-neutral continent by 2050: a commitment that places a particular responsibility on the aviation sector. In response to the European Green Deal the aviation industry has brought forward this date, ensuring that by 2030 European airports will have a zero-carbon footprint.

Emissions from airports fall under scope 1, 2 and 3 accounting as defined by the GHG Protocol. Scope 1 is emissions from airport-owned or controlled sources, such as airport-owned power plants that burn fossil fuel and conventional vehicles or ground support equipment that uses fossil fuels. Scope 2 covers indirect emissions from the use of purchased energy for electricity and heat. In contrast, scope 3 covers indirect emissions that the airport does not control but can influence, such as tenant emissions, on-airport aircraft emissions and emissions from passenger vehicles arriving at or departing the airport.

The EU Commission's more recent Sustainable and Smart Mobility Strategy reiterates the urgency of transitioning to zero-emission airports, whereby the best practices followed by the most sustainable airports must become the new normal and enable more sustainable forms of connectivity.

Milan leading the way to reducing emissions

Between them, Milan's two biggest airports, Malpensa (MXP) and Linate (LIN), handle 33 million passengers a year during regular times. Malpensa is one of the most important airports in Europe, offering 3,500 direct flights each week and numerous intercontinental and long-haul destinations for a total of 200 destinations. Keeping these

airports running efficiently requires reliable power. SEA Energia (Società Esercizi Aeroportuali) is responsible for the electricity, heating, and cooling of these two airports. The company needed to revamp its existing power plant at Milano Malpensa Airport to meet stricter environmental legislation and ensure a reliable supply of power, heating, and cooling. The path they took was to replace an existing aero-derivative turbine with a Siemens Energy gas turbine of type SGT-700.

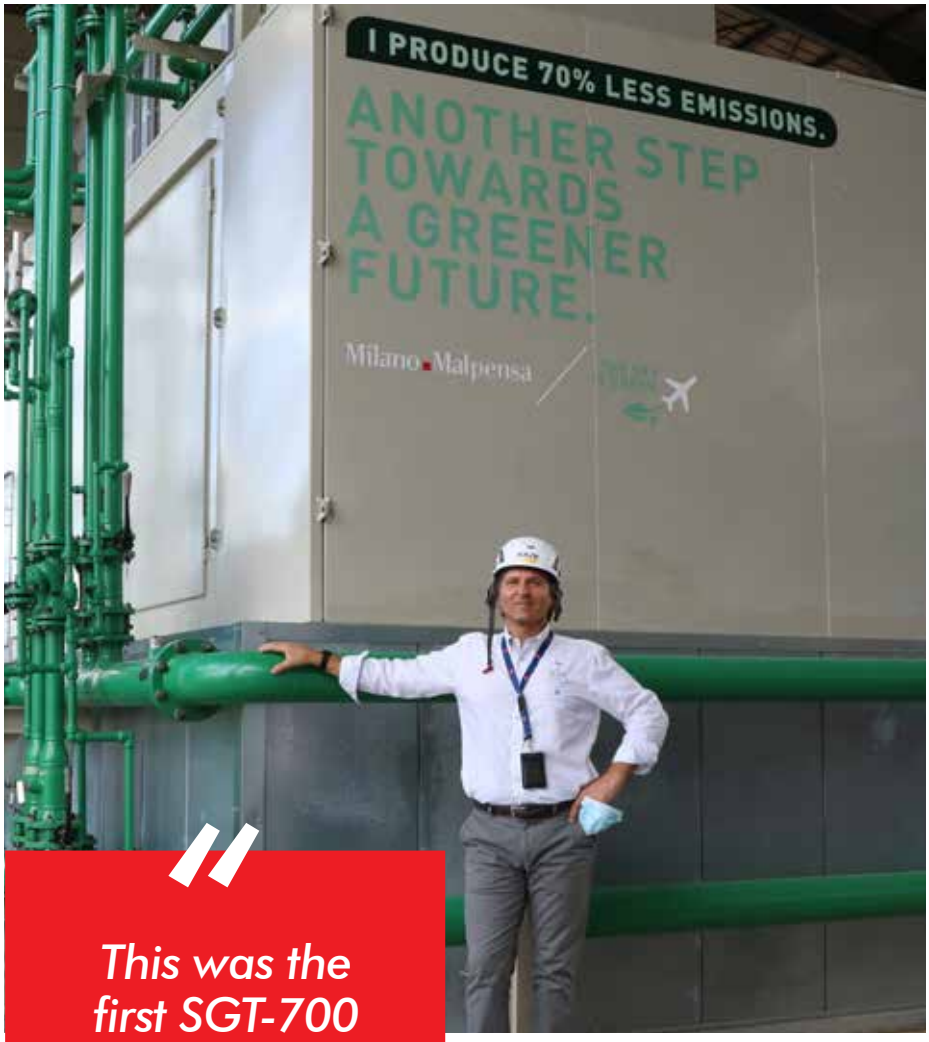
SEA Energia operates on an exclusive basis for a single major customer, producing electrical, heating, and cooling energy. The company's strategic vision focuses on the sustainable generation of value across its three main components: economic, environmental, and social. Its operations at the two airports aim to save resources, reduce air, soil, and water pollution, and constantly monitor activities to ensure maximum system efficiency.

Part of the concept includes upgrading the existing power plant at Milano Malpensa by replacing one of two existing aero-derivative turbines, an ageing Rolls Royce RB211, with one new SGT-700. This gas turbine is an ideal fit for power generation and mechanical drive applications. With the high exhaust heat, it is also excellent for cogeneration and combined cycle applications. The SGT-700 employs an 11-stage axial-flow transonic compressor incorporating the latest aerodynamics, with variable guide vanes for robust operability and optimized performance over a wide range of operating conditions. The two-stage uncooled free power turbine offers a nominal shaft speed of up to 6,500 rpm. For mechanical drive, it may run at 50% to 105% of the nominal rate. The power turbine can be matched for optimal performance at different ambient conditions. The installation of the new gas turbine will help SEA Energia enhance their plant performance both from an efficiency and an environmental perspective.

Siemens Energy preserved much of the existing plant and allowed power generation continuity on the second RB211 turbine that was to remain in place. As the airport continued to operate, it was essential to avoid any disruptions to the power plant's regular operation.

Overcoming a triumvirate of challenges

To ensure the successful delivery of the project, three significant challenges had to be overcome. The first was to ensure that there was no interruption or disruption to the operation of the power plant. To achieve this required Siemens Energy to install the new turbine into the system without jeopardizing the plant's regular operation.



Martino Bosatra, Board Member and Managing Director at SEA Energi. Image credit: SEA Energia.

> *"This was the first SGT-700 delivered by air freight instead of traditional sea routing."*

Then came the actual logistics. This was the first SGT-700 delivered by air freight instead of traditional sea routing. This involved some tricky discussions with the air freight company regarding fitting the turbine inside the Antonov transport plane.

Finally, there were the challenges presented by COVID-19. The pandemic struck the world early in 2020, and the effects are continuing to disrupt operations. This had a significant impact on the supply chain for manufacturing the turbine. Several suppliers closed their premises or reduced capacity due to pandemic working practices. It took a considerable effort from the purchasing department to ensure that the schedule was kept on track.

Further complications arose because of the lack of face-to-face meetings with stakeholders and EHS organizations on the site during the progress of the project. A worldwide footprint limited the possible negative impacts, and delivery of the new SGT-700 package was achieved on schedule.

A smooth commissioning process

The project kicked off at Malpensa in June 2020 when the Siemens Energy team arrived on-site to begin site preparation. The old turbine was removed and shipped

back to the RB211 refurbishment site in the UK. The requirement that this be achieved whilst not disrupting the plant's performance presented some challenges, particularly with the narrow spaces in the area due to the presence of existing equipment. This was particularly problematic when it came to the lifting operations: with the existing package weighing over 150 tonnes and measuring 14 meters in length, this required careful coordination. The current air intake, ventilation intake and local electrical room had to be preserved and adapted for the new turbine.

Once the old turbine had been removed, the foundations were checked and repaired, and the gas turbine and associated generator were delivered to the site in November. Once the turbine was in place, installation could begin.

Firstly, it was connected to the existing system, both mechanically and electrically, before checking the instrumentation and the interface with the control system. Then came commissioning, which involves confirming that the reinstalled system could communicate with the existing plant.

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With this checked, the machine could be connected to the power grid with gas fed to the turbine for the first firing. In this process, the machine is fired up and allowed to rotate while connected. If that is successful, the next step is to connect the machine and synchronize it to the grid. Once it has passed these steps, the circuit breakers are closed, and power can be fed to the grid.

Benefits for today and tomorrow

"The journey started more than three years ago with a challenging permit process, which is now completed," said Martino Bosatra, CEO of Sea Energia. "During this journey, a strong relationship has been built between Sea Energia and Siemens Energy. This relationship has created, for both partners, a lot of value, especially in terms of learning and collaboration but also in identifying potential solutions which might help SEA to reach its own target in carbon footprint reduction."

Once the plant is up and running in June, SEA Energia will enjoy three significant benefits: lower emissions, higher efficiency, and greater reliability. It will allow SEA Energia to comply with the ever more restrictive regulations on emission limits set by the Italian Region of Lombardy for power plants. The SGT-700 will significantly decrease the site's emissions while meeting all the airport's requirements for power, heat and cooling.

The contract guarantees compliance with the emission limits for environmental pollutants, especially NOx, CO and PM. With the SGT-700 optimizing the output, higher energy efficiency can be achieved. The turbine will also improve reliability to the customer with its proven track record of hundreds of thousands of working hours worldwide.

For SEA Energia, the prime focus was on improving the airport's day-to-day operation, but above and beyond that, there are further possibilities down the road. One opportunity could be to partake in the grid capacity markets that allow generators to sell any extra capacity back to the power grid. Although market conditions do not make that a priority at present, it is an option for the future.

Secondly, and more relevant over the long term, is the turbine's flexibility towards fuel. While natural gas is the preferred option, there is a growing movement towards utilizing hydrogen for power generation. With technology now available to generate green hydrogen, hydrogen produced using only renewable energy – a technology that Siemens has developed with its Silyzer electrolysers – the path is open to making the power plant's environmental footprint even smaller.

Siemens Energy is already running the turbines with a mix of gas and hydrogen and guarantees that by 2030 all SE gas turbines will run entirely on hydrogen. This is a significant assertion for operators, reassuring them that their investment will continue to be futureproof whatever the future path of the energy transition.

The Siemens Energy SGT-700 gas turbine. Image credit: Siemens Energy