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WINTER 2019

Connecting Europe's Stakeholders in Energy and Transport

AVIATION DECARBONISATION

ENERGY TRANSITION: "EDUCATING THE NEXT GENERATION"

CLIMATE CHANGE

INVESTING IN INDUSTRY OF THE FUTURE

URBAN MOBILITY

Includes editorial contributions from:

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MEP

Maria Carvalho
MEP

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Executive Director of the Innovation and Networks Executive Agency

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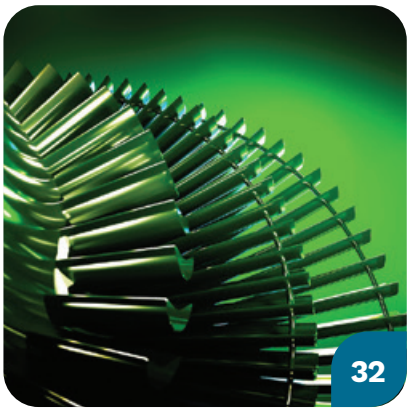

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Foreword

2019 concludes a decade of exceptional global heat and high-impact weather

Published this month, the stark conclusion of the World Meteorological Organisations echoes that of 2017, which was "...the warmest on record without an El Niño event..." while "The world's nine warmest years have all occurred since 2005, and the five warmest since 2010." Meanwhile, NASA's climate change newsletter of 3 December shows that when seasonal variations are taken into account, atmospheric CO_2 follows a steady, consistent upward trend. And the trend line is unnervingly straight.

Whatever we are doing, it's not working.

Some suggest that climate change is some unspecified geopolitical conspiracy, or a big business stunt designed to extract more revenue from the hapless people; others that it is simply a hoax.

The data suggest otherwise.

Should we give up and just accept that we cannot control the climate? The answer surely lies in the academic consensus surrounding the anthropogenic component of climate change. If we are instrumental in causing it, we must be instrumental in its mitigation. We must act.

There is no doubt about the financial will: Dirk Beckers reviews the work of INEA in support of clean and smart urban mobility. It currently manages a total of 91 projects with a total EU contribution so far of almost €700 million. Examining the role of the EIB in the future of industry, Wilhelm Molterer also sounds a note of optimism: he asserts that net-zero emissions by 2050 is becoming a possibility, even from a sector that currently emits 20% of global CO_2. He suggests that significant changes in value chains and business models are required, but that an energy transition is becoming viable because most of the necessary technologies are already available – and their costs are declining.

Nor should we doubt the optimism: Marian Jean Marinescu sounds an upbeat note about aviation. Its past performance is impressive: since 1990, the industry fuel efficiency has improved by 52%, while other performance indicators such as average fuel burn per passenger kilometer flown and noise energy per flight will also improve; figures offset by the expected growth in passenger numbers and consequent CO_2 and NO_x emissions. He argues that implementing the Single European Sky would have an immediate decarbonisation effect, but warns that measures to reduce emissions should not also have adverse effects upon competitiveness and jobs.

Meanwhile, Cyril Harry examines how interconnecting electricity and gas power systems can contribute to the success of the energy transition. If 80% of electricity will come from clean sources of generation by 2045, then gas will play its part as a bridge fuel in the transition. Gas-fired generation clearly relies upon the integration of a gas supply, while "power to gas" networks may involve using clean electricity to produce hydrogen or synthetic methane through water electrolysis. This type of energy storage can provide unmatched flexibility.

And so, despite the data, there is evidence that the next generation will inherit a habitable planet – and it will still be habitable for the one after that. Christiane Egger and Megan Gignac explore how the Regional Energy Agency of Upper Austria has started to engage very young citizens with its three-point plan: Start them young, train them well and let them take part. The aim? To make energy saving and climate protection second nature. Little seasonal cheer, perhaps, but there is hope after all...

...and a lot more for you to read inside.

Michael Edmund
Editor

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Last year's numbers speak for themselves: over **3 200** participants and more than **8 000** live stream followers, **95** sessions, more than **90** networking activities, over **400 Energy Days**, and trending for three consecutive days on social media.

The future of industry

‘Industry Decarbonisation – investing in industry of the future’

By Wilhelm Molterer (pictured), Managing Director of the European Fund for Strategic Investments (EFSI)

The long-term vision for a climate neutral society by 2050 is gathering momentum. To meet the objectives of the Paris Agreement and to limit temperature rise to a maximum of 1.5°C above pre-industrial levels, attention is increasingly being drawn towards industry, particularly areas difficult to decarbonise. These energy-intensive, or heavy, industries still constitute fundamental building blocks of our economy. However, they also emit large amounts of greenhouse gases. Four industries – cement, steel, plastics and ammonia – are responsible for 14% of the EU’s total CO_2 emissions, globally they even account for 20%. To achieve our climate goals, decarbonisation of heavy industry is key, and at the heart of this green transition lays green financing.

NET-ZERO EMISSION FROM INDUSTRY BY 2050 IS BECOMING POSSIBLE

While the overall picture of where the climate is heading is indeed alarming, recent research provide a great deal of hope, showing that global decarbonisation of industry by 2050 is technically possible, yet economically challenging. Equally, achieving net-zero emission from EU heavy industry is possible but requires significant investments and radical changes in value chains and business models. Furthermore, there is evidence that a fully-fledged energy transition in Europe is becoming technically and economically viable. Most of the necessary technologies are available today and their costs are declining.

But we need to act now. Firstly, because the energy sector is a complex and rather inflexible system. Infrastructure and regulatory changes take decades to implement, thus today’s decisions will shape our energy systems for years to come. The technical life of industrial assets can be up to half a century. Upgrading or replacing such facilities requires planning and investments to start well in advance. Secondly, global competition is rising. Just look towards China, which has become the world’s largest investor in solar and wind technology, and home to almost half of the world’s electric vehicles and 99% of electric buses. Europe cannot afford to fall behind.

EUROPE NEEDS TO TAKE THE LEAD

Climate action is a global responsibility, so why should Europe lead the way? From a narrow competitiveness perspective, developing new carbon-saving technologies before anyone else does it, will offer an opportunity to keep heavy industries in Europe even as the cost of CO_2 steadily rises. From a global perspective, the benefits go far beyond that. By becoming the frontier and finding ways to decarbonise its own energy-intensive industries, Europe will develop and demonstrate solutions that are urgently needed across the globe. Once we can prove the feasibility of these technologies at scale, industrial decarbonisation is more likely to accelerate on a global level. If Europe does not take the lead, it is doubtful anyone else will. If Europe does take its responsibility, it will be to everybody’s benefit.

A key concern for European industry is that univocal EU decarbonisation would undermine its competitiveness. There is little point in shifting to low-carbon technologies if the costs of the transition result in more imports of these materials from less green sources. We must ensure a “level playing field” and aim to strike the balance between environmental sustainability and international competitiveness.

In some cases, solutions are

> *Mobilising private capital for the purposes of climate action and environmental sustainability is one of our main areas of expertise.*

technically viable, but the economic challenges are daunting. High capital costs, lack of incentives or revenue models, long payback times and high risks are just some of the factors restricting green financing. In other cases, the necessary technologies are not yet here. Industry decarbonisation will require substantial efforts in research, development and innovation. It will require new innovative low-carbon production processes, significant investment in industrial equipment and changes in the energy system. In short, it will require a completely new, greener industrial ecosystem. The global emission equation is not an easy one to solve. Cutting emissions is associated with an expensive and typically inconvenient burden that will mostly help people elsewhere, or future generations. And whereas the benefits accrue over decades and centuries, the costs must be paid upfront. This long-term horizon poses financial challenges, calling for long-term investors.

EMBRACING THE GREEN MOVEMENT: EIB'S ROLE IN FINANCING INDUSTRIAL DECARBONISATION

The recent green movement is extremely encouraging for us at the EIB. Mobilising private capital for the purposes of climate action and environmental sustainability is one of our main areas of expertise. Last year, 30% of our total financing went to climate action projects, and we are proposing to increase this share to 50% by 2025. By working with our public and private partners, we strive to unlock more than 1 trillion euros of climate-action investment by 2030, and we will align all our financing activities with the Paris Agreement by the end of 2020.

These goals mean that we need to aim for climate in everything we do, including in industry. As the European climate bank, we follow a long-term vision that encourages the necessary investments now. We are committed to supporting the EU industry in its efforts to decarbonise by 2050. Our economists and engineers specialise in a wide range of industrial sectors and technologies, and they will ensure that money will be channelled towards the most ambitious and carbon-friendly projects. If we say we are working for a greener future, I can promise you, we are.

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European Investment Bank

New materials to feed the rise of renewable energies in Europe

Driven by energy security and diversification considerations, and by global environmental commitments, adoption of renewable energy technology is on the rise. This trend is already clear as governments around the world have started focusing on renewable energy as an important part of the energy portfolio.[1]

In Europe, renewable energies are going to play a fundamental role in the green transition initiated by past Commissions and now one of the top targets of the new Commission.[2] Since clean and green power is no longer an idealistic aspiration but an economically compelling and sustainable proposition, the next decade will see further growth and penetration of renewable energy in various countries.

Renewable power capacity grew 8% in 2018, led by wind energy and solar PV. For the last four years, more renewable power capacity was installed than fossil fuel and nuclear power combined, and renewables now account for over one third of global power capacity.[3] By 2030, 14% of EU energy will come from renewable sources.

In this context, technology innovations in the value chain will provide a two-fold competitive advantage to forerunners (both Countries and companies): (i) lower costs due to improved material technology; (ii) higher production capacity due to higher energetic efficiency. The EU has funded projects that will enable reaching such competitive advantage. Among them, GRIDABLE[4] is a promising European project, which connects renewable energy sources to the energy grid in a more efficient way through innovative materials.

The GRIDABLE project is on a route for cost efficient, high quality and safe production of polymer materials with interspersed nanosilica particles as major building blocks of future smart energy grid. The new materials provide better insulation properties to enable smaller insulation thicknesses and thus smaller components that are made of recyclable thermoplastic materials. In addition, they are more energy efficient compared to traditional thermoset plastics.

The GRIDABLE consortium is composed of eight partners with expertise in plastic material research, material development and engineering, and industrial manufacturing and processing of high-voltage components. The innovation brought about by GRIDABLE will result, new DC-cables and power capacitor units.

Schematic representation of the renewable energy grid. High Voltage DC power capacitors and cables constitute the backbone of the grid.

1 "Global trend in renewable energy" KPMG Singapore, 2016
2 European Commission - press release
3 REN21 - Renewables now
4 This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 720858

POSEIDON MED II LNG BUNKERING PROJECT
sailing on the LNG era

Poseidon Med II brings LNG to Eastern Mediterranean maritime transportation

Poseidon Med II, a key co-funded European project, paves the way to a dynamic expansion of LNG (liquefied natural gas) in the Eastern Mediterranean marine transportation.

LNG is a safe and environmental – friendly fuel that has already spread to the seafaring transport in the regions of Northern Europe and Western Mediterranean.

Aiming to establish a viable, efficient and sustainable LNG supply chain in the Eastern Mediterranean region, PMII, has taken, up-to-now, all the necessary steps;

Development by experts of all the conceptual design, safety, preliminary environmental and supporting engineering studies for the construction of small- scale LNG bunkering infrastructure at five ports of the Eastern Mediterranean (Piraeus, Patras, Heraklion, Igoumenitsa and Limassol).

Preparation of an addendum to the Master Plan of the port of Piraeus, identifying the areas where Ship to Ship (STS) and Truck to Ship (TTS) LNG bunkering operations are going to take place and submitted it to the relevant authority for approval. **For the port of Heraklion,** the Master Plan update for the proposed LNG bunkering installation has already been submitted for approval. Finally, the Master Plans, along with the accompanying preliminary safety and environmental impact assessments, **for the ports of Patras and Igoumenitsa,** have been completed and already been approved by the competent authority, i.e. the Port Planning and Development Committee (ESAL).

Relocation of the proposed LNG infrastructure to Vassilikos Terminal in Cyprus, where a new Jetty/FSRU infrastructure will be constructed. The programme is planning a permanent berth for the docking of LNG bunkering vessels, opposite to the jetty for the FSRU berthing in Vassilikos area.

Completion of the design studies for the construction of a small-scale LNG jetty (for the loading of bunkering & feeder vessels) and a truck loading station (for bunkering and off grid consumers' supply) at Revithousa LNG Terminal, while the tendering procedure for awarding the construction of the truck loading station is in progress.

Key contribution to the accomplishment of the Regulatory and Legislative framework for the implementation of safe LNG Bunkering operations in Greek ports, established by **a Presidential Decree (PD 64/2019),** published on June 20th in the Government Gazette.

Drafting a general "LNG Bunkering Manual" while setting standards for the appropriate training and competences of the involved personnel.

Completion of the conceptual and detailed designs for the retrofitting of ten conventional fueled vessels to LNG powered vessels. Moreover, the design studies for two new-built LNG fueled passenger ferries have been finalized, among which those for an innovative RO-PAX ferry that will use environmentally friendly technologies to improve propulsion and efficiency. All above-mentioned designs have received the Approval in Principle Certification by a classification society.

Completion of the designs for the construction of an innovative LNG Semi-Ballastable Barge Transporter (SBBT), for the Venice Lagoon area and submitted them to the classification society. The majority of the designs have already been approved and the contract for the construction has been awarded in September 2019.

Assessment study for seven Greek shipyards regarding their ability to support LNG fueled vessels maintenance, repairs and retrofits.

Preparation of Cost Benefit Analyses and the relevant Financial Instruments for the SSLNG facilities of the five Ports and the ten selected vessels.

Pre-Assessment of the LNG bunkering logistics' cost, taking into account synergies with other energy sectors, such as supplying with natural gas the industrial and/or the urban network of Western Greece (Patras & Igoumenitsa) and Vassilikos (Cyprus).

Poseidon Med II, initiated just four years ago, has already laid the foundations for LNG bunkering in Eastern Mediterranean, setting the example for a cleaner, more effective, competitive and sustainable marine transportation towards a zero-carbon future.

poseidonmedii.eu

Co-financed by the Connecting Europe Facility of the European Union

Supporting European cities towards a clean and smart urban mobility

By Dirk Beckers (pictured), Executive Director of the Innovation and Networks Executive Agency

The European Commission's Innovation and Networks Executive Agency (INEA) supports the transition towards clean and smart urban transport and mobility via important EU funding programmes.

Since January 2014, INEA has been implementing important EU funding programmes for transport, energy and telecommunications from research to deployment. It supports research and innovation actions via parts of the Horizon 2020 programme, under the guidance of the European Commission's Directorate-Generals for Research and Innovation, Energy, and Mobility and Transport. The latter is also responsible for transport infrastructure actions implemented by INEA under the Connecting Europe Facility (CEF). The Agency plays a key role in turning Commission policies into successful projects with tangible results. It aims to benefit economic growth and EU citizens by providing its stakeholders with expertise and high-level programme management, whilst promoting synergies between the programmes.

The Agency currently manages 33 research and innovation projects managed under the Horizon 2020 transport challenge, 14 Smart Cities and Communities projects under the Horizon 2020 energy challenge and 44 projects under the CEF priority on Urban Nodes. The total EU contribution for these projects is almost €700 million.

CIVITAS DESTINATIONS is a four-year CIVITAS demonstration project. Its aim is to support remote touristic destinations, islands, in overcoming their particular transport and mobility challenges. It will do this by integrating sustainable tourism and mobility strategies to respond to travellers' and residents' needs while providing high quality and sustainable environments. In total, a series of 80 innovative measures and solutions are being tested in six European insular regions (Funchal, Las Palmas de Gran Canarias, Limassol, La Valetta, Elba and Rethymno) that experience a significant influx of tourists, resulting in great pressure on the transport systems of their islands.

INEA'S CONTRIBUTION TO URBAN MOBILITY RESEARCH AND INNOVATION

The European Commission launched the CIVITAS Initiative in 2002. It comprises a network of ambitious cities dedicated to cleaner and better transport in Europe. Since its launch, there have been five funding phases, in which more than 80 demonstration cities have tested over 800 solutions as part of integrated CIVITAS demonstration projects. The CIVITAS projects receive a total EU contribution of around €180 million; involve some 400 beneficiaries - including 17 demonstration cities, and reach around 10% of the EU population.

Three major CIVITAS demonstration projects are currently ongoing: DESTINATIONS, ECCENTRIC and PORTIS[1].

As part of the last CIVITAS funding phase, an additional 29 research and innovation projects explore how new technologies and innovative services can support cities in achieving a more resource efficient transport, and how economic and social trends influence urban mobility.

The CIVITAS projects managed by INEA cover ten thematic areas that reinforce each other: Car-Independent Lifestyles, Clean Fuels

and Vehicles, Collective Passenger Transport, Demand Management, Integrated Planning, Mobility Management, Public Involvement, Safety and Security, Transport Telematics and Freight Logistics.

INEA'S CONTRIBUTION TO SMART CITIES AND COMMUNITIES

INEA actively contributes to the transition to a reliable, sustainable and competitive energy system by overcoming important European challenges, such as increasingly scarce resources, growing energy needs and climate change.

The Smart Cities and Communities lighthouse projects demonstrate sustainable, cost-effective and replicable district-scale solutions to increase cities' overall energy and resource efficiency.

The projects are positioned at the intersection of energy and transport innovation, enabled by open ICT urban platforms. They include thematic areas relevant to transport and mobility, for example in the area of electro mobility.

The first Smart Cities and Communities call managed by the INEA was launched in 2014, and 14 projects have been funded so far, with a total EU contribution of around €300 million. The projects involve some 550 beneficiaries from all over the EU, including 40 lighthouse cities and 53 follower cities.

INEA'S CONTRIBUTION TO THE CEF URBAN NODES PRIORITY

The CEF Transport programme supports the completion of the TEN-T network with a focus on nine multimodal Core Network Corridors. It contributes to the deployment of sustainable and efficient mobility solutions, and to the combination of transport modes and ICT.

The CEF 'Urban Nodes' priority, funded since 2014, aims to better integrate long-distance transport with the urban traffic system for both passengers and freight. INEA manages 44 projects selected in five calls for proposals, with a total EU contribution of €215 million in grants. They contribute to:

- Covering missing links and bottlenecks between transport modes in urban nodes (e.g. the connection between an airport and city centre, or international rail station and urban bypass);
- Covering missing links and bottlenecks by better connecting TEN-T journeys with urban ones;
- Increasing multi-modality, by sustainably shifting both freight and passengers from road transport to alternative modes, or by shifting from fossil to alternative fuels. This includes public transport optimisation, development of bikes and cargo-bike transport patterns, low-noise/carbon urban freight delivery, better use of public space, etc.

INEA'S SUPPORT COVERS THE FULL INNOVATION CYCLE

INEA further supports its Horizon 2020 beneficiaries by providing guidance and best practices for turning project results into business opportunities, and helping them to identify complementary funding instruments that can support innovative ideas towards full deployment.

The Agency is committed to fostering a real European wide take-up and deployment of innovative urban mobility solutions, so that European citizens can enjoy more efficient transport systems, with new and better transport services.

1 The PORTIS and ECCENTRIC projects have featured in previous editions of the *European Energy Innovation* magazine.

SCORES PROJECT

“Self Consumption Of Renewable Energy by hybrid Storage systems”

The European Commission has set ambitious goals in order to move to an energy-neutral built environment in 2050. This energy transition imposes major challenges on the building sector and the energy grid. Increased self-consumption of locally generated renewable energy sources is a must to overcome this challenge. A motivated team of professionals from industry and knowledge institutes has taken on the challenge to develop a hybrid energy storage system that will contribute to this goal.

The SCORES project is a collaborative project supported by the European Commission under the Horizon 2020 programme for Research and Innovation (Call H2020-EEB-2017) with a duration of 48 months.

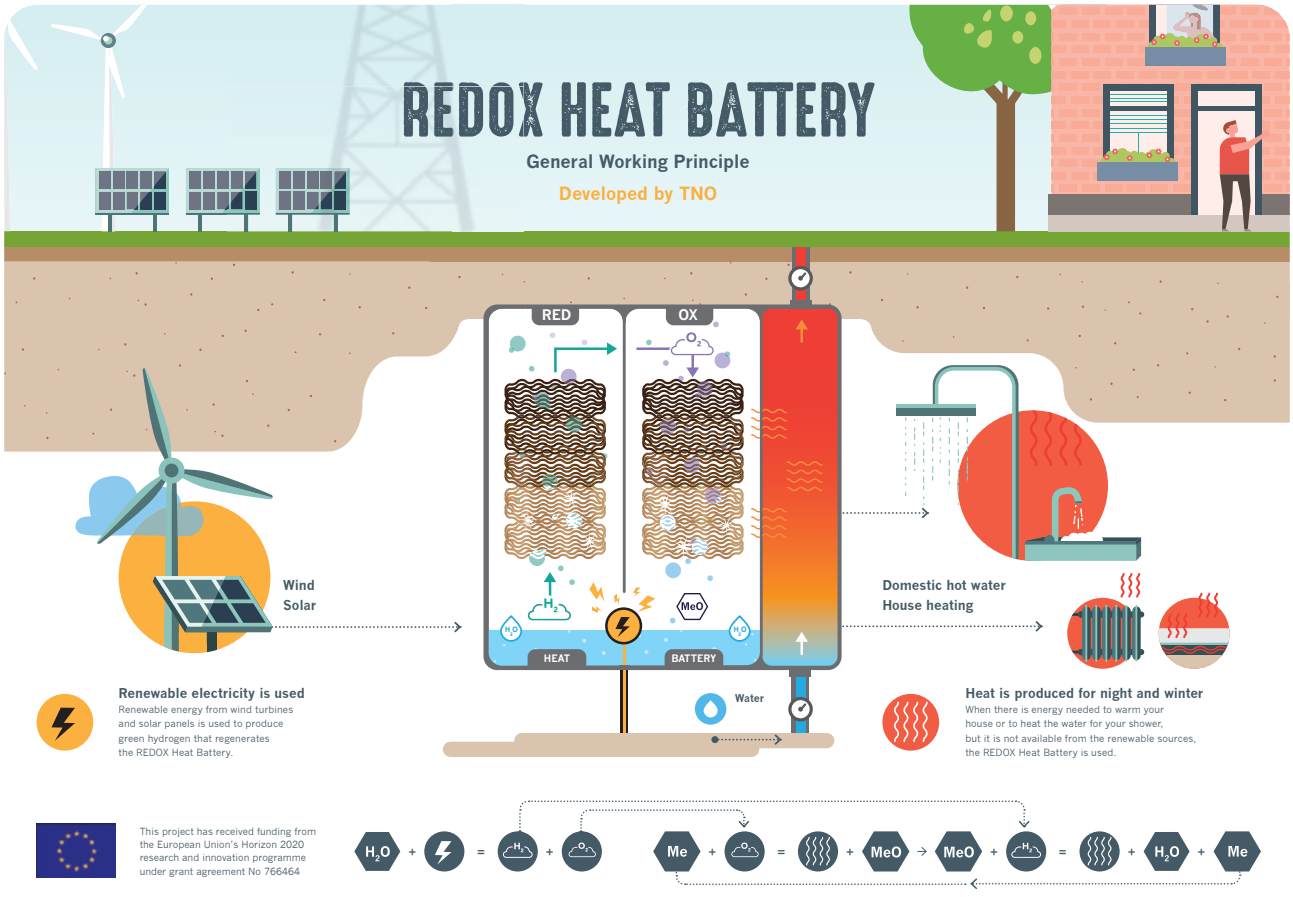
The project consortium consists of twelve partners from seven European countries and has a strong industrial character (three SMEs and six LEs), complemented by one university and two research and technology organizations, including TNO as a project coordinator.

Tradability and economic benefits

The main aim of the SCORES project is to develop and demonstrate a building energy system including new compact hybrid storage technologies, that optimizes supply, storage and demand of electricity and heat in residential buildings, increasing self-consumption of local renewable energy in residential buildings at the lowest cost and deferring investments in the energy grid.

Combination and optimization of multi-energy generation, storage, and consumption of local renewable energy (electricity and heat) brings new sources of flexibility to the grid and gives options for tradability and

Fig.1: REDOX heat battery – general working principle (Graphics: TNO)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 766464

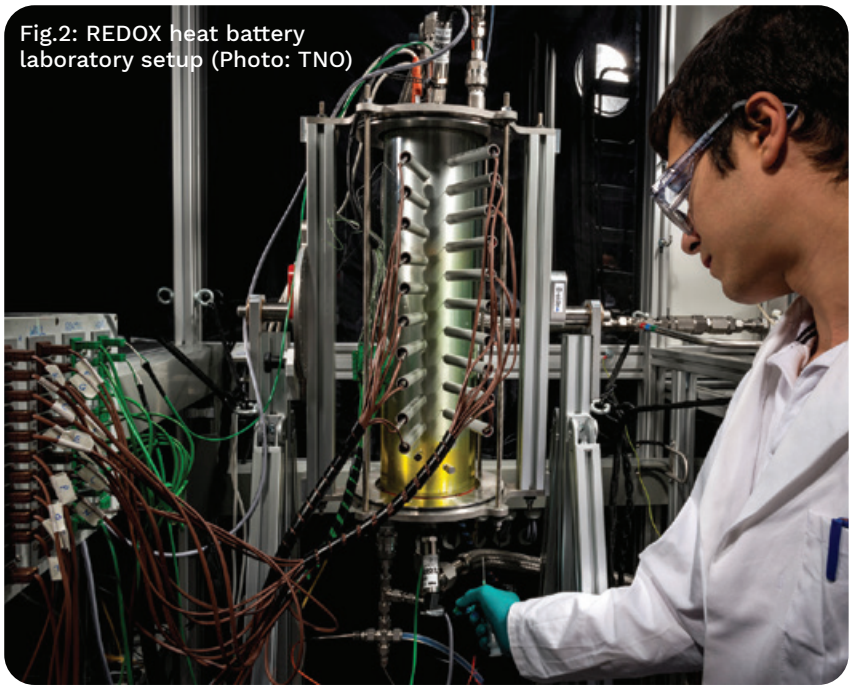


Fig.2: REDOX heat battery laboratory setup (Photo: TNO)

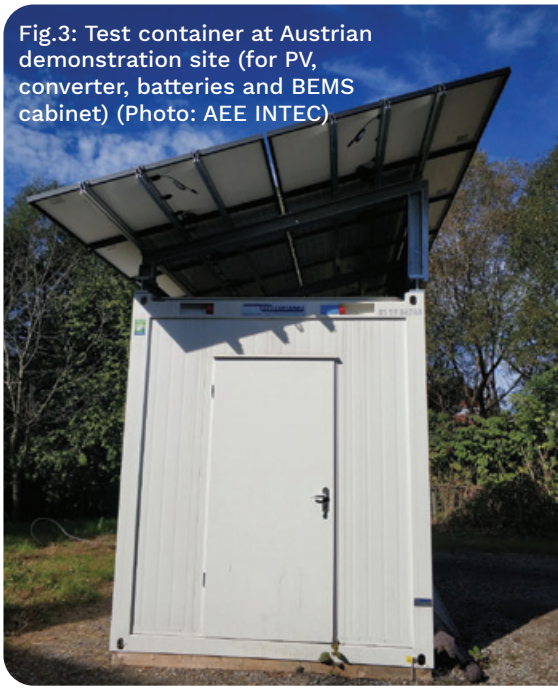


Fig.3: Test container at Austrian demonstration site (for PV, converter, batteries and BEMS cabinet) (Photo: AEE INTEC)

economic benefits, enabling reliable operation with a positive business case in Europe's building stock.

Real building demonstrations

Impact of the SCORES system will be a broad assessment covering stakeholders of various economical levels like individual homeowners, housing companies, grid owners, energy companies and governments, ecological issues and also the security of supply /reduced European dependence on fossil fuels originating from unstable countries from across the globe. Within this impact assessment, a first evaluation is performed on two demonstrations. Demonstrations of the integrated hybrid energy system will take place in two real buildings representative of different climate and energy system configurations for three cases, in Central Europe (Austria) with and without a heat grid, and in Middle/ Southern Europe (France) without a heat grid.

REDOX heat battery

One of the key technologies to be demonstrated is a Power – to – heat concept developed within the SCORES project. A team of engineers and scientists from the Dutch research organization TNO has built a laboratory scale setup for testing a heat storage technology based on redox reactions of metals - REDOX heat battery as it uses the REDuction and OXidation reactions to store heat.

In the REDOX heat battery the metal core is oxidized using air and the heat generated is used for supplying domestic hot water and space heating. After the reaction, the core is regenerated by supplying hydrogen produced by renewable electricity. This cyclic operation enables the use of this energy storage system similarly as we currently use standard rechargeable batteries at home, with the difference of storing heat rather than electricity. In the course of the SCORES project, the REDOX heat technology will be developed from the current TRL 4 to TRL 6 and demonstrated in a relevant working environment.

SCORES

Project ID:	766464
Website:	http://www.scores-project.eu/
Start date:	November 2017
Duration:	48 months
Project coordinator:	Ing. Peter van Os
Contact email:	peter.vanos@tno.nl
Project partners:	TNO, AEE-INTEC, CAMPA, EDF, FENIX TNT, FORSEE POWER, HELIOPAC, INSTITUTO POLITECNICO DE SETUBAL, KONIG METALL, RINA-CONSULTING, SIEMENS and STADTWERKE GLEISDORF.

A new energy forecast shows the danger of inaction as well as a pathway to progress

By Mark Radka (pictured), Chief, Energy and Climate Branch, United Nations Environment Programme

Officials from nearly every country are gathered in Madrid for the latest round of international climate talks – and their meetings come on the heels of a new warning.

The International Energy Agency, in a November report, calculated that even if all nations deliver on their climate pledges to date, the world is on track for ever-rising greenhouse gas emissions through 2040. That's a far cry from the cuts needed to meet the goals of the Paris Agreement.

The IEA also delivered a key insight: The "single most important element" for reducing greenhouse gas emissions while not stunting economic development is a sharp pick-up in energy efficiency improvements across the world.

Governments and the private sector must heed this call.

Far too much of the energy used today in countries across the world is in a sense wasted. For example, even in wealthy nations, many homes are poorly sealed – meaning heated or cooled air goes straight outdoors, providing no benefit to the occupants. And many buildings rely on decades-old, inefficient technologies to heat or cool the air in the first place.

More efficient lamps, air conditioners, refrigerators, and other appliances are available today, but energy efficiency standards and investments don't promote their widespread use, even though they save money for consumers and society as a whole.

Governments in some economies have adopted standards that ban inefficient products from their markets. In most countries, however, either no standards exist or they haven't kept pace with advances in technology and are outdated, meaning that roughly two thirds of the world's energy is consumed by products or in buildings that are in a sense out of date.

This leaves large opportunities for improvement. If stringent policies covering just five electricity consuming products were adopted globally, the electricity generated by over 500 large power plants would be saved, trimming utility bills for consumers by $100 billion.

Both governments and businesses have roles to play in doubling down on energy efficiency. Governments

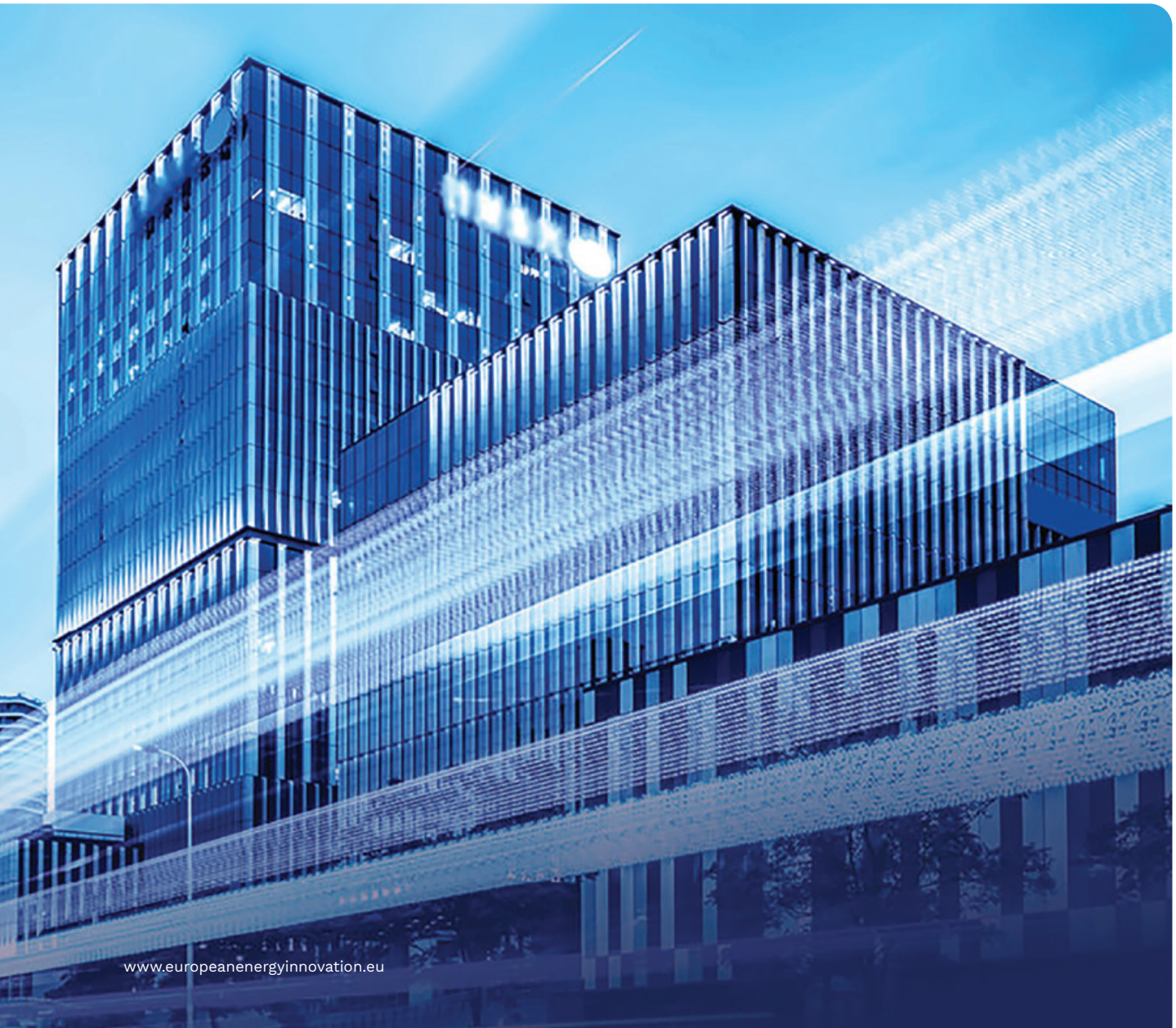
need to prioritize investments in efficiency improvements and put in place minimum energy performance standards and other policies that drive progress. Governments can also remove incentives for fossil fuel energy production and consumption, shifting the emphasis to using less energy in delivering desired services rather than producing more energy.

The private sector must continue to improve technologies, deploy better products, and share their experience in energy management, particularly in developing countries.

With increased public-private collaboration, worldwide energy efficiency can improve by three percent annually. This rate of improvement, possible using existing technologies, would deliver more than 40 percent of the greenhouse gas reductions needed to meet Paris Agreement targets. In other words, energy efficiency by itself can provide almost half of the climate solution.

There are new initiatives driving the needed focus on energy efficiency collaboration and investment. The Three Percent Club – launched in September by the United Nations Environment Programme, the International Energy Agency, Sustainable Energy for All and its Energy Efficiency Accelerators and Hub, the Global Environment Facility, the European Bank for Reconstruction and Development, and the EE Global Alliance – is building a coalition of countries, businesses, and international organizations that are committed to realizing a three percent global increase in energy efficiency each year.

As nations develop their updated commitments under the Paris Agreement, they must make using energy more efficiently a core part of the approach. Energy efficiency is the single most cost-effective tool for reducing carbon emissions. Without a change in course and a more aggressive commitments, we'll keep missing too much of this opportunity.



DELTA – Unlocking the Demand Response Potential across Europe

Extreme or unexpected weather conditions can put a strain on our electricity grids. When demand for power or renewable energy resource generation dramatically increases, utility companies often turn to their reserve power stations to make up what is required to satisfy the needs of the grid. An alternative to this approach is using Demand Response strategies, whereby consumers are incentivised to reduce or shift their energy usage when the grid is under pressure to balance demand and supply. This is where DELTA comes in.

DELTA and Demand Response

DELTA is an EU-funded research and innovation project developing new technologies to roll out demand response across Europe.

The project is building a framework for the integration of small to medium prosumers in the electricity network to help them participate in demand response services.

A prosumer is someone who both consumes and produces energy – for example a household that installs a solar panel or a factory that runs a wind turbine.

Demand response is a tool used to involve consumers in balancing supply and demand on the electric grid. By reducing or shifting their electricity usage during peak periods, consumers can help strengthen grid reliability and ensure stability.

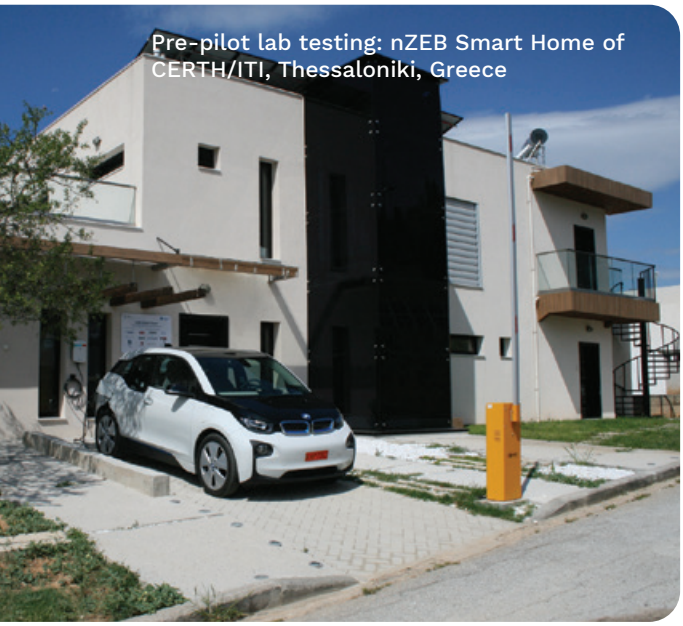
Small and medium sized prosumers

Thanks to its smart and efficient technology that relies on Virtual Power Plant principles, DELTA allows small and medium sized prosumers to be active players in the energy market.

Aggregators – companies that buy power and supply it to consumers – have traditionally worked mainly with large scale prosumers and consumers as it is difficult for them to work with smaller ones such as households. But DELTA's new blockchain-driven technology aims to make this process easier and more secure and efficient for aggregators.

Key technologies developed by DELTA

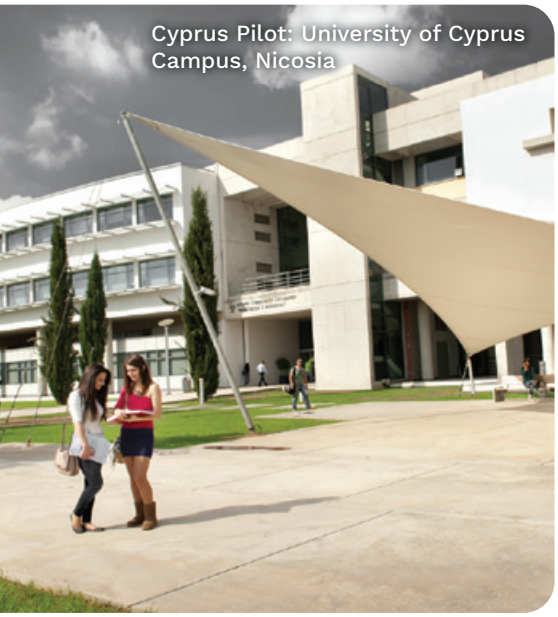
The **DELTA Virtual Node (DVN)** provides aggregators with the technology needed to efficiently manage their portfolios of small and medium scale consumers and prosumers. The DVN Platform, a software suite powered by a


Pre-pilot lab testing: nZEB Smart Home of CERTH/ITI, Thessaloniki, Greece


UK Pilot: Commercial Building Moor House (Central London) and residential housing estate Ernest Dence Estate (Greenwich)

secure permissioned blockchain, has the ability to unobtrusively and automatically group consumers and prosumers together based on their energy consumption characteristics. This involves both real-time and historical data, allowing aggregators to accurately forecast the energy flexibility they can offer to the grid when demand is high.

The **Fog-enabled Intelligent Device (FEID)** is the hardware placed in homes and businesses that gathers energy data and transmits it to the DVN. This piece of equipment is safe and secure, and thanks to edge computing technology being employed, it automatically processes information, forecasts consumption and receives DR signals in the form of smart contracts.



Cyprus Pilot: University of Cyprus Campus, Nicosia

"The core objective of DELTA is to develop and test new technologies for demand response and create new services that can be offered by aggregators to their prosumers and customers around Europe."

Project Manager Dr. Dimosthenis Ioannidis (pictured), CERTH/ITI

DELTA

DELTA has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773960.

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YouTube: DELTA H2020

Project facts
Duration: 05/2018-04/2021
Partners: 10 organisations from 8 European countries
Budget: € 3 873 625

Product policy efficiency is a good deal

By Maria Carvalho, MEP

Photo: ©European Union 2019

According to the European Commission (EC), the investment made by manufacturers in eco-design will soon be saving consumers an average 490 euros in energy bills per household every year.

This effort, along with energy consumption labelling, is also bringing us closer to achieving our climate goals. Again, according to EC estimates, the efficiency gains represent nearly half of the reduction in energy consumption and about one quarter of the emissions reduction targeted by the European Union for 2020.

Let us not forget the benefits for the European industry itself, with estimates of combined savings and extra earnings reaching a whopping €45 billion.

When speaking about products, whether they are household appliances, lighting or smartphones and computers, energy efficiency is definitely a good deal. In addition, it is also very much a moral imperative: the climate crisis we are experiencing compels us to take those steps.

In November, I had the opportunity to host the "Europeans Favourite Products 2019-24" event, in the European Parliament, organized by three of the majors players in the market: APPLiA, DIGITALEUROPE and LightingEurope. I must say that I was impressed by the level of engagement to this strategy shown by the industry and other stakeholders.

Of course, there are concerns, particularly regarding the possibility of disruptive changes emerging from the new Product Framework Policy. However, there is also a strong commitment to keep Europe leading the way in terms of sustainable technologies.

I believe in the ability of industry, particularly in our European ecosystem, to adjust to the challenges we are facing without a strong interference from the legislators.

Legislation must be evidence-based, considering ethical values. It must not create unnecessary additional administrative burdens to businesses. We need to achieve our goals in the simplest way possible and we need a stable framework without surprises. In other words, legislators must mimic the levels of efficiency they are demanding from the industry.

That is not to say that everything is already done from a regulatory point of view. It never is.

For instance, some years ago, questions arose in regards to the labelling system, as brands started to add "+" signs (one or several) to their A level products. This led to confusion among consumers. In 2017, the regulations changed to prevent this and, from 2021 on, new products will be labelled in a simple "A" to "G" scale, with the corresponding colour pattern (green to red).

When we think about what is coming in terms of European Commission priorities for product policy, the call for a strong development of the circular economy is without a doubt something that will require attention.

Again, the advantages of this strategy seem undisputable. Both from an environmental and from an economic point of view. Reusing products and product components will reduce waste, carbon emissions and energy consumption. It will create new businesses and jobs, stimulating the growth of secondary markets. It will empower citizens. As it was the case for the recent advancements in terms of reparability.

However, we have to make sure that product safety remains top priority. To do that, we need a clear and comprehensive set of rules and mechanisms. We must decide what components can be reused and in what conditions. We must determine what to do with those components that are not recyclable, many of them potentially hazardous to human health and the environment. We must know exactly who answers for the safety of this process in each of its steps.

Advanced Materials for Clean and Sustainable Energy and Mobility - Key R&I priorities are clear

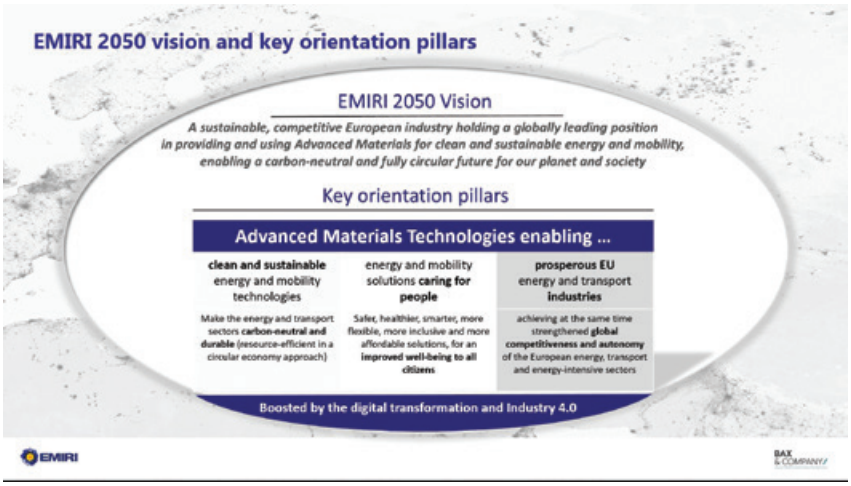
In the face of the 21st century's global climate and energy challenges, Europe's ambition is to become the leader in the transition to an economy that keeps growing within environmental and societal constraints. The strategic directions set by the new President of the European Commission Ursula von der Leyen in 'A European Green Deal' confirm the willingness of the new European Commission to reinforce earlier ambitions such as the commitment of Europe to the Paris Agreement on Climate and position Europe at the forefront of sustainability. Addressing these objectives, in line with the ambitious timescales considered, will require breakthrough technologies and disruptive models at a scale and a pace never encountered before, that will transform our society in all activity sectors. The European energy and mobility sectors, which today generate about half of all GHG emissions, have already made significant steps; from energy harvesting to energy storage, as well as technologies that improve the energy efficiency and decarbonisation of end uses. The share of renewable energy has increased from 8.5% in 2005 to 17.5% in 2017 – enabled by harvesting and storage technologies – while energy efficiency of end-use sectors increased by 30% compared to 1990.

Achieving these ambitious targets will only happen by taking advantage of all possible technological options: better use of natural resources, re-use in a circular economy approach, increased use of renewable energy and feedstock, electrification of mobility and energy-intensive processes, new catalytic processes to re-use CO_2, eco-designed materials... Overall, this requires further urge investments in Research and Innovation activities across all the Technology Readiness Levels (TRLs), with a particular emphasis on advanced materials – which represent up to 80% of the costs of the key components of clean and sustainable energy and mobility technologies. These investments will not only provide an environmental benefit but will also strengthen the economy – the RES and energy efficiency sectors employ more than 2 million people in the EU – and create a competitive advantage for Europe in a future where clean technologies are indispensable.

Advanced materials at the heart of clean techs

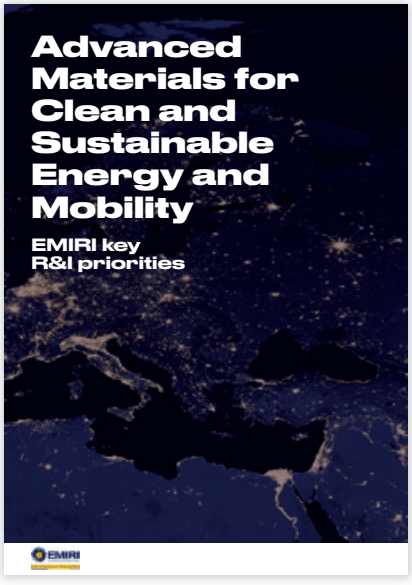
The advanced materials industry (Chemicals, Polymers, Metals and alloys, Glass, Ceramics, Composites...) is renowned as one of the leading technology sectors in Europe. It generates innovation that benefits society at large providing more than 2.5 million direct jobs (and around four times more in indirect jobs along the various value chains) and contributes to more than 650 billion euros of Europe's gross domestic product. Home to approximately 40.000 companies, European

Since 2012, EMIRI, the Energy Materials Industrial Research Initiative, is representing more than 50 organizations (industry, research, associations) active in advanced materials for clean and sustainable energy & mobility technologies. EMIRI contributes to industrial leadership of developers, producers and key users of advanced materials by shaping innovation, manufacturing and energy policy framework at European level.

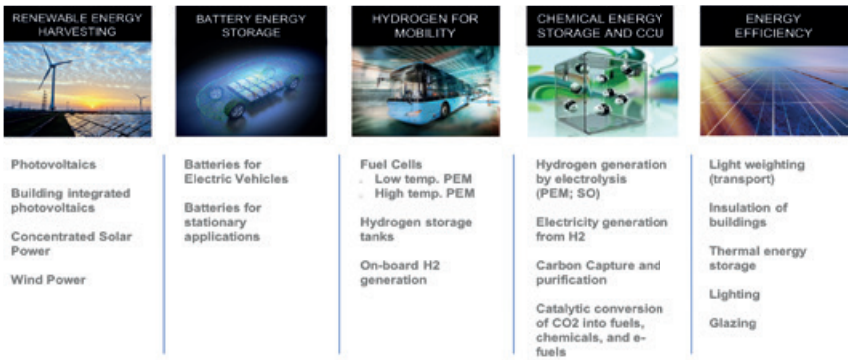


advanced materials industry plays a crucial role in serving society's need for clean and sustainable energy and mobility in Europe, and all over the world. The impact of the industry on the broader European economy is significant and must be sustained. The advanced materials demand for clean energy and sustainable mobility is anticipated to grow continuously – even at a two-digits rate in specific applications like batteries – until 2050 and beyond, also satisfying an increasing request for safer, more affordable and environmentally friendly solutions. Industrial competition is fierce, not only from established world regions but also from new, strong challengers. In this context, there are vast amounts to be done in the research and innovation field to provide a differentiating competitive advantage for the EU in this market.

High-performance advanced materials are at the core of the technological innovations needed to reach a sustainable and climate-neutral economy and society. Such materials are a part of the solution to our global challenges, offering better performance in their use, at lower cost, resource and energy requirements, and improved sustainability at the end-of-life of the products. The development of these new materials has to manage the scarcity of resources and be part of a circular economy value chain which will contribute to Europe's competitiveness in a context of increased sustainability standards. With the imperative to change our energy technology mix, to respond to the challenge of decarbonisation and of the security of energy supply, research and innovation investments to improve the competitiveness, performances and environmental footprint of advanced materials for clean and sustainable energy and mobility technologies are more than ever needed for Europe to compete in the global market and support the delivery of a prosperous, modern, competitive and climate-neutral economy by 2050.



EMIRI priority technology areas



De-risking and accelerating the innovation | addressing the right priorities

History shows that it takes about 10 – 15 years of R&I activities before the required advanced materials are developed and are ready for market uptake. Together, the Industry & the European Commission need to partner up to accelerate the innovation in the field. While the EU has a strong position in research, a too-frequent extensive market uptake is due to long capital-intensive development times in combination with substantial technology and commercialization risks. These factors make it difficult for new materials to make the journey from the lab to industrial-scale production and the markets.

One of the key activities of EMIRI is to identify research and innovation areas where new advanced materials can make a difference in the clean and sustainable energy and mobility sectors. EMIRI will further on aid to lead the way for these early-stage technologies and materials to industry growth and market.

Detailing the Advanced Materials challenges to tackle and the innovation approaches recommended, the 2nd edition of the EMIRI Technology Roadmap is a reference for policy-makers in EU and its Member States co-designing Horizon Europe, for the industry as well as the research world. More than 100 experts from EMIRI's community contributed to building this new version of the EMIRI Technology Roadmap, which is available for download on EMIRI website or directly at http://bit.ly/2MeeaMa. All public and private stakeholders in European advanced materials, energy and mobility sectors are invited to consider the revised priorities set out in this document in their future research and innovation programmes. ●

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Training the next generation – from 3 to 30

By Christiane Egger & Megan Gignac, OÖ Energiesparverband, Upper Austria

Long before the uprise of Fridays for Future, the region of Upper Austria (one of Austria's 9 regions) had already understood that young people can be strong and valuable proponents of the clean energy transition. They are the citizens, workforce and decision makers of tomorrow. They are those who have the most at stake. Furthermore, they provide fresh ideas and new enthusiasm for action and overcoming the challenge.

Since its foundation in 1991, the Regional Energy Agency of Upper Austria (OÖ Energiesparverband, ESV), has been driving the energy transition on all fronts by working with the entire range of stakeholders. This includes young professionals and students of all ages. Energy saving and climate protection education must start at a young age in order to make it second nature and a fully integrated part of citizens' lives. The ESV actively engages younger generations with a wide portfolio of activities specifically targeted to people 3 to 30 years old.

START THEM YOUNG – "RENEWABLE ENERGY GOES TO (NURSERY) SCHOOL"

Energy savings and climate protection needs to start early – very early! The ESV developed and ran an innovative programme called "PV goes to school". Nursery, primary and secondary schools were offered a 75% subsidy for the installation of a 3-kWp PV system on their building, a comprehensive toolbox of age-appropriate and interactive educational material on renewable energy and a compulsory 1-day training for teachers on how to integrate the material in their (nursery) school's curriculum. The programme generated an impressive response with 40% of all primary and secondary schools and 25% of all nursery schools in Upper Austria taking part. In total, 2 MW PV was installed and around 600 educators from 550 schools were trained. This novel programme helped to sensitise not only the children, but also their parents, the school staff and the larger community.

TRAIN THEM WELL – QUALITY EDUCATION FOR THE FUTURE GENERATION OF PROFESSIONALS

In 2001, together with regional vocational schools, the ESV created an apprenticeship programme for heating installers with dedicated education on renewable heating ("eco-installers"). Since then, thousands of students were trained to install the technologies needed for the energy transition. The ESV also organises 1-day outings to companies

Gerhard Dell and Christiane Egger, Managing Directors of the OÖ Energiesparverband, with a recipient of the Young Energy Researchers Award

Teachers in training

in Upper Austria for vocational school students. On site, they receive hands-on information about the company, their services and products. This also serves to initiate contact between companies and potential future employees. Since 2013, over 1,000 students have taken part in 27 such outings.

Also in the early 2000s, the first study programme for green energy engineers was developed together with the University of Applied Sciences. Today, there are over 600 graduates from three such study programmes (2 bachelor and 1 master). The master degree programme "Sustainable Energy Systems" is offered in English, thus attracting international students to Upper Austria and preparing regional students for the globalised world.

LET THEM TAKE PART – CONTRIBUTING TO THE ENERGY TRANSITION IN UPPER AUSTRIAN COMPANIES

The ESV supports energy technology companies in increasing competitiveness and market leadership in the context of the Cleantech-Cluster (CTC), a network of 250 businesses in Upper Austria. In 2019, acting on this ambition, the ESV

Primary school children learning about renewable energy

came up with a cutting-edge event that tapped into the creative thinking and problem solving skills of bright young minds.

The "International Clean Energy Challenge", held from 22-26 July 2019 in Upper Austria, brought together 64 highly-qualified young professionals (under 33 years old) from more than 30 countries and 11 partner companies for a novel event of collaborative innovation. In diversified and interdisciplinary teams, they tackled real-life challenges presented by the partner companies.

Each of the teams was assigned to a specific challenge, typically consisting of a service, concept or market that the company is keen on developing or expanding.

This original new concept attracted strong interest. 200 high-potential candidates from 43 countries applied. The selected participants consisted mostly of young professionals working in businesses, industry, energy agencies, associations, public bodies and research institutions and some students in advanced education. They came from a diversity of educational backgrounds including engineering, economy, architecture, business administration, chemistry, mathematics, law, political science and more. The event brought qualified professionals in contact with forerunner companies and was overall a great success for all people involved.

HIGHLIGHT OUTSTANDING WORK FROM UPPER AUSTRIA AND BEYOND – THE YOUNG ENERGY RESEARCHERS CONFERENCE AND AWARDS

Every spring in Wels/Austria, the ESV holds one of Europe's largest annual conferences on sustainable energy – the **World Sustainable Energy Days (WSED)**. Through a series of specialised conferences covering technologies, markets, policies and more, the WSED attract over 660 participants from more than 50 countries each year.

In 2012, a central place for young energy researchers was created within the WSED. The **Young Energy Researchers Conference** is dedicated to presenting the work and achievements of young researchers in the fields of energy efficiency and biomass. It offers them the opportunity to interact with researchers and industry experts from all over the world. Throughout the years, over 400 young researchers have participated in the event. For many, this was a first-time opportunity to hold an international presentation. As organiser, the ESV covers most of their costs. Moreover, the most outstanding contributions are honoured with the "Best Young Energy Researcher" Award and 1,000 Euro each in prize money. For the upcoming 2020 edition, over 120 papers were received from 44 countries.

Over the past year, youth speaking out through Fridays for Future has offered a much welcomed renewed momentum to climate protection. Their message is clear: we all need to make the necessary changes happen. Each individual has an essential role to play. Business leaders, public administrations and policy-makers need to fulfil their obligations to the next generations. **You are warmly invited to join the World Sustainable Energy Days in Wels/Austria from 4 – 6 March 2020 to take an active part in the clean energy transition (www.wsed.at).**

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OÖENERGIESPARVERBAND

In order to reduce greenhouse gas emissions and mitigate the effects of climate change, the future energy production will be increasingly based on renewable energy sources,

A challenge to be solved before the full benefits of renewables can be obtained, is that these systems (mainly photovoltaic and wind turbine plants) are intermittent and volatile and this determines possible imbalances on the electric grid.

An appropriate solution can be found in the synergy between the different networks (electricity, district heating, and natural gas), which can be obtained by the optimised use of conversion and storage technologies such as heat pumps, power to gas and cogeneration systems, through a smart control systems that take into consideration the whole energy system.

These are the main topics studied within the PLANET Horizon2020 European project, by 11 partners from 7 different countries and coordinated by the Energy Department of the Politecnico di Torino (Italy).

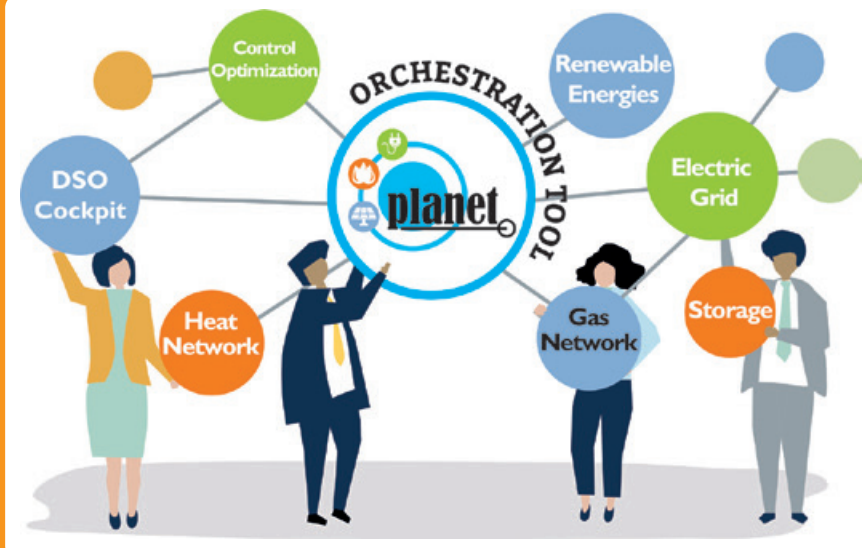
PLANET will develop a holistic Decision Support System (DSS) integrated in a ICT monitoring and orchestration cockpit for utilities, policy makers and network operators. The DSS will aid them to leverage innovative energy conversion in alternative carriers & storage technologies in order to explore, identify, evaluate and quantitatively assess optimal grid planning and management strategies for future energy scenarios that target full energy system decarbonisation.

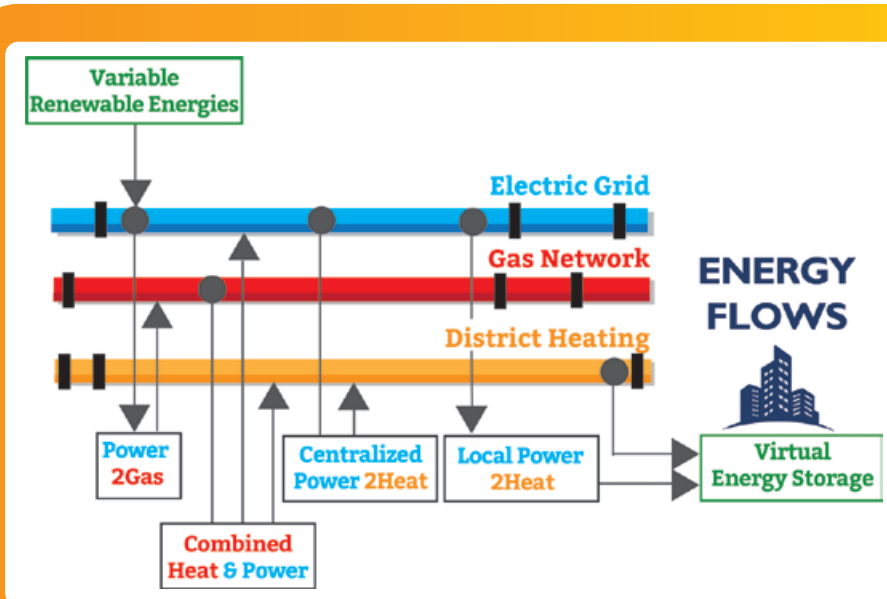
A robust analysis of the possible synergies between electricity, gas and heat networks will be carried out by creating simulation models for the integration between energy networks and conversion/storage technologies, e.g. power-to-gas (P2G), power-to-heat (P2H) and virtual thermal energy storage (VES).

Application of the developed tools in two different test cases in Italy and France will showcase their benefits and also reveal potential grid stability issues and effective countermeasures.

Finally the project will further investigate the possible economic impact of this a approach, the new business opportunities in electricity, natural gas and district heating markets as well as the necessary adaptations of the regulatory and standardization landscape to facilitate the adoption of these technologies. ●

https://youtu.be/gy4kxplMSZk





Green-energy landscapes – solution to a dilemma

By Professor Michael Roth, School of Landscape Architecture, Environmental and Urban Planning, Nürtingen-Geislingen University, Germany

Which is more important: renewable energy or landscape heritage? Two researchers in a COST Action examined how the public and policymakers might not have to choose and strengthened their careers at the same time.

Over 200 engineers, landscape conservationists and social scientists from 37 countries joined the 'Renewable energy and landscape quality' (RELY) COST Action to address a dilemma. "Renewable energies are one of the best ways to mitigate climate change, but you can't hide infrastructure such as wind farms. That creates conflict," says Professor Michael Roth, chair of RELY.

"RELY generated new knowledge for melding extreme positions," he adds. The result was 'Renewable Energy and Landscape Quality' – a book of 33 country overviews of renewable energy and landscape polices, along with guidelines and case studies on siting infrastructure. For example, RELY showed that people are more willing to accept renewables production when it is on waste land, benefits communities financially or includes local people in the planning process.

Photo: Michael Roth (Chair of the Action)

"The book was a huge success," says Roth. "It synthesised research in the field and our working groups to reach a wider audience."

In addition, RELY held exhibitions and public meetings around Europe to share its work.

Enhanced perspectives

Contributing to the case studies research was Tadej Bevk, a Slovenian post-graduate researcher from a so-called Inclusiveness Target Country – a country with a less-developed research infrastructure.

In RELY, he found a PhD focus and instant network. "I had 50 mentors. I could write to people for information and got a focal point for framing research on landscape perceptions," he says. "I have a better international perspective and got right into the state of the art."

He reciprocated with a chapter in the book. "COST gives me more credibility within my own country. It is tremendously helpful for people at my stage of career," Bevk confirms.

Meeting challenges

There was also an academic need behind the Action, Professor Roth explains. "Research on the interrelation between landscape quality and renewable energy is fragmented throughout Europe. No one had done a high-level screening on this."

The size of RELY made it possible to document and analyse a wide range of research, Roth adds. Research on factors for reconciling renewables with landscape quality continues in two EU-funded projects, PEARLS and ADAPTAS.

In addition, RELY was personally rewarding for Roth. "This was the first EU project of this size that I ran. It confirmed that I could manage a similar project again." After the Action started, Roth jumped straight into leadership of a German nationally funded project on conservation and renewable, assessing landscape quality for grid expansion.

Following RELY, he thinks that people can accept infrastructure for the switch to low-carbon energy. "It is possible to build renewable energy projects if they are built in the right way in the right places," he says.

> *"RELY generated new knowledge for melding extreme positions."*

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Solutions to Materials Challenges in Geothermal

Geothermal energy – energy right beneath our feet – has an enormous potential with a proven reliability to meet heating, cooling and flexible electricity generation demands. With a low carbon footprint, this largely untapped natural and renewable energy resource has the capacity to offer a sustainable and clean energy future. Despite the opportunities offered, exploitation of geothermal resources continues to remain a challenge, often due to the high investment and operational costs of geothermal power plants. The Secure, clean and efficient energy work programme within Horizon 2020[1] supports research, demonstration, innovation and market-uptake actions across different low-carbon energy sectors including the Deep geothermal energy as part of its strategy to make the EU global leader in renewables. The calls to date have concentrated on developing the next generation of renewable energy technologies through innovative materials (corrosion-/temperature-/wear-resistant, enhanced heat transfer), increased performance (drilling), improved cost effectiveness (plant flexibility), optimisation of plant operations (geo-fluid characterisation) and the reduction of emissions.

Addressing materials challenges in geothermal: Collaborative Initiatives As Part of EC H2020 programme.

GeoCoat[2]: Developing Next Generation Coatings for Geothermal Power Plant

The project is developing novel high performance, specialised corrosion- and erosion-resistant coatings for geothermal applications. These high performance corrosion and erosion resistant coatings are based on selected high entropy alloys (HEAs) and ceramic/metal mixtures (Cermets) to be applied through high velocity oxy fuel (HVOF) thermal spray, electro spark deposition (ESD), electroless plating, and laser cladding. The novel materials are being tested both in both simulated and real geothermal environment at the Hellisheiði geothermal power plant.

Geo-Drill[3]: Holistic Drilling Solutions for Cheaper Geothermal Power

The project aims to reduce the high costs associated with drilling by addressing the materials challenges associated with the wear and fracture of drilling components. The Geo-Drill concept is based on three technology pillars a) Reduced drilling cost through hydraulic DownTheHolefluid/mud hammer b) Advanced drill monitoring through low-cost and robust 3D printed sensors c) Improved component life through advanced materials and coatings.The strength of these technologies will be combined to meet the unified objective of developing novel drilling technologies that will significantly reduce the cost of deep geothermal drilling, with a targeted depth of 5 km and high temperatures of 250°C and above.

GeoSmart[4]: Towards Flexible and Efficient Geothermal Systems

GeoSmart aims to optimise and demonstrate innovations to improve the flexibility and efficiency of geothermal heat and power systems, by developing a suite of equipment and tools including a) Energy storage and power block management innovations to provide daily flexibility b) Integrate more flexible Organic Rankine Cycle (ORC) systems that can cope with variations in needs in the electricity markets c) Combine Heat and Power (CHP) supplier to extract more heat from the post-generator ("waste" heat) brine outflows when required for increased heating supply during colder weather

1 https://www.h2020.md/en/content/secure-clean-and-efficient-energy
2 http://www.geo-coat.eu/
3 https://www.geodrillproject.eu/
4 https://www.geosmartproject.eu/
5 http://science4cleanenergy.eu/
6 https://www.twi-global.com/media-and-events/press-releases/2019/geohex-towards-enhanced-heat-exchangers-performance
7 https://www.twi-global.com/media-and-events/press-releases/2019/geopro-understanding-geofluid-chemistry

Hellisheiði Power Plant

S4CE[5]: A Well-established Interdisciplinary Network of Scientists to Trust the Environmental Safety of Geo-energy Operations

S4CE aims to develop, test and implement technologies needed for successfully detecting, quantifying and mitigating the risks connected with geo-energy operations in the sub-surface. S4CE's ambition is to develop and implement state-of-the-art technologies to assess the environmental footprint of geo-energy sub-surface operations in EU. The project promotes the benefits of a multi-sensor approach in managing sub-surface operations.The project is deploying advanced instrumentation in three existing field sites in Europe; the CarbFix site in Iceland, one geothermal operation in Cornwall and a water-gas well in St. Gallen, Switzerland.

GeoHex[6]: Towards enhanced heat exchangers performance

GeoHex aims to develop heat exchanger (HX) materials addressing both improvements in anti-scaling and anti-corrosion properties, as well as, heat transfer performance, leading to more efficient and cost-effective systems. The project relies on the use of low cost carbon steel as the base material for the HX. Through modifying the surface with nano porous coatings and controlling the surface chemistry (along with the surface structure), GeoHex will significantly improve the heat transfer performance of single phase and phase change heat transfer processes, respectively. The project relies on the use of Ni-P/Ni-P-PTFE duplex and amorphous metal glass coatings to attribute the anti-scaling and anti-corrosion properties to the low-cost carbon steel substrates.

GEPRO[7]: Understanding Geofluid Chemistry

Project GEOPRO is designed to generate targeted advances in the understanding and modelling of geofluid characteristics, to support geothermal users by a) Supporting improved design efficiency – knowledge-based design of wellbore, pipework, heat exchangers for optimal conversion of the primary energy into electrical power b) Enabling knowledge-based design activities for best control of the constraining fluid phenomena (such as scale formation, outgassing, cavitation during changes in temperature and pressure), maximising uptime and operational effectiveness of the plant c) Providing underpinning knowledge for the future exploration and exploitation of supercritical systems through improved "vectors to ore" arising from the ability to better use fluid chemistry to predict deep subterranean conditions.

Acknowledgements: The projects are funded by European Unions H2020 programme under grant agreement no 764086 (Geo-Coat), 815319 (Geo-Drill), 818576 (GeoSmart), 764810 (S4CE), 851917 (GeoHEX) and 851816 (GEOPRO)

Sector coupling: interconnecting electricity and gas for a successful energy transition

By Cyril Harry, Chair Gas-to-Power, Eurelectric

Four years after the adoption of the Paris Agreement, a positive momentum is building to fight climate change. In 2019 worldwide rallies for climate actions clearly demonstrated the growing awareness of our society: it is time to act and to enter into a new era.

Surfing on this wave, European energy companies have drastically redirected their business strategy in the last two years and are now all the way committed to implement the "zero-carbon" energy transition by 2050.

Von der Leyen Commission is expected to release its "European Green Deal", aiming at accelerating the decarbonisation of the European economy, putting climate and environmental concerns at the heart of a renewed industrial policy. Kadri Simson, Commissioner-designate for energy, is assigned the task to speed up the deployment of clean energy across the economy, with a power system largely based on renewables, greater interconnectivity and improved energy storage. Combined with electricity, gas is also considered to have a role to play in the transition towards a carbon-neutral economy.

In its study on electrification and decarbonisation conducted in 2018, Eurelectric showed that, by 2045, 80% of electricity will come from clean sources of generation. In the transition towards a carbon neutral economy, gas will play a complementary role, as a bridge fuel, to ensure the reliability of power systems, especially in regions that don't have access to hydro or nuclear.

While electrification will drive the "zero-carbon" transition thanks to the development of renewable power generation, the gas industry will have to gradually tackle its own decarbonisation to ensure a sustainable future. This is needed for decarbonising both the thermal power generation and energy usages, which cannot be easily electrified.

Since early 2018, the concept of "sector coupling" has been feeding numerous debates. Whereas stakeholders do not fully share the same understanding of the concept, they acknowledge that decarbonisation of both power and gas sectors requires a holistic approach.

Sector coupling refers to the links between gas and power systems and aims at strengthening the synergies between their respective networks and markets, from both a commodity and infrastructure perspective. This concept includes both gas-to-power (supplying for gas-fired power plants) and power-to-gas streams (hydrogen and synthetic methane production through water electrolysis fuelled by renewable electricity).

Sector coupling can facilitate indirect electrification, via the conversion of electricity into electrolysed gases ("power-to-gas") for direct use as hydrogen or for injection into gas infrastructures. This contributes to lifting potential congestions on power networks and enabling electricity storage.

However, it is important to keep in mind that the coupling between the gas grid and the power networks is already a reality on the "gas-to-power" side. In 2018, the EU28 gas-fired power plants produced more than 600 TWh, representing ~20 % of the electricity generation mix in terms of volumes.

Gas-fired generation currently represents around 220 GW of installed capacity in the EU, with additional firm power generation capacities needed in the coming years for adequacy reasons.

Eurelectric continues to emphasize the key role of clean and firm power generation and transition-enabling solutions to reach a carbon-neutral power supply by 2050. In this context, it identified that highly-efficient gas-fired power plants fulfil security, balancing and flexibility functions that are not easily replicated by a renewables-based power system. By 2045, gas-fired power plants will account for 15% of the installed capacity to secure system reliability and the firmness for power adequacy.

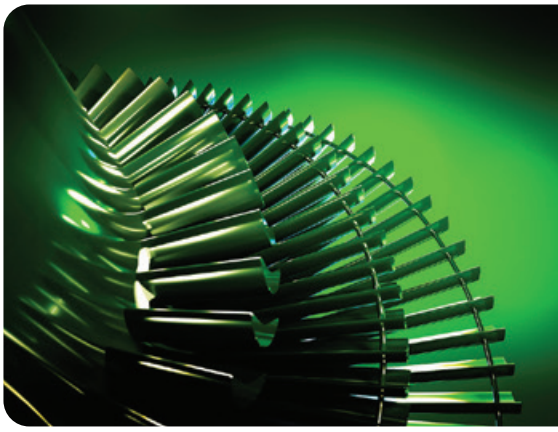
The power sector will contribute to both direct (up to 60%) and indirect electrification through the development of renewable hydrogen produced from electrolysis, but its integration into the energy system also requires deployment of other decarbonised gases (ex: biomethane, other types of hydrogen) to reach the collective "zero-carbon" goal by 2050. This is part of the coupling initiatives which will enable not only greening of gas-fired power generation but also greening of energy-usages which cannot be easily electrified.

SECTOR COUPLING THROUGH LEVERAGING ON THE GAS SYSTEM FLEXIBILITY

Together with new sources of system reliability and flexibility (demand-side response, batteries, etc.), the gas system can provide, from a sector coupling view, an unmatched flexibility capacity. Gas assets, whether we refer to LNG terminals, transport capacity (line pack) or storage (withdrawal and injection capacity) are able to provide flexibility on a wide range of timeframes, from daily to seasonal and pluri-annual flexibility. Europe's gas infrastructure comprises an annual energy delivery capacity of nearly 1 000 bcm (i.e. 10 000 TWh/y).

Part of the flexibility of the gas system relates to storages. For instance, the EU 28 gas storage capacity represents 100 bcm, equalling 900 GW of instantaneous flow, which is around 150 % of the peak electricity demand on an energy-equivalent basis.

The decarbonisation objective depends more on such coupling initiatives and their smooth coordination than on an "energy carriers contest" to identify who will win the lion's share. The purpose is to decarbonise, leveraging on the advantages and patterns of each decarbonised energy vector.



About the author

Cyril Harry, Head of Gas Asset Regulation & Analysis, ENGIE

Cyril is currently Head of Gas Asset Regulation & Analysis, within the Global Energy Management Business Unit of ENGIE in charge of the midstream business and market activities. He is responsible for the regulatory files related to gas supply & assets management at Central Western Europe level.

He is also combining his current role for ENGIE with his position of Chairman "Gas to Power" within Eurelectric association, which represents the interests of the electricity industry at pan-European level.

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Turku aims for carbon neutrality by 2029

According to Mayor Minna Arve, Turku has a responsibility to set an example in climate work because it can. At the same time, the city will become more comfortable, providing a safer and more fluent everyday life.

Turku aims to cut down its greenhouse gas emissions enough to ensure carbon neutrality by 2029, when the city celebrates its 800th anniversary.

However, carbon neutrality is only one important step on the way towards a climate positive Turku and Finland. This would allow more carbon to be bound than is emitted into the atmosphere.

'The residents and decision-makers in Turku have a strong climate will: our ambitious climate plan has been approved unanimously by the City Council,' says Mayor Minna Arve.

'We have a responsibility to set an example, because we can. At the same time, however, the city will become more comfortable, providing a safer and more fluent everyday life.'

Getting rid of fossil fuels

The CEO of Turku Energia, **Timo Honkanen**, says that a transfer towards renewable energies in electricity and heat production is already rapid. Turku Energia is a company owned by the City of Turku.

'The multi-fuel power plant producing heat and electricity in the region utilises primarily renewable sources of energy, such as by-products from the forest industry. In 2020, the share of coal at the plant will be only ten per cent. In the near future, we can leave coal out altogether.'

Through its partner companies, Turku Energia has also increased its shares of wind power and hydropower, and particularly the share of wind power is expected to increase in the future. The Kakolanmäki Wastewater Treatment Plant uses heat pumps to collect waste heat energy, which can then be utilised in the production of district heating and cooling.

Heat from the ground?

Turku is also considering an exciting new field.

'We are examining the possibility to utilise the geothermal heat of the ground. According to the plan, a hole seven kilometres deep would be drilled in the Turku region, from which heat would be conducted to above ground. According to the calculations, the hole could produce up to ten per cent of the heat needed by the entire city for a quarter of a century.'

Honkanen emphasises that the decision has not yet been made. Turku wishes to see the experiences from a similar project in the City of Espoo first.

Turku Energia is also helping its customers to find environmentally sustainable solutions.

'We recently produced a solar power plant of 1,500 panels on the roofs of the Meyer Turku shipyard, for example.'

Ice hockey star Saku Koivu, Mayor Minna Arve, Chairperson of the City Council Elina Rantanen, Chairperson of the City Board Lauri Kattelus (Photo by Risto Lahtinen)

Solar panels on the roof of new student housing (Photo by Turku Energia)

Eco-friendly living and transportation

Mayor Minna Arve says that the City of Turku Concern companies have cooperated to invest in the improvement of energy efficiency and significant new energy solutions, the Energy Twist for the residents.

'For example, our student housing foundation has created a significant energy-positive site where all of the roof space is used for solar panels, our rental housing company and its residents have saved several million euros in energy costs per year, and our right of residence company is giving up all fossil solutions and investing in electric transportation.

A private company is making one of the largest solar heat power plants in the world on our market square.'

The carbon sinks in the forests and parks of Turku will grow faster than before, as the City will use no more than 40 per cent of the annual forest growth instead of the earlier 60 per cent. The forests also serve to cool down the city and provide refreshment and well-being.

In cooperation with its neighbouring municipalities, Turku is also building a sustainable and centralised urban structure supporting sustainable transportation.

'The next step is to aim to decide on and implement a regional tramway solution to function as the new spine of attractive urban development.'

Reaching the goal together

Mayor Arve notes that climate change must be faced together, and that cities can support each other in this significantly.

'Turku Climate Plan 2029 follows the joint European model, and we report to the UN every year through the CDP. In 2019, our climate work received an A rating.'

'Cooperation networks such as ICLEI are essential in compiling the competence of cities to benefit everyone: this way, we can learn from each other and support each other. At the same time, cooperation makes our voice stronger and makes our valuable experience available for the UN climate process, for example. This is why I will be participating in the UN climate summit in Madrid in December to share Turku's experiences and our aim for climate-positivity.'

Constructing a climate-positive city naturally also requires the input of all residents.

'Companies and residents in Turku are working every day to develop and produce sustainable solutions to benefit everyone. Together, we make up the Turku Climate Team, where we all support and encourage each other. Our climate captain is Saku Koivu, a well-known and beloved former ice hockey captain of the teams of Turku, Finland, and Montreal. Together with him, we challenge everyone to participate, and we campaign for sustainable solutions.'

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Pushing the boundaries of innovation through public procurement

Public procurement accounts for about 14% of the European Union's (EU) gross domestic product, meaning it has enormous potential to guide new developments in a range of sectors, help to stimulate future markets and address key societal challenges. Furthermore, public authorities who support the process of innovation or purchase innovative goods and services are often directly rewarded with improved services at optimised costs.

Innovation procurement can involve buying the process of innovation, or buying the outcomes of innovation. Pre-Commercial Procurement (PCP) happens when public buyers describe their needs, and procure research and development services of products, services or process which would meet their needs but do not yet exist. Public Procurement of Innovative Solutions (PPI) occurs when instead of buying 'off-the-shelf' solutions, the public buyer acts as an early adopter and buys a product, service or process that is new to the market and contains substantially novel characteristics (as defined in the European Commission's Guidance on Innovation Procurement).

There are many reasons to do innovation procurement. It can help to improve public service effectiveness and efficiency, solve problems and meet new needs with solutions not currently available on the market, as well as support start-ups and innovative SMEs to launch and grow.

"By working together, cities, central purchasing bodies and other major public procurers can maximise their purchasing power to create a demand that drives needs-based innovation," highlights Mark Hidson, Global Director of ICLEI's Sustainable Procurement Centre.

In Europe, there are currently several initiatives and projects run by public authorities to push innovation procurement and reap its benefits.

PROCURE2INNOVATE

Since January 2018, 19 partners from ten different European countries are joining forces through the Procure2Innovate project to improve institutional support for public practitioners interested in using PPI or PCP to acquire information and communication technologies (ICT) products and services. This support is being offered by ten competence centres on innovation procurement, that is, organisations that have the mandate by national law to encourage wider use of PCP and of PPI. Five of them are already established in Austria, Germany, the Netherlands, Spain and Sweden, while another five new ones are being established in Estonia, Greece, Ireland, Italy and Portugal.

During the lifetime of the project, these competence centres will build a permanent network that will facilitate knowledge sharing, collaboration and exchange of best practices. Competence centres from other countries will be welcome to join the Procure2Innovate Network.

"The Procure2Innovate network is a key mechanism for institutional innovation in the public sector. The network disseminates innovation procurement approaches across borders. Through this cooperation national competence centres can achieve synergies and offer better services to public procurers, especially allowing them to take more advantage of innovative suppliers in the common European market," explained Marlene Grauer, international project manager

at KOINNO and coordinator of Procure2Innovate.

INNOBROKERS

Another initiative in the field is the Innovation Procurement Brokers (InnoBrokers), helping procurers and suppliers from across Europe to engage and discuss opportunities for collaboration. Now, the public authorities working in the project have published nine challenges seeking early-stage ideas for solutions as part of their pre-procurement market engagement.

In Spain, Agencia Andaluza del Conocimiento is looking for a company that can develop and implement an e-infrastructure with the capability to spatially integrate and manage environmental online data, and an intelligent lighting management system for roads using new technologies to adjust and/or adapt the combination of existing technologies.

A Danish city and a Danish region are looking for a digital 'material-passport' solution that can help data optimisation and support new logistics for collections, sorting, reuse and recycling of post-consumer textile waste. They are also looking for suppliers of circular textiles that can constitute both workwear and flatwear. On the circular textile theme, an Irish County Council is looking to source more sustainable or Circular workwear, specifically, Personal Protective Equipment (PPE) for outdoor workers.

A group of Austrian public buyers is looking for an open system for emergency calls for public areas. A German City Council is seeking an industrial partner who can provide smart sensor systems for the city's waste bins, and a German waste management association is interested in a water turbine for fluctuating loads. The City of Malmö (Sweden) is looking for suppliers who offer indoor lighting as a service with a circular approach.

InnoBrokers is engaging with start-ups and SMEs across Europe to find innovative solutions to needs, recognising the value of increased research and development.

AWARDED INITIATIVES

Every year, the Procura+ Awards, an initiative by ICLEI with current support from the Procure2Innovate project, reward successful, already running, sustainable and innovation public procurements that can be inspiring for other public authorities.

The winner of the 'Innovation Procurement of the Year' 2019 was the Municipality of Frederiksberg (Denmark) for its innovation partnership for decentralised cloudburst management. Frederiksberg needed to reduce the load on its existing drain network and used an innovation partnership to develop customised solutions for cloudburst management. The municipality held a market dialogue to inform interested market actors about the upcoming procurement and the Innovation Partnership process. Two consortia developed useable products and solutions that the city can procure, with constant improvement built into the contract. Both solutions catch rainwater and release it when the sewers are ready. The underground basins also use the stored rainwater to water trees and green areas, reducing operation and maintenance including time, water, fuel for the trucks and CO_2.

The 'Outstanding Innovation Procurement in ICT' Procura+ Award went to CERN, in Switzerland. In this case, ten public research organisations from seven European countries joined forces in a Pre-Commercial Procurement (PCP) to meet the demands of large scale scientific projects for big data storage and analysis tools. The consortium required a service that is more adaptable to changing needs, provides a cloud-based system designed specifically for science and research, increases standardisation, benefits from economies of scale, and offers appropriate service payment models for research bodies using it. The result of the multi-stage PCP process was the pilot Helix Nebula Science Cloud. This cloud-based system makes it possible to host the service in new data centres with excellent power usage effectiveness.

Applications for the 2020 edition of the Procura+ Awards are open. The deadline for applications is March 31, 2020.

Contact Information

For more information, visit:
Procure2Innovate, www.procure2innovate.eu
InnoBrokers, www.innobrokers.eu
Procura+ Awards, www.procuraplus.org/awards

Paula Land, Sustainable Economy and Procurement team, and Meritxell Díaz, Media and Communications team at ICLEI – Local Governments for Sustainability

10 years of ENTSOG

By Jan Ingwersen (pictured), General Director, ENTSOG

ENTSOG – European Network of Transmission System Operators for Gas was founded on 1 December 2009 in line with Regulation (EC) 715/2009 and was established to contribute to the completion of the internal market for gas and to achieve the European energy policy objectives of sustainability, security of supply and competitiveness. In 2019, ENTSOG has 44 TSO Members, 3 Associated Partners and 8 Observers.

This year ENTSOG is celebrating its 10-Year anniversary and has since its foundation worked to deliver its mandate: to ensure the efficient management and coordinated operation of the European gas network and to facilitate the network's sound technical evolution. Some of ENTSOG's achievements during that time include:

- **Advancement of the internal energy market.** ENTSOG developed and continue to monitor the implementation and functioning of Network Codes and Transparency Guidelines, developed with broad consensus within the industry and with the stakeholders.
- **Effective gas infrastructure planning and management**, from assessment of gas infrastructure gaps, through the publication of its Ten-Year Network Development Plans (TYNDP) and looking at longer term horizons for European Scenarios to deliver the necessary gas infrastructure.
- **Increased security of supply** by intensifying the close cooperation and coordination between gas TSOs within EU and with gas suppliers for resilient and safe gas delivery to consumers. Every season ENTSOG produces Winter and Summer Supply Outlook reports, and daily publishes relevant TSO access and operational information on the Transparency Platform.
- **Innovating for decarbonisation of gas grids** through exchanging of information of gas TSO decarbonisation projects on ENTSOG's Innovative Projects Platform
- **Quality dialogue with stakeholders, industry consolidation and professional dialogue with institutions** on ENTSOG's monitoring and operational tasks and by supporting our members in implementing new regulation in all EU member states to the further streamlining market integration, security of supply and transparency requirements. ENTSOG has achieved this through cooperation with European Commission, ACER, ENTSO-E, industry associations and other stakeholders and collaboration with efforts of the TSOs and the NRAs.

With new challenges ahead to meet EU Climate and Energy goals, ENTSOG with the expertise of its members, will continue to play an important role in the further development of the European gas markets and in **preparing the gas grids for their role in the transition to a future sustainable energy sector.**

different regions of EU. The aim of the Roadmap, to be published at the end of 2019, is to provide ENTSOG's recommendations for the European Green Deal discussions and make gas **TSOs proposal on how to effectively combine well-functioning, liquid gas markets and achieved effective security of gas supply, with the commitment to decarbonisation goals.** ENTSOG members believe, that building on achievements on markets and levels of security of supply gives a solid fundament for the future with increasingly renewable, decarbonised and low carbon gases.

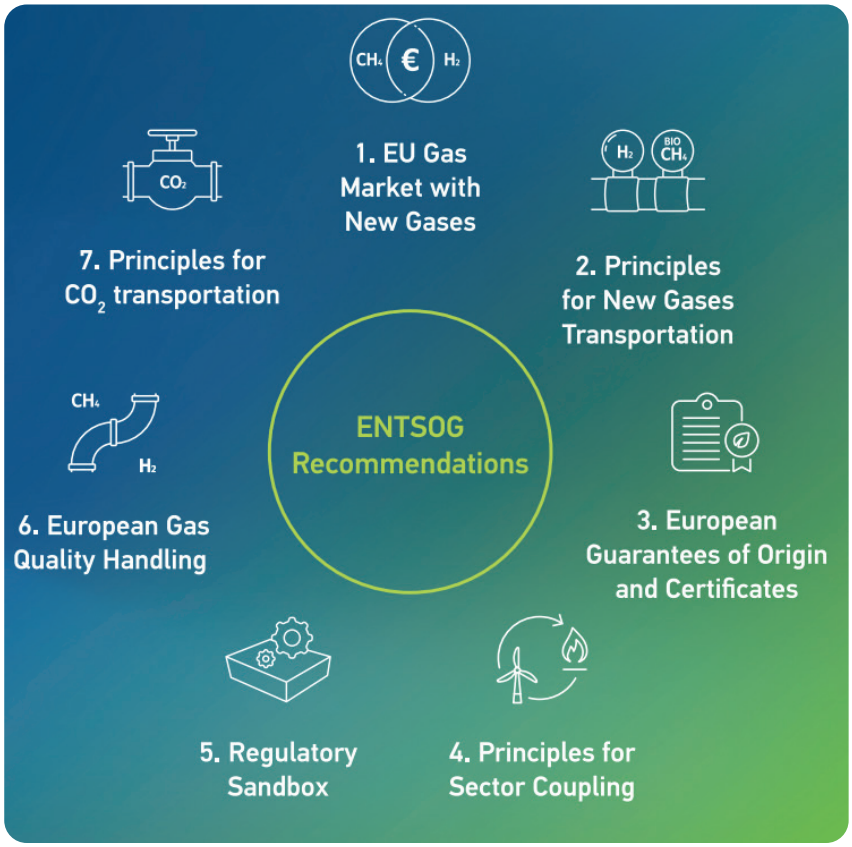
Decarbonisation of gas supplies with biomethane and hydrogen is already taking place in Europe. Gas offers the opportunity to decarbonise all sectors at a lower cost with the continued use of existing gas transmission assets and end-user facilities. Based on today's natural gas infrastructure as well as regional resources and national preferences, the 2050 gas networks will transport and store (bio) methane and hydrogen molecules.

ENTSOG 2050 ROADMAP FOR GAS GRIDS

Analysing the trend of consumer-oriented energy usage and planning, in ENTSOG's '2050 Roadmap for Gas Grids' the **European gas Transmission System Operators (TSOs) propose how to make gas grids ready for decarbonisation.** This Roadmap reflects ENTSOG's TSO members' views and analyse three possible pathways forward for the Member States, industry and consumers on how to achieve net-zero Greenhouse gas emissions by 2050 with their gas grids under:

1. Methane Pathway
2. Blending of Hydrogen and Methane Pathway
3. Hydrogen Pathway

ENTSOG envisages that the pathways can exist in parallel in



Electrolysis, Power to Gas, Pyrolysis, Steam Methane Reforming, Carbon Capture, Utilisation and Storage and biomethane and synthetic methane production technologies deserve support to achieve scalability. **Gas, as international energy carrier, is and will be needed even more necessary to decarbonise also other sectors: electricity, industry, heating and other sectors.**

For this, ENTSOG believes that the **future EU energy system should build on a Hybrid Energy System – an interlinkage between the gas and electricity systems based on synergies between these two** international energy carriers. The Hybrid Energy System will allow the EU economy **to meet decarbonisation targets, obtain flexibility, storage options, cross-border transportation capacities and security of supply** in a faster and more efficient way – realising synergies between the existing infrastructures. These are the values that the consumers will continue to value the most.

TSOs future role is to manage the gas grids in a way that those assets can be enablers of transition. The choices and decisions are influenced by the overall EU climate and energy policies and will differ amongst the EU Member States. Therefore, **TSOs will manage diversity of technological choices while ensuring that achievements of the internal energy market for gas are maintained and further developed, in realities of both methane and hydrogen-based economy.** To achieve a cost-efficient decarbonisation there will be a need to review the regulatory framework and, where necessary, to amend it to **ensure the development of gas-based decarbonisation technologies.** ENTSOG proposes to work on this by reaching agreement with all institutions and stakeholders on seven topics:

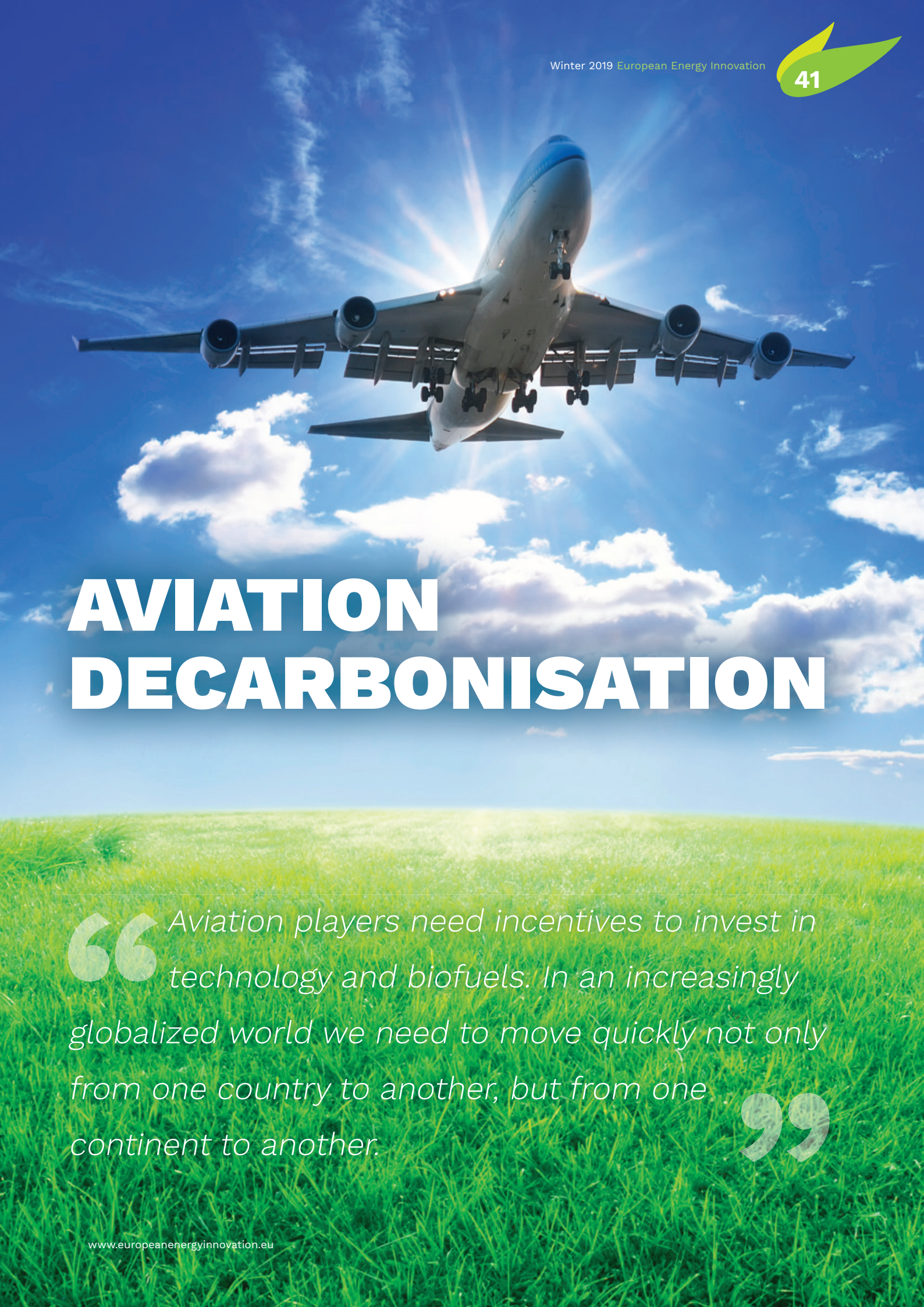
1. EU Gas Market with New Gases
2. Principles for New Gases Transportation
3. European Guarantees of Origin and Certificates
4. Principles for Sector Coupling
5. Regulatory Sandbox
6. European Gas Quality Handling
7. Principles for CO_2 transportation

The ENTSOG Roadmap 2050 was launched at ENTSOG's Annual Conference on 11 December 2019, which also celebrated the ten years since its foundation. More details on the conference and stakeholders' views on the Roadmap2050 can be found at this link.

About the author

Jan Ingwersen is General Director of ENTSOG, seconded from ENERGINET – the Danish gas and electricity TSO. He previously held positions at DONG Energy, Gastra and consultancies. Jan headed implementation of the liberalisation of the gas market in Denmark for Gastra/Energinet (2000-2005) and the storage and offshore transmission activities of DONG Energy (now Oersted) (2006-2013). He has over 30 years' experience working in all parts of gas sector value chain – gas procurement, offshore and onshore gas transmission, gas storage and gas sales.

Jan holds a technical MSc from University of Aalborg, Denmark, a commercial degree from Copenhagen Business School and management education from IMD, Switzerland.



AVIATION DECARBONISATION

Aviation players need incentives to invest in technology and biofuels. In an increasingly globalized world we need to move quickly not only from one country to another, but from one continent to another.

How Clean Sky can support the move to climate-neutral aviation

By Axel Krein (pictured), Executive Director, Clean Sky Joint Undertaking

A key priority on the European Parliament's and new European Commission's determined agenda to tackle climate change will be securing impact-driven European research and innovation. Building on the Horizon 2020 programme, Horizon Europe will provide an even greater opportunity to steer further excellence into European research, making sure that outcomes are impactful and meeting far-reaching objectives such as mitigating damage to the environment.

In that respect, European universities, research organisations and industrial companies are continuing to work on a technical proposal for a new Clean Aviation Partnership programme. This programme will aim to drive towards a deep decarbonisation of aviation, supporting the European Green Deal, leading to a carbon-free society by 2050, and taking European aviation and aeronautics to the forefront globally in this transition.

A major step in that direction took place at the Paris Air Show - Le Bourget in June 2019. Led by Airbus CEO Guillaume Faury, Safran CEO Philippe Petitcolin, Rolls-Royce CEO Warren East and Leonardo CEO Alessandro Profumo, twenty-three Aeronautics Industry leaders, Research Organisations and University Associations across Europe signed a Joint Declaration to express their strong commitment to a future European partnership that can lead the way towards a deep decarbonisation of aviation by 2050. The Joint Declaration made it clear that the partnership should build on the progress made under the Clean Sky programmes, and develop further-reaching innovations and concrete roadmaps for their implementation in a new breed of aircraft from 2030 and beyond. To highlight that these ambitious aims can only be achieved through cooperation between the public and private sectors, the Declaration was handed over to Jean-Eric Paquet, Director-General for Research and Innovation, European Commission.

Initial analysis has identified a number of ambitious zero- and low-emission concepts. These include full electric and hybrid-electric solutions applicable to regional and short-range categories. Hydrogen or low-carbon fuel-powered architectures using advanced aircraft configurations and ultra-efficient gas turbines will cover the medium and long-range segments. As a consequence, substantial research activity will need to be actively aligned via an Innovation Architecture and connected to the future Partnership, ranging from Member States' national innovation funding initiatives in aeronautical fields to synergy areas within Horizon Europe, all supported by commonly agreed goals and objectives within an integrated and comprehensive roadmap.

We are not talking about a mere continuation from Clean Sky 2 to a future Clean Aviation Partnership. This is a vital and necessary transformation to successfully take on the challenge ahead.

In parallel, Clean Sky 2 is still running with full steam ahead! Now halfway through the programme, it is very gratifying to see that our vast eco-system of researchers and engineers is delivering cutting-edge results for

DRAGON research concept for distributed electric propulsion (©ONERA)

greener aviation in fields such as propulsion, systems, aerostructures, aerodynamics, and overall aircraft configuration. These technologies are targeted for integration into global airline and operator fleets within the next two decades.

To mention a few of these key Clean Sky 2 technologies, one particular example is the Ultra High Bypass Ratio engine demonstrator UltraFan, which aims to reach a potential fuel improvement of approximately 10% compared to 2014 reference aircraft. Standout technologies include the composite titanium fan blades, which have taken a lot of weight out of the engine design compared to the previous standard, and the power gearbox technology, which aims to achieve the best optimum operating efficiency of the engine core and fan. The first wind tunnel tests are planned for 2020 for jet engine noise and installation assessment, and a first flight is scheduled for 2023.

In our Rotorcraft technology platform, the RACER demonstrator's first flight is scheduled for the end of 2020. It features an aerodynamic shape, lightweight materials and equipment integrated in a streamlined design to create a vehicle that flies 50% faster than conventional helicopters.

Another key focus for Clean Sky 2, and indeed any future European aviation research programme, is hybrid/electric propulsion. The E-Fan X flight demonstrator is an important stepping-stone towards hybrid-electric commercial aircraft at the scale of today's single-aisle family. Co-funded by the British ATI Programme and Clean Sky 2, the project will make use of important building blocks and results from Clean Sky 2 in its ambitious next step towards flight demonstration. The assembly and test of these building blocks (2MW generator and associated power electronics for instance) will be conducted by 2021.

We will need excellent results from these projects, and the many more we are working on, in order to reach our ambitious objectives! ●

Key Clean Sky facts & figures

334	420	373	350
INDUSTRY MEMBERS	SMES	RESEARCH CENTRES	UNIVERSITIES

28	110	>466
COUNTRIES	REGIONS	GRANTS

Clean Sky 2
JOINT UNDERTAKING

Contact details:
For more information on results, news and key events, please visit www.cleansky.eu

Green Deal should be about people, not only about climate

By Marian-Jean Marinescu, MEP

2019 will probably remain in the European history as the year of the The Green Deal, as there are too little chances to remain as the year of BREXIT. But... you never know. The Green Deal was announced by the new head of the EU Commission in July 2019. Long story short: Europe climate has to be neutral by 2050, as the head of the EC Commission Ms Ursula von der Leyen put it. Now the question is: what could that mean for the aviation industry? Aviation currently accounts for 2% of global carbon emissions. Since 1990, industry fuel efficiency has improved by 52%. Worldwide, flights produced 895 million tons of CO_2, while the humans over 42 billion. These are the figures on aviation green footprint.

According to the latest Aviation Environmental Report published in January this year the number of flights (EU28 + EFTA) increased by 8% between 2014 and 2017, and is expected to grow by 42% from 2017 to 2040 in the most-likely forecast. In addition to this, technological improvements, fleet renewal and increased operational efficiency have been able to partially counterbalance the impact of recent growth, but there has still been an increase in overall noise and emissions since 2014. In 2016, domestic aviation and international aviation were together accountable for 3.6% of the total EU28 greenhouse gas emissions and for 13.4% of the emissions from transport. The environmental efficiency of aviation continues to improve and, by 2040, further improvements are expected in average fuel burn per passenger kilometer flown (-12%) and noise energy per flight (-24 %). By 2040, CO_2 and NOX emissions from aviation are expected to increase by at least 21% and 16%, respectively.

I agree with Ms von der Leyen as she said that the Green Deal "represents a historical occasion to modernize EU's economy, revitalize its industry and ensure long-term growth and jobs." The question is: how could we do this in a balanced competitive manner preserving the jobs while striving for decarbonization?

I would be glad to see that the several different policy proposals of which the Green Deal is made up of will focus more on results, competitiveness, fair transition and jobs than on imposing new taxes. The impact of a transition to carbon neutrality is comprehensive, especially for the regions where working places and wealth have been generated due to these industries. This means that a comprehensive policy, which also considers social aspects on top of climate, energy, environmental and economic aspects, is needed.

The measures that the EU and aviation companies take to reduce CO_2 emissions should not kill the competitiveness of these companies nor reduce jobs. EU regulatory decisions must be based on innovation and the concrete results of the researchers in the field. The funds from the Horizon program should not, for example, be used for teachers' salaries, but for research with concrete results. Decarbonization of aviation can have immediate results by implementing The Single European Sky. Unfortunately, we are dealing with a double language: Member States, on the one hand, are talking about decarbonization, and on the other, they are blocking an easy measure with immediate results, such as the Single European Sky. The objective of the Single European Sky (SES) is to reform the architecture of air traffic control in the EU, in order to meet future capacity and safety needs. This should be achieved through improving the overall performance

of air traffic management (ATM) and air navigation services (ANS), with the specific aims of increasing airspace capacity threefold (so reducing delays), improving safety performance tenfold, reducing by 10% the environmental impact of flights and reducing ATM costs by 50%.

Small, regional companies in Europe have lost 10-15% of their customers due to environmental taxes. Especially these ones must be supported by the EU. They need affordable biofuels, as at the moment they are simply too expensive. Of course, we want a clean environment, and that's what we do for our citizens. But affordable airplane tickets would be a measure for the benefit of our citizens as well.

Aviation companies need incentives to reach decarbonization targets. We cannot ask them to keep adding taxes, because this will affect their competitiveness, on one hand, and on the other, it will mean that we place a burden on the travelers' shoulders as well as on theirs, which will lead to more and more expensive tickets. Aviation players need incentives to invest in technology and biofuels. In an increasingly globalized world we need to move quickly not only from one country to another, but from one continent to another. Air connectivity is vital and therefore it needs incentives to get sustainable.

We want decarbonization? What about Clean Sky, Shift to Rail, Single European Sky as solutions for decarbonization? Why don't Member States want to start implementing SES?

"Aviation players need incentives to invest in technology and biofuels. In an increasingly globalized world we need to move quickly not only from one country to another, but from one continent to another."

We keep asking for climate proofing. What about competitiveness proofing? What about job proofing? The new Commission should find a balance between the three of them, as the Green Deal should be about people, eventually, not only about climate.

Electric flight for a more sustainable aviation

By Andreas Strohmayer, Professor for Aircraft Design at University of Stuttgart

AIR TRANSPORT AND THE ENVIRONMENT

In response to the Paris Agreement the European Commission has set ambitious goals to have a climate neutral aviation system by 2050. The evolutionary improvement of conventional airframe and aircraft systems technologies has achieved tremendous enhancements over the past decades and will continue to contribute to this target. But a significant gap will remain that has to be closed with more radical approaches, if targets are to be met that take into account the predicted growth rates in air transport. Since aviation today is undoubtedly the only viable transport mode for distances beyond about 1,000km, this growth cannot be constrained without jeopardising the ability of the world citizens to move and interact. Mobility restrictions could easily promote Orwellian conditions, a situation definitely to be avoided in a global and open society. In order to close the emissions gap, full-electric and hybrid-electric propulsion technologies are promising candidates for the required fundamental innovation in the aviation system. The integration of an electric propulsion system in an airframe specifically designed for this purpose has the potential to increase efficiency with reduced or eliminated in-flight emissions and less community noise, providing at the same time viable operating costs and increased reliability.

WHICH ROUTE TO TAKE TO ELECTRIC FLIGHT?

In conventional fuel-based propulsion concepts, the 'power plant' combines the transformation of chemical energy stored in the fuel to mechanical power, and propulsion via the production of thrust by accelerating air-mass flow with propellers or fans, driven by the shaft power. Additional thrust may be generated by the recovery of thermodynamic energy in the exhaust gases.

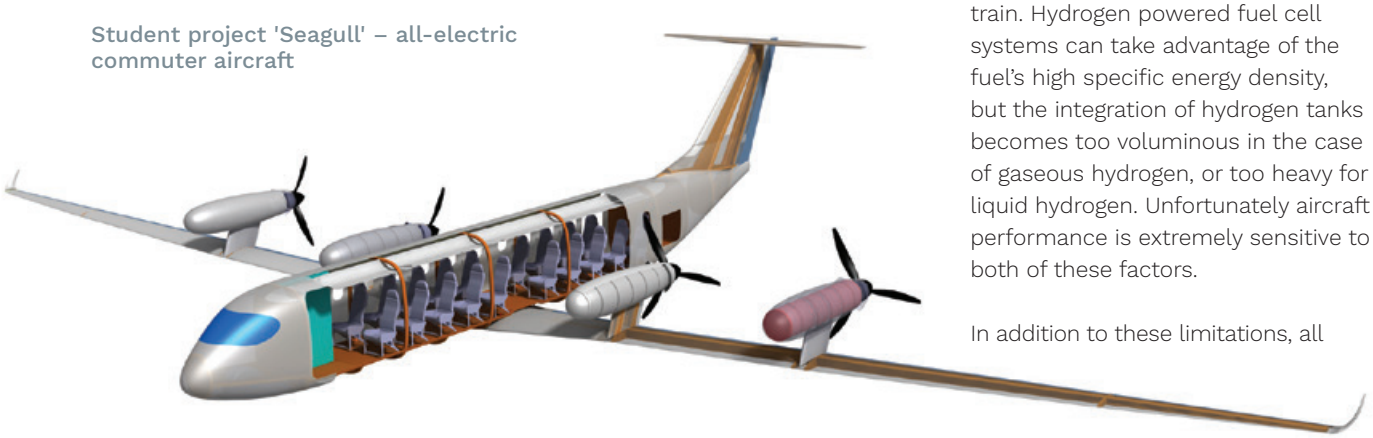
In electric flight, the conversion from chemical energy stored in fuel can be locally separated from the propulsor. Furthermore, electric motors can be installed at unconventional places on the airframe due to their relatively small size. For energy storage a variety of concepts are under evaluation: solar-powered systems convert the sunlight energy in the using a photovoltaic process to electricity that drives the motor. In full-electric systems the energy is stored in batteries. Hybrid-electric propulsion systems keep fuels as high-density energy storage, which is converted into electricity by generators; battery systems may provide additional energy during certain flight phases. Finally, fuel-cell systems convert chemical energy from the fuel, which is typically liquid or gaseous hydrogen, to electric power in a relatively cold electrochemical reaction.

EACH ROUTE HAS ITS CHALLENGES

While the Solar Impulse 2 has impressively demonstrated what can be technologically achieved, solar powered flight will not find its way to air transport due to an extremely unfavourable ratio of surface required for solar cells to useful payload. Battery-powered systems can be highly efficient as no energy conversion is involved, but their major drawback is the low specific energy, i.e. the amount of energy that can be stored per unit of battery mass. For a given aircraft mass, constrained by lift capability and structural strength, only a limited amount of batteries can be installed, thereby restricting the flight distance compared to fuel based propulsion systems. To some extent hybrid-electric systems can compensate this disadvantage, but only at the cost of higher systems complexity and lower efficiency compared to an all-electric power train. Hydrogen powered fuel cell systems can take advantage of the fuel's high specific energy density, but the integration of hydrogen tanks becomes too voluminous in the case of gaseous hydrogen, or too heavy for liquid hydrogen. Unfortunately aircraft performance is extremely sensitive to both of these factors.

In addition to these limitations, all

Student project 'Seagull' – all-electric commuter aircraft



Student project 'HyBird' – hybrid-electric 9-seater

electric system architectures share inherent challenges such as thermal management of the heat loads in the electric components, electromagnetic interferences at high currents, or arcing at high flight altitudes where the thin air no longer serves as an electric insulating medium. There is a need for a common roadmap, linking upstream research and demonstration to research priorities on the key enabling technologies, as well as an adapted regulatory framework for electric propulsion in aviation. The full technology cycle from exploration, maturation and demonstration of the application in a product has to be accelerated for all components of the electric power train, ranging from energy storage, power conversion and distribution to electric motors and propulsive devices.

NECESSARY CHANGES IN AIRCRAFT DESIGN?

The increased number of components in a hybrid-electric power train, compared to a conventional architecture, can lead to efficiency losses that have to be compensated with improved sub-systems and efficiency gains at the aircraft level. In addition, any architecture relying on batteries has a major disadvantage that battery weight remains constant during a flight mission, while a conventional aircraft burns fuel and therefore loses weight. For these reasons, despite all improvements with respect to in-flight emissions, a pure conversion of an existing design to an electrically powered aircraft will always suffer a significant loss of mission range. In order to overcome these drawbacks, the designer has to adapt the aircraft configuration to maximise synergetic effects when integrating an electric propulsion system. Such synergies, for example, can be found in a distributed propulsion system providing high lift functionalities, in a boundary layer ingestion concept improving drag characteristics, or in wing tip propulsors for directional control. Also, energy harvesting technologies could be of interest, where excess energy is recuperated similar to advanced automotive solutions in operation today. In summary, efficient electric aircraft will look very different to current aircraft configurations.

A NEW AIR TRANSPORT SYSTEM

Aviation is characterized by long design and operation cycles in a highly regulated international framework. Therefore, while exploration and demonstration of innovative technologies for electric flight have finally started on a broader level, improvements will only become visible at a global fleet level about a decade after the introduction of the corresponding advanced products. It will be increasingly important to focus on accelerated technology development, following an aligned roadmap for three distinct market segments: a full-electric short-range commuter network, hybrid-electric regional transportation and long range flights powered by ultra-efficient gas turbines with enhanced thermodynamic cycles, making use of sustainable carbon-neutral bio- or synthetic aviation fuels.

The feasibility of electric and hybrid-electric propulsion today has been demonstrated with small general aviation airplanes. Now these technologies have to step-up to larger aircraft, where a full-electric 19-passenger commuter would be a feasible target for the European industry. This would open new flexible routes to link smaller cities, enabling air mobility for the European citizens at zero emissions on thin routes. One step further, hybrid-electric regioliners with distributed propulsion and a synergetic configuration design will surpass the efficiency and environmental performance of the current generation of regional aircraft. And not least, focussed and successful research towards a new sustainable air transport system would help ensure the leadership and competitiveness of the European aircraft industry. ●

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Giving wings to renewable energies

By Dr Martin Cames (pictured), Research Fellow, Energy and Climate Protection Division, Öko-Institut

In the Paris Agreement, countries agreed to reduce greenhouse gas (GHG) emissions with the aim of holding the global temperature increase well below 2°C and of making efforts to limit it to 1.5°C above pre-industrial levels. To achieve this goal, the Parties are aiming to balance anthropogenic GHG emissions and sinks, or in other words, to achieve full decarbonisation or carbon neutrality in the second half of this century. Since emissions from aviation and maritime transport are clearly anthropogenic, they fall under the objectives of the Paris Agreement even without being explicitly mentioned.


Photo: © Oeko-Institut

Air traffic contributes significantly to human-induced global warming. In 2017, only 3% of the global population boarded a plane. Nevertheless, air traffic contributes about 5% to global warming. The objectives of the Paris Agreement are thus not achievable without adequate reduction contributions from the aviation sector. Taking into account that air traffic continues to grow each year by 4% to 5% on average, it becomes clear that this is a challenging task. According to current forecasts of the International Civil Aviation Organization (ICAO), by 2037 the distances travelled worldwide will have doubled in comparison to 2019.

The full decarbonisation of the aviation sector is unlikely to be achieved without a comprehensive package of policies and instruments, including technical efficiency improvements such as tightening the current carbon dioxide (CO_2) emission standards for aircraft, operational measures such as improvements in air traffic management and market-based instruments. The latter include ICAO's Carbon Offsets and Reduction Scheme for International Aviation (CORSIA) and the EU's inclusion of aviation in its Emissions Trading System. Furthermore, indirect subsidies such as exempting fossil kerosene from fuel taxes or international flights from value added tax (VAT) need to be abolished.

In addition, sustainable and carbon neutral alternatives to fossil fuels must be developed and deployed to achieve the long-term objective of carbon neutrality. In land-based transport, the use of fossil fuels in internal combustion engines can be substituted successively by the direct use of renewable electricity in electric vehicles. However, in the aviation sector, electric traction is – due to the distances travelled – only possible in some niche areas such as short-distance flights. From today's perspective, there are hardly any alternatives to internal combustion engines or turbines in aviation. In this respect, full decarbonisation of air transport can only succeed if post-fossil fuels are used. This means that fuels made from biogenic resources or renewable electricity are particularly important. The central question here is how such post-fossil fuels can be made available to the extent that they will be needed in the aviation sector in the future.

While, until about five years ago, the focus was almost always on biofuels in this context, renewable electricity-based fuels are also being increasingly discussed today. This is because the purported advantages of biofuels became more questionable, including their greenhouse gas reduction potential, which turned out to be significantly lower than expected when upstream emissions and indirect land use changes are considered. In addition, biofuels encounter ethical challenges as the land needed to produce biofuels often competes with food production for a population that is growing worldwide and shifts its consumption patterns to an increasing demand for arable land.

In this respect, fuels generated by

means of renewable electricity – mostly wind power and photovoltaic, but also geothermal and hydro – are attracting increased attention. Renewable electricity can – along with non-fossil CO_2 – be converted into liquid fuels using various synthesis methods. These substitution strategies are referred to as power-to-liquid or e-fuels.

Generating e-fuels through the Fischer-Tropsch or methanol synthesis has been demonstrated in pilot installations but their generation costs are still by factor three to four higher than fossil kerosene. To bring e-fuels to the markets and make them competitive with fossil kerosene, their further development and deployment should be promoted and initially, as with renewable energies about 30 years ago, subsidised. This could be achieved through a policy mix including gradually increasing fuel quotas, investment and/or production subsidies for e-fuel generation and carbon pricing for raising the revenues required for those subsidies.

To ensure that e-fuels contribute to global GHG reduction and do not harm sustainable development, three main criteria must be fulfilled: 1) e-fuels must be produced from additional renewable energy, 2) the CO_2 required must be from non-fossil sources and 3) their production must avoid or appropriately address possible competing needs for land and fresh water. Only if e-fuels are derived from additional renewable electricity and non-fossil CO_2 could they reduce the CO_2 emissions of aviation almost entirely. If e-fuels production plants caused additional fossil electricity generation, global CO_2 emissions could even increase.

However, e-fuels are not a silver bullet. If the current global kerosene consumption were to be generated from renewable electricity, the current global renewable electricity generation capacity would not be sufficient to produce sufficient e kerosene. This takes neither the demand growth of aviation nor the demand of other sectors for renewable electricity into account. We therefore need to make sure that e-fuels are used only in sectors where alternatives such as the direct use of electricity are not available (aviation, shipping, steal, cements and selected chemical products), at least not in the time which remains for full decarbonisation.

To decarbonise the aviation sector, a combination of measures will be required. Firstly, the current subsidies for international aviation such as the exemption from VAT and fuel taxes need to be phased out. Secondly, a meaningful carbon price needs to be established and continuously increased. Thirdly, we need to ensure that alternative fuels are produced in a truly sustainable manner and that they significantly contribute to reducing GHG emissions. And lastly, alternatives to flying and long-distance travelling – e.g. replacing business meetings and conferences by telephone or video sessions – should be encouraged, and less frequent flying as well as different holiday destinations should be promoted. To misquote R.E.M.'s 1987 song, we could then conclude: This is the end of flying as we know it - but we feel fine.

About the author

Dr Martin Cames joined Öko-Institut's Energy and Climate Protection division in 1994 as Research Fellow and heads the Berlin branch of the division since 2008. In 2006, he was visiting researcher at the Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). In 2009, he finished his PhD on Emissions Trading and Innovation. Since many years he is working on national and international climate policies with specific focus on new market-based mechanisms as well as on instruments to address greenhouse gas emissions of international maritime transport and aviation.

Since 2008, he is member of the German delegation for the climate change talks under the United Nation's Framework Convention on Climate Change (UNFCCC) focussing on offset mechanisms (CDM, JI) and international aviation and maritime transport (bunker fuels). From 2012 to 2014 he was a member of the Executive Board of the Clean Development Mechanism under the UNFCCC.

Research for a greener aviation at the French Aerospace Lab

Due to the importance of fuel costs in aircraft operation, increasing aircraft efficiency and reducing fuel consumption have always been major objectives for aeronautic research at ONERA in close connexion with industrial needs. In aerodynamics, these drive research on laminar flows, flow separation control, propulsion integration and aircraft optimisation in general. In propulsion, research are carried out on fans' and nacelles' design, as well as the investigation of the disruptive open rotor configuration, in a continuous effort to increase turbines' by-pass ratio, a key factor for propulsion efficiency,. Materials are instrumental also, with research on composites material for airframe mass reduction, or research on high temperature materials and high pressure turbine cooling to increase engines' thermodynamic efficiency.

These researches are carried out in various contexts: at national level with DGAC and national industry, at European level in Horizon 2020 and CleanSky 2 projects in which ONERA has a great track record.

More recently, climate change and reducing CO_2 emissions have emerged as a dominating concern for aviation. This is particularly challenging in the context of a continuous increase of air travel demand. In spite of impressive and continuous technological progress since the sixties, aviation emissions are increasing and the improvement of technologies currently deployed on aircraft will not be sufficient to compensate the forecasted traffic growth. Disruptive technologies or low carbon fuels shall be implemented for future generation of aircraft.

ONERA is exploring a broad scope of solutions. This starts with new aircraft concepts moving away from the classical tube and wing configuration, such as for example flying wings, as well as efforts to develop a stronger integration between airframe and propulsion. In that field, a strong axis of work is boundary layer ingestion by the propulsion system, which aims at improving the global propulsion efficiency. Pushing the limit further, electrification of aircraft propulsion is also receiving much attention. Although full electric propulsion cannot be considered for commercial aircraft due to limitations of batteries performance, hybrid electric propulsion could be a way to reduce fuel consumption by allowing totally new designs that could for example take advantage of distributed propulsion to optimise aircraft performances.

ONERA
THE FRENCH AEROSPACE LAB

The use of alternative fuels is another direction, with biofuels that can provide a significant emissions reduction over their life cycle, and also synthetic fuel made from renewable energy that may allow ultimately a full decarbonation of aviation.

ONERA has been actively working on the compatibility of synthetic hydrocarbon fuels with current aircraft and infrastructure to allow their short term introduction. With a view to a full decarbonation of aviation, hydrogen is also considered today.

Beyond CO_2, ONERA is also working on understanding the full climate impact of aviation. NOx and especially contrails formation are suspected to possibly contribute significantly to the radiative forcing induced by aviation. The actual impact of contrails is still debated and the modelling of their formation and properties is still an active field of research in which ONERA also participates.

FutureFlow

The FutureFlow project helps to strengthen the role of active consumers in the flexibility market

The FutureFlow project t has resulted in allowing the extraction of all flexible resources which are available in the power system. This will assist TSOs in achieving the goal of offering direct market access to all resources and confirm their position as being the most reliable "system frequency manager" for now and the future. The evolution of the energy market towards a system with bulk generation from geographically concentrated wind and solar power, with a large part of it connected to voltage levels out of direct TSO control, requires solutions like FutureFlow to process the tremendously higher number of inputs and outputs from which the frequency signal will be dependent.

By FutureFlow, the electrical energy market is achieved in its ultimate form. The solution brings the full transparency on the available system flexibility. The coordination between balancing and redispatch resources cross-border and over different voltage levels have been prevented by the lack of a targeted business solution to favor their market access and their transparent contribution to system frequency, congestion resolution and voltage regulation.

Now, with FutureFlow, the features of energy market coupling for a day-ahead and intraday are compressed into a timeframe of a few minutes. These functionalities are integrated with the latest achievements reached by TSOs for optimizing the calculation and sharing resources for operational reserve and redispatch across control zones. The sharing of resources is not limited to those available at transmission level but can potentially reach all distributed generation and demand side resources connected to the grid, at whatever voltage level. It is thanks to these features that FutureFlow achieves the maximum extraction of social welfare from almost real-time markets, including heavily congested systems.

As a direct consequence, the flexibility price has a clear chance to become the real price of wholesale electricity for the European market. The text of the Energy Regulation 2019/943 indicates full marginal pricing for balancing and imbalances as the reference pricing practice. However, to avoid price distortions, the overarching and detailed view on the actual volume of generation and demand to modulate the frequency signal is the only acceptable precondition to deliver transparent and cost-reflecting market prices. FutureFlow gathers this view from traditional balancing service providers and from all

VPP structures that have been modelled and tested on ground for this project. This has created a composite library of business cases and solutions that can be used for industrial applications in areas where the flex potential of, e.g. small hydro, has been largely untapped, thus allowing the fast and quick inclusion of the VPP flexibility into the market.

For TSOs the unprecedented results of this project pave the way to the solution of other severe issues which have been proving difficult to solve until now, even with the increasing support of RSCs.

In this respect, FutureFlow works as a power system "telescope", gathering a much broader and much more detailed view on available generation and demand-side resources to determine system security perimeter every 15 minutes for the coming day...

The tool could furthermore provide increased precision for cross zonal capacity calculations - with borders adapting more flexibly to congestions (no matter if internal or cross-border) for each 15-minutes market terms, as well as for calculating well-rounded cross-border cost allocations for PCI – including the effect of balancing markets in the CBCA assessment.

Thanks to its features, FutureFlow can become a cornerstone solution for the ultimate market integration of distributed generation and demand side as well as becoming a key tool for grid operators to tackle the challenges of the evolving European power system.

www.futureflow.eu

96 **prosumers** (large RES, small RES, CHP generation, industrial generation, industrial load)

from

4 **countries** (Austria, Hungary, Romania and Slovenia) with overall reserve power

exceeding

50 **MW** took part in real-time cross-border pilot tests

60% potential of cost reduction for automatic Frequency Restoration Reserve among four countries

57% potential of cost reduction for redispatching based on Power flow decomposition

4 **platforms** developed and tested in real-time environment

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691777.

Solar Heat for Industrial Processes

Establishment of a European Common Innovation and Research Agenda

By Elena Dufour, Nestor Fylaktos, Josephine Stemmer and Peter Nitz

Solar thermal technologies face technological and competitiveness challenges hindering their wider contribution towards the European decarbonisation goals. These challenges become even more demanding when considering the use of such technologies in industrial applications.

INSHIP's (Integrating National Research Agendas on Solar Heat for Industrial Processes) primary objective is to connect research institutions and researchers across Europe, to provide a clear vision for R&D needs in Europe, and establish innovative pathways for growing and diversifying SHIP (Solar Heat for Industrial Processes) by gathering the participation of 28 European R&D institutions. Two core deliverables addressing these issues were completed within 2019. These were discussed at a workshop tailored for industry and policymakers that took place in Brussels in February 2019.

The first is a report on R&D needs that identified several areas of the state-of-the-art R&D and proposed steps towards future improvements. Topics identified in the project preparation stage were proven to be still relevant, such as the integration of higher TRL systems to industrial processes, and the need for a new breed of low TRL solutions with an emphasis on cost reductions and system integration. Utilising data collected from the National Concept Notes (prepared by project partners and important national stakeholders), as well as feedback from the industry and policy makers, the report highlighted the need for proper financing instruments and the convergence to common technical standards. These results were corroborated by the realisation that SHIP needs to promote its value proposition more (and move away from pure cost calculations), and also emphasise awareness for the technologies, both at the industrial and the policy maker sides. SHIP research should leverage EU funding, since the bulk of funds so far have been coming from national sources. For this, the technology needs to underline its credentials as a viable tool towards decarbonisation of the industry, one of the sectors that will be hardest to move towards zero-carbon-emitting fuels.

The innovation strategies document examined how INSHIP's 10 European research countries position themselves in terms of their policy support, competitive advantage and practice-based innovation gauged across a multitude of SHIP-related variables. The results of the report show that acknowledgement and support of SHIP is generally still low (but not universally across all countries examined), and the type of innovation support provided is disparate, with some strong regional schemes but none nationally, or vice-versa. Again, it became apparent that SHIP is disadvantaged compared to other renewables (and CSP in

Fig. 1 Solar Metallic Volumetric Receiver

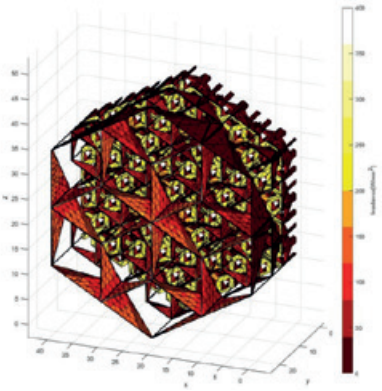


Fig. 2 Alternative low-cost collector for medium temperature (150-200°C)

particular) due to its low visibility among the general public, and the inadequately communicated potential.

The project has embarked on an ambitious programme of disseminating these findings, and other important outcomes as the project's KERs (Key Exploitable Results) to national audiences, comprising the local industry, academia and policy makers through national workshops held between 2019 and 2020 in all involved countries. Three workshops have already taken place in Greece, Spain and France. More will follow within 2020.

INSHIP integrates a high number of research activities (44) across low, medium and high temperatures as well as in hybrid systems. Some of them progressed to a high level of maturity, with a potential to be commercially deployed, with a lifetime that goes well beyond the end of INSHIP. Some of them are listed below:

- Solar volumetric receivers with an innovative hierarchical structure (Fig 1). To overcome the high cost of ceramic materials of high temperature solar volumetric receivers, a metal using selective laser melting (SLM) was tested in the INSHIP concept providing an efficient and tailored geometry. The new receiver exhibits a hierarchically layered volumetric structure and provides heat for high-temperature processes (>600°C) with an efficiency reaching more than 60%.

- Another outcome of the project can also be found in the setup of a new quasi-stationary CPC-type solar thermal collector. This new cost-effective linear focussing collector for industrial applications of up to 200 ºC can be installed on all surfaces including vertical and tilted ones. Overall, this product can have a higher performance-to-cost ratio compared to standard technologies – due to its novel optical design – and lower maintenance than tracking solutions.

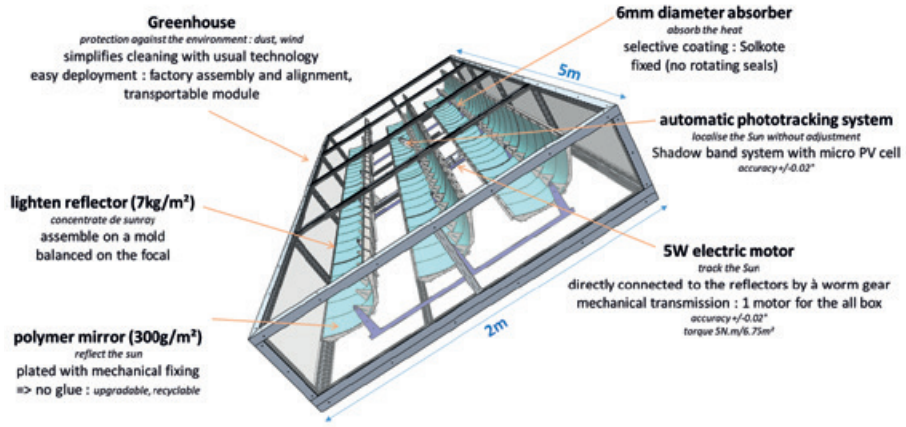
- Encapsulated parabolic trough solar collectors working at 200°C were also developed (Fig 2 & 3). They can be installed in buildings facades, encapsulated in a small greenhouse protecting the system from the wind. With an optimized weight, the plug and play mechanism allows swift installation, and the front glass window enables easier cleaning than conventional systems. This solution eases maintenance in buildings where space is scarce.

- A solar dish with spherical mirror has also been studied in the framework of INSHIP (Fig 4). The mirror is cheaper than a parabolic mirror, while the structure of the solar dish makes the installation of the system on non-flat lands possible. Its range of application is adequate for processes with a working temperature between 600 and 1350 °C.

The project is presently at the end of its third year, with a total project duration of four years. Information on the project, the consortium and related activities and resources is available at the INSHIP website (www.inship.eu).

INSHIP ECRIA is a Research and Innovation Action supported by the European Commission under Horizon 2020 (LCE-33-2016, GA Nr. 731287).

Fig. 3 Scheme of alternative low-cost collector for medium temperature



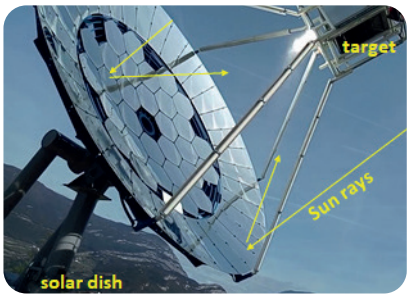


Fig. 4 Solar dish with spherical mirror

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Horizon 2020
European Union funding
for Research & Innovation

Too ambitious for EU? It's high time to modernize heating systems in our buildings. My not-so-veiled tips to Mr Timmermans

By Federica Sabbati (pictured), Secretary General, European Heating Industry

Today most buildings in Europe have a poor energy performance, and this is preventing their decarbonization.

The good news is that the energy efficiency of our buildings can be greatly improved by accelerating the replacement of installed heating systems, which are largely old and inefficient. The technologies to replace them with already exist: from condensing boilers to electric and gas heat pumps, from hybrids to solar thermal, from micro combined heat and power to fuel cells, from thermal energy storage to digital energy managements systems.

What's more, these technologies are flexible enough to allow the progressive, gradual modernization of your building, with increasing insulation for example. They can integrate new renewable sources of energy: whether it's biomethane or hydrogen, innovative technologies are in the making. Building renovation, as we know, requires considerable financial investment for the average family to carry in one go: replacing a heating system is the investment which can have the highest impact on energy efficiency today – as heating is responsible for about 80% of the energy consumption in a house.

But why do we need to accelerate the replacement rate of installed systems? Can we not just go on replacing them as we do now? To answer this question, let me ask YOU a question: when was the last time that you replaced your heater? If you don't remember, that's probably too long ago. But this means that there are many heaters in Europe which are too old and we need historical pieces in our museums, not in our cellars.

If you answer to my question "On 3 January, last year" you probably remember it because you spent New Year's Eve in the cold and can consider yourself lucky to have found

an installer on 2nd January for a one-to-one replacement. The bad news is that you probably missed on the great innovation available on the market, which needs a bit of planning ahead.

Let me try with another question: what alternatives to your current heater would you install in your house? If you don't know... that's quite common, because a heating appliance is not a TV which you buy online and just plug in: you need a specialized technician, an installer to check your home, recommend the suitable option and install it for you. A final one: how much are you prepared to spend to save energy and CO_2 at home today: €200, €2,000 or €20,000?

You should know that with €200 you will probably repair a small malfunctioning in your boiler; with €2,000 you may get a new energy-efficient, state of the art heating appliance. Do you want to go for even more efficient and renewable? The bill may get closer to €20,000, and you may need system adaptations in your home.

Low consumer awareness; high upfront investments; shortage of installers, scarcity of upskilled professionals to match innovation; asymmetry of technical information; replacements required in an urgency situation: these are some of the real issues affecting the replacement rate of inefficient heaters and hence the decarbonization of buildings. Today's European policy framework doesn't target effectively any of these aspects.

In recent years, EU policies have focused on improving the efficiency standards of new products sold in the EU market (so called Ecodesign policy, affecting about 5 million new heating products sold every year in Europe) and setting standards for new buildings (Energy Performance of Buildings Directive), currently 1% of the building stock. This is good, because it ensures that new appliances and our new homes are sustainable.

But these policies are only "greening" the tip of the iceberg: 5 million new appliances over 130 million old appliances; only 1% of European newly built dwellings versus the large majority of old and historical European buildings. And the rate of replacement across Europe is too slow: at the current speed of 4% a year, it will take over 20 years to replace the 72 million inefficient heaters installed in European homes.

It's high time that European policymakers showed ambition in the renovation field.

The potential for energy saving from buildings is huge and would allow Europe to meet the increasing CO_2 emissions cut targets. A 2016 Ecofys study shows how accelerating the modernisation rate of old heating systems from today's slow rate of 4% a year to 5% – which is a whopping 25% increase in the rate - can bring almost 40% CO_2 savings by 2030, compared to 1990 levels.

But new, ambitious policies are needed. For starters, policies to inform and empower consumers such as Europe-wide communication campaigns on the benefits of energy efficiency; launch the energy label for installed appliances in every European country; require regular inspections of heaters, because inspections are a moment where end-users and experts meet and can plan ahead.

Second, policies to accelerate the dismissal of older systems, such as national scrapping schemes for old appliances below a certain efficiency level or above a certain age. And financial instruments to support the upfront investment in energy efficient appliances, renewable-based ones and renovation.

Third, don't look at the energy transition only with product policy glasses. Think education and training initiatives: we need to attract and upskill many more installers and technicians to put innovation in our homes. We need to adapt the curricula to match the energy transition and to provide lifelong training, because technologies evolve and industry innovates to keep competitive.

Finally, don't think that you can avoid all of this with a single, silver-bullet solution, i.e. imposing only one technology or heating solution for the whole of Europe. It won't work.

The energy transition in the building sector, with its large supply chain could create European jobs while bringing the energy transition in every home, in every school, in every city. It's high time that we prioritize the modernization of the heating stock. This is a not-so-veiled tip to the new Commission Executive Vice President Frans Timmermans for his European Green Deal.

European cities gain recognition and fresh support for tackling urban mobility challenges

By Richard Adams and Adrienne Kotler – ICLEI Europe

The urgent need to decarbonise road transport and move towards more sustainable modes has been clear for several years, and the evidence supporting this continues to mount.

The European Environment Agency's recent analysis of European air quality shows that exposure to air pollution caused around 400,000 premature deaths in the European Union (EU) in 2016. As the sector with the highest levels of nitrous oxide emissions, road transport plays a leading role in the story behind these harrowing figures.

What's more, the negative externalities – and with that the potential for positive knock-on effects – of transport are vast and extend far beyond air quality and emissions to encompass public health, social integration, and much more.

However, changing transport for the better is no simple matter – (urban) mobility systems are becoming increasingly complex. Practitioners and politicians need support to integrate mobility into their visions for dynamic, green and liveable cities, and to manage its role in the transition towards a more sustainable future for all.

Landmark document assists cities with sustainable mobility planning

That is why the new edition of the "Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan" (SUMP) is of immense importance. Released in October 2019 at the CIVITAS Forum in Graz (Austria), they support planners and policy makers to create their own SUMPs.

SUMPs contribute to the realisation of key European goals, such as reduced air and noise pollution, improved accessibility, increased road safety, and enhanced quality of life. In recent years, they have become an

Siegfried Nagl, Mayor of Graz; Matthew Baldwin, Deputy Director-General, DG Move; Siegfried Rupprecht, Executive Director, Rupprecht Consult. ©Stadt Graz/Schiffer

indisputable success story and are increasingly seen as a must-have for aspirational cities.

As Matthew Baldwin, Deputy Director-General, DG MOVE, European Commission, commented, "Over 1,000 SUMPs now exist in Europe and we need to ensure this number continues to grow – every city has the capacity to benefit."

Released in 2013, the first EU SUMP Guidelines have served as the key reference point for cities adopting SUMPs and a foundation of SUMP growth. In the intervening six years, however, the mobility landscape has changed massively.

New business models like "Mobility as a Service" and technologies like driverless vehicles have appeared; user habits are shifting towards vehicle sharing and active mobility; and a new political climate has emerged in which local governments are bolder, openly restricting car access and prioritising other modes.

These realities and a new wealth of SUMP experience, accumulated through increased SUMP implementation, necessitated a revision of the Guidelines.

The final document resulted from an intense one-year stakeholder engagement process that engaged over 300 contributors from Europe's SUMP community. This was steered by an Editorial Board that included members from the European Commission's DG MOVE, DG REGIO and INEA, the CIVITAS SUMP projects, Eltis, JASPERS, and leading mobility researchers. The CIVITAS SUMPs-Up project, coordinated by ICLEI Europe, led the authorial process.

Siegfried Rupprecht, Executive Director of Rupprecht Consult and one of the main authors, said, "We have been able to draw on the experience of the first Guidelines, and addressed topics lacking in the first version."

The new publication systematically guides its readers through a 12-step cycle that encompasses SUMP preparation, development and implementation, whilst overviewing recommended tools and methods related to this.

Over 60 case studies gathered from European cities put theory into practice, whilst more detailed advice is given on aspects including citizen engagement, monitoring and measure selection and financing.

The document also underlines the flexibility of SUMPs – the implementation process can be adapted to the specific circumstances of individual cities and countries. Regardless of location, they are suited to the fast changing and increasingly intricate world of mobility planning.

Wider support for the Guidelines is already apparent. Members of the CIVITAS Political Advisory Committee (PAC) – consisting of local politicians from across the EU – endorsed the document at the Forum.

A series of 17 complementary topic guides and practitioner briefings are also available alongside the Guidelines. All can be found on the Eltis Urban Mobility Portal: www.eltis.org.

The tales of Europe's clean transport trailblazers

European cities are leading the way in sustainable mobility, both with respect to SUMPs and beyond. A new booklet – also released at the CIVITAS Forum – chronicles the trailblazing work of six such cities - Gdynia (Poland), Ghent (Belgium), Graz (Austria), Ljubljana (Slovenia), Stockholm (Sweden) and Vitoria-Gasteiz (Spain).

Authored by ICLEI Europe, it provides an overview of how cities have used and been inspired by CIVITAS in the transformation of their urban mobility systems – and ultimately the cities themselves.

For example, Stockholm's electric vehicle charging infrastructure and information campaign, which forms part of its work in the CIVITAS ECCENTRIC demonstration project, is featured. This also contributed to the city winning the prestigious Legacy award at this year's CIVITAS Awards.

Stockholm received this in recognition of its "clean mobility package," which includes a comprehensive electric vehicle charging infrastructure masterplan; bold steps in support of low- and zero-emission vehicles; and safe walking and cycling paths. CIVITAS involvement spanning from the TRENDSETTER project in 2002 to its current involvement in ECCENTRIC has aided this work.

The other CIVITAS Award winners were Antwerp (Belgium), Bremen (Germany), and Vinnytsia (Ukraine), who took home the Citizen and Stakeholder Engagement award, Transformation award, and Bold Measure award respectively. The city of Kruševac (Serbia) received an honourable mention.

Reflecting on the example set by CIVITAS Award winners, Herald Ruijters, Director, DG MOVE said, "These inspiring successes show that Europe can lead the way with bold, ambitious action in sustainable mobility and clean transport."

If other cities follow suit, Europe will become known as the place in which people can move and connect in a manner of their choosing without putting the planet in further peril.

european energyinnovation

Connecting Europe's Stakeholders in Energy and Transport

SPRING 2020 EDITION PROGRAMME

Our Spring 2020 edition will be published in March.

Featured articles from MEPs, senior EU Commission officials, industry experts and researchers will cover a wide range of topics including:

- Transport decarbonisation
- Building efficiency and retrofit
- Bioenergy
- Climate change
- Marine energy
- Financing energy efficiency

This edition of the magazine will be one of the official publication for EUBCE, 28th European Biomass Conference & Exhibition, In Marseille, France, on 27-30 April 2020.

View our publication online at
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Thank You

European Energy Innovation would like to thank many people who make the publication what it is: the people who contribute the articles, the advertisers, and our readers for their helpful comments and feedback.

To all of you, we send our best wishes and the compliments of the season.

Happy Christmas, and a peaceful and prosperous New Year

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