

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.

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**Christer Björkqvist**  
Managing Director

### Is the energy crisis the perfect storm we have been waiting for?

As the world is recovering from COVID-19, the energy crunch that started in Europe and China is creating a global chain reaction, with soaring fuel and electricity prices that already led to shutdown of energy intensive industrial plants and could lead to blackouts as winter approaches.

The triggering reason behind the energy crunch was the global economic rebound of the COVID-19 pandemic, combined with a constrained supply. Firstly, the gas reserves were low after a long winter, and due to an unexpected seasonal low wind power production in northern Europe, flexible energy sources like gas turbines had to step in to keep a balance in the grid. In parallel with that Europe's main gas supplier Russia withheld extra summer supplies beyond its long-term contracts, to fill its own winter reserves, and most likely to put some pressure on an

early certification approval of the now completed Nord Stream 2 gas pipeline. At the same time China, Japan and South Korea are outbidding Europe for liquefied natural gas, all in all leading to seasonal record highs of natural gas prices. With shortages of gas supplies even before the winter, there is a risk that coal and oil consumption will again increase, even if the carbon prices have doubled since January to over 60 euros in October. On the other hand, there is a similar shortage in coal supply due to closing of mines and weather-related events, such as heavy rains and flooding in China's biggest coal producing province, shutting down most mines. This, together with a political conflict, where China imposed a ban on coal import from Australia, has resulted in a global coal shortage and an equal surge in price as for natural gas.

The big question is now how all this will impact the upcoming climate change summit COP26 and President Alok Sharma's stated target to "consign coal to history". Will it finally boost interest and political incentives for investments in clean hydrogen production (power-to-gas) and infrastructure developments? This could accelerate the implementation of a sustainable solution whereby hydrogen would be used for seasonal storage, providing security of supply and grid stabilisation for the expected large-scale increase of intermittent renewable energy.

Could this be the perfect storm that we have been waiting for? The global energy crisis showcases the importance of taking a holistic hybrid system approach to solve the energy "trilemma", as highlighted in ETN's vision publication (see the next page). To a large extent the crisis could have been avoided with better planning and additional energy transition actions, like ensuring sufficient gas storage and flexible back-up capacity, as nuclear and coal plants are gradually phased out in favour of intermittent renewable power. From that perspective the energy crunch could be good news. For example, as the main outcome of the EU summit in Brussels in late October, the European Commission is now proposing a toolbox of short and medium-term actions to further strengthen resilience against future shocks, including incentives to increase investments in energy efficiency measures, enlarged gas reserves, as well as development and implementation of sustainable storage solutions. Hopefully global leaders will follow this example at the COP26.

Energy efficiency, fuel flexibility and system integration have for a long time been priority topics for ETN, and as you can see in this newsletter edition, we have several ongoing projects that aim to accelerate further improvements and solutions on these topics. The relevant and important role of gas turbine technology in the user community's decarbonisation strategies was also highlighted at ETN's International Gas Turbine Conference. However, the users emphasised that further integration and technology advances will be required both for the existing fleets and for the next generation of gas turbines. Another key message was the need of a catalogue of gas turbine decarbonisation solutions for different markets and applications, as one solution does not fit all needs. In our last IGTC keynote panel session, Siemens Energy, Mitsubishi Power, Solar Turbines and Baker Hughes all presented promising progress towards these goals and highlighted their commitment to provide carbon-neutral energy solutions by 2030.

# High-Level User Meeting: key messages from the user community

*ETN's annual High-Level User Meeting "Operational optimisation and technology development needs for the transition to a carbon-neutral society" was held virtually on 4 October 2021. During the meeting, the gas turbine user community welcomed and fully supported the ETN vision that has recently been documented (see our publication "[Gas turbines: an enabling technology for a carbon-neutral society](#)").*

Five key messages were highlighted to accelerate the energy transition:

1. Gas turbines are seen as an enabling technology for a carbon-neutral society due to their dispatchability, high efficiency, flexibility and low-emission credentials, with a clear path towards carbon-neutral operations. Still, further improvements for the energy efficiency, operational flexibility and fuel flexibility of today's gas turbine assets are of vital importance for cost-efficient solutions that will enable a wider and faster decarbonisation. Additionally, new innovative solutions for the next generation of gas turbines need to be explored and developed that can enable highly efficient, carbon-neutral integrated gas turbine system solutions, without reducing the reliability, compromising safety or affecting security of supply.

2. To kick-start the development of a hydrogen economy, it is necessary to take a holistic approach, and among all the relevant players (suppliers, OEMs, users, policymakers), discuss openly the interconnected political and technical requirements, such as the importance of:

- predictable and supportive policy framework
- supply and storage solutions of hydrogen
- availability of hydrogen infrastructure
- cost-efficient, safe and reliable gas turbine performance with up to 100% hydrogen of both current and new equipment

By reaffirming and highlighting the commitment by the different stakeholders to do their part, as well as through cooperation agreements, the required trust can be built up to establish the market demand that will release the essential investments to make this happen.

*continued on page 3*



## ETN's High-Level User Meeting 2021 – Users' key messages

### Main focus areas to accelerate the gas turbine transition to a carbon-neutral future



*Focus optimising the existing fleet while accelerating the decarbonisation roadmap.*

*Call for industry players to approach the challenge jointly.*

### ETN strategy well aligned with users' needs and ETN acting as key enabler

#### Vision for the energy transition

**Energy efficiency**  
Explore new and more efficient options

**Decarbonisation**  
Improve the carbon footprint of new and existing assets towards carbon-free generation

**Transition to new energy systems**  
Expand the solutions portfolio in the transition to new energy systems

#### Strategic areas and goals

Integrated and trustful cooperation among the sectors to achieve affordable and decarbonised gas turbine-based solutions

Fleet improvements towards the most efficient and cost-effective solutions for the energy system

Decarbonisation and security of supply solutions through expanded fuel flexibility and system integration

ETN Global



continued from page 2

3. Expanding the gas turbine decarbonisation solution portfolio is necessary, as one decarbonisation technology does not fit all needs. Several gas turbine decarbonisation technologies and solutions will be required, for example carbon-neutral fuels (such as hydrogen, ammonia, synthetic methane and biofuels), waste heat recovery, and CC(U)S – see ETN's latest [R&D Recommendation Report](#) for a complete listing. The technical and economic feasibility of each of these technology solutions needs to be demonstrated before entering the market. However, as the economic feasibility will to a large extent depend on the local market and regional conditions, it will be vital to develop a catalogue of solutions.
4. Improving decentralised energy system solutions (advanced control systems, energy management systems) is essential to ensure reliable, efficient, and flexible operations. Decentralised, but still dispatchable generation will fit naturally with decentralised renewable power sources (wind, solar, biomass). Decentralised systems are best served with medium and small-scale power systems.
5. Unlocking the full potential of carbon-reduction technologies requires a closer and deeper cooperation among the stakeholders in the whole value chain. This can be achieved through sector coupling, interconnecting all sectors that produce and consume energy, heat and fuels.

The user community sees some progress and promising developments towards this vision, but a more integrated cooperation among the different stakeholders and a commitment of an interconnected decarbonisation roadmap is required. More proof points and clear milestones, in particular from the policymakers, parallel to market incentives, would trigger this development.

ETN President Pedro Lopez presented the users' key messages during ETN's International Gas Turbine Conference (IGTC) keynote session "Technology development path for a carbon-neutral society" on 15 October 2021. He also highlighted some key messages to the OEMs:

1. Provide short term engine specific retrofit solutions to enable a safe, flexible and reliable operation with fuels that contain up to 30% hydrogen. Launch a gas turbine specific upgrade package to operate with up to 100% hydrogen before 2030, without significant increase in the NO<sub>x</sub> emissions and maintaining the plant's performance.
2. Provide a lifetime extension programme for plant specific gas turbines guaranteeing safe operation and optimised performance. It will involve lifetime assessment of critical components including advanced component repair to reduce material resources and costs of ownership.
3. Optimise power plant operation and maintenance through better use of digitisation and analytics. Combine analytics with engineering knowledge to reduce the operational costs and increase of plant's overall performance.
4. Develop gas turbine specific upgrade packages enabling operation with other low-carbon fuels, e.g., biofuel (short term) and ammonia (long term)
5. Develop parallel technology development of decarbonisation solutions (CCUS) and other integrated energy system solutions (storage, waste recovery and other hybrid solutions)

The full IGTC presentation is available on ETN's [website](#). ■





## New members

We warmly welcome Lincotek (Italy), Atlas Copco Airpower (Belgium) and Thomassen Energy (the Netherlands) who joined ETN.

### Lincotek

**Lincotek**, headquartered in Italy, is a global contract manufacturer for services in markets including industrial gas turbines, aviation and medical device applications, as well as a manufacturer of industrial coating equipment and a producer in the additive manufacturing field.

### Atlas Copco

**Atlas Copco Airpower** is part of Atlas Copco Group, a global industrial group of companies, headquartered in Sweden. Atlas Copco develops, manufactures, services, and rents industrial tools, air compressors, construction and assembly systems. The Group operates in four areas: compressor technology, vacuum technology, power technology and industrial technology.

### Thomassen Energy

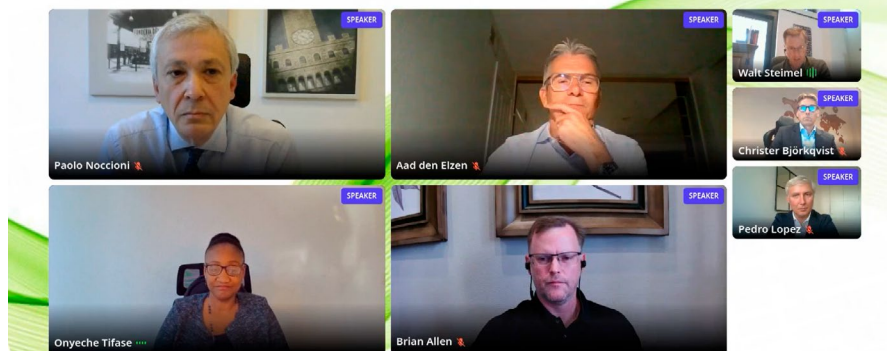
a Hanwha company

**Thomassen Energy** is a supplier of technologically advanced aftermarket gas turbine components, performance upgrades, in-house component repair and outage services for existing GE Frame 3, 5, 6B, 7E, 7F, 9F platforms. The company, located in the Netherlands, is part of the Hanwha Impact division of Hanwha Group gas turbine services organisation.

## International Gas Turbine Conference – proceedings are available



**IGTC**  
International  
Gas Turbine Conference



ETN's 10<sup>th</sup> International Gas Turbine Conference, "Gas turbines in a carbon-neutral society", was held virtually on 11-15 October 2021. The conference welcomed over 200 participants from all over the world and included five keynote sessions, nine technical sessions, a virtual exhibition, an interactive networking lounge and other possibilities for virtual networking.

We would like to thank again our "Carbon-neutral OEM sponsors" (Siemens Energy, Mitsubishi Power, Baker Hughes and Solar Turbines), "Enabling technology/service exhibitors" (Camfil Power Systems and GadCap Technical Solutions), Media partners

(The Energy Industry Times and Gas Turbine World) and "Carbon-neutral solutions supporter" (Sensor Coating Systems). We would also like to highlight the support by our Conference Advisory Board and Paper Reviewers and thank them for their valuable contribution to this conference.

Presentations and technical papers are now available for the IGTC attendees, who have received the access details by email. All participants can also still access the recordings of the sessions and visit the virtual exhibition until 15 November 2021 using their personal conference link.

## AGM & Workshop: save the date!

ETN's Annual General Meeting and Workshop will be held on 29-30 March 2022 as a hybrid event. After two virtual Annual General Meetings, we look forward to meeting with our members in person, but will still provide the opportunity for virtual participation in case of travel restrictions. Location for the event will be confirmed soon – stay tuned!



## AM Machine Evaluation Initiative starts

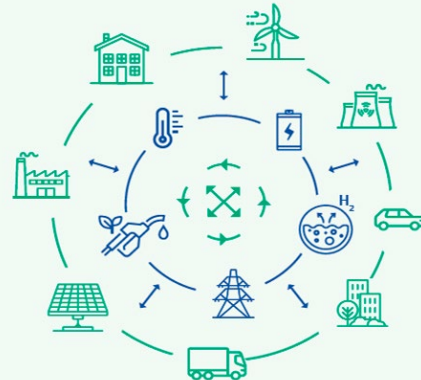
ETN's first industry-funded project, the Additive Manufacturing (L-PBF) Machine Evaluation Initiative, was launched in September. Additive manufacturing technology is a key enabler for developing capabilities with innovative component designs and for reducing costs and lead time of production. Ensuring productivity and end-product quality is vital for the long-term competitiveness of our industry. This collaborative project provides the opportunity 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.

This initiative was developed by the members of ETN's Additive Manufacturing Working Group. The project will review capabilities of Laser-Powder Bed Fusion (aka L-PBF, Selective Laser Melting) equipment currently available on the market. The involved manufacturers will be manufacturing parts with Nickel Alloy 718 powder, according to specifications defined in collaboration with members of the ETN Additive Manufacturing Working Group. The parts to be produced include features of specific interest to the energy sector, such as thin walls and cooling channels. Performance, quality and productivity are key elements that will be evaluated.

The outcome of the project will consist of a detailed report, evaluating and comparing technical and commercial characteristics of selected AM machines available on the market and sample parts they produce. The full report will be available only for the project partners. See more details about this unique initiative [here](#).



## Decentralised Energy Systems Working Group



ETN's new Decentralised Energy Systems Working Group launch meetings took place virtually in September 2021. At these meetings our members shared their expectations for the new Working Group and had the opportunity to discuss the scope and objectives within dedicated subgroups. The European Commission also highlighted the R&D opportunities for system solutions where dispatchable gas turbines integrated with intermittent renewable sources could fulfil the main expectations of decentralised energy systems: sustainability, security of supply and availability. At the next Decentralised Energy Systems WG meeting, scheduled to take place in November 2021 (exact date to be confirmed soon), the objective is to present a suggested way forward that will take into account the interest of the members, market developments and funding opportunities. If you are an ETN member and would like to join this new Working Group, please [contact us](#).

## GT enclosure standard for hydrogen fuel

The launch meeting of ETN's "Gas turbine enclosure standard for hydrogen fuel" taskforce was held virtually on 10 September 2021. As the enclosure design, ventilation, and flow/gas detection have all initially been designed based on NG properties, there is a need to agree on the best practices and develop a suitable safety standard, as industry partners start seeing increasing enquiries from clients to increase the share of hydrogen capabilities of their assets.

This taskforce will address these needs, enabling safe operations on different hydrogen blends, as well as pure hydrogen. As part of the phase one, a gap analysis of ISO21789 and literature review will be launched, also defining the required scope of work of a testing programme and associated budget. The phase two will be the performance of the required tests co-funded by the industry partners. A smaller initial taskforce is currently in the process of preparing

the phase one. The outcome and the proposed phase one programme will be presented to the Hydrogen Working Group in a virtual meeting later this year, during which the upcoming tasks will be presented and assigned. The date for this meeting will be announced to the members of the Hydrogen Working Group in the coming months. If you would be interested to follow this taskforce, please sign up for ETN's Hydrogen Working Group by [sending us an email](#).



## Interview with Hannes Laget, ENGIE Laborelec

*Increasing the fuel flexibility to carbon-neutral fuels and energy storage could be sustainable solutions as resilience against future energy crunches. ETN caught up with Hannes Laget, Project Manager, Green Thermal Lab at ENGIE Laborelec, with whom we discussed ENGIE's involvement in the FLEXnCONFU project.*

### **What is ENGIE Laborelec's role in the FLEXnCONFU project?**

ENGIE Laborelec, thanks to its privileged relationship with its mother company ENGIE, will bring to the FLEXnCONFU project the technology user's perspective, together with EDP and Tirreno Power, two other utility companies involved in the project. Our role is to focus on the implementation of the FLEXnCONFU concepts – the use of hydrogen and ammonia in combined cycle power plants through fabrication, storage and combustion of the fuels – in existing and new built plants. Therefore, Laborelec is in charge of the feasibility studies of the concepts, which will be applied, amongst others, to the integration of the concept into one of the Belgian power plants of the ENGIE Group.

### **Why did ENGIE Laborelec join the FLEXnCONFU consortium?**

As an ENGIE research centre, we want to follow the latest developments in the gas turbine industry. Through the introduction of new fuels, which do not emit CO<sub>2</sub>, we believe we can make a difference for climate change, still using our existing units, and the flexibility these units provide to the European grid. By participating in such collaborative research projects, we can shape the future while learning from all the other partners.

### **Fuel flexibility of the combined cycle gas turbine is a key element in the FLEXnCONFU project. How will ENGIE Laborelec address it?**

Indeed, fuel flexibility is a key driver for the FLEXnCONFU project to be materialised. Hydrogen burns much quicker than natural gas, which can enhance the stability of the flame. On the other hand, when ammonia is concerned, the opposite happens, and current gas turbines might not be able to accommodate large amounts of ammonia without redesigning the complete combustion chamber.

Most of the modern gas turbines admit up to 20 or 30% of hydrogen co-combustion, on a volumetric basis. We have demonstrated factually that this is the case indeed, using one of our gas turbines. However, starting from 10% hydrogen co-combustion, we have also observed that the NO<sub>x</sub> emissions

were well beyond the emission limit values. Additional measures, such as DeNO<sub>x</sub> catalysts might be required to make the FLEXnCONFU concept viable.

Moreover, we have seen that the production of (green) hydrogen and ammonia is not for free and requires quite some amount of electricity. As this fuel is very precious, it is of utmost importance that the efficiencies of all the sub-processes, starting from the electrolyser, ammonia synthesis, fuel compression and storage, up to the combustion of the fuel in a gas turbine, are as high as possible.

### **What will be the next steps in the coming months?**

Over the next months, our team will look at the impact of the hydrogen and ammonia fuel on the materials used in the gas turbine. Through these investigations, we want to understand whether the alternative fuels will affect the lifetime of some of the gas turbine parts, and if so, whether we should change some of the materials currently in use, and/or consider adapting our maintenance practices.

We will also start the feasibility studies for the co-combustion of hydrogen and ammonia in one of our combined cycle plants in Belgium.

### **Any last comments?**

In the energy industry, we are living in very exciting times. In order to curb global warming, a very large range of solutions is required, going from energy savings to alternative green fuels and to energy storage concepts. To reduce our CO<sub>2</sub> footprint, we will need a mix of those technologies. However, in order to go fast, we need to implement the best (meaning most impactful) technologies first, not forgetting to develop the required technologies to follow. To accelerate the transition, there is no better way than collaborating with partners sharing our strategic collaborative research approach, including openness and fairness values as the foundation. ■



[www.flexnconfu.eu](http://www.flexnconfu.eu)

Follow FLEXnCONFU on  & 





## Interview with Frank Emil Moen, EI

*The ROBINSON project consortium held their General Assembly meeting in Egersund, Norway, in September 2021, celebrating the opportunity for a face-to-face meeting at the end of the first year of this EU-funded project. ETN had the chance to discuss with our host Frank Emil Moen, Managing Director of Energy Innovation AS, and learn more about the work carried out in Egersund and on the island of Eigerøy, where ROBINSON's integrated energy system to decarbonise the island will be demonstrated.*

### **What is Energy Innovation's role in the ROBINSON project?**

Energy Innovation (EI) is a centre for training, certification, education, business development, innovation and R&D in the field of onshore and offshore wind power and green tech. In the ROBINSON project we are involved in all work packages, being the local coordinator at Egersund for the Eigerøy main demo. We are also in charge of the ROBINSON work package that defines the islands' requirements and addresses any barriers and system specifications.

### **How did the idea for the ROBINSON project develop?**

The ROBINSON project idea was developed through a process that started back in 2018. The local grid owner was communicating through local media a need for more power for Eigerøy and launched a plan for installation of a new transmission line from the mainland, crossing a narrow strait. The transmission line would have a considerable cost, and a negative environmental impact. In parallel, the fish industry communicated considerable development plans on the island, with the need of both more power and permission for emission of organic wastewater to the recipient in Egersund Harbour. Energy Innovation arranged a network dialogue meeting in Egersund inviting local stakeholders,

researchers and other interested parties to discuss alternative solutions. Instead of installing a new grid from the mainland, could we develop a smart integrated energy system on the island, in combination of introducing gasification and a combined heat and power unit, and also a system for cleaning the wastewater? More than 100 people attended the meeting, and we had even international participants. Through the meeting I established contact with Peter Breuhaus from IRIS (International Research Institute of Stavanger - now merged with other institutes and known as NORCE), who is the chair of ETN's Project Board, and we followed up with an application for a pre-project supported through the national ENOVA programme for Integrated Energy Systems. Energy Innovation was an applicant, with NORCE as a research partner, and Dalane Energi and Eigersund Næring og Havn were among the project partners. The result from the pre-project was then used to develop an application for an EU-funded Horizon 2020 project.

### **How is the ROBINSON project perceived on local and national levels? What are the expectations?**

The ROBINSON project has already had considerable attention not only on local and regional level, but also on

*continued on page 8*



## Interview with Frank Emil Moen

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national and international level. The idea of introducing and demonstrating a smart integrated fully renewable energy system, avoiding a costly and very visible new grid, as well as large CO<sub>2</sub> emissions, is for sure appealing. We have also experienced that the project is attracting new industry to the island, as it will be possible to connect to a sustainable and therefore attractive energy system.

**The project includes the combination of different technologies with a combined heat and power unit. Based on the ROBINSON example, do you see an opportunity for integration of gas turbine technology with renewables on other islands?**

Norway has a considerable fish industry extracting protein from pelagic fish to be used for food in the growing aquaculture industry. We have many protein fish factories all using large amounts of fossil fuels. Demonstrating an effective gasification based on renewables and connecting a combined heat and power unit, even able to produce power, will have a considerable potential of emission reduction in the fish industry, not only in Norway, but also in other parts of the world.

## What will be the next steps in the coming months?

We have just started the second year of the ROBINSON project. The first year has been used for important clarification and planning. We will now start the process of more detailed planning for the implementation of the various components of the system.

## Any implementation and follow-up plans at the end of the project?

The aim of the project is to implement and demonstrate an integrated energy system that will cover approximately 18% of the need for a 100% renewable system on the island of Eigerøy. During the project period we will describe various possibilities getting to a 100% renewable system in 2030. As a result, we are now looking into the installation of a combined floating offshore wind, wave and solar platform outside Eigerøy. We are planning for installing a 13 MW pilot for the system called FlexiFloat. Having this system in place, together with the implementation of the ROBINSON concept, it will provide considerable contributions to 100% renewable system on the island (see the movie of FlexiFloat [here](#)). The ROBINSON project can become a pioneer in the decarbonisation process of islands globally. ■

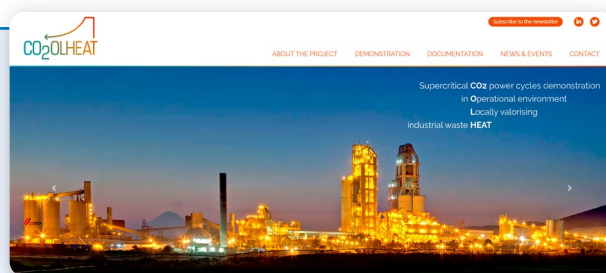


[www.robinson-h2020.eu](http://www.robinson-h2020.eu)

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## CO2OLHEAT website launched

The website of our CO2OLHEAT project is now live – check it out [here](#)! This EU-funded project, coordinated by ETN, aims at unlocking the potential of industrial waste heat and its transformation into power via supercritical CO<sub>2</sub> (sCO<sub>2</sub>) power cycles. Highly innovative and cutting-edge technologies will be used to design and demonstrate in a real industrial environment and in a high technology readiness level (TRL 7) the EU first-of-its-kind 2MW sCO<sub>2</sub> plant. This pioneer power block will generate completely clean energy while saving significant amount of primary energy and thus also CO<sub>2</sub> emissions. The technology will be demonstrated in the CEMEX cement plant in Prachovice in the Czech Republic. The project will also have six virtual replication sites through our project partners. Make sure to follow the project also on [LinkedIn](#) and [Twitter](#). ■



## PUMP-HEAT project comes to an end



The aim of the PUMP-HEAT project is to increase the flexibility of the combined-cycle power plants and the operation of gas turbines. The innovative concept is based on the coupling of combined-cycle power plants with a fast-cycling highly efficient heat pump equipped with thermal energy storage. This EU-funded project started in 2017 and comes to an end this year. The new PUMP-HEAT eBook includes an overview

of the innovations developed to untap the combined cycle power plants' full potential for operational flexibility and improve total energy efficiency. A list of recommendations about the concept's replication is also provided, which was collected during the project's implementation. You can download the eBook [here](#) to read more about this project. For any further information, including requests of bilateral meetings for assessing potential application to specific case of interest, you may refer to PUMP-HEAT project coordinator [Alberto Traverso](#), University of Genoa. ■



## EU sustainable finance & taxonomy



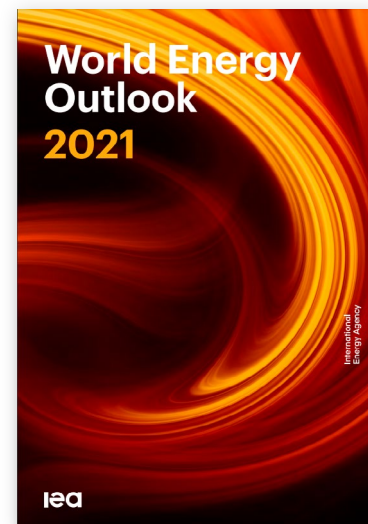
*ETN, together with our CO2OLHEAT project consortium, and supported by a number of other companies, proposed to recognise the waste heat to power (WH2P) activities as sustainable under the EU Taxonomy framework.*

ETN and the CO2OLHEAT project partners responded to the call for feedback on the Sustainable Finance Platform's criteria that will complete the EU Taxonomy, proposing the recognition of the "Production of electricity using waste heat" activity as sustainable, under the Transition to a circular economy objective.

WH2P applications contribute to the transition to a circular economy not only by addressing the negative impacts of the linear economy, but more importantly by the introduction of a systemic shift, introduction of industrial symbiosis and building resilience. Moreover, WH2P applications generate business and economic opportunities, thus increasing companies' competitiveness and providing environmental and societal

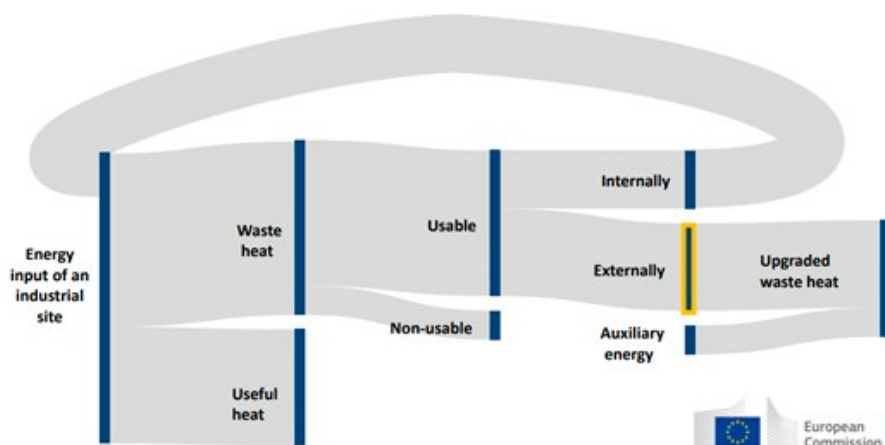
benefits. Industrial processes are currently responsible for nearly 26% of the European primary energy consumption and are characterised by a multitude of energy losses. At the same time, the potential of EU waste heat is enormous, given the minimal environmental footprint of this state-of-the-art technology.

If successful, WH2P activities, as well as their enabling activities (e.g., related manufacturing and research), will get better access to future financing. This will also allow companies to report the WH2P activities as environmentally sustainable. The feedback submitted by ETN and the CO2OLHEAT project partners, together with the scientific evidence, is available on ETN's [website](#). ■



## IEA World Energy Outlook 2021

The International Energy Agency (IEA) released their annual World Energy Outlook in October 2021. According to the report, "a new energy economy is emerging around the world as solar, wind, electric vehicles and other low-carbon technologies flourish". However, the IEA warns that the "clean energy progress" is not quick enough to reach net zero emissions globally by 2050. This edition of the report looks at the governments' pledges to reduce emissions, as it was published ahead of the 26<sup>th</sup> Conference of the Parties (COP26), which will be held in Glasgow, UK, in November. The full World Energy Outlook can be downloaded [here](#). ■



*The above scheme (from JRC Technical Report "Defining and accounting for waste heat and cold", authors Lyons, L., Kavvadias, K., Carlsson, J.- 2021) identifies the circular use of heat flows, both internal (on-site) and external (off-site) ones.*

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## Upcoming meetings and events

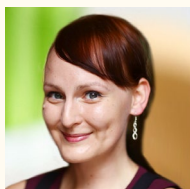
Meeting/Event	Date	Location
ETN Project Board meeting	8 November 2021	Virtual meeting
ETN Board meeting	30 November – 1 December 2021	Brussels, Belgium
ETN Annual General Meeting & Workshop**	29-30 March 2022	Hybrid event (location tbc)
ASME Turbo Expo 2022*	13-17 June 2022	Rotterdam, The Netherlands

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

## ETN Team



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**Noora Kilpinen**  
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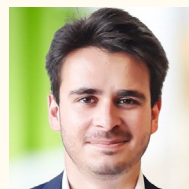
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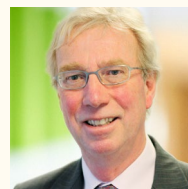
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### ETN at a Glance!

Download our publication  
**"Gas turbines: an enabling  
technology for a  
carbon-neutral society"**  
[here](#) and read more about  
ETN's vision.



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