

ETN's 17th Annual General Meeting & Workshop 15 - 22 March 2021

Virtual event

Monday 15 March	Annual General Meeting (AGM) 2021: "Strategy for a low-carbon future"
Tuesday 16 March	Technical Committee 1: Low-carbon GT technologies - "Expanding the solutions portfolio of new energy systems"
Wednesday 17 March	Technical Committee 2: Operational and fuel flexibility - "Analysing new technological solutions in respect of market opportunities"
Thursday 18 March	Technical Committee 3: Materials degradation, repair technologies & manufacturing – <i>"Expected materials impacts and new</i> <i>technology opportunities to overcome challenges in the energy</i> <i>transition"</i>
Friday 19 March	Technical Committee 4: Condition monitoring and asset management - <i>"Implications of introducing 5% to 30% hydrogen</i> <i>into the grid"</i>
Monday 22 March	Closing session: "ETN strategy implementation and transition roadmap"

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Introduction

ETN's Virtual Annual General Meeting (AGM) & Workshop Week took place on 15-22 March 2021. The opening day of the event was dedicated for the AGM, which was followed by the Workshop, consisting of four Technical Committee (TC) sessions, addressing topics of high interest to the gas turbine user community:

- TC1: Low-carbon GT technologies "Expanding the solutions portfolio of new energy systems"
- TC2: Operational and fuel flexibility "Analysing new technological solutions in respect of market opportunities"
- TC3: Materials degradation, repair technologies & manufacturing "Expected materials impacts and new technology opportunities to overcome challenges in the energy transition"
- TC4: Condition monitoring and asset management "Implications of introducing 5% to 30% hydrogen into the grid"

This year we also organised a virtual closing session *"ETN strategy implementation and transition roadmap"*, during which the outcome of the Technical Committee sessions was summarised.

The annual ETN Activity Update 2020-2021 and all AGM and Workshop presentations are available on our <u>website</u>. Please note that you need to be logged in to access these documents. If you do not have an account yet, you can create one <u>here</u>.



Annual General Meeting, 15 March 2022

Annual General Meeting: "Strategy for a low-carbon future" – 15 March 2021

Welcome and ETN President's speech

Christer Björkqvist, ETN Managing Director introduced Pedro Lopez (Uniper), President of the ETN Board, who opened the meeting and welcomed the participants. In his speech Pedro Lopez listed some success stories, such as the ISO standard development within our Air Filtration Working Group and a new ETN Working Group on Supercritical CO₂. He also highlighted ETN's efforts that have opened R&D opportunities for our sector, resulting in new EU-funded projects FLEXnCONFU and ROBINSON. Pedro Lopez then welcomed the new ETN members and thanked all members for their involvement and support during the past year, encouraging them to be actively involved in the wide range of activities in the coming year.

Approval of minutes of the last Annual General Meeting

The minutes of the 16th Annual General Meeting, held virtually on 30 June 2020, were approved by the General Assembly without further comments.

Activity report

ETN's Managing Director Christer Björkqvist presented the annual report of activities. He listed the new members who joined ETN since the last AGM:

- University of South-Eastern Norway (Norway)
- GE Gas Power (Switzerland)
- Stadtwerke Münster (Germany)
- ADNOC (United Arab Emirates)
- Finno Exergy (Finland)
- Rey Juan Carlos University (Spain)
- Politecnico di Milano (Italy)

Christer Björkqvist introduced the members of the ETN Board, the Project Board and the IGTC Conference Advisory Board, and thanked them for their active involvement. He then listed ETN's ongoing projects and latest meetings and events, as well as ETN's recent publications.

Financial report and budget

ETN Treasurer Andy Williams (Chromalloy) presented an overview of the financial report for 2020 and budget for 2021. He noted that 2020 has been a challenging year for the world as a whole and specifically for many businesses, as we have all struggled with the effects of the global pandemic. ETN was not immune to this issue as travel restrictions limited our ability to network effectively and hold some of our key annual meetings and our bi-annual International Gas Turbine Conference. Tightening of financial expenditure also meant that many companies questioned the benefits of being part of external bodies and in a few cases, we saw some resignations. However, through all these challenges, the organisation has been able to show significant value to our members. Andy Williams noted that we have brought in new members to replace those that have resigned, we have commenced 2 new EU-funded projects, with a third on the way in 2021, and we have continued to engage with our members and created a vision document that sets a clear roadmap through the next phase of the energy transformation journey. As a result, our financial position remains robust. Andy Williams reported that we have only had to use a very small amount of our reserves to balance the books in 2020 and are predicting a breakeven position for 2021. Andy Williams noted that as we emerge from the global slowdown over the last 2 years, ETN is

extremely well positioned financially and technically to support and grow our network and engage in additional projects. ETN is seen as the major voice of the industry and a body that has real influence in shaping our industry as we embody the total value chain, and together with a strong financial position, we have a stable platform from which to grow and support our members through the next decade.

The proposed budget for 2021 was approved by the General Assembly.

Vision and strategy introduction

Christer Björkqvist highlighted some recent energy and climate policy developments. Pedro Lopez then presented the key messages from ETN's High-Level User Meeting.



The ETN Board members presented their organisations' views and commitments in the energy transition and highlighted the most important areas for their organisations that ETN should focus on. John Oakey (Cranfield University) presented the Board's proposed vision and mission of ETN.

Vision:

Safe, secure and affordable carbon-neutral energy solutions by 2030, implemented globally by 2050

Mission:

- ✓ To encourage and facilitate information exchange about carbon-neutral solutions
- ✓ To bring together and to foster cooperation among the stakeholders of the gas turbine industry, its associated equipment providers and users
- ✓ To accelerate research, development, and demonstration of solutions in line with our vision
- ✓ To influence policy and legislative issues relevant to the gas turbine industry

Walt Steimel (Shell) explained ETN's strategy and roadmap and highlighted what is new when it comes to our roadmap.

The General Assembly concurred with the ETN Board's proposed vision and strategy going forward.

Adjournment

The Annual General Meeting was adjourned at 16:00 CET.

Workshop – 16-22 March 2021

ETN's virtual Workshop took place between 16 and 22 March 2021 and was composed of five individual two-hour sessions.

TC1: Low-carbon GT technologies – "Expanding the solutions portfolio of new energy systems" Chairs: Marco Ruggiero, Baker Hughes & David Sánchez, University of Seville

In the near future we will see a variety of tools used to reduce or eliminate the carbon footprint of energy production. Some of these are technologies that will enhance existing energy conversion systems, while others represent new cycles getting ready to become commercially viable. During the session the stateof-the-art and opportunities from research, market and policy points of view were highlighted.

Introduction: Technology review for low-carbon technologies, Marco Ruggiero, External Funding & Technology Development, Baker Hughes, & David Sánchez, Professor of Energy Systems and Turbomachinery, University of Seville

Low-Carbon Resources Initiative: introduction, users' needs, promising technology solutions, Jeffery Preece, Senior Program Manager, LCRI/EPRI

• Cooperation opportunities and Q&A

Pressure gain combustion: a new engine concept to enhance the fuel economy of gas turbines

- Novel pressure gain combustion technology for low carbon GT operation: technology <u>description and experimental result</u>, Fabio Ciccateri, CFD Specialist, Finno Exergy
- <u>Pressure gain combustion technology development for gas turbine engines</u>, Don Ferguson, Research Engineer, US Department of Energy National Energy Technology Laboratory

New solutions to reduce the total cost of ownership of combined cycle gas turbines in a low-capacity factor scenario

- Business case for sCO₂ Waste Heat Recovery System, Ambra Giovannelli, Assistant Professor of Fluid Machinery & Energy Conversion Systems, University of Roma Tre
- <u>Supercritical CO₂ STEP 10 MW demo plant</u>, Markus Lesemann, Director, Business Development, Gas Technology Institute

<u>Carbon capture, utilisation and storage (CCUS) projects and global cooperation</u>, Juho Lipponen, Coordinator, Clean Energy Ministerial CCUS Initiative

TC2: Operational and fuel flexibility – "Analysing new technological solutions in respect of market opportunities"

Chair: Peter Kutne, Head of Department Gas Turbine, DLR

Gas turbine technology offers a broad variety of solutions for a future energy system due to its operational and fuel flexibility. Furthermore, the integration of gas turbines with other technologies can open new markets. But what are the necessary steps to make these technologies available, and which boundary conditions are necessary to make such flexible solutions economically feasible? The presentations and discussion in this TC threw some light on it.

Introduction, Peter Kutne, Head of Department Gas Turbine, DLR

Hydrogen

- <u>ETN Hydrogen Working Group: H₂ combustion position paper</u>, Peter Jansohn, Head Energy System Integration, Paul Scherrer Institute
- <u>ETN Hydrogen Working Group: H₂ deployment in centralised power generation study</u>, Daria Bellotti, PostDoc Researcher, University of Genoa & Serena Gabriele, Gas Turbine Configuration Management, Baker Hughes & Jon Runyon, Gas Turbine Combustion Engineer, Uniper
- Discussion

Operational flexibility

- <u>Hybrid solutions combining the GT with X</u>, Peter Kutne, Head of Department Gas Turbine, DLR
- Flexibility solutions for cogenerative combined cycles: assessment of electric ancillary service market and technology market readiness, Stefano Barberis, Project Manager, RINA-C & Alberto Vannoni, PhD student, University of Genoa
- Discussion

Ammonia

- <u>Techno-economic analysis on enhancing combined cycle flexibility via power-to-ammonia</u> <u>solutions – preliminary results from FLEXnCONFU project</u>, Rafael Guédez, Senior Researcher, KTH Energy Department & Jose García, PhD candidate, KTH Energy Department
- Discussion

TC3: Materials degradation, repair technologies & manufacturing – "Expected materials impacts and new technology opportunities to overcome challenges in the energy transition"

Chair: John Oakey, Cranfield University

Introduction, John Oakey, Professor of Energy Technology, Cranfield University

1. Expected impacts on materials

<u>Overview of expected impacts on materials</u>, Ferenc Pankotai, Manager, Combustion Engineering and Additive Manufacturing, Solar Turbines

- Effects from the increased use of hydrogen and sustainable fuels in retrofit and purpose-designed turbomachinery
- Materials requirements for advanced cycles, including oxy-fired sCO₂ cycles

Hydrogen GT operations experiences within Shell, Walt Steimel, Rotating Equipment Global Discipline Lead, Shell

Approach for hydrogen-fired utility projects: retrofit and new utility installations, Brian Allen, VP Product Line Management, Mitsubishi Power

Discussion

2. Mitigation solutions and technology development opportunities

Additive Manufacturing

- Introduction current applications and future opportunities, Anand Kulkarni, Principal Key Expert, Siemens Energy
- Material gualifications, Mikkel Pedersen, Head of AM R&D, Oerlikon
- <u>ETN AM Equipment Evaluation initiative</u>, Jan de Roos, Senior Rotating Equipment Engineer, Shell & Ulli Klenk, Principal Key Expert Additive Manufacturing, Siemens Energy & Steve Nardone, Lab Manager Metal Additive Manufacturing, Engie & Valentin Moëns, Technical Project Officer, ETN
- Discussion
- **3.** Future TC3 materials topics (e.g., application of advanced manufacturing controls (AI, robotics, etc.), component repair, coating developments, ceramics/composites)

TC4: Condition monitoring and asset management – *"Implications of introducing 5% to 30% hydrogen into the grid"*

Chair: Chris Dagnall, General Manager, DNV

Technology and safety: Identifying potential implications, solutions or mitigation opportunities

- Safety aspect recap from the previous TC4 session (AGM & Workshop 2020)
- Operation, combustion, emissions, leak detection, enclosure design, exhaust systems, heat recovery boilers, start-up and control
- Maintenance, inspection intervals, lifing issues, reliability, associated costs
- Instrumentation and monitoring requirements, combustion control, sensor requirements

Introduction, Chris Dagnall, General Manager, Rotating Machinery Solutions, DNV

Hydrogen operation assessment, Tom Kavanagh, Head of Asset Improvement & Making Net Zero Possible, Uniper

Hydrogen Usage in Gas Turbines – Impact on Enclosure Safety, Irfan Siddiqui, CFD Consultant, Frazer-Nash Consultancy

Technology aspect, Marc Vignal, EAME Marketing Lead, Solar Turbines

Panel discussion

- o Tom Kavanagh, Head of Asset Improvement & Making Net Zero Possible, Uniper
- o Irfan Siddiqui, CFD Consultant, Frazer-Nash Consultancy
- o Marc Vignal, EAME Marketing Lead, Solar Turbines
- Walt Steimel, Rotating Equipment Global Discipline Lead, Shell

Topics for discussion

- Discuss from an asset management perspective the current and near future position with introduction of 5% to 30% hydrogen
- What is the end user position and readiness?
- What would a hydrogen readiness roadmap look like?
- Are new data, new sensors, and different control system required?
- Asset management and condition monitoring challenges and investment consideration

Closing session: "ETN strategy implementation and transition roadmap"

During the virtual closing session, the outcome of the Technical Committee sessions and follow-up actions was summarised. The session gave an overview of ETN's involvement in EU's research and innovation activities and provided an opportunity to find out the latest updates within ETN's Working Groups and hear more about the planned activities from the Working Group chairpersons and co-chairs. The session included updates also on ETN's User Groups and the Young Engineers Committee.

During this session, Peter Breuhaus, Chair of ETN's Project Board introduced the Project Board's proposal to widen the scope of ETN's Micro Gas Turbine Working Group and rename it as Decentralised Energy Systems Working Group. The goal of this new Working Group is to bring together stakeholders of the value chain for decentralised energy solutions involving micro and small gas turbines, with the objective to accelerate the development of cost-efficient integrated secure technology solutions in line with the market needs. The ETN Project Board will now further discuss the objectives and coverage and plan the official launch of the new Working Group later this year.

The Board, Project Board and ETN office will start working on the implementation of the many initiatives/topics that were brought forward by our members. These include topics such as pressure gain combustion; carbon capture utilisation and storage (CCUS); hydrogen and ammonia economics benchmarking; new GT cycles and process integration; materials challenges for the implementation of exhaust gas of sCO₂ cycles; additive manufacturing component quality control/assessment; enclosure standard for hydrogen; hydrogen readiness assessment process; and several cooperation opportunities with external organisations. These topics will be discussed at ETN's relevant Working Group meetings.

If you would be interested to participate in any of the ETN activities and initiatives, please contact the <u>ETN office</u> indicating which initiative you would be interested to join.