Project Board Activities 2018

PETER JANSOHN

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ETN Project Board 2018-2020

Peter Jansohn (chair)
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BHGE, IT

Olaf Bernstrauch
Siemens, DE

Grant Terzer
Capstone, US

Chris Dagnall
DNV-GL, UK

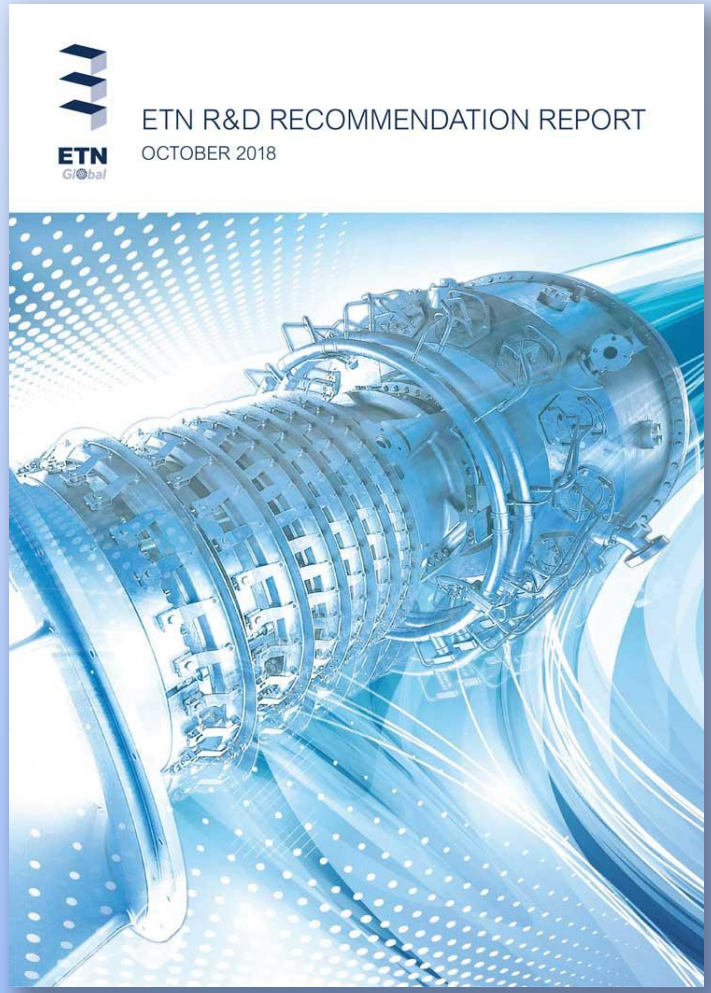
Rene Vijgen
Sulzer, NL

Project Board

Tasks, duties:

- Advise on how to maximise potential of joint initiatives
- Provide guidance in the development of project proposals
- Recommend the initiation of projects to the ETN Board
- Bi-annual state-of-the-art R&D report and recommendations

ETN Global



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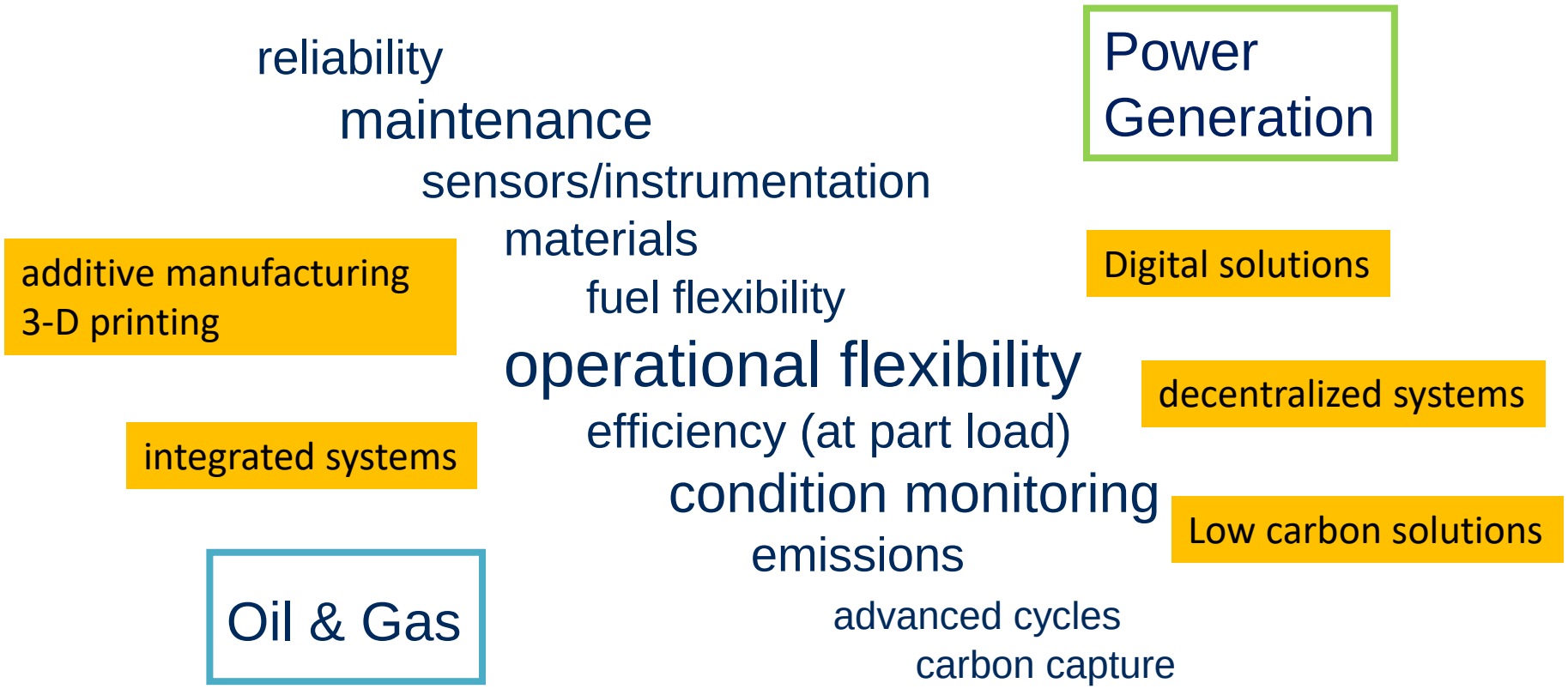
R&D Report
Edition 2018



Operation in harsh environment

'Cold' corrosion
- Coatings
- Water wash
- Materials selection

Hot corrosion
- Coatings
- Materials selection

Filtration

Flexibility

Start ; ramp ; min/max load

Transients/Stabilisation

Ancillaries services

Digitalisation

Condition monitoring

Data management

Optimisation of maintenance intervals

Life predictive modelling

Energy Efficiency and Emissions

Part load

Minimum load

Maximum load

Reliability

Reliability of the total system

Cost Optimisation

CAPEX & OPEX

Control Systems Obsolescence

Preservation of GTs & Plant

Advanced Cycles

(Green) Hydrogen

H_2

Ammonia

Mixing/blends

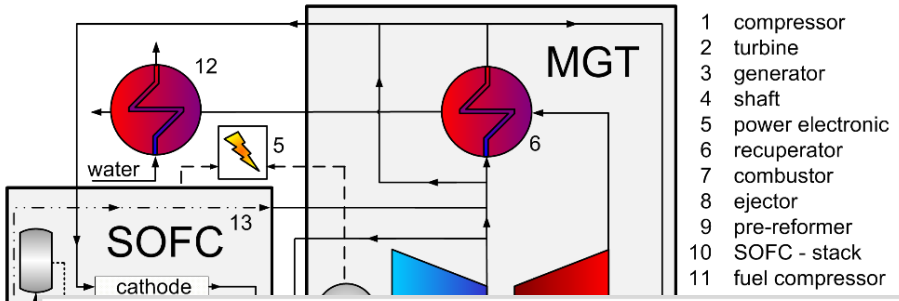
Market Conditions / Political Boundaries

5 main issues / topics

(with a strong influence on gas turbine technology development, gas turbine sales and gas turbine deployment/use)

- Economic environment for oil & gas business
- Integration of (large amounts of) renewable energy sources
- Operating conditions of gas turbine based power plants
- Decentralised electricity production
- CO_2 / climate change

R&D Activities & Topics



1 compressor
2 turbine
3 generator
4 shaft
5 power electronic
6 recuperator
7 combustor
8 ejector
9 pre-reformer
10 SOFC - stack
11 fuel compressor

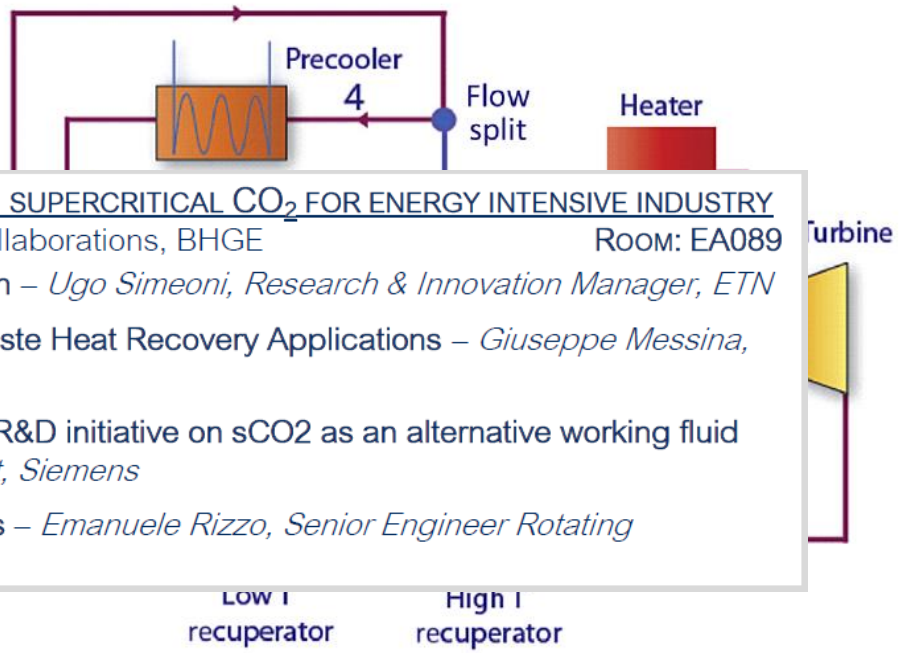


Fig. 4 – S-CO_2 recompressing cycle layout. S-CO_2, supercritical CO_2.

TECHNICAL COMMITTEE 1: NEXT GENERATION POWER CYCLES: SUPERCRITICAL CO_2 FOR ENERGY INTENSIVE INDUSTRY

Chaired by Marco Ruggiero, External Funding & Research Collaborations, BHGE — ROOM: EA089

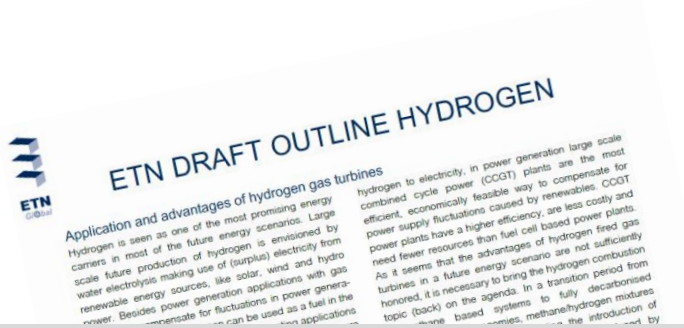
Horizon 2020 call: Industrial (Waste) Heat-to-Power conversion – *Ugo Simeoni, Research & Innovation Manager, ETN*

Demonstration of Supercritical CO_2 Cycles Technology for Waste Heat Recovery Applications – *Giuseppe Messina, Project Process Engineer, ENEA*

Supercritical from heat to power: CARBOSOLA - the German R&D initiative on sCO2 as an alternative working fluid for waste heat recovery – *Michael Wechsung, Principal Expert, Siemens*

Turbomachinery challenges for supercritical CO_2 applications – *Emanuele Rizzo, Senior Engineer Rotating Machinery, BHGE*

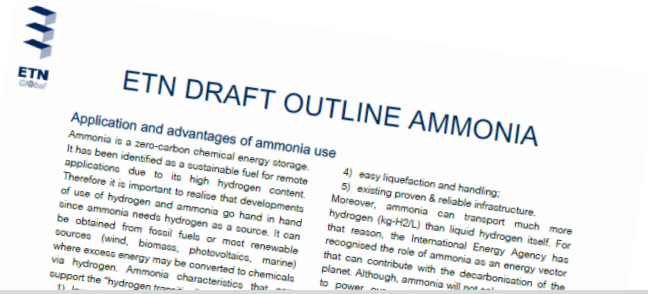
R&D Activities & Topics


ETN DRAFT OUTLINE HYDROGEN

Application and advantages of hydrogen gas turbines

Hydrogen is seen as one of the most promising energy carriers in most of the future energy scenarios. Large scale future production of hydrogen is envisioned by water electrolysis making use of (surplus) electricity from renewable energy sources, like solar, wind and hydro power. Besides power generation applications with gas

hydrogen to electricity, in power generation large scale combined cycle power (CCGT) plants are the most efficient, economically feasible way to compensate for power supply fluctuations caused by renewables. CCGT power plants have a higher efficiency, are less costly and need fewer resources than fuel cell based power plants. As it seems that the advantages of hydrogen fired gas turbines in a future energy scenario are not sufficiently honored, it is necessary to bring the hydrogen combustion topic (back) on the agenda. In a transition period from


ETN DRAFT OUTLINE AMMONIA

Application and advantages of ammonia use

Ammonia is a zero-carbon chemical energy storage. It has been identified as a sustainable fuel for remote applications due to its high hydrogen content. Therefore it is important to realise that developments of use of hydrogen and ammonia go hand in hand since ammonia needs hydrogen as a source. It can be obtained from fossil fuels or most renewable sources (wind, biomass, photovoltaics, marine) where excess energy may be converted to chemicals via hydrogen. Ammonia characteristics that support the "hydrogen transition"

4) easy liquefaction and handling;
5) existing proven & reliable infrastructure.

Moreover, ammonia can transport much more hydrogen (kg-H2/L) than liquid hydrogen itself. For that reason, the International Energy Agency has recognised the role of ammonia as an energy vector that can contribute with the decarbonisation of the planet. Although, ammonia will not

TECHNICAL COMMITTEE 2: GAS TURBINES OPERATIONAL AND FUEL FLEXIBILITY — ROOM: PLENARY

Chaired by Peter Kutne, Head of Department Gas Turbine, DLR

PUMP HEAT - Performance Untapped Modulation for Power and Heat via Energy Accumulation Technologies
Alessandra Cuneo, Project Manager, RINA-C

Horizon 2020 call: Integrated solutions for flexible operation of fossil fuel power plants through power-to-X-to-power and/or energy storage – *Alessandra Cuneo, Project Manager, RINA-C*

Creating a CCU CO2 hub in Greece – From Power-to-X To Power-to-X-to-Power – *Kostis Atsonios, Research Associate, CERTH*

Hydrogen Working Group


- The high reactivity of hydrogen ... the auto ignition risk in the premixing section ... needs to be addressed in future combustor development
- The targeted high TITs do not allow for higher air to fuel ratios which would help to reduce the reactivity of H2 flames
- Hydrogen flames exhibit a different thermoacoustic behaviour and therefore require different measures to avoid high pressure pulsations
- In the transition to a hydrogen based energy system fuel flexible gas turbines are needed to utilise blends of hydrogen and other gaseous fuels e.g. natural gas

- Strategies ... hydrogen content in the ... have to be developed
- Cost effective retrofit solutions have to be developed to allow for a fast transit to a technology capable of higher hydrogen fuel contents and to fulfil customer's needs
- Safety related topics of the overall system have to be investigated.

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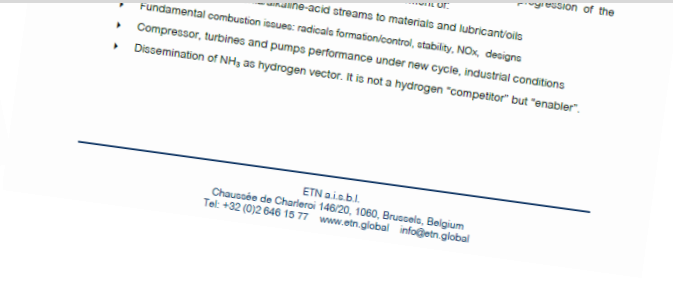
- Fundamental combustion issues: radicals formation/control, stability, NOx, designs
- Compressor, turbines and pumps performance under new cycle, industrial conditions
- Dissemination of NH_3 as hydrogen vector. It is not a hydrogen "competitor" but "enabler".

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R&D Activities & Topics

TECHNICAL COMMITTEE 3: ADDITIVE MANUFACTURING — ROOM: BIGORRE & OSSAU

Chaired by John Oakey, Professor of Energy Technology, Cranfield University

AM-Motion benefits and trends of AM in Europe – *Paula Queipo, External Relations Director, Prodintec*

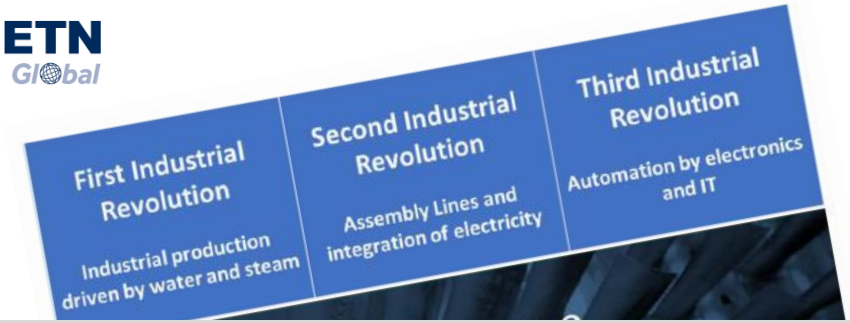
ETN AM research roadmap – *Ferenc Pankotai, Manager Combustion Engineering and AM, Solar Turbines*

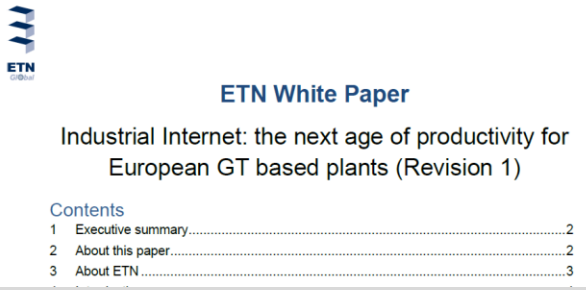
3D Printing a Pump Impeller – Specification, Testing and Acceptance Criteria – *Jan de Roos, Senior Rotating Equipment Engineer, Shell*

ETN Additive Manufacturing Working Group – Benchmarking Initiative – *Steve Nardone, Project Manager Metal Additive Manufacturing, ENGIE*

ETN AM Equipment Database – *Valentin Moens, Technical Project Officer, ETN*

R&D Activities & Topics





ETN White Paper

Industrial Internet: the next age of productivity for European GT based plants (Revision 1)

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TECHNICAL COMMITTEE 4&5: GAS TURBINE COMPONENT LIFE ASSESSMENT — ROOM: EA011

Chaired by Chris Dagnall, General Manager, DNV-GL Energy

Expectations of an operator on gas turbine components life assessment – *Jean-Louis Meyer, GT Senior Engineer, EDF*

Accessing Remaining Life of Critical Gas Turbine Parts – *Stefan Reh, Head of Test and Simulation for Gas Turbines Department, DLR*

Methodology to assess the remaining life of gas turbines components – *Ambra Giovannelli, Dr. Fluid Machinery, University of Roma TRE*

Predictive tools for gas turbine maintenance decision support – *Valentina Zaccaria, Assistant Professor in Energy Engineering, MDH*

Maintenance interval extension for gas turbines – methodology and cases – *Sigrid Gijbels, Thermal Generation Lab Manager, ENGIE*

processes

Figure 2: Knowledge Management

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Research and Development

ETN involvement in the EU Energy and Research Roadmap to a low carbon economy

- Active involvement in EU Technology and Innovation Platforms (ETIP)
  - Renewable Heating and Cooling Platform (RHC)
  - Smart Networks for Energy Transition (SNET)
  - Zero Emission Platform (ZEP)

- ETN provided comments and input to the Strategic Energy Technology Plan

European Technology and Innovation Platform "Renewable Heating and Cooling"

ETN ETIP RHC representative in the Biomass Panel

- Peter Kutne (DLR)

RHC Renewable Heating & Cooling
European Technology and Innovation Platform

ETN activities 2017-18

- Provided comments on the Biomass Technology Roadmap
- Provided comments on the Strategic Research Priorities for Solar Thermal Technology

European Technology and Innovation Platform "Smart Networks for Energy Transition"

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ETIP SNET
EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM
SMART NETWORKS FOR ENERGY TRANSITION

Working Groups

WG1
Reliable, economic and efficient smart grid system

WG2
Storage technologies and sector interfaces

WG3
Flexible Generation

WG4
Digitisation of the electricity system and Customer participation

WG5
Innovation implementation in the business environment

NSCG
NATIONAL STAKEHOLDERS COORDINATION GROUP

ETN representatives

Governing Board

- Rob Versteirt (ENGIE)

WG3 Flexible Generation

- Peter Breuhaus (IRIS)
- Peter Jansohn (PSI)
- Iarno Brunetti (ENEL)
- Olaf Bernstrauch (Siemens)

Activities

ETIP SNET Implementation Plan 2017-2020

- Topic 33 - Developing the next generation of flexible thermal power generation
- Topic 34 - Adaptation and improvement of technologies to novel Power-to-Gas and Power-to-Liquid concepts

ETIP SNET Vision

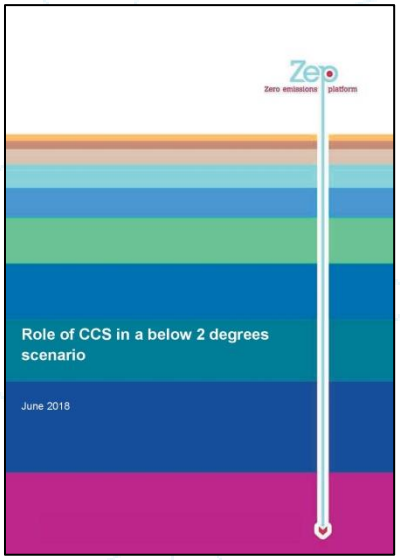
European Technology and Innovation Platform "Zero Emission Platform"

Temporary Working Groups (TWG)

Network Technology	Network Policy & Economics	External Relations Group
TWG Collaboration across the CCS chain	TWG Policy and Funding	
TWG Role of CCS in below 2°C scenario	TWG PCIs	
TWG CCU and Sink Factor Methodology		

Key priorities

1) Deployment and commercialisation of CCUS;
2) CCU;
3) Engagement with EU and MS;
4) Influence stronger policy support;
5) CCUS financing.



ETN involvement in the SET-PLAN

SET-Plan Action 4 WG– Increase the resilience, security and smartness of the energy system:
temporary working group as part of the ETIP SNET.

SET-Plan Action 5 WG– New materials and technologies for buildings:
ETN proposal - increase the energy efficiency in the buildings by installing micro gas turbine based systems. Approved & included in the Implementation Plan

SET-Plan Action 6 WG – Energy efficiency for industry:
implementation plan will be periodically revised; identify cooperation activities funded by the Member States. Workshop (co-organised by ETN) held on 27-28 June 2018.

SET-Plan Action 9 WG– Carbon Capture Utilisation and Storage:
ETN initiative - supercritical CO2 is part of the Research and Innovation activities.

Oil and Gas Climate Initiative

OIL AND GAS CLIMATE INITIATIVE

Delivering solutions for a sustainable low-emissions future

Key objective to reduce the greenhouse gas emissions

- Energy efficiency waste heat recovery
- Low carbon technology solutions
- CCUS CO_2 recycle

Projects and Projects Initiation

Based on expression of interest from the ETN membership community

Project Board

ETN Office

Guidance & Support
Quality assurance
Business case

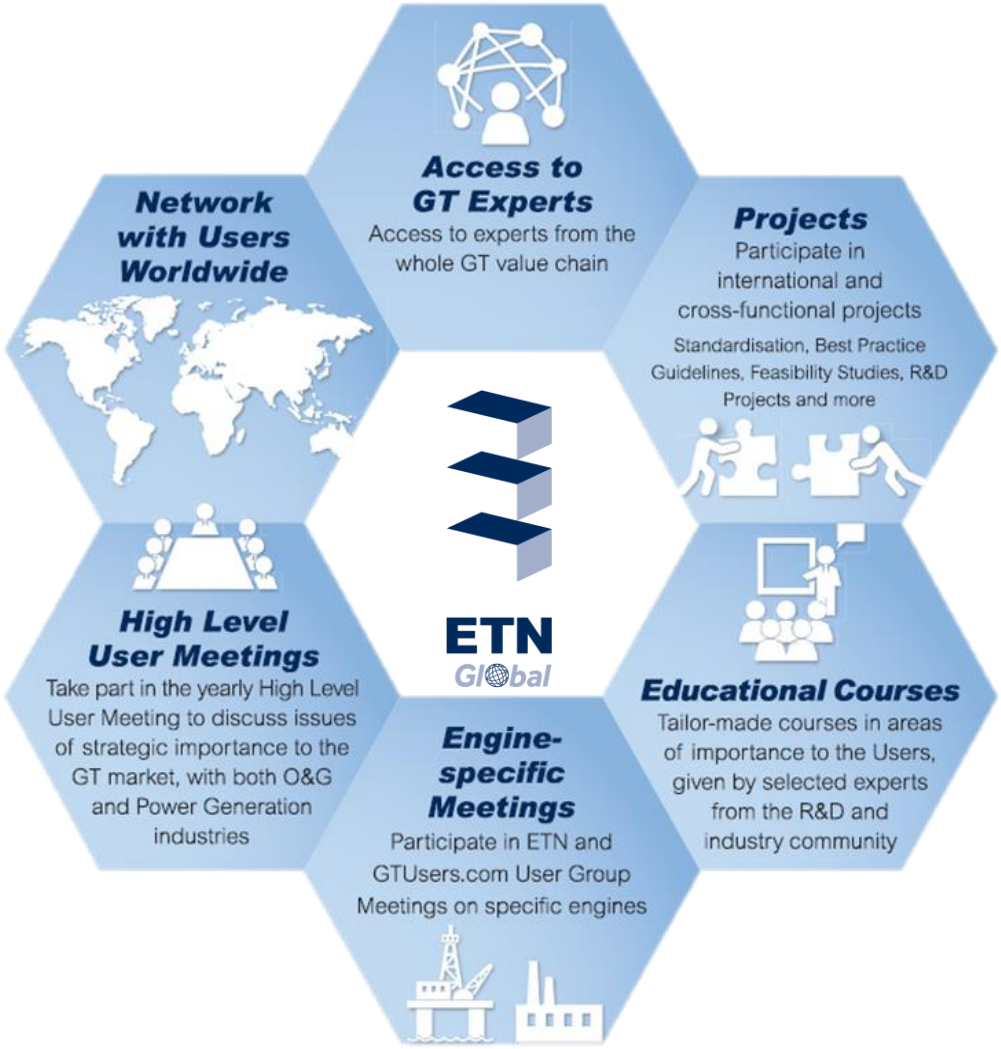
Initiation of ETN project development process

Focused High Quality Projects

Dissemination by ETN

Type of activities:

- R&D Projects
- Feasibility Study
- Best-Practice-Guidelines
- Development of Standards
- Position papers



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