



ETN is a non-profit association bringing together the entire value chain of the gas turbine technology community globally. Through cooperative efforts and by initiating common activities and projects, ETN optimises turbomachinery research and technology development and promotes the operation of environmentally sound gas turbine technology with high reliability and low cost.

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Christer Björkqvist
Managing Director

Momentum for hydrogen is building up

In our last Quarterly Newsletter edition I highlighted that growth opportunities are in sight for the gas turbine community, which has been affirmed through a number of newly issued statements and reports. IEA recently showcased in its latest report a strong global increase in energy consumption, and BP foresees a substantial increase of energy demand in their Energy Outlook. We also see tougher emission legislation and an increasing global public pressure to improve air quality and reduce CO₂ emissions resulting in an accelerating increase in intermittent renewable generation and displacement of coal-fired generation. In the EU, the Members of the European Parliament voted in March in favour of increasing the EU's 2030 emission cuts target to 55%. It will be interesting to see the reaction to this as the EU heads of states will meet on 9

May in Romania at the Future of Europe summit. However, regardless of the outcome, the search for sustainable technology solutions that can provide vital contributions to emission reduction targets is being intensified.

In this context the momentum for hydrogen is building up due to its high energy density and the fact it allows clean, long-term storage and transportation of large volumes of energy. On top of that it offers a carbon-neutral solution to the growing intermittency problem of renewable energy sources. The Economist recently noted in its "Technology Quarterly" hydrogen as "the most promising" technological solution to decarbonise our energy system. The foundation for this statement are the wide deployment opportunities for hydrogen, from energy production & storage; industrial energy; heat & power for buildings; to transportation.

The increasing interest and engagement in hydrogen is global. At the World Economic Forum meeting in Davos 2019, industry CEOs and government leaders offered support of a multilateral cooperation, proposed by the Hydrogen Council, to rapidly accelerate scale-up of hydrogen technologies. With only two months to go until the G20 summit in Osaka, the eyes are now on Japan who has been criticised for its heavy use of coal-fired power generation and plans to build new coal-fired plants. Japan is currently in the process of mapping out a long-term low-emissions strategy to be submitted to the United Nations ahead of the summit. In this context their Prime Minister Shinzo Abe recently reiterated the ambitious goals to become the first "hydrogen society", and promised that they would incorporate into their strategy the newly proposed targets by a Japanese government panel, such as the commercialisation of CCS and CCU by 2030 and a reduction in costs of producing hydrogen to less than one-tenth of the current level by 2050. He also stated that to produce such ground-breaking innovations, it is necessary to bring together wisdom from around the world.

We hope that ETN's new Hydrogen Working Group that was successfully launched at ETN's Annual General Meeting (AGM) in March will contribute to this by bringing together a wide participation that can enable and accelerate a more flexible use of hydrogen in gas turbines.

Another ETN Working Group with a high interest in is our Additive Manufacturing WG, who released ahead of our AGM an ETN booklet "Best practices for defects detection in additively manufactured components in the energy sector". This year's AGM and Workshop hosted by Total was a great success with a high participation and many interesting presentations and discussions. You can read more about the meeting in this edition, and if you are a member you can find presentations and meeting minutes on our website.

Finally, I would like to remind the GT user community about our forthcoming User Group Meetings, SGT-A35 (RB211) meeting on 7-9 May in Amsterdam, hosted by Shell, and the LM2500 meeting on 4-6 June in Stavanger, hosted by Equinor.

ETN celebrated its 15th Annual General Meeting in Pau

ETN's 15th Annual General Meeting & Workshop was held on 27-28 March 2019 in Pau, France, generously hosted by our member Total. 118 participants joined the event to discuss ETN's activities, projects and new initiatives.

On the opening day, the ETN members had an opportunity to attend a site visit to Total's Remote Assistance, Intervention and Diagnosis (RAID) room before the official start of the AGM. RAID is a digital innovation that enables the remote monitoring of Total's rotating machines from a "super" monitoring room, located in Pau. In the meantime the ETN Board and Project Board held short meetings to discuss the latest developments and strategy for ETN's ongoing activities and future initiatives.

In the AGM opening session, Bernard Quoix welcomed the participants to Total's technical headquarter in Pau. He also greeted the 9 new members who had joined ETN since the last AGM in Bucharest in March 2018 and welcomed them to the network. In his opening speech Bernard Quoix stated that *as we are going through an accelerating transformation and transition to a low-carbon society, we have to embrace this trend and address it as one industry, or risk being left behind.* Bernard Quoix highlighted the importance of a strong user community, working closely together with the rest of the value chain, and the need for focused technical working groups where we can exchange best practices and explore innovative developments.

Christer Björkqvist (ETN) presented the annual report of ETN's activities and achievements from the past year and listed the upcoming meetings and supported external events for 2019. Gary Lock, member of the ETN Board (Frazer-Nash Consultancy) gave an overview of ETN's [proposed strategy](#), followed by a financial report highlighting a sound economic situation presented by the ETN Board member Mick Conway (RWG). Prioritised R&D topics were then presented by Peter Jansohn, Chairman of the ETN Project Board (PSI), who in-



roduced the new revision of ETN's [R&D Recommendation Report](#) prior to closing of the AGM.

The Workshop was then started with a short safety moment on the health risks and precautions associated with hexavalent chromium, given by Cath Goy, ETN Vice President (Uniper), who also chaired the following panel session on hydrogen. Geir Rørtveit (Equinor), Geert Laagland (Vattenfall), Satoshi Tanimura (MHPS) and Thomas Thiemann (Siemens) presented their company views and discussed the current status of hydrogen deployment and its challenges. Following the high interest from ETN members on hydrogen as an energy vector, a new Working Group on hydrogen was launched at the AGM & Workshop. The goal of the Hydrogen Working Group is to enable and optimise the use of hydrogen and ammonia in gas turbines, by identifying and addressing potential barriers. The Working Group consists of representatives from OEMs, academia, utilities and service providers.

On the second day, the programme continued with a panel discussion on "Additive manufacturing in the gas turbine supply chain", chaired by John Oakey (Cranfield University). In this session Paolo Del Turco (BHGE), Steve Nardone (Engie), Lukas Fuchs (EOS) and

Michael Hinz (Höganäs) presented the status of additive manufacturing in gas turbine technology from their company perspectives. The panellists showcased impressive technology developments and agreed that further cooperation would allow faster and wider deployment in the gas turbine sector. The panel discussion included a short Q&A, followed by a split up into Technical Committee (TC) sessions. The parallel TC sessions addressed ongoing projects and future R&D possibilities, and included presentations on supercritical CO₂, hydrogen, additive manufacturing and gas turbine components life assessment, which are prioritised topics that ETN will continue to address in our Working Groups and new projects.

After the Workshop, ETN's Micro Gas Turbine Working Group held a meeting on 28-29 March discussing the European Strategic Energy Technology (SET) Plan Actions 5 and 6, as well as comments for the ISO19372.

The AGM & Workshop Summary Report, as well as all presentations and photos are available on [ETN's website](#). ETN's Activity Update 2018-2019 can also be downloaded on [our website](#).

We would like to thank Total for their generous sponsorship and support for our successful event. ■

Conference Advisory Board for ETN's 10th IGTC



IGTC
International
Gas Turbine Conference

ETN's 10th International Gas Turbine Conference (IGTC) will take place in Brussels in October 2020. A call for ETN members to join the Conference Advisory Board (CAB) was launched at the AGM in Pau. The main tasks for the CAB members will be to define the themes,

provide input to the programme, propose speakers, as well as to review and select abstracts/papers. We are also looking for additional technical paper reviewers. If you or one of your colleagues would like to be involved, please send an email to us listing your area(s) of expertise. The first CAB teleconference will be held in July 2019, followed by a meeting in conjunction with ETN's Workshop in October 2019. For more details on the planned meetings and timeline, please contact the [ETN office](#). ■

Member of the Year: Peter Kutne, DLR

Every year during the Annual General Meeting, ETN awards a prize to one of our committed members. The Member of the Year 2019 prize was given to Peter Kutne (DLR) for his wide involvement and valuable contributions to ETN's Working Groups and activities. Other two nominees were Chris Dagnall (DNV GL) for his continuous commitment to ETN and the efforts in leading ETN's TC4&5, and Jonas Rydland (ConocoPhillips) for his active involvement in ETN's LM2500 User Group and its Steering Committee. ■



ETN's best practices for additive manufacturing



The ETN booklet ***"Best practices for defects detection in additively manufactured components in the energy sector"*** is now available for ETN members on [our website](#). The booklet, issued by ETN as part of the activities within our Additive Manufacturing Working Group, gives a general overview of the current utilisation, development and future trends of additive manufacturing (AM) in the energy sector, highlighting the actual knowledge of the defects induced by AM processing. Next AM Working Group meeting will be a teleconference call, planned to be held on 20 May 2019. ■

New members

We are pleased to welcome Vattenfall (Netherlands), Enipower (Italy) and Staffordshire University (United Kingdom) as new members.



Vattenfall is a European energy company with operations in Sweden, Germany, Netherlands, Denmark, United Kingdom and Finland.



enipower

Enipower

operates in the thermo-electric Italian power generation sector and is the second biggest producer of electricity and the largest producer of natural gas in Italy.



Staffordshire University

focuses on research and its impact particularly in low carbon and renewable energy systems. Gas turbine systems at different scales, particularly in micro-scale, with burning biofuels have become a focused area of research in their Centre of Sustainable Energy Systems and Smart Technologies. ■

Educational courses

ETN is collecting information about turbomachinery related technical courses, given by our members, in order to promote and share the knowledge and experience of our community. The list of courses for 2019 is available on [ETN's website](#). If you would like to list some of your courses on our website, please [send us](#) a short description and a link to be displayed on our website. ■

Partner events

Discounted registration fees for ETN members

ETN has selected a number of relevant conferences and established cooperation with them, providing opportunities to influence the programme as well as discounted registration and exhibition fees for our members. Please contact the [ETN office](#) for more details about registration and fees.

NexTurbine¹⁹
The 8th Annual Summit
30-31 May 2019, Wuxi, China
The 8th Annual [NexTurbine Summit](#) will be held on 30-31 May 2019 in Wuxi (Shanghai), China. Exhibiting ETN members will be offered to provide a one pager about their products and services that will be translated into Chinese and included into a NexTurbine booklet which will be circulated to the Chinese user community prior to the conference.



ASME Turbo Expo

[ASME Turbo Expo](#) will take place on 17-21 June 2019 in Phoenix, AZ, United States. ETN's Managing Director Christer Björkqvist will co-chair the Electric Power Committee's panel "The Voice of the Customer" and participate in two panel sessions: "Future of Power Systems", organised by the Cycle Innovations Committee, and "Cogeneration and the Future of Gas Turbine Systems".



ME Rotating Machinery

This year's Middle East Rotating Machinery Technology and Innovation [Conference & Showcase](#) will take place on 8-10 October in Dubai, United Arab Emirates.



EUW & POWERGEN Europe

[European Utility Week](#) & [POWERGEN Europe](#) will be held on 12-14 November 2019 in Paris, France. ETN's Managing Director Christer Björkqvist will chair a hub session "The Future Role of Gas Turbines" on the opening day.



International Gas Turbine Congress

The 12th [International Gas Turbine Congress](#) will take place on 17-22 November 2019 in Tokyo, Japan. The congress is held every four years and is organised by the Gas Turbine Society of Japan (GTSJ). ETN is one of the collaborating societies and will attend the conference.



Future Energy Asia

ETN is cooperating with the [Future Energy Asia](#) Exhibition & Conference, to be held on 12-14 February 2020 in Bangkok, Thailand.

ETN's User Group Meetings are approaching

Registration is open to ETN's upcoming User Group Meetings on our website.



SGT-A35 (formerly Industrial RB211) [User Group Meeting](#) will take place on 7-9 May 2019 in Amsterdam, Netherlands, hosted by Shell. This event is open to all SGT-A35 operators from around the globe, providing an opportunity to discuss operational and maintenance topics with independent service providers and peers within the wider SGT-A35 user community.



LM2500 User Group Meeting will be held on 5-6 June 2019 in Stavanger, Norway, hosted by Equinor. This event provides an opportunity for a focused dialogue between the user community, BHGE and independent service providers in order to define and develop solutions to prioritised operational issues and requirements. ■

CEN working group on gas quality

The CEN Sector Forum Gas Working Group on Wobbe Index (CEN/TC 234 WG11) is progressing towards its objective to submit an Integrated Scenario for Wobbe Index regulation across the European Union. A survey was conducted in 2018 to evaluate the consequences and effects of Wobbe Index ranges and rates of changes on all parts of the gas chain. Its outcome was compiled in the first part of the Simple Scenario Assessment (SASS) draft.

The second part of this assessment evaluates the input provided, and formulates general recommendations and observations in the draft that was recently circulated to the ETN

members involved. The third part will be drafted, discussed and adapted in the next meetings held by this CEN Working Group, with the objective to present an acceptable Wobbe Index scenario (Integrated Scenario) at the Madrid Forum meeting on 5-6 June 2019. It will be followed by a public consultation this autumn.

In parallel, an annex section is being drafted by a smaller subgroup, with the objective to assess the impact on Wobbe Index of an increased share of renewable gases in the European gas grid. All meeting summaries are available for our members on [ETN's website](#). ■



From powder quality control to post-processing: A journey in the AM industry for gas turbines



Additive manufacturing (AM) is rapidly transforming the manufacturing processes of the gas turbine industry. HiETA Technologies opened its doors to ETN describing the benefits that AM can bring when applied in the gas turbine product development.

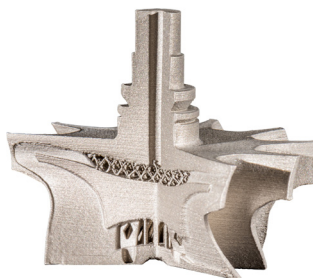


With a specific expertise in thermal management and lightweighting, HiETA Technologies is a product development and production company, specialised in the use of metal 3-D additive manufacturing. The company invited ETN to visit their premises in Bristol in January 2019. HiETA facility is equipped with 10 Selective Laser Melting (SLM) machines located in separated rooms to maintain different environmental conditions according to the AM manufacturing phases: powder management and storage, product manufacturing, component post-processing.

Design for AM & Component Running Experience

One of the key advantages of using AM technology is the flexibility in the components' design, which allows manufacturing optimised lightweight components, and the absence of tooling means vastly reduced production times compared to conventional methods. The increase of turbines efficiency, and consequently the combustion temperature, drives a need for internally cooled hot gas path components. When optimised surfaces, structures and thin walls are designed and developed for the AM process it is possible to get significantly more effective heat transfer solutions than via conventional manufacturing. On the other hand, layer thickness, laser time on the powder, and laser power are parameters to optimise in AM processes in order to avoid defects, such as cracking.

HiETA have a range of products running with customers, with over 25,000hrs running accumulated on high temperature turbomachinery components and over 100,000 cycles on highest life compact heat exchangers, proving that AM can produce robust, reliable parts.



Material and turbomachinery applications

The next step in the development of an AM product is the selection of the powder, based on the application. For the turbomachinery industry CM247LC, Hastelloy X, IN718 and IN625 are the most used materials at HiETA. While CM247LC shows very good mechanical properties at high temperatures, suitable for gas turbine components, it is very difficult to process and IN718 has lower cost. New research activities are ongoing at HiETA for the development of a new nickel-based super-alloy, designed specifically for the AM process and capable of maintaining excellent mechanical properties in critical working environments.

Inspection, quality and powder control



"The quality of powder and finished components is a priority at HiETA Technology", said Dr Desislava Bacheva, who is in charge of NDT controls at HiETA. The assessment of powder quality is done by inspecting the

chemical composition and by running flowability tests, as well as assessing characteristics such as morphology, particle size distribution and trapped gas. Accurate tests are also carried out on the AM machines to detect potential laser deflections and on AM finished components, such as leak tests, optical microscopy, Archimedes tests and X-Ray Computed Tomography.

There are more than 50 interdependent process parameters, influencing the quality of finished AM. However, Dr Bacheva explained that the level of the inspection depends on the customer's needs.

AM future innovations

Research and innovation are at the forefront in AM product development in the energy sector. HiETA is focusing on the use of multiple materials, multiple lasers in the same AM machine and digital twins, which could bring high benefits in the design phase but has not been implemented being computationally intensive.

HiETA is a member of ETN's Additive Manufacturing Working Group. More information about the latest updates and ongoing activities within the AM Working Group is available on [our website](#).

CO₂ emission regulation compliance criteria

As reported in our previous Quarterly Newsletter edition, the European Union's Clean energy package negotiations were completed at the end of last year. The package, introduced by the European Commission in November 2016, included among others a revised Electricity market regulation.

ETN is cooperating with other associations in the sector to provide input to ACER (Agency for the Cooperation of Energy Regulators) who has been asked to provide technical guidance to the calculation method of CO₂ emissions for eligibility in capacity markets, within the scope of the new EU regulation on [internal market for electricity](#).

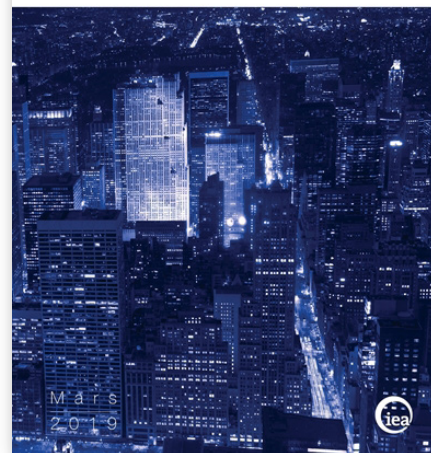
The Clean energy package is establishing carbon intensity criteria for eligibility in capacity markets, with expected entry into force in mid-2019. This represents a major structural change to how these schemes work, with potentially large implications for fuel and technology use in the EU, with the largest impact expected on coal power plants and gas turbines' installations running on liquid fuel. The Article 18 b (paragraph 4) of the proposed regulation defines the eligibility for capacity mechanisms based on the requirements related to CO₂ emissions limits:

- (a) "Generation capacity emitting more than 550 gr CO₂ of fossil fuel origin per kWh of electricity that started commercial production after [OP: date of entry into force] shall not be committed or receive payments or commitments for future payments under a capacity mechanism as of entry into force at the latest";
- (b) "Generation capacity emitting more than 550 gr CO₂ of fossil fuel origin per kWh of electricity and more than 350 kg CO₂ of fossil fuel origin on average per year per installed kWe that started commercial production before [OP: date of entry into force] shall not be committed or receive payments or commitments for future payments under a capacity mechanism as of 1 July 2025 at the latest."

ETN members are welcomed to provide their input. For more information, please contact the [ETN office](#). ■

Global Energy & CO₂ Status Report

The latest trends in energy and emissions in 2018



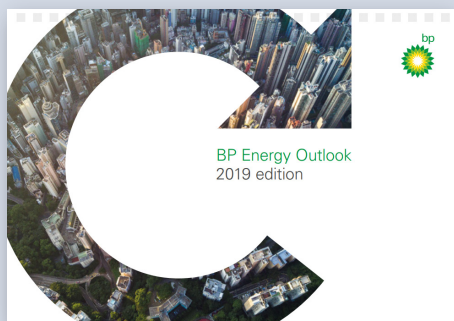
IEA: energy consumption increased globally

The International Energy Agency's (IEA) [Global Energy and CO₂ Status Report](#), released in March 2019, indicates that global energy consumption increased by 2.3% in 2018, which is nearly twice the average rate of growth since 2010. A robust global economy as well as higher heating and cooling needs in some regions explain the increasing energy demand.

The report also shows the rise of global energy-related CO₂ emissions by 1.7%, to a historic high of 33 gigatonnes in 2018, coal-fired power plants being the single largest contributor to the growth in emissions.

Worldwide gas consumption increased by 4.6%, led by the growing demand in the US, and followed by China. According to Dr Fatih Birol, the IEA's Executive Director, last year can be considered "another golden year for gas, which accounted for almost half the growth in global energy demand." ■

BP Energy Outlook 2019



BP's annual [Energy Outlook](#), published in February 2019, predicts the global energy demand to increase by a third by 2040, with industry and buildings accounting for around 75% of the increase. Although renewables are expected to become the main source of power by 2040, fossil fuels will still play an impor-

tant role in 2040 according to BP. The Energy Outlook forecasts a strong and widespread growth for natural gas, while oil demand is also expected to grow before "gradually plateauing". BP also highlights the dual challenge of increasing energy demand globally with less carbon emissions in order to meet the climate targets in line with the Paris Agreement. ■

Upcoming meetings and events

Meeting/Event	Date	Location
SGT-A35 User Group meeting	7-9 May 2019	Amsterdam, Netherlands
NexTurbine*	30-31 May 2019	Wuxi, China
LM2500 User Group meeting	5-6 June 2019	Stavanger, Norway
ASME Turbo Expo*	17-21 June 2019	Phoenix, AZ, United States
ETN Board meeting	17-18 July 2019	Brussels, Belgium
ETN Project Board meeting	23-24 July 2019	Brussels, Belgium
Sustainable PolyEnergy generation and HaRvesting – SUPEHR 2019 conference	4-6 September 2019	Savona, Italy
ETN High-Level User Meeting**	30 September 2019	To be confirmed
ETN October Workshop**	1-2 October 2019	To be confirmed
European Utility Week & POWERGEN Europe*	12-14 November 2019	Paris, France
Middle East Rotating Machinery Technology and Innovation Conference*	8-10 October 2019	Dubai, United Arab Emirates
GTSJ International Gas Turbine Congress*	17-22 November 2019	Tokyo, Japan

* ETN members are entitled to a discounted registration fee | ** Only for ETN members

ETN Team



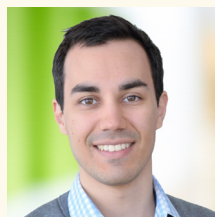
Christer Björkqvist
Managing
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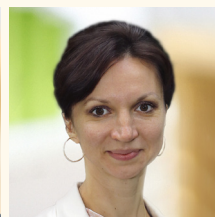
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ETN at a Glance!

Download the [ETN Brochure](#), featuring:

- ETN Mission & Objectives
- ETN Technical Committees
- ETN Projects
- ETN Events & Activities
- ETN Membership Benefits
- And more!



Are you a gas turbine user?
[Download the Brochure](#) showcasing the benefits of being part of ETN's global gas turbine user community.



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