Turbo Expo Showcases Gas Turbines

The theme of this year's show was achievements and needs to unlock a net-zero future in propulsion and power.

BY ALISSA ESPINOZA

ASME's 2024 Turbomachinery Technical Conference & Exposition in London, held June 24 – 28 at ExCeL London, welcomed more than 111 exhibiting companies from 22 countries, up from 89 exhibitors at the last Europe-based event in 2022. More than 2,500 attendees networked, attended technical presentations, and walked the exhibitor floor.

"ASME's Turbo Expo continues to attract leaders from industry, government agencies, and academia thanks to its strong reputation and program, which includes companies shaping the future of propulsion and power," said ASME's Executive Director and CEO Tom Costabile.

GAS TURBINES' INTEGRAL ROLE IN A SUSTAINABLE FUTURE

Day two of Turbo Expo 2024 kicked off with the panel session, *The Gas Turbine's Role in the Decarbonized Power Generation Portfolio*. Executives, engineers, technical leaders, and managers from GE Vernova, Mitsubishi Power, Siemens Energy, and Solar Turbines discussed the challenges with production, transport, and storage of lower-carbon fuels; advancements to combustion systems; retrofits, and more.

Moderator Jeffrey Benoit, Vice President – Global Clean Energy Solutions, PSM – a Hanwha Company, broke out the "new" combustion systems into two sections:

- newly manufactured gas turbines from OEMs
- new technology retrofits for gas turbine fleets currently in operation

Retrofits

Peter Stuttaford, CEO of Thomassen Energy (TEM), a Hanwha Company, talked about the company's FlameSheet combustion system retrofit that can be installed in most OEM's gas turbines F-class and below. The platform offers fuel flexibility, operational range improvement, ultra-low NOx emissions, and entitlement lifecycle costs. In a gas turbine power plant—a GE Frame 7E in Daesan, South Korea—FlameSheet operated up to 60% hydrogen by volume.

Hydrogen and Ammonia

The transport, production, and storage of lower-carbon fuels have historically presented many challenges. According to Carlos Koeneke, Technical Director at Mitsubishi Power Systems Americas, "the appetite" to produce, store, and co-fire low-carbon fuels is higher in regions of the world where fossil fuels are expensive. "In Asia, for example, most countries import LNG, which is not only more expensive than natural gas in terms of production, but shipping it usually involves long distances across oceans. These circumstances make hydrogen production economically reasonable in the affected countries."

He said the long transport distances have created an additional incentive to use ammonia as a hydrogen carrier, as it does not require maintaining hydrogen at low temperatures.

"One new trend is co-firing ammonia directly instead of converting it back to hydrogen through the use of cracking," Koeneke noted. "Several tests are currently being conducted to burn ammonia in conventional boilers and directly in gas turbines."

New Combustion Technologies

"All OEMs have decades of experience co-firing hydrogen with diffusion combustors," Koeneke said. "The percentage of hydrogen has been high in cases of refinery by-product gases (in the order of 90% or higher). The current challenge is mainly related to the use of dry-low NOx combustors, where the risk of abnormal combustion, among others, associated with flashback requires testing and combustor modifications."

Technological innovations are accommodating fuel flexibility. However, how these newer systems work with existing installations depends heavily on the specific gas turbine, according to Jason Jermark, VP of Global Service Operations at Siemens Energy, given the "wide range of over 20 different frames currently in operation, as well as the type of fuel being used—which includes options such as hydrogen co-firing, 100% hydrogen, (fully) cracked ammonia, direct ammonia combustion, methanol, HVO, and FAME," he said. "Working in combination with various partners, we have recent examples of both pilot applications and scalable solutions. The goal for all new fuel-flexibility developments is to be retrofittable to ensure that they can be seamlessly integrated into the existing fleet with minimal modification."

Panelist Daniel Reitz, Manager of Marketing and Product Strategy at Solar Turbines, said over the years, Solar Turbines has accumulated experience operating on a wide variety of fuels by adapting the combustion and auxiliary hardware—pumps, valves, etc.—to the fuel properties and is continuing to do that for low-carbon fuels.

"The low-carbon fuels such as renewable natural gas, bio-propane, biogas, biodiesel

blends, renewable diesel, and hydrogen-natural gas blends have physical and chemical properties similar to the fuels we have experience operating our turbines on already," Reitz said. "We characterize them as drop-in fuels, which means we have hardware available to burn these fuels. Regarding fuels with properties very different from drop-in fuels, hardware modifications or development is needed to support them."

Gas Turbines

Gas turbines are said to become "fully decarbonized, dispatchable energy sources" that could support and balance intermittent power sources.

According to Reitz: "Gas turbines are inherently flexible and allow for easy adaptation to a wide variety of fuels with different characteristics. In addition to providing fuel flexibility, gas turbines provide high efficiency, low emissions, high availability, high reliability, and high-power density."

With a larger integration of renewables, dispatchable gas turbines will become more necessary. "In future decarbonized energy systems where renewable energy sources play a significant role, there will be a growing need for dispatchable power to bridge longer periods of low renewable energy generation," Jermark said. "While current battery technologies may face limitations in terms of storage capacity, gas turbine power plants offer the capability to quickly provide reliable power, as well as heat through combined heat-and-power generation, and deliver essential grid services."

TURBOMACHINERY STRATEGIES FOR A CLEAN-ENERGY FUTURE

Flexibility and turbine advancements were the focal point of Wednesday's panel session: *Turbomachinery Solutions for Decentralized Energy Systems: Addressing Clean, Dispatchable, and Affordable Energy*. The panel—moderated by Giuseppe Tilocca, Scientific Officer, and Christer Björkqvist, Managing Director, at ETN Global—noted three major strategies addressing the challenges with current gas turbines and turbomachinery and a decrease in flexible capacity: fuel flexibility, digitalization, and efficiency improvements.

"Gas turbines and turbomachinery are evolving by pushing the boundaries of their inherent flexibility to provide mature and cost-effective solutions thereby ensuring a reliable and sustainable energy supply during the energy transition and beyond," Tilocca said.

The flexibility requirements, as noted by organizations such as the Joint Research Center and the Agency for the Cooperation of Energy Regulators, are expected to increase significantly; however, flexible capacity is decreasing. Effectively, Europe is projected to lose 107 GW of flexible capacity by 2030. This decline is driven largely by economic decommissioning.

Tilocca expanded on the strategies addressing these challenges:

- **Fuel Flexibility:** Gas turbines are being designed to operate on a variety of fuels, including hydrogen and biofuels, to ensure they can adapt to different energy sources.
- **Digitalization:** Advanced digital tools and analytics are being used to optimize operations and maintenance, allowing turbines to perform efficiently under varying conditions.
- **Efficiency Improvements:** Continuous advancements in turbine technology are improving the overall efficiency of these systems, reducing emissions, and lowering operating costs.

These measures are critical for ensuring that gas turbines remain a viable and sustainable option in a cleaner energy future. Moreover, Sean Fitzpatrick, CEO at Pure World Energy and operator of several microgrids, stressed the need to foster education and communication regarding the positive role of turbomachinery in the net-zero transition.

"Turbomachines are flexible solutions that by smart integration with renewables and storage systems will provide flexibility to decentralized systems and reduce the demand on national grids," he said.

Technology Gaps

New combustion systems that enhance fuel flexibility are already available and being integrated into existing infrastructure. For example, Tilocca noted that the German Aerospace Center (DLR) has developed a retrofit system for a 100 kWe turbine adapted to run entirely on hydrogen, based on technology from Ansaldo Green Tech. This turbine is ready for commercial deployment in Germany, indicating that the technology is already available.

The main gaps these technologies address include:

- Fuel availability
- Investment framework
- Regulatory support

By filling these gaps, new combustion technologies help reduce reliance on fossil fuels, decrease emissions, and support the transition to a sustainable energy ecosystem.

How Gas Turbines Support Decentralized Power Generation

Clean and dispatchable technologies are the future, and gas turbines are an essential component for decentralized power generation. Tilocca said that decentralized generation involves producing electricity closer to where it is used, reducing transmission losses, and enhancing grid resilience.

The key roles of gas turbines in decentralized power generation include:

Providing Reliable Backup Power: Gas turbines can quickly ramp-up production to meet demand during peak periods or when fluctuating renewable sources are insufficient.

Ensuring Grid Stability: Prof. David Sanchez from the Universidad de Sevilla said gas turbines help maintain grid balance and quality.

Supporting Renewable Integration: By complementing intermittent renewable energy sources like wind and solar, gas turbines help ensure a stable and reliable power supply.

Market Requirements/Dynamics

Several market dynamics and operating conditions must be considered to transform current energy practices and support a cleaner energy future.

- Affordability
- Market uncertainty
- Reduced operating hours

To navigate these challenges, it is essential to develop cost-effective, adaptable solutions that can meet evolving market demands while supporting the transition to a sustainable and clean-energy future. ■

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