

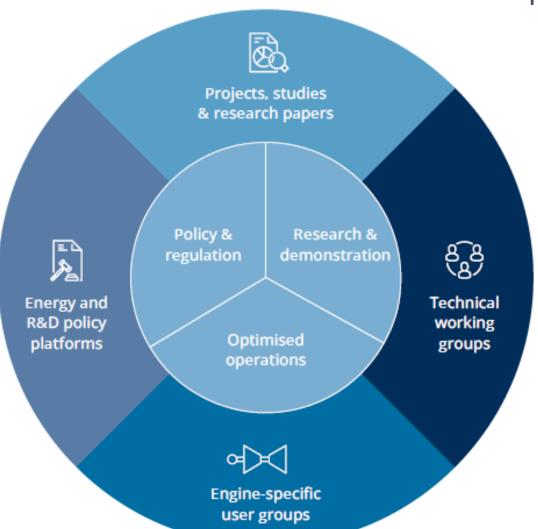
Current ETN activities

Christer Björkqvist, Managing Director, ETN Global

ETN Global

Global cooperation for safe and affordable dispatchable carbon-neutral energy solutions







- Non profit association with 120 member organisations:
 - ✓ Utilities, Gas companies, Industrial users
 - ✓ Gas turbines OEMs
 - √ suppliers and service providers
 - √ consultancies
 - ✓ research institutes and universities



- 22 countries: Europe, Asia, & North America
- 1900+ Participants



889

Technical working

groups

Policy &

Engine-specific user groups

Energy and R&D policy

platforms





ETN response to the REPowerEU Plan and the Winter Preparedness Package – Aug 2022



Objective: to highlight additional available options to meet the urgent short-term power and heat needs,

while maintaining progress on the long term 'net-zero' priorities to make European energy systems and industry more resilient and efficient.

Highlighting short-term and mediumlong terms measures



ETN - the gas turbine industry response to the REPowerEU Plan and the Winter Preparedness Package

02 August 2022

The intention of this document is to support EC ambitions and to expand the available options to meet the urgent short-term power and heat needs, while maintaining progress on the long term 'net-zero' priorities to make European energy systems and industry more resilient and efficient

Recent events, most notably the war in Ukraine, have led to a seemingly permanent shift in the world context for energy supply, with the potential to become a global energy supply orisis. Security of supply has become the near-term priority for most of the governments, especially in Europe, due to the dependency of many EU states on Russian energy imports, the impact of the geopolitical uncertainty and international sanctions in response to the war in Ukraine and the urgent need to ensure adequate supplies for the upcoming winter.

In response, decisive actions and regulatory changes for the energy sector have been taken by the governments in recent months with four clear objectives:

- to increase security of supply resilieno
- ii) to increase energy independency from Russia
- iii) to save natural gas by reducing its demand for the upcoming winter, and
- iv) to constrain the rise in energy pric

These actions and regulatory changes are reflected in the <u>REPowerEU Plan</u> published on 18 May 2022, as well as in the <u>Winter Preparedness Package</u>, published on 20 July 2022: outlining available tools and strategic measures to reduce the dependency of European nations on Russian-supplied fossil fuels, mainly natural cas.

As an established association representing the entire gas turbine value chain including endusers in the power and industrial sectors, ETN Globals has reviewed these plans and considers that our industry can play a significant role in supporting the strategic objectives (i.e. the provision of new gas imports and the associated impacts on existing infrastructure or new infrastructure requirements; the diversification, setting minimum mandatory gas storage levels; as well as accelerating the implementation of renewable energy supplies and energy efficiency measures). However, as we believe that such role is not fully reflected in the Plan, we call on the European Commission and Member States to take into consideration the following measures to provide additional contributions and savinos:

- Natural gas and other suitable fuels identified for power generation and heat should first bely
 focused on the plants that provide critical energy services (i.e., grid stability, critical heat subject of the plants that provide critical energy services), and then on the most efficient power plants
 (e.g., those which can be incentivised to operate at full capacityfimaximum efficiency in combined
 cycle configuration) to ensure the maximum output for the minimum fuel used. This could save 2-5
 born p.a. compared to current practice.
- The gas turbine and end-user community could incrementally save a further 0.1-0.2 born p.a of gas by improving the efficiency (e.g., through equipment upgrades) of the existing gas turbine fleets for power generation, heat and industrial processes. These upgrades are achievable in scheduled maintenance cycles if appropriate regulatory mechanisms are adopted to incentivise them. This will also bring a CO2 saving benefit to support furopean decarbonisation ambitions.
- To further reduce the dependence on Russian natural gas, beyond that possible through the expansion of indigenous conventional/unconventional sources and increased imports, the gas turbine community could reduce its dependence on natural gas supplies, saving 5 born natural gas

ETN a.i.s.b.l. Chaussée de Charleroi 146-148/20, 1060, Brussels, Belgium p.a., if alternative hough is are used in the short term. This would exploit the fuel fexibility of gas under the short term is the short term. This would exploit the fuel fexibility of gas under the short term of the use of liquid terms of the use of liquid terms. The short terms of the use of liquid terms of the short terms of the s

Beyond those urgent short-term measures which will save a significant amount of natural gas, the gas turbrise community can and must also play a strategic role in the decarbonised energy future, providing carbon-neutral dispatchable power by using H2 and other clean gases for power generation, heat and industrial processes. The existing gas surbine fleet can be retrofitted to use high levels of these clean gases with the natural gas supply being completely replaced in some cases. In 2000 this could potentially save a further 30 bcm p.a. while delivering 150 TWh electricity per year. For this, "H1to Power 8 Heat and Clean Gases to Power 8. Heat projects need to be incentivised in addition to incentives for the production and transport of these clean gases. Only when clean gas production and demand are well coordinated and balanced, can the EU start to take advantage of this new clean and innovative energy industry. Additionally, post-combustion carbon capture and -storage (CCS) might be fitted to gas power plant to provide energy efficient, clean power in the short-to medium term.

The current energy supply crisis has shown that focusing on conventional renewable growth alone is insufficient for the EU to create a resilient and carbon-neutral energy future due to the intermittency of most renewable energy technologies and the slow growth of large-scale energy storage options. If rapid progress is to be delivered, more carbon-neutral dispatchable power & heat production is required to balance electricity grids, to meet demand peaks and to offset the intermittency and supply variability of most renewable options. To achieve this, we need a diversified clean fuel production portfolio to reduce excessive dependence on single energy sources in the future. Such clean fuels, along with all additional indigenous conventional and unconventional gas supplies are also essential for the rapid scale-up of hydrogen production through steam methane reforming combined with CCS which is essential to meeting European net-zero targets.

For the gas turbine community to deliver these solutions, the required regulatory framework needs to be a priority for the current and future actions of EU policy makers, if the proposed sustainable energy solutions are to become a reality.

The gas turbine community recognises that the short-term urgency to ensure security of supply will require the rapid deployment of available, more polluting options, such as coal-fired generation. While this is a necessary emergency response to protect EU economies and societal well-being, we cannot afford this to continue beyond the early stages of the response due to the well-established climate impacts. It is essential that our future climate is not penalised by this crisis. The rapid provision of a fitfor-purpose regulatory and incentivisation framework is required for the faster development of carbonneutral dispatchable energy solutions. This will enable the EU to bring forward its carbon neutral targets by some years, so that the absolute CO_cemissions over the period to 2050 remain as set out in the plan established prior to the Russian/Utraine war or may even be further reduced.

ETN is available to provide supporting information on the short-term impact as well as further information on the wide and important contributions that gas turbine technology could provide in a net-zero society (referencing ETN Global vision paper).

Yours sincerely

Pedro Lopez, ETN President

Christer Björkqvist, ETN Managing Directo

ETN a.i.s.b.l.
Chaussée de Charleroi 146-148/20, 1060, Brussels, Belgium
Tel: +32 (0)2 646 15 77 www.etn.global info@etn.global

Key messages in the response



Short-term measures

- 1. Gas and other suitable fuels identified for power generation & heat should first be used in:
 - a. plants that provide critical energy services (i.e., grid stability, critical heat supply, critical infrastructure, essential transport services), and then on
 - b. the most efficient power plants (e.g., those which can be incentivised to operate at full capacity/maximum efficiency in combined cycle configuration) to ensure the maximum output for the minimum fuel used. **Potential savings 2-5 bcm p.a**
- 2. Improving the efficiency (e.g., through equipment upgrades) of the existing gas turbine fleets for power generation, heat and industrial processes. **Potential savings: 0,1- 0,2 bcm p.a of gas**
- 3. Additional use of conventional/unconventional sources (dual fuels) like liquid fuels, biogas or other process-derived gases. **Potential savings: 5 bcm**

Medium/ long-term measures

Shifting to carbon-neutral dispatchable power by using H2 and other clean gases for power generation, heat and industrial processes. **Potential savings in 2030 onwards: 30 bcm p.a**

Supportive regulatory framework required!

EU Platforms and initiatives

ETN Gl@bal

ETN's active participation for dissemination and future R&D project opportunities

- SET Plan (Strategic Energy Technology Plan)
 - Action 5 New Materials and Technologies for Buildings
 - Action 6 Energy Efficiency for Industry
 - Action 9 Carbon Capture and Storage (cooperation with ZEP)

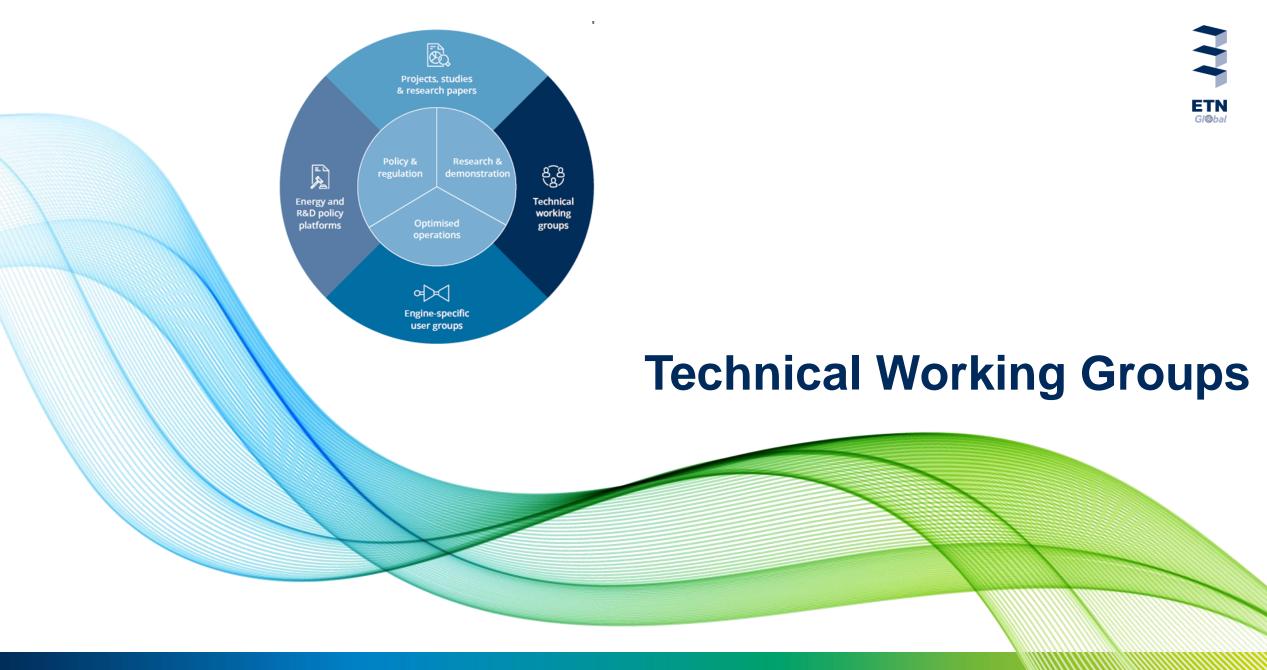


- Working Group 3 Flexible generation
- BRIDGE (coordinating energy research and innovation projects across the EU) – active through ROBINSON



Clean energy for EU Islands – active through ROBINSON





ETN Key Topics, WG's and Projects



Air filtration WG

Hydrogen WG

Energy efficiency
Part-load efficiency
New cycles

Security of supply

Afford-

ability &

Access

sCO₂ WG



Operational optimization SGT-A35 & LM-2500 User groups

Fuel Flexibility

Low-carbon/carbon-free fuels

Decentralised energy system solutions

Robinson

Flex Confu

AM Machine Evaluation Project

Additive 3D Manufacturing WG

CCS/CCUS solutions

Net-zero

Decentralised Energy solutions WG

CCS Taskforce

Hydrogen Working Group

Chair: Peter Kutne, DLR

Co-Chair: Geert Laagland, Vattenfall

Objectives:

Accelerating the development and use of hydrogen-based gas turbine technology by:

Identifying potential barriers, and exploring:

Economic aspects & business cases

Retrofit solutions for high hydrogen-content fuel Safety aspects

Demonstration Operational issues/effects on GT components

Research needs

 Exploring cooperation opportunities to ensure safe, reliable and cost-efficient solutions for existing and future fleets

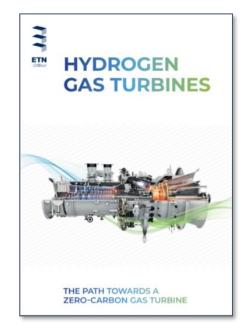
Activities:

- Taskforce "GT Enclosure standard for hydrogen fuel" with the objective to develop an ISO safety standard
- Techno-economic study (Young Engineers Committee) accomplished & published
- Review paper "Addressing the combustion challenges of Hydrogen addition to Natural Gas" – finalised

Working Group



The path towards a Zero-Carbon Gas Turbine Published in January 2020



Download at etn.global/hydrogen-report

Air Filtration Working Group

Chair: Olaf Brekke, Equinor

Co-Chair: Dominique Orhon, Total Energies

Objectives:

Improve the quality and flexibility of Air Filtration systems by:

- Allowing the users to have a single point of reference for state-of-the-art filtration technology
- Addressing air filtration issues through projects of common interest

ETN liaison members of:

- ISO/TC142 "Cleaning equipment for air and other gases"
- ISO/TC 192 "Gas Turbines"

Activities:

 Development of ETN standard is for test methods of air intake filter systems for rotary machinery in offshore applications (harsh environment)

Working Group







Additive Manufacturing Working Group

Chair: Ulli Klenk, Siemens Energy

Co-Chair: Jan de Roos, Shell



AM Best Practices Published in 2019

ADDITIVE MANUFACTURING

Objectives:

Strengthen the between stakeholders cooperation the turbomachinery value chain on additive manufacturing (AM) topics by:

- Exchanging knowledge and experiences focusing on the added value of AM
- Cooperating on AM practices for applications in the energy sector

Activities/ Projects:

Additive Manufacturing Machine (L-PBF) Evaluation Initiative

Objective to better understand the capabilities and boundaries of the technology for the energy industry by reviewing market-available solutions, with the ultimate goal to provide supportive ground to push these limits further. More info

Download at etn.global/ETN-AM-Best-Practices













Supercritical CO₂ Working Group

Chair: Marco Ruggiero, Baker Hughes

Co-Chairs: David Sánchez, University of Seville; Albannie Cagnac, EDF

Objectives

Develop, enable and optimise the use of supercritical CO₂ power cycles by:

- Highlighting potential use, applications and benefits
- Addressing operational issues/effects on components (turbomachinery, heat exchangers and combustion systems) related to the use of sCO₂; as well as operational safety aspects
- Exploring market opportunities
- Exploring strategic alliances internationally to gain economies of scale worldwide
- Paving the way for funding opportunities by highlighting the research needs on sCO₂

Activities

- Survey on sCO₂ accomplished at the beginning of 2022
- Temporary focus on the sCO₂ bottoming cycle for off-shore applications; two ASME papers will be produced on this topic

Working Group



Business case for sCO₂ Waste Heat Recovery System Published in October 2020



Download at etn.global/sco2-whrs-case

Decentralised Energy Systems WG

Chair: Peter Breuhaus, NORCE

Co-Chair: Enrico Bianchi, Ansaldo Energy Green Tech

Objectives:

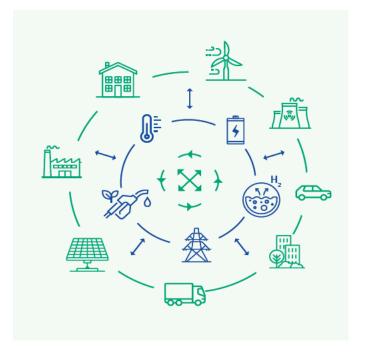
- Bring together stakeholders of the value chain for decentralised energy system solutions with dispatchable micro and small gas turbines
- Explore market opportunities and solutions
- Accelerate the development of cost-efficient integrated secure technology solutions
- Gas turbine integration into decentralised sustainable energy systems and its interactions with other systems components

Activities:

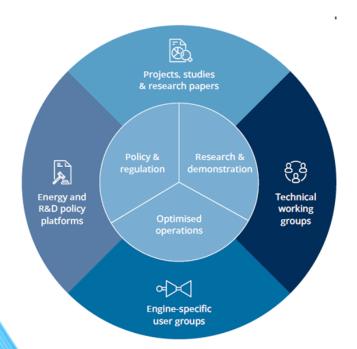
- Report on "Decentralized Energy Systems: Towards Carbon-Neutral Energy Solutions for Gas Turbines" to be presented at AGM in March 2023:
 - Chapter I on "Decentralised Energy Systems: a State of the Art"
 - Chapter II on "Integrating Gas Turbines Technologies to DES: a New Challenge"

Working Group





Source: EU strategy on energy system integration, July 2020





Engine Specific Engine Groups

ETN Engine specific User Groups In person meetings 2023





SGT-A35 USER Group 2023 meeting

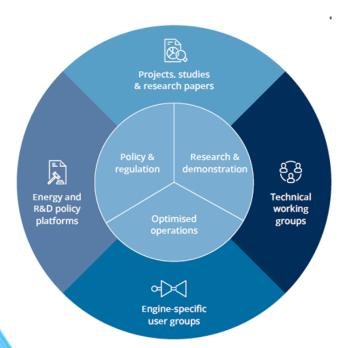
(9th & 10th) or (10th & 11th) of May 2023 Aberdeen, Scotland

SGT-A35, Equinor, Stavanger May 2022



LM2500, Total Energies Aberdeen 2022

LM2500 USER Group 2023 meeting (6th & 7th) or (7th & 8th) of June 2023 BP, London, UK





Project Studies and Research papers

ETN Projects





2021-2025 ETN's role: coordination, dissemination and communication activities



2020-2024 ETN's role: coordination, dissemination and communication activities



2020-2024 ETN's role: dissemination and communication activities



2022 AM Machine Evaluation Project



co2olheat-h2020.eu







robinson-h2020.eu









flexnconfu.eu









etn.global



These projects have received funding from the European Union's Horizon 2020 research and innovation programme: PUMP-HEAT: GA 764706; FLEXnCONFU: GA 884157; ROBINSON: GA 957752; CO20LHEAT GA101022831

ETN R&D Recommendation Report

Edition 2021 to be updated in 2023

Topics: Market conditions & policy framework

Operational flexibility

High efficiency (also at part load)

Extended fuel spectrum

Emissions

Decarbonisation

Advanced cycles

System integration and energy storage

Decentralisation

Materials

Advanced repair

Digitalisation

Reliability, availability, maintenance

Sensors & instrumentation

Condition monitoring & lifing

Power Generation



Systems integration

Decentralised systems

Flexibility (Fuel & Operation)

Digital solutions



Industrial

Cooperation for a successful energy transition!







Access to

GT Experts



Standardisation, Best Practice Guidelines, Feasibility Studies, R&D Projects and more



ETN Educational

Educational Courses

Tailor-made courses in areas of importance to the Users, given by selected experts from the R&D and industry community

High Level User Meetings

Take part in the yearly High Level
User Meeting to discuss issues
of strategic importance to the
GT market, with both O&G
and Power Generation
industries



Participate in ETN and GTUsers.com User Group Meetings on specific engines



₹ETN NEWS

ETN Global is a non-profit association bringing together the entire value chain of the gas turbine technology community. Through cooperative efforts and by initiating common activities and projects, ETN encourages and facilitate information exchange and cooperation to accelerate research, development, demonstration, and deployment of safe, secure and affordable carbon-neutral energy solutions by 2010.

ETN's new R&D Recommendation Report published

INSIDE THE NETWORK:
New members;
Gas turbines: an enabling technology for a carbon-neutral society— ETN's rew publication

ETN AT WORK:
ETN's ISTC 'Gas turbines in a carbon-

Additive Manufacturing L-PBF Machin Evaluation Initiative; New CO2OLHEAT project launched; ETN is recruiting

Baker Hughes; ROBINSON project & ETN's new Dece

Interview with Rolf Andre Leidland,

IEA's roadmap to net zero emissions

tralised Energy Systems Working Group.



to a sustainable society

The recent natural disasters with the unpreceder

flooding in Europe and China as the latest example have reinfrored beliefs of the sugnery to address climate charge. Parallel the panderic has ripped through countries with the force of a universal fall wave, leaving behind profound socio-economic destruction. This provides an opportunity for both a sustainable recovery and an acceleration of the energy transition. The European Union is planning to use this occasion and recently announced its largest recovery and stimula, package over financion of Europe, with a budget of over package ever financion of Europe, with a budget of over

From a research and exput primo desired with surface confidence.

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technology for a carbon-neutral so and our "Research and Developme Recommendation Report". The Signific

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