Newsletter

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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 facilitates information exchange and cooperation to accelerate research, development, demonstration, and deployment of safe, secure and affordable carbon-neutral energy solutions by 2030.

IN THIS ISSUE

Christer Björkqvist
Managing Director

Wake-up call to revise the foundation for net-zero transition roadmap

The global energy landscape is undergoing profound changes with volatile, complex market & supply situations, in parallel with an increased urgency to decarbonise to meet our 2030 goals and 2050 net zero targets.

At ETN's annual High-Level-User Meeting (HLUM), held in September, the wider user community confirmed its commitment to substantial carbon reductions by 2030 and to become carbon-neutral between 2035-2050. The meeting started with a holistic review of the International Energy Agency net-zero transition scenario as well as of current energy policies that are at the heart of the energy crisis although intensified by the Russian/Ukraine war. ETN's President, Pedro Lopez (Uniper) also called for a wake-up call, referring to the rapid need of a fit-for-purpose regulatory and incentivisation framework for power & heat back-up capacity to variable renewable sources and for faster transition to carbon-neutral dispatchable energy solutions, where especially carbon capture & storage and low carbon gases, can play a decisive role. Relying only on conventional renewables (non-dispatchable technologies) and batteries is totally insufficient to deliver a resilient, secure and future oriented energy system.

The President of the European Commission Ursula von der Leyen has recently presented a series of new initiatives & proposals for EU energy policies, including planned price caps, additional taxes on energy producers, establishment of a new European hydrogen bank, and incentives for increased electrifications. Still, a realistic long-term energy policy where numbers add up both in the short-term and in the medium-to-long-term is still missing. With the scheduled coal phase-out and increasing variable renewable power around the corner, parallel with a gradually increasing electricity demand there is an urgent need for a policy that fully takes this into account. The silver lining of this energy crisis is that it creates an opportunity to revise the foundation for a net-zero transition roadmap, which in a holistic and balanced way considers the three core aspects of the energy trilemma: affordability; security of energy supply; and sustainability. Such solid foundation will be key to establish a stable long-term climate policy that can both overcome the energy crisis and accelerate the path towards a sustainably decarbonised energy landscape. ETN is the perfect platform to both define viable pathways and to ensure a cost-effective and timely delivery of the required technical developments.

As highlighted in our last Quarterly Newsletter, Volume 2022, Issue 03, ETN has already communicated to policymakers the significant role that our industry can play in supporting the EU's strategic objectives. Commissioner Simson has welcomed our suggestions and informed us that they will be studied in detail within her Cabinet. This is very promising news, and we will continue this dialog. Additionally, we will also engage in discussions with international modelling and scenario agencies highlighting pathways that can enable a stable energy transition with constant carbon reductions.

ETN has already started the process of creating a portfolio with promising pathways for different sectors and applications. At our October Workshop in Berlin the needs and requirements of the gas turbine user community, collected at our HLUM, were discussed with experts from the whole value chain. The next step is to further explore these demands and inputs within our Technical Working Groups aiming to create a more detailed roadmap with clear timelines for the selected gas turbine related pathways which can both be disseminated to policy makers and the R&D community.

The President of the European Parliament Roberta Metsola recently called for giant leaps to replace small steps in the battle to overcome the energy crisis. Therefore, it is more important than ever to ensure these leaps are on the right pathways. I welcome active support and cooperation both in the mapping process as well as to overcome technical barriers and accelerate the time to market for carbon-neutral gas turbine solutions.

IGTC 2023: Call for papers

ETN's 11th International Gas Turbine Conference (IGTC) "The role of gas turbines in the energy transition and a carbon-neutral society" will take place on 10-12 October 2023 in Brussels, Belgium.

IGTC 2023 Conference Advisory Board welcomes the submission of papers by 07 December 2022 in the following gas turbine research areas and application fields:

- Technical papers describing technology advances and innovative solutions
- Review papers giving a comprehensive technology overview of the past 2 years
- **Case study papers** describing recent experiences

Submitted papers should be relevant to the gas turbine user community and deal with one or several of the five categories detailed below (ETN's R&D 2021 report provides more information about the subjects):

Decarbonisation and emissions reduction

- Power-to-X-to-power technologies
- Retrofit and newly built H_2 power plants
- Integration of GT hybrid solutions
- GT advanced cycles (wet cycles, sCO_2, exhaust gas recirculation, hybrid cycles, integration of storage solutions, heat pumps etc.)
- Environmental life cycle assessment
- Emission reduction on existing gas turbines
- Decentralisation and distributed generation
- Carbon capture and storage
- WHR (Waste Heat Recovery)
- Additive Manufacturing for Energy Transition
- …

Flexibility

- Extended fuel spectrum (hydrogen, biomass, ammonia, LNG/LPG…)
- Operational GT flexibility
- Maintenance flexibility
- Emission at flexible load and cycling
- Efficiency at partial and minimum load conditions
- Reliability (material and life impact)
- Plant and system flexibility
- …

Digitalisation

- Condition monitoring and lifing
- Digital engine modelling, digital twins
- Plant and system integration
- Integration in virtual power plant
- Data management, architecture & security
- Artificial Intelligence and data driven design
- …

Asset optimisation through life cost

- Overall system efficiency
- Condition-based maintenance
- Extension of service intervals and total engine life
- Component lifing
- Predictive maintenance
- Sensors & instrumentation
- New component developments
- Additive manufacturing and repair
- …

Economic, policy, market

- Economic impact on technical solutions in line with the market conditions and policy framework
- System analysis
- Emissions legislation
- Regulatory framework
- …

Deadline for abstract submission: **07 December 2022.**
More information about the call for papers is available **here**.

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About IGTC

The International Gas Turbine Conference (IGTC) is a well-established and renowned biennial conference. Its objective is to demonstrate the opportunities for our technology both in the energy transition as well as in a carbon-neutral society by highlighting the latest technical developments on the identified pathways by the user community.

The conference will provide an opportunity for the R&D community to meet and discuss with users and GT experts from around the world as well as policy makers. The conference highlights the energy market outlook in Europe and in key markets globally, as well as presents and disseminates current R&D activities and latest achievements for flexible, efficient, reliable, and environmentally sound gas turbine technology.

The keynote sessions and panel discussions will address critical issues related to climate change mitigation in the context of the different and fast changing markets. Special attention will be given to increased operational flexibility, fuel flexibility, retaining reliability and lower emissions for both single cycle and combined cycle operation. Energy policies that set boundary conditions and initiatives for GT technology development in Europe and globally will be presented, followed by panel discussions with distinguished experts and high-level policymakers.

In parallel, the technical sessions, critical research, and development activities necessary for the advancement of GT technology, from operational, environmental, and cost perspectives will be addressed. Recent GT technology and innovative solutions will be presented. The technical sessions will combine research initiatives, case studies and reports of real case applications, with the aim to give a balanced view of current developments and future needs for research in GT applications.

All our newsletter subscribers are invited to save the date for IGTC 2023, which will take place on 10-12 October 2023 in Brussels, Belgium and to visit our event webpage, which will be updated regularly. ■

Photo credit @Najib Samatar

New members

We warmly welcome Imperial College London (United Kingdom), UCLouvain (Belgium), Centrica Storage (United Kingdom), BASF (Germany) and Crosstown Power (Switzerland) who recently joined ETN Global. ETN currently has 121 members from 22 countries.

Imperial College London is a global top ten university with a world-class reputation in science, engineering, business and medicine. The Department of Mechanical Engineering has a distinguished tradition of excellence in teaching, research and practice, bringing together internationally leading staff, exceptional students and state-of-the-art facilities. Working in collaboration with industry and with the support of the research councils the department delivers world class research in many areas related to energy, storage, gas turbines and mechanics of materials.

UCLovain university offers courses in all disciplines, from bachelor's degree to doctoral degree level, as well as many lifelong learning programmes. The university offer an education fuelled by solid research. The university's drive to innovate is clear: €273 million in annual research investment, 356 projects funded by European framework programmes (as of 2021) and close relationships with the commercial world, particularly with the 275 companies in the university's two science parks.

Centrica Storage Limited (CSL) a wholly owned subsidiary of Centrica, which operates the Rough 47/3B offshore platform in the UK Southern North Sea and the Easington Gas Terminal that receives production gas from the Rough field and 3rd party production from the Tolmount gas field. The Rough gas field was operated as a gas storage facility until 2016, production facility from 2018 and has received approval in 2022 to revert to gas storage.

BASF Group's 111,000 employees contribute to the success of its customers in nearly all sectors and almost every country in the world. Their portfolio comprises six segments: Chemicals, Materials, Industrial Solutions, Surface Technologies, Nutrition & Care and Agricultural Solutions.

Crosstown Power is a Management Consulting and Technology Innovation business. Services within the power sector cover various areas: M&A, PMI, Strategy & Operations, Organisational Setup, Supply Chain, Business Relocation. Company's most innovative products are Hydrogen Combustion Systems (retrofit solutions) which operate with any proportion of Hydrogen & Natural Gas for the Energy Transition for Gas Turbines. ■

Enlit Europe will take place in Frankfurt, Germany on 29 November - 01 December 2022.

ETN has been invited to write an article "The Green future for gas turbines" for the conference's newsletter "The Guide". Get your copy onsite or subscribe to the electronic newsletter here.

ETN's Managing Director Christer Björkqvist and Senior Technical Manager Rene Vijgen will both be present at the conference. Drop them a message if you would like to meet!

If you haven't bought your tickets yet, you still can by clicking here. ■

ETN's October Workshop 2022 was a success!

ETN's biennial October Workshop, which took place in Berlin, Germany on 12-13 October 2022, generously sponsored by Siemens Energy was a successful meeting with over 90 participants who came in person. Attendees also had an opportunity to visit Siemens Energy production facility on 11 October, prior to the start of the Workshop.

Martin Stiegler, the Vice President of Gas Turbine Services from Siemens Energy welcomed the participants to Berlin. He highlighted that the current energy supply crisis is concerning but reducing global CO_2 emissions should still be the main mission to achieve a successful energy transition. He added that technology is not the issue. As one of the manufacturer's, Siemens Energy will have gas turbines ready to run on 100% hydrogen by 2030. What we should be addressing is rather:

1) how can we make *"fair distribution of climate change's costs and benefits as well as [create] new arrangements for social and economic growth*";
2) how can we ensure the infrastructure is ready? There is a need for successful sector coupling of those with highest greenhouse emissions, such as heating & cooling, transport and the industries to the power industry and an expansion and extension of the current grid;
3) how can we make a successful transition and achieve the net-zero 2050 goal? Martin's answer was broad-based cooperation between businesses, governments, and the society. Governments and businesses need to address the needs of the society, while the society needs to see transparent policy making and get a clear understanding that a greener future is not cost free, there is a profound need for adjustments. Yet ETN has an important role to play as cost-efficient change is possible through collaboration.

ETN's President, Pedro Lopez (Uniper), thanked Siemens Energy's for their generous support and hospitality in his welcome message. He went on to present key messages from ETN's High-Level User Meeting with a theme *"Efficient, flexible and low carbon pathways towards net-zero solutions"*, which took place at ETN's office on 28-29 September 2022. He listed the following 5 common R&D requirements across the user-community for 2030:

- **Retrofit solutions** - short-term need to enable safe, flexible & reliable operation with fuels containing **up to 30% hydrogen**. GT specific upgrade package for operations with **up to 100% hydrogen before 2030** without significant increases in NOx emissions while maintaining plant's performance.
- **GT-specific CCS solutions & alternatives** (storage, waste recovery, and other hybrid solutions)
- **GT-specific upgrade packages** – enabling part-load efficiency & ramp rate improvements
- **Lifetime extension programmes** for GTs - for cycle behaviour and alternative fuels guaranteeing safe operation and optimised performance. Including lifetime assessment of critical components & advanced component repair to reduce material resources and costs of ownership.
- **Optimisation of plant operation & maintenance** – through better use of digitisation & analytics. Combine analytics with engineering knowledge to reduce the operational costs and increase of plant's overall performance.

ETN Managing Director Christer Björkqvist presented current ETN's activities (see Figure 1), which are focused around 3 areas:

- **Policy & Regulation**: ETN provides relevant energy as well as R&D policy updates to its Members through Monthly News Summaries and engages with the EC, if and when necessary. He highlighted that ETN also actively participates in various forums, such as SET-Plan (Action 5, 6 & 9); ETIP-SNET (Working Group 3); BRIDGE initiative & Clean energy for EU Islands forum.
- **Research & Demonstration**: ETN currently has 5 Technical Working Groups, each involved in a relevant activity – Additive Manufacturing; Air Filtration; Hydrogen; Decentralised Energy Systems & Supercritical CO_2. ETN is also involved in 3 EU-funded projects: CO2OLHEAT, FLEXnCONFU & ROBINSON and one industry-funded project – AM Machine Evaluation Initiative.
- **Optimised Operations**: ETN currently has 2 engine-specific user-groups: SGT-A35 & LM2500.

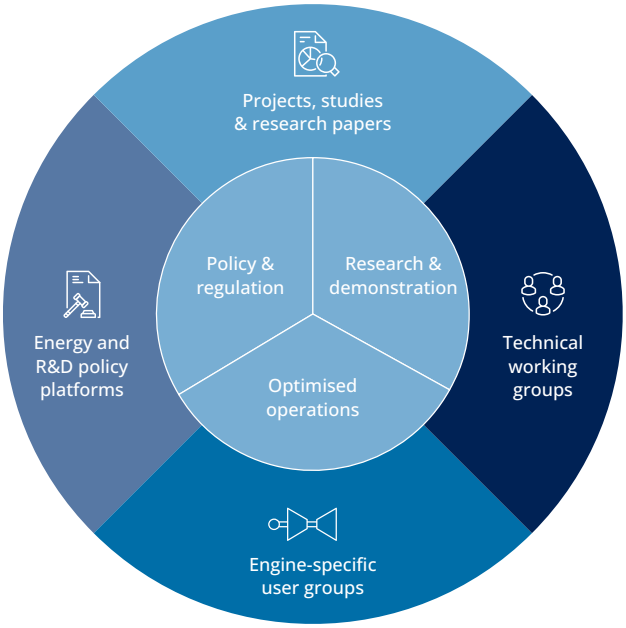

Figure 1: ETN's activities.

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He highlighted that ETN's 2021 Edition of the R&D Recommendation Report is planned to be updated in 2023 to reflect current market conditions and changing needs of the user community.

Christer Björkqvist went on to present recent political interventions to overcome the security & supply energy crisis starting with EU Green Deal and followed by REPowerEU Plan, Gas Storage Regulation, Save Gas for a Safe Winter, High Electricity Price Mitigation Proposal and the on-going work on trying to reform the electricity market across Europe through solidarity arrangements, establishing new LNG routes & gas supply routes, reducing gas prices and increasing gas storage facilities, and improving liquidity for market operators.

ETN's Senior Technical Manager, Rene Vijgen, presented various decarbonisation roadmap's with focus placed on the global net zero by 2050 scenario developed by International Energy Agency in May 2021 and the Ten Year Network Development Plan for EU countries published by ENTSOG and ENTSO-E in April 2022. The conclusions are clear according to IEA, the capacity of the renewables will increase sharply between 2020 and 2030; worldwide electricity generation will double in 2050 compared to 2020 levels; fossil-fuel fired electricity generation will be dramatically reduced after 2030 and for gas turbine-based assets the market will gradually change from being energy-based to capacity-based.

EPRI's Gas Turbines Program Manager, Bobby Nobel, discussed the role of gas turbines in the changing energy market. He highlighted the flexibility that GTs provide; the hybrid gas turbine, which allows for ultra-fast response as it is connected to a battery and hybrid system controller; and low/carbon-free GTs (running on hydrogen and other alternative fuels) as well as opportunities, issues and challenges for the GTs, especially when it comes to ensuring low NOx emissions.

Dr Maximilian Kuhn, an Advisor at Hydrogen Europe, presented the impact of recent developments on hydrogen availability. He highlighted that as hydrogen has received its global recognition for the role in can play in fighting climate change, it also brought about certain challenges to the scene within the EU, such as questions of certain regulatory hurdles in terms of certification schemes; funding & security guarantees for building a hydrogen backbone and corridors; questions of overseas imports for creation of regional hydrogen hubs and markets; a need for clarifying the role of EC's Hydrogen Bank & the Hydrogen Facility; allowing a stacking of support schemes for a transitional period of time; fast-forwarding selected large-scale projects to Final Investment Decisions to kick start the scale-up of low carbon & renewable hydrogen. However, where there are challenges, there are also opportunities. There have been several EU policies adopted and many more are on the way, there is plenty of green hydrogen production potential on all the continents with EU busy negotiating potential import corridors mainly from Africa and Middle East, and many infrastructure plans including storage on the way.

The presentations during the second half of the day paved the way for the two themes that were explored at the parallel sessions: (1) low carbon fuels & carbon capture solutions and (2) energy efficiency, performance & decentralised energy systems. In the evening ETN Members were invited to attend dinner generously co-sponsored by VBR Turbine Partners and MTU Maintenance, providing an excellent opportunity for networking and exchanging views and ideas on the current opportunities and challenges faced by the GT industry.

On the second day two parallel sessions were held to discuss prioritisation and cooperation opportunities on the two themes. Much of the work done was presented by ETN's Technical Working Groups and supplemented by research undertaken by members from ETN's community. As an outcome of the HLUM and Workshop a portfolio of pathways and solutions for various sectors and gas turbine applications has been selected. These pathways will now be further explored and followed up on within ETN's Working Groups with the objective to initiate common activities that can accelerate the development and implementation of these solutions. Please find a process map (see Figure 2, on page 7) detailing our strategy in this regard.

ETN would like to thank all the sponsors for their support and assistance in making this event a success. We are also grateful to the speakers for their informative presentations, and all the members for their active participation, fruitful discussions, and excellent ideas.

All presentations are now available for download for ETN Members on our event webpage (log in required).

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ETN's Roadmap 2022/2023

"Efficient, flexible and low carbon pathways towards net-zero solutions"

Strategy to accelerate the energy transition

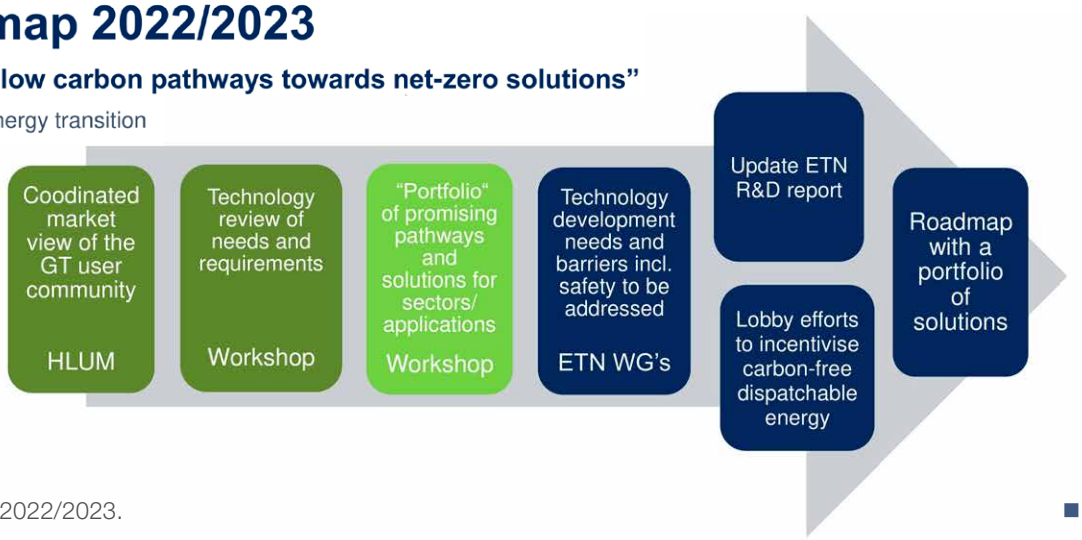

Figure 2: ETN's Roadmap 2022/2023. ■

ETN's Annual General Meeting and Workshop

ETN's Annual General Meeting and Workshop will be held on 28-30 March 2023 in London, United Kingdom.

This is a 2-day event, which brings together representatives from the entire gas turbine community. The first day will be dedicated to the Annual General Meeting and Working Group meetings, whereas the second day will be filled with presentations and discussions on topics that are deemed most relevant in the current climate.

Our event does not only provide a great opportunity to receive an annual update on ETN activities, but also creates a perfect setting to network and hear about the latest trends and technical development within the industry; find out the needs from the user community; as well as discuss ideas with GT experts from around the globe.

ETN Members are invited to save the date and keep an eye out for sponsorship and exhibition opportunities as well as the agenda on the event webpage. ■

Webinar: R&D activities on sCO^2 in Europe

ETN's second episode in the webinar series "R&D activities on sCO_2 in Europe" will be held virtually on 05 December 2022 at 14h00-15h00 CEST. This session will focus on Components challenge, elaborating on sCO_2 compressors.

The following experts will speak presenting challenges they encounter in their research and daily business:

- Giacomo Persico (Politecnico di Milano)
  – *"Scientific challenges of pumps and compressors"*
- Marco Ruggiero (BakerHughes)
  – *"Industrial experience in the design and test"*
- Rasmus Rubycz (AtlasCopco)
  – *"Industrial experience on sCO_2 compressors"*

This event is free and open to all ETN members and non-Members but requires a registration. Please visit our event page to learn more and to register. ■

Interview with FLEXnCONFU project partners

Daria Bellotti, Cheng Liang, and Pascal Koschwitz

Daria Bellotti, Assistant Professor – University of Genoa

Cheng Liang, Innovation Engineer – Proton Ventures

Pascal Koschwitz, Research Assistant – Technical University of Darmstadt

The design, development and test of an innovative small-scale containerised Power-to-Ammonia (P2A) system is one of the main goals of the FLEXnCONFU project: the P2A demo (TRL 6) will be installed and tested next year at the Innovative Energy System Laboratory (IES-Lab) located at the Savona Campus of the University of Genoa (UNIGE). To understand the operational behaviour of the P2A system better, a dynamic model of the system has already been developed and simulated. To learn more about this innovative solution, we caught up with Daria Bellotti (University of Genoa), Chen Liang (Proton Ventures) and Pascal Koschwitz (Technical University of Darmstadt) who are ROBINSON project partners.

What is the innovative aspect in the proposed Power-to-Ammonia (P2A) solution?

On one hand, the P2A solution is cost efficient and on the other hand, very time flexible. Low cost is vital for a successful market entry, whereas time flexibility is needed to cater to the fluctuating renewables. The innovation lies in the new and very simplified P2A cycle design, which makes use of only the most necessary cycle components. The key component is a temperature-controlled reactor, which employs a state-of-the-art conventional catalyst. The aim is to keep low operating temperature and pressure in the reactor, which in turn, will support the cycle's flexibility.

How has the cycle been optimised with regards to maximum ammonia production?

To maximise the ammonia production at every load, the optimum temperature profile of the reactor and the optimum inlet ratio of hydrogen to nitrogen had to be determined. This was done by a variation analysis (see Figure 3) in a commercial chemical simulation software. For this purpose, the kinetics data for the novel catalyst from the catalyst supplier was also incorporated in the simulations.

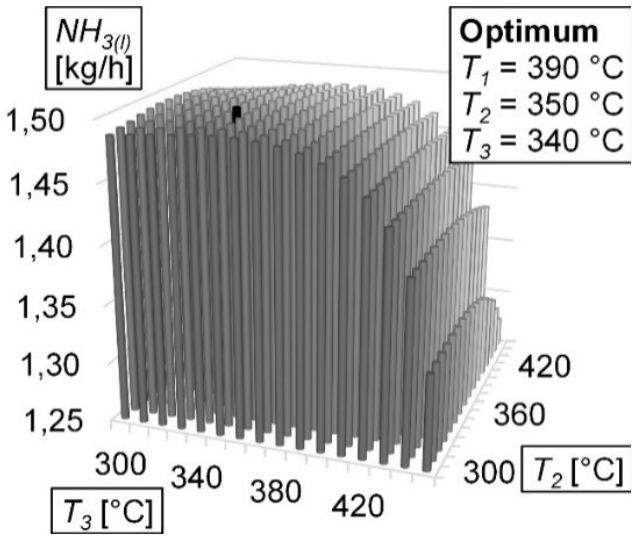

Figure 3: Result of the variation analysis with regards to the optimum reactor temperature profile.

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What are the main results of the comprehensive design study of the reactor as the key component so far?

The simulations and the data from the catalyst manufacturer suggest that a low reactor temperature profile seems possible. This will be tested in the test campaigns in 2023. If this turns out to be the case, it would be a great step forward to small-scale dynamic P2A processes. This is because a lower reactor temperature means a faster start-up of the cycle as well as quicker changes in operating loads.

What will be the next steps in the coming month and in 2023?

The coming month will be dedicated to finalising the construction of the P2A containerised module, and the site preparation for the installation of the P2A unit at the UNIGE Campus.

The P2A plant is currently under construction (see Figure 4) by ICI Caldaie in Verona, Italy. In parallel, the system control architecture and interface are being developed by MAS from Athens, Greece. The container will then be shipped and installed at UNIGE Savona Campus (see Figure 5) in the first half of 2023. After the commissioning of the P2A demo, the test campaign will start to evaluate the system performance under several different operating conditions. The results of the simulation studies, both steady state and dynamic, will support the test phase and the experimental results will be used for the models' validation. ■

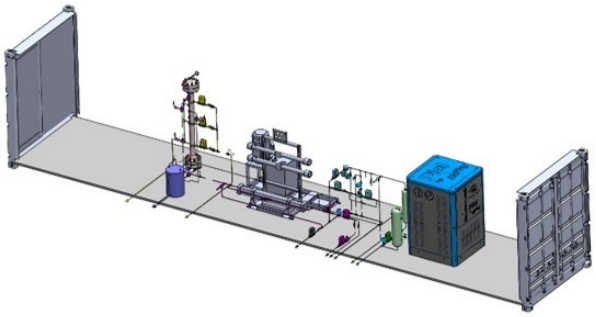

Figure 4: Preliminary CAD design of the P2A container.

Figure 5: Savona test site for the installation of the P2A container.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957752

Upcoming meetings and events

Meeting/Event*	Date	Location
ETN Webinar Series "R&D activities on sCO_2 in Europe"-second session	05 December 2022	Virtual
ETN Board Meeting	06 December 2022	Virtual
ETN Annual General Meeting & Workshop	28-30 March 2023	London, United Kingdom

** Please note that full list of ETN's meetings and events can be found on our website.*

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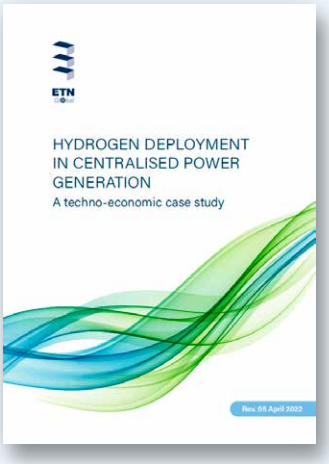
ETN at a glance

Download our latest publication Hydrogen deployment in centralised power generation.



Download the three pager and learn more about ETN's vision.

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