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SUMMER 2016

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EU Commissioner
for Transport



Dominique Ristori
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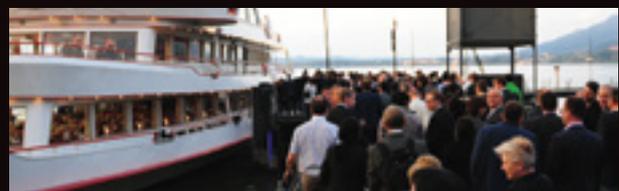
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Energy



**SUSTAINABLE
ENERGY WEEK
13-17 June 2016**

Contents



10

- 6** Building the Energy Union in a fast evolving energy landscape
Dominique Ristori, Director General for Energy, European Commission



18

- 10** We must place citizens at the heart of the Energy Union
Theresa Griffin, Member of the European Parliament

- 14** Aviation Emissions : a global solution for a global issue
Violeta Bulc, EU Commissioner for Transport

- 18** Rotating EU Presidency: The Netherlands' turn at the wheel
Michael Edmund, Editor

- 20** SPARK: a clean energy solution for energy poverty - educational and fun too!
Interview with Sudah Kheterpal, inventor of "SPARK"



20

- 22** High Flyers: the Clean Sky Fairy Tale
Eric Dautriat

- 24** EXPLIC Program - EXPLoration of the limits of a "drop-in" jet fuel
Mickaël Sicard, Onera

- 28** The sustainable future of aviation: how the sector can achieve its climate goals
Michael Gill, Executive Director, Air Transport Action Group

- 30** ERA - in a greener scheme
Simon McNamara

- 34** CITYKeys: Measurement matters
Nikolaos Kontinakis, CITYkeys project coordinator, EUROCITIES



56

- 40** How IoT will play a crucial role in slashing energy use
Mario Campolargo

- 44** Driving innovation through retrofitting and BIM within Energy-efficient buildings
Stefano Carosio, co-chairman EeB PPP Partnership Board

- 48** Energy efficiency in shopping centres: comfort and energy savings
Marine Faber and Roberta D'Angiotella, Buildings Performance Institute Europe

- 54** Is the EU willing to do what it takes to get ocean energy over the line?
Rémi Gruet, CEO, Ocean Energy Europe

- 56** Unleashing bioenergy
Christofer Fjellner, Member of the European Parliament

- 59** 2016 will be a pivotal year for the future of bioenergy in Europe
M. Jossart, General Secretary, The European Biomass Association (AEBIOM)

- 62** Understanding the true cost of the heat energy we consume
Alexandra Latham, EGEC

- 64** GABI, a COST ACTION for the development of shallow geothermal energy
COST Association

- 66** Heat Transition and Geothermal Energy - A German Perspective
Dr Martin Sabel, Bundesverband Wärmepumpe (BWP) e.V.

The publishers of European Energy Innovation would like to offer their sincere thanks to all individuals and organisations who have contributed editorial images photos and illustrations to the magazine. Whilst every effort has been made to ensure accuracy of the content, the publishers of European Energy Innovation accept no responsibility for errors or omissions.

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European Energy Innovation is published by:

Prologue Media Ltd
1a Shire Lane
Chorleywood
Hertfordshire WD3 5NQ
United Kingdom

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DESIGN & PRODUCTION

RayHeathDesign.co.uk

WEBSITE DESIGN

pulseart.co.uk

PRINT

The Magazine Printing Company,
Enfield, Middlesex, United Kingdom

Foreword

Welcome to the Summer edition of EEI magazine: proud media partners of EUSEW, the flagship "platform for sharing ideas and knowhow, and for forging alliances to bring about an Energy Union". Theresa Griffin MEP tells us that the forthcoming raft of energy-related legislation, which concerns decarbonisation, energy security and the development of a properly-functioning energy marketplace, should emphasise energy as "a basic social right" with the interests of citizens at its core: precisely the focus, she says of EUSEW this year.

We are delighted to feature a second article from EU Transport Commissioner Bulc, who discusses the need for planet-wide solutions to the problems posed by aviation emissions. She balances the positive contributions made by aviation: economic growth, jobs, trade and, of course, mobility, with its environmental impact: 2% of global CO₂ emissions, a figure projected to grow strongly. There is, she observes, growing difficulty in reconciling this growth with the concept of sustainability, a difficulty that emphasises the importance of two key elements of the European Aviation Strategy: The Single European Sky project and SESAR.

Echoing the supra-national theme, Director-General for Energy Dominique Rostori discusses our response to the twin challenges presented by climate change and the evolving geopolitical landscape. Europe's 2030 targets on emissions, energy efficiency and renewable energy, and its Framework Strategy for a Resilient Energy Union both demand co-operation across Europe and beyond its borders: "we cannot continue with fragmented solutions", he says, but need "a more integrated approach, based on the principles of solidarity and cross-border cooperation." Adding his perspective, Mario Campolargo explains how the Internet of Things (IoT) can play a crucial role in helping Industry slash its energy use, but that the key challenge is making sure that it is developed on a pan-European basis.

In discussing the pursuit of the sustainable aviation goals set down as long as 2008, Michael Gill of ATAG acknowledges that new disruptive technologies may still be decades away, while going on to emphasise the potential role of biofuels within a four-pillar strategy for the industry. Eric Dautriat reviews the first seven years of the Clean Sky project and the key achievements of Clean Sky1; and looks forward to how the project is set to expand with Clean Sky2 - and beyond.

Elsewhere, Rémi Gruet explores the considerable potential of Ocean Energy: there are plans to deploy 100GW by 2050, which could supply 76 million households and create 400,000 skilled jobs. But, he asks, Is the EU willing to do what it takes to get ocean energy over the line?

In times of great political uncertainty, of cross-border humanitarian catastrophe and global climate change, a united response is needed more than ever. With co-operation very much on our minds, we trust that you will be able to follow EUSEW in some way or another. In the meantime, there is much more to read inside...

Michael Edmund
Editor

Building the Energy Union in a fast evolving energy landscape

By Dominique Rostori, Director-General for Energy, European Commission



The world's energy landscape is rapidly changing and Europeans face two major challenges: We have to respond to the pressing climate challenge of keeping the increase in global average temperature below 2°C with the aim to limit the increase to 1.5°C but also to find answers to geopolitical challenges that have major impacts on European citizens and companies.

For the first challenge, two years ago, the European Council agreed on a 2030 Framework for energy and climate setting EU-wide targets by 2030 to reduce emissions by at least 40% compared to 1990; to be at least 27% more energy efficient and to have at least 27% of renewable energy sources in our final energy consumption.

Secondly, geopolitical challenges over the past years have highlighted to all Europeans that diversifying energy sources and suppliers as well as adapting the energy system are crucial for our energy security. In that context, the Commission adopted on 25 February 2015 a Framework Strategy for a Resilient Energy Union with a forward looking climate change policy. It is one of the most strategic priorities for the EU for the coming years. It has created a new momentum for the transition towards a low-carbon, secure and competitive economy. The success of the Paris climate conference further underpins this strategy.

In this context, one of the top political

priorities for President Juncker is for the EU to be the number one in renewables. Already today, Europe is one of the most energy and carbon-efficient economies in the world. More than 50% of our European electricity is CO₂-free.

Moreover, technological developments are transforming the energy sector. We are transitioning from an energy sector characterised by long investment cycles for large power plants to increasing shares of renewable energies and more distributed generation patterns - in smart grids, smart homes - putting the energy consumers at the centre of the stage. 78% of new installed capacity in the renewables' sector. Research, innovation and investments are more than crucial in that context and we continue to build bridges between project promoters and investors.

The European Fund for Strategic Investments (EFSI) was the first initiative launched by President Juncker which identified energy as one of the top priorities where investments are needed. This is particularly the case when it comes to building interconnections and infrastructure, energy efficiency and renewable energies. Today, the first implementations of EFSI are already largely oriented towards energy efficiency projects!

To fully support the energy transition, secure our energy and keep costs in check, we cannot continue with fragmented solutions. We will move away from a purely national approach to a true internal market perspective that leverages regional cooperation and Union-wide strengths. Today, security of supply cannot be considered as a solely national issue

anymore, it requires us to develop a more integrated approach, based on the principles of solidarity and cross-border cooperation.

But if we want this fundamental energy transition to be successful, it also has to be socially fair and consumer oriented. The Energy Union is powered by people as it proposes a "new deal" by offering more choice, better services and more control over the way we use, and possibly produce, energy.

Important next steps will be taken after this summer, as the European Commission will adopt a package of measures in the energy efficiency field to ensure that we meet our 2030 target in a cost-efficient way. It will contribute to the decarbonisation of our economy, enhancing our energy security, providing Member States and investors with more predictability and certainty, and also boosting economic growth and jobs. It will consist of the revisions of the Energy Efficiency Directive and the Energy Performance of Buildings Directive, accompanied by a Smart Financing for Smart Buildings Initiative.

For consumers - both households and industries -, the Commission will publish this year a new energy prices and costs report. This will increase their transparency by providing an overview on different price levels in Member States and their influence on European competitiveness.

Moreover, later this year the Commission will put forward proposals on an ambitious package on renewable energy and a new electricity market design to boost cross-border trade, help embed renewables at the heart of our system and increase security of supply. The package will also include a Bioenergy Sustainability Policy.

In a nutshell, the Energy Union that we are currently building is laying down the foundation of an integrated and innovative energy market that will allow the EU to become world number one in renewables and increase energy security. These are precisely the topics we are going to discuss during the European Sustainable Energy Week (EUSEW) from 13 to 17 June in Brussels, the most important European conference dedicated to sustainable energy policy issues. I am looking forward to this year's edition and to further build the Energy Union all together! ●

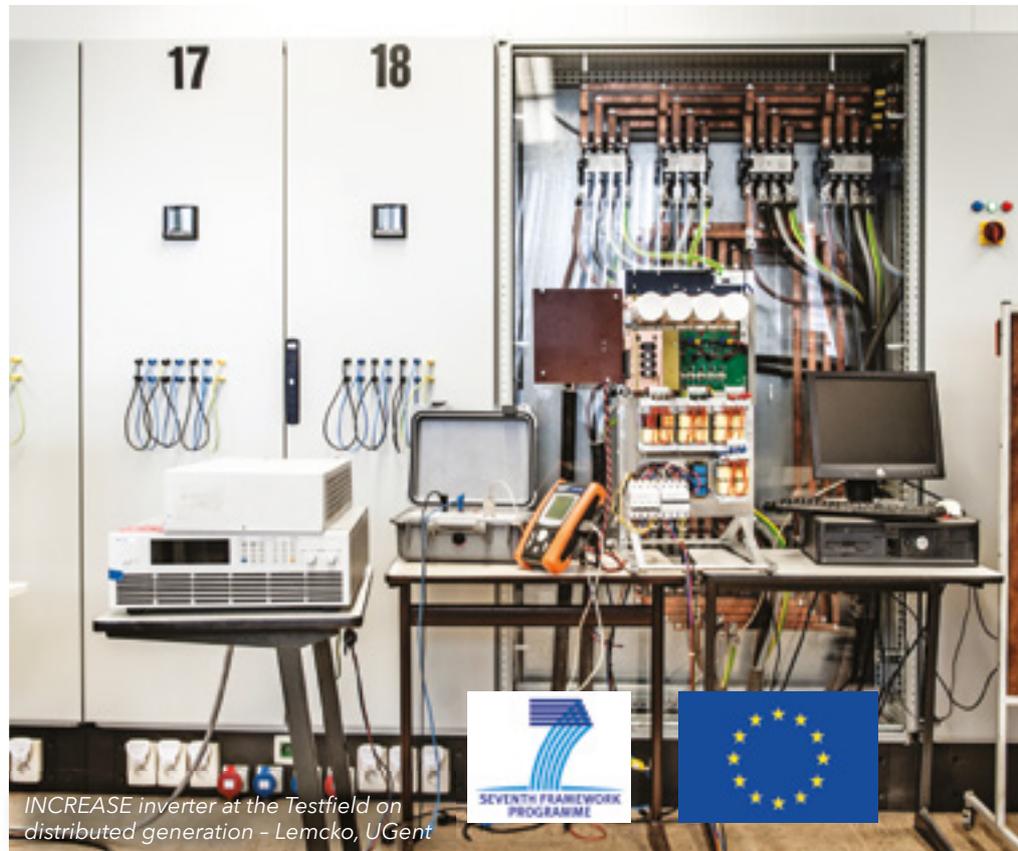
FP7- project: INCREASE



The significant rise in distributed renewable energy sources (DRES) has placed an enormous burden on the secure operation of the electrical grid, impacting both the transmission system operators (TSOs) and distribution system operators (DSOs). The massive increase of the intermittent DRES in low (LV) and medium (MV) networks has led to a bidirectional power flow, which raises the urgent need for new operational and control strategies in order to maintain the ability of the system operator to provide the consumers a reliable supply of electricity at an acceptable power quality level.

Technically, INCREASE focuses on how to manage renewable energy sources in LV and MV networks, to provide ancillary services (towards DSOs, but also TSOs), in particular voltage control and the provision of reserve. INCREASE investigates the regulatory framework, grid code structure and ancillary market mechanisms, and proposes adjustments to facilitate successful provisioning of ancillary services that are necessary for the operation of the electricity grid, including flexible market products.

INCREASE proposes a three level approach. The first level only uses local parameters (voltage at the point of connection, exchanged power) for the control. This is a fast control that will mitigate the voltage unbalance (at the LV network) and uses P-V droops to achieve soft curtailment to solve the overvoltage problem (at the LV and MV network). The first level control ensures the reliability and stability of the system. The second level control will result in an optimal system and aims to minimise the loss of renewable energy. This second level control is achieved by a multi-agent aggregator concept and consists of fair power sharing, the coordination of OLTC control and PV inverters to solve (current and voltage) congestion. In order for the DSO to evolve from congestion manager to capacity manager, a service layer is



INCREASE inverter at the Testfield on distributed generation - Lemcko, UGent

required. This service layer is the third level in the INCREASE approach. It solves a multi-objective optimisation problem by combining and extending optimisation strategies and results in flexible energy products to provide Ancillary Services with them. The DSO always needs to have control over the grid in order to prevent that the DR and DRES schedules worsen the supply security. For this purpose, a Traffic Light System (TLS) is used that gives the DSOs the ultimate control over the DR unit schedules.

INCREASE enables DRES and loads to go beyond just exchanging power with the grid, which enables the DSO to evolve from congestion manager to capacity manager. This will result in a more efficient exploitation of the current grid capacity, thus facilitating higher DRES penetration at reduced cost. Because of the more efficient use of the existing infrastructure, grid tariffs could decrease, potentially resulting in a lower cost for the consumers.

The INCREASE simulation platform enables the validation of the proposed solutions and provides the DSOs with a tool they can use to investigate the influence of DRES on their distribution network. The INCREASE solutions will also be validated (i) by lab tests, as well as (ii) in four field trials in the real-life operational distribution network of Energienetze Steiermark in Austria, of Eandis in Belgium, of Elektro Gorenjska in Slovenia, and of Liander in the Netherlands. ●

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MSP – Multi Sensor Platform for Smart Building Management

The FP7 project MSP - Multi Sensor Platform for Smart Building Management has the objective of strengthening the leadership of European industries in the highly competitive area of smart sensing systems in building management and mobile applications. The MSP project is focused on the development of essential devices and sensors that are required for miniaturized smart systems suitable for indoor and outdoor environmental monitoring:

- Nanotechnology based gas sensors for detection of potentially harmful or toxic gases
- Novel sensors for particulate matter and ultrafine particles
- Infrared sensors for people presence and fire detection
- Visible light sensor and UV-A/B light sensors
- Highly efficient photovoltaic and piezoelectric devices for energy harvesting.

The rigorous employment of Through-Silicon-Via technology enables a highly flexible “plug-and-play” 3D-integration of the sensor devices on a CMOS platform chip to miniaturized smart systems with significantly advanced functionalities. The implementation of a micro controller and a wireless communication system enables stand-alone operation in smart sensor networks, communication to smart phones and is targeted towards future Internet-of-Things applications.

The MSP-project opens entirely new applications: Up to 50% of energy

consumption and CO₂ emissions can be saved using intelligent air conditioning systems that are controlled by air quality. Additional infrared sensors provide fire alarm and detect and locate the presence of people in the building – this can set new safety standards in building technologies. Gas sensors implemented into smartphones can provide warning of a defective heating system and an increased or even deadly CO concentration - a potential source of danger in millions of households worldwide. An ozone sensor can be used to monitor air quality and support athletes in planning outdoor training.

The MSP-project started on 1st September 2013. Materials Center Leoben (MCL), an Austrian COMET K2 Competence Centre, coordinates this €18 million project that comprises of 17 large and small companies, universities and public research centres from 6 European countries:

- Materials Center Leoben, ams AG, and EV Group (EVG) from Austria
- ams Sensor Solutions Germany GmbH (previous AppliedSensor GmbH), Fraunhofer Gesellschaft (IIS & IISB), Siemens AG, and the

University of Freiburg from Germany

- Boschman Technologies B.V., and Holst Centre from the Netherlands
- University of Oxford, University of Cambridge, University of Warwick, Cambridge CMOS Sensors, and Samsung R&D Institute UK, from the United Kingdom
- University of Louvain, and Vito from Belgium
- Università degli studi di Brescia from Italy.

The MSP project started in the autumn of 2013 and is due to complete in spring 2017.

For further information please visit: www.multisensorplatform.eu

MORE INFORMATION

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We must place citizens at the heart of the Energy Union

By Theresa Griffin, Member of the European Parliament (pictured)

This year, the European Union and Energy Union face important legislative proposals on the European Union Emissions Trading System, Security of Supply, Energy Efficiency and Energy Market Design.

These proposals call on the European Union to resolve three major issues: the transition to a sustainable and decarbonised economy with increased energy efficiency, renewables and a smart, flexible, energy supply; the need to guarantee secure and stable energy;

and the development of a functioning retail market.

In order to achieve these objectives, we cannot just consider energy as a commodity, but more importantly as a basic social right. The Energy Union



should have the interests of EU citizens at its core and the energy transition should result in a more decentralised and democratic energy system - benefiting society as a whole. That is why I am particularly pleased that this year's EU Sustainable Energy Week will focus on consumers.

More immediately, in July the Commission presented a Communication entitled 'Delivering a New Deal for Energy Consumers', underlining the key issues facing our retail energy markets and the obstacles consumers face as the energy sector transforms throughout Europe.

Five years after the Third Energy Package, its aim of providing a truly competitive and consumer-friendly retail market has not yet been realised. Consumers are still paying too much for their energy bills and are stuck on outdated and expensive tariffs. We need to fight for more transparency and clarity on bills whilst making it easier for all consumers, including those who do not have access to the internet, to compare offers and switch energy suppliers free of charge. Similarly, we need to fight for a ban on unfair commercial practices, including aggressive marketing techniques over the phone and on the doorstep, often targeted at the most vulnerable and our elderly citizens.

To be successful, Europe needs to continue the transition from a centralised system based on fossil fuels to one which is decentralised, flexible and increasingly based on renewables. We need to make sure that citizens directly benefit and believe that consumers should be supported to take ownership of this transition

through practices of energy self-production and increased initiatives towards energy-efficiency. This includes reducing the administrative barriers to self-generation capacity and replacing lengthy authorisation procedures with simpler notification requirements. It also means promoting the development of demand-response and smart technologies while making sure that the most vulnerable and those who do not have easy access to information or technology are not left behind.

All these changes are underpinned by my desire to tackle and address the growing problem of energy poverty throughout Europe. Currently over 50 million citizens in Europe struggle to pay their energy bills and it is our collective responsibility to assist them. In 2016, no one should have to choose between heating, cooling and eating. I believe that we can only bring down energy bills if we coordinate our efforts at regional, national and European levels. Recently, in the Anti-Poverty Target Report, the European Parliament called on the Commission to develop a common definition of energy poverty. We are now waiting for action from the Commission and suggestions in the upcoming legislative package, including in the Energy Efficiency Directive, Energy Performance of Buildings Directive and Energy Market Design.

The next step is to ensure that the Parliament's recommendations are incorporated into all the relevant upcoming legislative texts - thus ensuring a genuine New Deal for citizens. In 2016, we must ensure that consumers are central to the energy transition and empowered throughout the process of change. ●

“Blackbox” cooling solution to enhance Yara’s growth goals

Yara is the leading provider of sustainable crop nutrition solutions, supporting farmer profitability through knowledge, optimal quality and productivity. It has a leading position in nitrogen applications, and has become a total solutions provider in the market for emission control solutions. The Porsgrunn location, about 140 km southwest of Oslo produces NPK and CN fertilizers.



NPK fertilizers are primarily composed of three main elements: Nitrogen (N), Phosphorus (P), and Potassium (K), each essential in plant nutrition. Nitrogen helps plants grow quickly, increases the production of seed and fruit, and betters the quality of leaf and forage crops. Nitrogen is also a component of chlorophyll, the substance that gives plants their green color, and also aids in photosynthesis. Phosphorus, also a key player in the photosynthesis process, supports the formation of oils, sugars, and starches. Additionally, phosphorus encourages the growth of roots, and promotes blooming. Potassium, assists in photosynthesis, fruit quality, the building of protein, and the reduction of disease. The production capacity of the plant is stated in table 1.

PORSGRUNN

The company started the so called Bamboo project a couple of years ago. Bamboo is a fast growing plant, which

makes it the perfect synonym for the fast-growth plans of Yara. As part of this program the plant-management has decided to increase the production capacity. One of the bottlenecks is the cooling capacity of the plant during the summer period.

STANDARD OPTIONS VS “BLACKBOX OPTION”

As standard solutions could not achieve the required output temperature (i.e. as low as possible without having freezing problems) Bronswerk was requested to prepare three customized options in order to realize the preferred air conditions. The main difference between the three options could be found in the degree of compliance with the specifications. All of the three solutions would have the same thermal performance, however the “blackbox” option, which was chosen by Yara, would be the fastest and most economical solution within the project requirements. This option was called the black box option

because the solution was the focal point, and no stone was left unturned in finding this solution. Bronswerk allocated all possible resources to conduct extensive research resulting in a suitable (customized) solution. The difficulty in finding this solution lay in increasing the production performance while meeting the demands and staying in compliance with the restrictions of Yara. The result was an air-conditioning unit different from standard solutions in terms of temperatures and allowable pressure drops (see figure 1). These kinds of challenges are perfectly suitable for Bronswerk: debottlenecking and revamping existing installations to improve the capacity within the actual plot size limits keeping the original equipment in tact as much as possible! These were exactly the reasons why Yara allowed Bronswerk to make their process more sustainable.

Table 1: Production volumes Yara Porsgrunn site

Production volumes	
Ammonia	500,000 tons
Nitric acid	1,350,000 tons
NPK	2,000,000 tons
CN (as solids)	810,000 tons

PROCESS OPTIMIZATION AND SOLUTION

The proposed solution was especially designed to meet the critical design demands (to cool back washed ambient air of a temperature of 13° Celsius (100% RH) to a temperature

of 2° Celsius (100% RH) First, the unit needed to be able to cool down to 2° Celsius without the risk of ice formation. Bear in mind that standard units are only able to cool down to 7° Celsius before ice formation starts. Secondly, the unit needed to be able to withdraw 2 m³/hour of moist from the air for the air cooling to be efficient. The natural working fluid used for this process was R717 (ammonia). In order to use

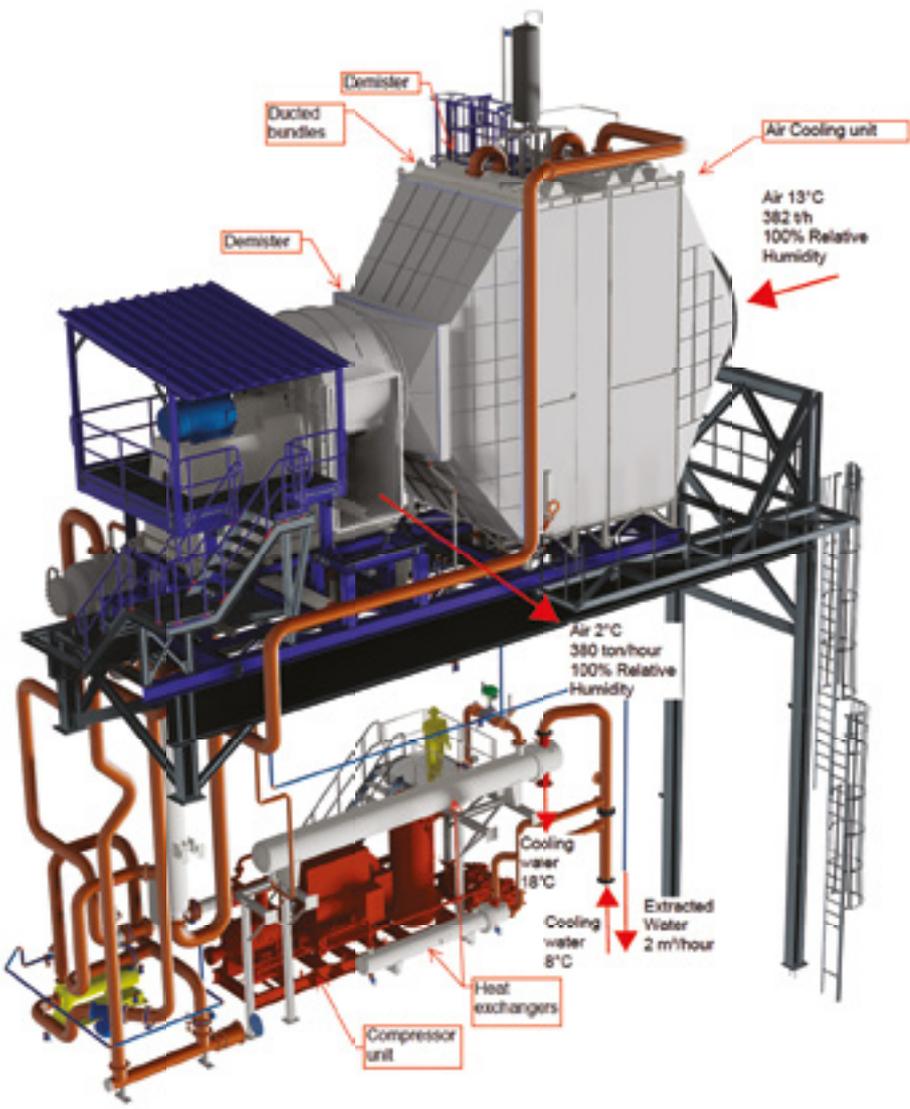
this medium to cool down the air and to extract the moist, an in-between circuit was designed, consisting of a compressor, heat exchangers and ducted bundles as shown in figure 1. There were only a few concerns. Firstly, because of applying two bundles in an existing channel the resulting pressure drop of the installation had to be compensated in some way. For this reason Bronswerk provided the

new set up with a new fan, eliminating any kind of pressure loss in the process. Furthermore, the system will be not in operation throughout the whole year. This will mainly occur during winter times when the air has less humid. For this reason a by-pass system was applied enabling Yara to shut off the unit thereby preventing unnecessary usage. Last but not least, droplets needed to be separated from the cooled down air. Therefore two demisters were applied on both sides of the bundles to extract the water from the air.

THE PROJECT STATUS

At this moment Bronswerk is finalizing the remaining activities for this project which will be in full operation at the end of 2016. First major results are being expected in spring 2017 but the forecasts are very positive. The research, combined with a suitable process solution, engineering and hardware supply, make this project one of a kind and underline both Yara's and Bronswerk's ambition to be a role model within the industry when it comes to process optimization and sustainability. ●

Contact details:
 For more information or to find out what this can mean for your system, send an email to Femke@bronswerk.com



Aviation emissions: a global solution for a global issue

By Violeta Bulc, EU Commissioner for Transport (pictured)



Aviation is a strong driver of growth, jobs, trade and mobility for our economy and citizens. It contributes €110 billion annually to the EU's Gross Domestic Product, and directly employs 2 million Europeans. However, it also has an increasing impact on the environment. Today aviation represents around 2% of global CO₂ emissions and this is expected to increase in the future. According to the International Civil Aviation Organisation (ICAO), emissions will grow by at least 63% by 2020 compared to 2006 levels, and by at least 290% by 2050 if no effective mitigation action is taken. The latest European Aviation Environmental Report also confirmed that the sustainability challenge will increase as the sector continues to grow, despite the technological improvements that are being made.

The Aviation Strategy for Europe we adopted last December recognises that the future competitiveness of air transport is closely linked to its sustainability. The strategy stresses the importance of decreasing CO₂ emissions and the way forward for Europe. First we need to complete the Single European Sky project. This would cut CO₂ emissions by an average of 10% per flight within the EU. Then, we have to continue supporting research & development actions for innovative "green" technologies: SESAR for innovative solutions to improve the efficiency of the European Air

Traffic Management, and Clean Sky for the development of breakthrough technologies to significantly increase the environmental performance of aircrafts.

Aviation is international by nature, and the decarbonisation efforts must be pursued globally. That is why the EU is coordinating actions with other countries and regions in the world. For instance, the comprehensive aviation agreements, which the Commission negotiates on behalf of the entire European Union, allow us to promote green policies as part of the negotiations. The European Commission has already concluded eight such agreements, seven more are still being negotiated and, as part of the Aviation Strategy for Europe, we want to negotiate new ones with important aviation partners, such as China, Turkey, the Gulf Region, ASEAN, Mexico and Armenia.

However, only through a global and legally-binding agreement can we address the sustainability challenged posed by aviation. Last December in Paris the European Union fought until the last moment to include international aviation in the scope of the COP21 deal. Despite all our efforts this did not succeed, but with 191 Member States, ICAO is now the right forum to make this possible. The EU is currently working closely with ICAO on two global measures: the development of a global CO₂ standard for aircraft, and the creation of a Global Market-Based Mechanism (GMBM).

CO₂ STANDARD FOR AIRCRAFT

In February, an agreement was reached within ICAO to set the first-ever global CO₂ standard for aircraft. European experts played a central role in brokering this deal – as had already been the case at the COP21 in Paris. The standard aims at setting the maximum amount of CO₂ emissions that commercial aircrafts are allowed to release per kilometre, for both new and in-production aircraft, which will be reviewed over time. By 2040, it could save up to 650 million tons of CO₂ emissions. The technical deal now has to be formally endorsed by the ICAO General Assembly this autumn. Once done, this would be an important step towards our sustainability objective. It will also create further momentum for the work on the GMBM.

GLOBAL MARKET-BASED MECHANISM

The objective of the GMBM is to set up a global mandatory system which can offset CO₂ emissions from international aviation and enable carbon neutral growth as of 2020. The EU has already put in place a domestic market-based mechanism, the Emissions Trading System. However, a global system is the only way to effectively decarbonise the sector. In 2013, the ICAO Assembly committed to develop a GMBM by 2016. Discussions are ongoing within ICAO and the Commission is pushing for an ambitious outcome at the General Assembly this autumn. Throughout 2016, I will be meeting a

number of our key partners to invite them to support us.

As European Transport Commissioner, pushing the EU's decarbonisation agenda forwards is one of my first priorities. Climate change is real, and the decisions we take today are going to impact our generation and the ones to come, in the EU and beyond. Aviation is a global business therefore we need global solutions. I therefore invite all parties to come on-board. ●

Carbon capture from renewable energy



As one of the major initiatives encompassed by Oslo's new climate and energy action plan, Klemetsrud plant is currently undergoing a test program for establishment of at least one full-scale plant for CO₂ capture by 2020.

The Klemetsrud Plant is one of Eastern Norway's largest land-based industrial companies, and a major point source for CO₂ emissions from biological materials. Nevertheless, significant CO₂ emissions from the process still remain.

A Carbon capture and Storage (CCS) initiative can significantly contribute to reducing these greenhouse gas emissions. When CO₂ is drawn from the air and deposited, the emissions are reduced to less than neutral, going from plus to minus in the emission calculation. Then the so called "carbon negativity" is achieved.

Oslo has a unique opportunity to further develop its status as a European pioneer in the area of environmental and climate efforts, and to have a leading role in the development of technology related to the capture and storage of CO₂ emissions from waste-to-energy plants. Carbon capture from renewable energy contributes toward a more sustainable waste management, as well as a green circular economy and can potentially increase the sustainable performance of the Klemetsrud plant.

Some of the reasons that made Klemetsrud an ideal candidate for a CCS project are:

- The plant will be in operation continuously throughout the year, and will still be operating after 40 years, even if ownership changes hands over time. It therefore provides an excellent base for technological development.
- The plant provides flexible energy, supplying both heat and electricity.

- It's located relatively close to Oslo Harbour, and boat transport of liquid CO₂ from Oslo Harbour will be feasible.
- A Norwegian pilot plant could pave the way for greater emphasis on CCS in tendering procedures and criteria, and for future requirements regarding CCS at waste-to-energy plants within the EU.

IMPACT ON AIR AND WATER

Klemetsrud plant meets very strict environmental requirements in its operations, in fact stricter than the requirements imposed by the authorities. This, combined with an ongoing upgrade of the facilities, result in very low emissions to surrounding air and water. Flue gas emanating from the incinerators at Klemetsrud undergo an extensive cleaning process involving several stages, in order to ensure the proper removal of all pollutants and the lowest possible emissions. After the thorough cleaning process, the smoke that emanates from the chimney is 99.78% pure water vapour.

EFFICIENT WASTE MANAGEMENT

Overall, the plant contributes to the environment by processing residual waste that may otherwise end up at landfill sites and converting it into eco-friendly energy. A major advantage of the source-sorting system utilized by the plant is that bags with different types of waste can all be dumped into the same bin and transported in the same vehicle to the waste management plant. This further reduces CO₂ emissions on transport and saves space in urban areas, since it becomes unnecessary to have several different waste containers for the various waste categories. ●



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Gonvarri Steel Services is leading Biostirling-4SKA

As part of their R&D activities, Gonvarri is leading the Biostirling-4SKA project: A cost effective and efficient approach for a new generation of solar dish-Stirling plants based on storage and hybridization.

CONTACT DETAILS

www.biostirling.com
www.gonvarri.com

Biostirling-4SKA is a concentrated solar power dish for a Stirling engine combining solar power and gas fuel. It has been engineered to be tested by powering a prototype of the Square Kilometre Array (SKA) 24 hours/365 days. The SKA will have potential to revolutionize the study of the Universe and the energy is one of its challenging fields. Taking the SKA as validator, Biostirling will have many other applications by its uninterrupted powering supply in an off-grid condition. ●

Solar Steel by Gonvarri Steel Services has delivered more than 1.5GW of PV power worldwide.



Rotating EU Presidency: The Netherlands' turn at the wheel

Wie op twee hazen te gelijk jaagt, vangt geen van beide

-Dutch Proverb

By Michael Edmund, Editor

The Netherlands took over the rotating EU Presidency on the first of January, just as the elation surrounding the COP21 'landmark agreement' began to be succeeded by analysis and inquest. These things being as they are, the Dutch were never going to have to attempt the role of consolidating any advances made in Paris: their priorities had already long been set. Nevertheless, Dutch Minister for Sharon Dijksma (Infrastructure and the Environment) has met her French counterpart Ségolène Royal (Ecology, Sustainable Development and Energy) with the specific aim of maintaining momentum after Paris, while the Commission has also undertaken to examine carbon pricing further.

Perhaps somewhat inevitably, a litany of events, at once fascinating and appalling, has unfolded over the last six months. Atrocities committed upon the streets of Paris have found terrible

echoes in Brussels; the humanitarian catastrophe that continues to wash up upon the shores of Greece and Italy has provoked the ghastly sight of barbed wire rolling across European fields once again; and claim has met counter claim over the potential role of Turkey and its European aspirations. Disturbing tales from many European countries of the unacceptable behaviour of individual migrants have reinforced a collective sense of unease about migration in general. Political upheaval in Germany, mirrored in Austria and elsewhere, is not the only manifestation of this unease, which has also found a democratic expression in the Brexit referendum whose outcome is being followed with interest in many member states made restless by Europe's plight. The continuing weaponisation of gas and the collapse in oil prices have been complicated by the international rehabilitation of Iran and the emergence of Azerbaijan. And all the while, the Damoclesian threat of

economic catastrophe still looms over many European economies.

Each new revelation, while clamouring for space on European front pages has demanded some form of response and threatened perhaps to derail the Dutch agenda. While adding to any list of priorities risks diverting attention and effort away from the existing ones, the question of which European priorities should have priority over all the other priorities seems a great deal less incongruous when assessed against such a bleak geopolitical backdrop. A quick glance at the official programme of the Dutch presidency indicates how its four key priorities have reflected the immense challenges we face:

- a comprehensive approach to migration and international security
- Europe as an innovator and job creator
- sound, future-proof European finances and a robust eurozone



- forward-looking policy on climate and energy

These policy areas are linked, perhaps inextricably so; there has nevertheless been too much activity to review even that specific to Energy and Innovation. Arguably, highlights have included the Open Innovation 2.0 Conference, which discussed European Innovation Living labs and Innovation Ecosystems, as well as funding opportunities under Horizon 2020 and online Engagement Platforms such as Big Data.

Among big initiatives to receive attention, the Single European Sky was deemed by the European Aviation Summit to be “an essential component for strengthening the competitiveness of the entire European aviation sector”. A key message was agreement on the need for a joint European aviation strategy; while drones and big data were recognised as major new technological developments.

A high level meeting in February addressed the next steps towards The Energy Union, which include regional co-operation to improve energy security and cooperative governance on wind energy in the North Sea. Energy Ministers also discussed the smooth integration of renewable energy into a more flexible electricity market. Transport Ministers met to discuss Smart mobility, Green mobility and Innovating for the future, and then, jointly with Environment Ministers, sustainable transport solutions, a follow up to COP21, and global solutions for Aviation and Shipping.

Europe is a highly urbanised continent, and the EU Urban Agenda has naturally figured prominently. Organised events have included a New Europe City Makers meeting in February, the 2016 Cities of the Future and an international innovation conference in Amsterdam, both in April; a COTR meeting and City Maker’s Summit in May, leading

to the ministerial EU Urban Agenda conference and the Amsterdam Pact. Other events have included the SBE16 Utrecht conference, which focused on NET-Zero building refurbishment and a RURI (Route to Rural Innovation) event for municipal managers, policy makers and researchers interested research and innovation in urban areas. The European Innovation Partnership on Smart Cities and Communities is scheduled to host an event continuing the rollout of smart city solutions that integrate technologies from energy, transport, and ICT.

The proverb at the beginning of this article may loosely be rendered as “He who chases two hares will catch neither”. The Dutch are rightly proud of a reputation for plain speaking: it would seem that during the last six tumultuous months, addressing new issues has not been at the expense of neglecting existing ones. The Presidency of the EU has been in safe hands. ●

SPARK: a clean energy solution for energy poverty - educational and fun too!

Interview with Sudah Kheterpal, inventor of "SPARK"





Q For the benefit of our readers, could you briefly explain how your device works?

The Spark clean energy-generating musical instrument acts as a mini portable generator that creates clean, kinetic energy as it is played. Just 12 minutes of playing generates one hour of light and with its smart power system, Spark can charge up a mobile phone.

Q What is the level of interest?

Spark has generated widespread interest since launching on Kickstarter in July 2014. Since then it has been featured in national and international press including the Guardian, The Huffington Post, Businessweek USA, Wired magazine and Vogue India. It also won the London Design Awards 2014 and 2015 for Best Product Design for Personal Use and Education.

Q Can you give us an idea of the cost?

To purchase Spark costs 27 euros

Q What is the typical power output?

Spark can generate 25 lumens of light, which provides really effective reading light. It's smart boost system allows for a 5V output for USB charging.

Q How widespread is the distribution?

Spark is being distributed in off grid areas in Kenya and India and whilst this distribution network is growing, we can also see the benefit of bringing Spark closer to home. With its fun appeal for young people, its educational potential and its practical application, Spark is set to make a profound impact in European refugee camps. We are currently looking for a partner to help make this happen.

Q Do you foresee any other potential applications for the technology?

Absolutely, we are currently developing a number of different products that combine kinetic energy with other energy harnessing technologies. In a wider context, Spark works not only as an effective clean energy solution for energy poverty but also as a learning tool.

As part of our mission, we aim to to inspire young people by bringing core subjects to life, to create sparks in their imagination, to educate around climate change and most importantly, to help them to see what they can achieve. Through the Spark educational kit or Edu-Spark, children can learn Science, Technology, Engineering and Maths (STEM) by building their own power in a fun way through combining the Arts.

The Edu-Spark will be available in September 2016. ●

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High Flyers: the Clean Sky Fairy Tale

By Eric Dautriat



Seven is a magic number in all fairy tales. It is also a magic number with regards to the European Union and, in particular, to Framework Programmes. Clean Sky is no exception, and without being exactly a fairy tale, it follows a seven-year drumbeat. As Clean Sky 1 draws to a close and Clean Sky 2 starts to grow, perhaps now is a good time to look back over the past seven years and reflect on our achievements so far.

Seven years ago, in 2009, the Clean Sky JU was started. The concrete role of this strange animal was all but clear. We knew we would have to learn by doing, and were happy to do so. A criticism was floating around about Clean Sky being a 'closed club' for the benefit of big players only. There were big hopes and great expectations, following all the efforts from the founders to define a far-reaching technological programme with ambitious objectives, in particular for CO₂ reduction. A bridge was being built over the Valley of Death of innovation. The journey was starting.

Seven years later, the JU team has overseen many achievements: almost all the major Demonstrators defined at the beginning have already been run or are in the final phases before testing. Very few have been given up – a handful were replaced by others of at least similar impact under the programme executive body's watchful eye. A few of our key Demonstrators to date include:

- The Tech 800 demonstration engine (April 2013) - this demonstrates technological advances for small- and medium-sized helicopter engines with savings of 15% fuel burn.
- Advance Low Pressure System

engine demonstrator (October 2014) - ALPS introduces a composite fan structure in large 3-shaft engines, used on long-range aircraft.

- The regional turboprop flight test (July 2015) - here an entire panel of the aluminium upper fuselage is replaced by an innovative composite multi-layer panel containing optical fibres and electrical sensors/actuators for in-flight measurements.
- Bluecopter (July 2015) - this features matured technologies with the objective of reducing the drag of an Airbus Helicopters' H135 by optimising the design of parts of the shape.
- Multi Criteria Departure Procedure (July 2015) - trajectory optimisation allows the Flight Management System to compute an optimised set of parameters during the initial climb phase just after take-off, targeting a reduction of CO₂ emission, a reduction in perceived noise, or a combination of both.
- COPPER Bird (July 2015) - this demonstrates the feasibility of more electrical architectures for innovative test equipment and systems for regional aircraft, helicopters and business jets. Upcoming tests are expected to show benefits in terms of emissions' reduction.
- The Open Rotor (September 2015) - this new propulsion concept is expected to enable reductions of over 30 to 35% in fuel burn and CO₂ emissions per passenger-km. This is the most ambitious step towards CO₂ reduction to date.

Clean Sky's environmental objectives are now confirmed by the Technology Evaluator as virtually achieved: 'virtually' because the concrete inclusion of

the demonstrated technologies into products is now pending. In addition, more than 600 participants have now come through the doors of the 'closed' club - including more than 250 SMEs, one third of which have fewer than ten employees.

Meanwhile, Clean Sky 2 was started, with more than twice the budget of Clean Sky 1. Building on its predecessor's success, Clean Sky 2 aims to achieve a higher level of technology integration at aircraft level and to raise the maturity level of systems incorporating these new technologies. The programme has gathered an impressive momentum in its first 'extended year' of operation (from July 2014 to the end of 2015). There have already been two Calls for Core Partners and three Calls for Proposals, resulting in more than 200 new members and partners, including many newcomers, joining the community.

Clean Sky is developing beyond Clean Sky. This means that besides the management of Clean Sky 1 and 2, the Programme is widening its scope for the benefit of these very programmes, in particular by building synergies with the EU Structural and Investment Funds managed by National Authorities and Regions. Ten Memoranda of Understanding have been signed in one year with ten states or regions, and some have already started to bear fruit.

Clean Sky beyond Clean Sky also means taking advantage of the focus on Demonstrators, which is giving an unequalled momentum to research, to encourage lower-TRL, bottom-up initiatives including the involvement of PhD students in projects, and also to create more bridges between SMEs and academia. An example of us moving forward on this is our Award for the Best PhD thesis in the field of

Aeronautics within a Clean Sky project - the ceremony will take place during the Clean Sky conference at ILA Berlin Air Show on 1st of June 2016.

...In seven years from now, we or our successors will be preparing the final assessment of Clean Sky 2. My personal forecast is as follows: no doubt Clean Sky 3 will already be on track, because three is also a magic number in fairy tales. A seamless, inclusive programme across the entire technology readiness levels (TRL) scale will have been agreed, establishing the Clean Sky Joint Undertaking as the 'common house' of EU research for aircraft technology. The programme will be requested to manage the living priorities of the programme, bringing flexibility and openness. An adapted governance will allow upstream research to be guaranteed a continued funding flow. In seven years' time, the synergies with Structural Funds will be well-established and reaping local, regional rewards, and an ecosystem of aeronautical research will be firmly rooted in the regional breeding grounds. At the other end of the spectrum, international cooperation with countries like Canada and Russia will have concretised in selected relevant fields.

A renewed technical ambition will confirm European aeronautics as the most innovative in the world - the only way to keep its leading position in the global competition. New, game-changing architectures will be flown. No doubt, the European Union bodies and the industry, hand in hand, will allow the necessary resources to be continuously invested in this rewarding industrial sector. ●

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More on Clean Sky can be found on www.cleansky.eu

EXPLIC Program - EXPloration of the Limits of a "drop-in" jet fuel

Progress in aeronautical and space sciences often has its roots in University laboratories and Research Establishments. To keep its rank in the international competition, Europe needs to keep vigorously supporting these research players. It also has to foster scientific exchange between all these entities and its end users, namely the aerospace Industry and Agencies.

This is done in part thanks to the dedication of non-profit European aerospace associations like Eucass and CEAS, through the conferences they organise. Additional stimulus is to come from the collaboration of these two societies with other learned associations dedicated to disciplines like mechanics or applied mathematics and which serve other human activities like ground transport, energy production and usage, etc.

This is the purpose of the E-CAero project, funded by the EU since 2010. Cross fertilisation and collaboration between all these economic sectors is anticipated to stimulate aerospace R&D. The Onera presentation of Mickaël Sicard is brought to you by Eucass under the E-CAero umbrella.

By Mickaël SICARD (ONERA)

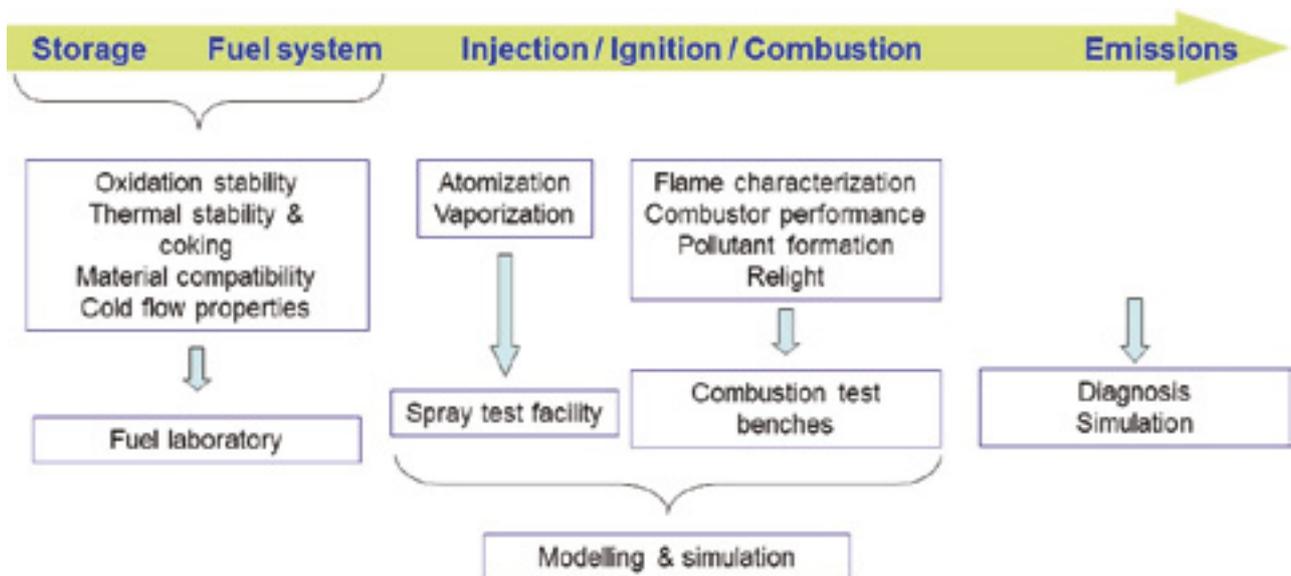
The potential reduction of green house gas (GHG) emissions has emerged as a major driver for the introduction of alternative fuels in aviation. Furthermore, integration of aviation in the Emission Trading

Scheme (ETS) in 2012 will be an incentive for the introduction of fuels with reduced carbon footprint. The aviation community itself has also called for a reduction of the emissions sector with the aviation industry targets to cap the emissions at their 2020 level

and further to halve the emissions level in 2050 compared to 2005.

Before July 2014, increasing prices of crude oil and their high volatility had a critical impact on airline profitability. Fuel had become their first source

Properties evaluated all along the aircraft fuel use chain in the EXPLIC program



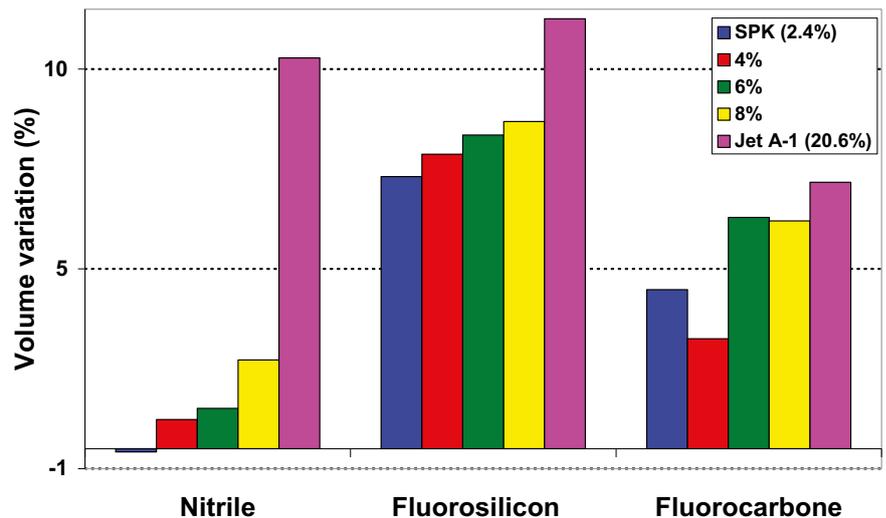
of expense (representing up to 30% of direct operating costs) with unpredictable, large fluctuations that were difficult to manage. In the longer term, crude oil will rise in price again. Moreover, security of supply is an issue for a sector which today fully depends on "fossil" hydrocarbon fuel.

Compared to other transport modes, the introduction of alternative fuels in aviation requires careful consideration due to the particular requirements of aviation fuels (low temperature properties, high energy content, etc.) that exclude the use of the fuels currently deployed for road transport. In addition, aviation fuels need to be approved to international standards by all stakeholders before being deployed.

The field of alternative fuels is moving fast. The landscape of alternative fuels in aviation has significantly evolved with the approval by ASTM of the Fischer-Tropsch Synthetic Paraffinic Kerosenes (FT-SPK), the Hydroprocessed Esters and Fatty Acids (HEFAs), the Synthesised Iso-Paraffinic (SIP) fuels and very recently (march 2016) the Alcohol to Jet (AtJ) fuels. None of these fuels contains aromatics. One of the current limitations of the blending ratio (50 % for FT-SPK and HEFAs) stems from the lack of aromatics that keeps them from matching the specification for density, lubricity and compatibility with some polymer materials. Currently, fuels with less than 8% aromatics cease to be "drop-in". Combustion tests have shown that a potential benefit of decreasing the aromatic content would be the reduction of particulates emissions. By far, the most obvious problem is the impact on seals. Low or zero aromatic fuels represent an unknown with significant risk of causing seals leakage.

From 2007, ONERA has become

Volume variation of nitrile, fluorosilicon, fluorocarbene O-rings aged 28 days in Jet A-1/SPK blends (aromatic % 2.4, 4, 6, 8 and 20.6) compared to unaged O-rings



involved in programs dedicated to alternative fuels for aircrafts such as CALIN (French program), DREAM and ALFA-BIRD (both FP7 funded) and was the coordinator of SWAFEA (European commission program). It was decided in 2013 to self-finance a program on alternative jet fuels. The main objectives of this ONERA funded program, called EXPLIC, is to better understand the consequences of the chemical modification of a jet fuel on its performance criteria and to determine the acceptable blending limits of alternative jet fuels in fossil jet fuels. In order to do so, focuses will be done:

- to determine the minimal concentration of the aromatics compounds suitable with a drop-in concept;
- to better understand the role of various types of aromatics (mono- or di-aromatics);
- to study the impact of alternative fuels with a disrupted profile blended with "fossil" jet fuels.

These three strands of work are consistent with two significant issues of alternative jet fuel development (decrease of the aromatic content and introduction of fuels with narrow distribution of molecules). The experimental work is based on a combination of standard tests and complementary tests aimed at promoting the better understanding of the phenomena involved.

One of the strengths of this project is to work all along the aircraft fuel use chain. The influence of the chemical composition is determined on physicochemical properties (density, viscosity, net heat of combustion...), thermal stability, cold flow behaviour, material compatibility, spraying, ignition, emissions... That is to say the behavior of the fuel is studied from the storage up to the emissions.

Beyond the scientific results, it allows ONERA acquiring a deeper knowledge of the technical problematic of the alternative jet fuels and developing new skills on jet fuel characterisations and modeling. ●

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REGIONAL ENVIRONMENTAL CENTER



INCAS' involvement in environmental research

INCAS – National Institute for Aerospace Research 'Elie Carafoli' is the leading research establishment in aerospace sciences in Romania, with more than 60 years tradition in aerospace engineering, flow physics and applied aerodynamics. Using state-of-the-art technologies and unique infrastructure, INCAS has been involved in all major national aeronautical projects for civil and military areas. The institute is currently acting as a major player in EU policy for R&D development under FlightPath 2050 vision and the Horizon 2020 program, as full member of EREA and as founding member of IFAR.

An interdisciplinary research group is operating INCAS airborne and ground based research infrastructure for land and atmospheric observations named ATMOSLAB. INCAS currently operates a fleet as follows:

- One Hawker Beechcraft King Air C90 GTx aircraft equipped with in-situ instrumentation for cloud and aerosol measurements and an airborne topographic laser scanning system, with an optional photo/thermal camera.

The LiDAR and aerial photography data analysis is used to obtain detailed maps for flood prevention, protection and mitigation, archaeological studies, forest inventory, airport safety and other applications.

- Two Britten-Norman BN-2 B26 aircrafts - the first being equipped for in-situ gas and aerosol measurements (to be equipped with an nadir port) while the second aircraft is in process for integration of a Selex SeaSpray 5000E SAR radar.
- One UAV with a maximum research payload of 70 kg.

Another direction of research is



focused on improved prediction methods and technologies for lower noise and emissions, and higher performance for high-lift devices using its wind tunnel infrastructures.

While the take-off engines are still the dominant noise source, the airframe noise is as significant as the engine noise on approach when engines are operating at low thrust. The main components of the airframe noise are the high lift devices and the landing gears, making it essential to identify the components that are mostly responsible for the flyover noise emissions and correlate the design of the noise control devices to those identified gear components.

The institute's airborne laboratory and its subsonic and tri-sonic wind tunnel infrastructures, are complemented by its AERO-VR laboratory, an immersive virtual reality laboratory comprising four components: an immersive 3D virtual laboratory with haptic systems, HPC system with collaborative work environment, data room and 3D scanning system.

The laboratory allows the development of virtualization capabilities for aerodynamic structures, defining and validating the configuration of the

aircraft or integral components, in the initial phases of development (pre-concept, statistical data acquisition and experimental wind tunnels).

In the future INCAS plans to cover niche areas such as: 3D geodesy and surveying applications, analysis of pollution dispersion through 3D representation of volumetric data and air traffic management through enhanced representation of 3D trajectories obtained by collecting GPS data from UAV for ensuring reduced fuel consumption and also reducing CO₂ emissions.

INCAS' concern regarding the pressing environmental issues of today is becoming increasingly important in the expansion of its research and development programs that will hopefully drive change and inspire solutions for the future. ●

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The sustainable future of aviation: how the industry can achieve its climate goals

By Michael Gill, Executive Director, Air Transport Action Group

Air transport is a vital feature of our modern, globalised world, connecting people and businesses across oceans and continents. Without air connectivity, our societies would be unrecognisable. To truly appreciate the benefits of aviation, one only needs to look at the numbers. The global aviation industry employs roughly 63 million people and accounts for 3.5% of global GDP (\$2.7 trillion).

The benefits of air travel are clear, but this connectivity comes with an environmental cost. In 2014, civil aviation, as a whole, emitted around 739 million tonnes of CO₂, which is



roughly 2% of man-made carbon emissions. Our industry recognises that our operations contribute to climate change and we are taking the responsibility to lessen this impact extremely seriously.

In 2008, aviation leaders came together to put in place a set of global carbon reduction goals, the first such goals made by any international transport industry. They are to:

- achieve a 1.5% average annual increase across the sector until 2020;
- ensure carbon-neutral growth from 2020; and
- cut overall emissions to half of what they were in 2005 by 2050.

Aviation is approaching the challenge of achieving these goals through a four-pillar strategy: developing new technology, more efficient operations, better infrastructure (particularly in air traffic management) and a market-based measure for aviation CO₂ emissions.

These goals are ambitious, but they are achievable, and the strategy the industry has in place is bearing fruit. We are already more than meeting our first goal, with an average annual fuel efficiency of 2.4% since 2009. Our ability to achieve the goal of carbon-neutral growth is expected to be enhanced later this year, when the ICAO Assembly convenes to decide on the implementation of a global market-based measure for aviation emissions growth, likely to take the form of a mandatory offsetting scheme.

Aviation's third goal is the long-term challenge for the industry. Carbon-neutral growth is a holding measure, rather than a solution in itself. Reducing overall emissions by half is no easy task, but work is already underway to lay the foundations. This goal can only be achieved through technological development and innovation, something which the aviation industry has a strong track record in.

New, disruptive, technologies are needed to cut CO₂ emissions drastically, whilst also preserving the economic growth that air transport enables. This can take the form of entirely new aircraft and engine designs, powered by means other than fossil-based fuels. Research is already underway on hybrid-electric, and even fully-electric, aircraft. However, this is unlikely to materialise for a number of decades. In the meantime, innovation in energy supply, fitting in with current technology, is required.

This is where sustainable alternative fuels enter the picture in aviation's climate strategy. This fuel is almost chemically identical to traditional jet fuel, but has a far lower environmental impact. Some sustainable alternative fuels can be up to 80% less carbon-intensive over their lifecycle. This fuel can either recycle the carbon used to grow feedstock, if it is crop-based, or in the case of waste-to-fuel processes, merely use carbon that would have been emitted into the atmosphere to power an aircraft. This makes these alternative fuels sustainable.

In the early years of biofuel used in the road sector, a great deal of controversy

arose surrounding the feedstocks used. Many of the feedstocks were not seen as sustainable, as they were either made from food crops (such as corn), or competed with food for resources. This simply replaced one problem with another.

Aviation, however, has gone to great lengths to avoid this issue and ensure that our alternative fuels are environmentally sound. Suppliers all over the globe have come up with innovative means of producing alternative fuel from truly sustainable feedstocks, taking advantage of local resources.

For example, Project Solaris in South Africa, a partnership between South African Airways, Boeing and SkyNRG, has begun to produce a biofuel made from high-oil, nicotine free tobacco, which replaces tobacco previously grown for smoking. In Norway, plans are underway for a refinery making fuel out of forestry residue. The Masdar Institute in Abu Dhabi, alongside partners Etihad Airways and Boeing has found a way of producing an alternative fuel using plants that thrive in the desert. This project also has the added benefit of supporting local aquaculture by using the plants to filter out waste water from the fish farms, taking sustainability to the next level.

While the technology for producing sustainable alternative fuels is there, producing them at commercially viable levels is more challenging. However, the first half of 2016 has seen two landmark developments in this sense.

In January, Oslo Airport became the first international hub to offer

alternative fuel to all airlines operating out of the airport. The airport supplies aircraft with the fuel through its existing hydrant system, a significant step towards normalising the use of alternative fuel.

In March, North America got in on the act, with United Airlines announcing that they will regularly fly out of Los Angeles Airport using a blend of alternative fuel.

The following month, in April, the global ATSM body approved yet another 'pathway' for producing alternative fuel, creating more options for suppliers and airlines.

The momentum is growing. What started with small steps will continue to develop, but in order to really gain ground and see significant CO₂ benefits from sustainable alternative fuels, greater effort will be needed from government partners.

If real gains are to be achieved, then we need to see invest in air traffic management reform and research into new technology, including sustainable alternative fuels, as well as improving intermodal transport planning. Importantly, we call on governments to agree on the global market-based measure at ICAO later this year.

As an industry, we also need to keep up the good work on commercialising sustainable alternative fuels as we move towards our 2050 goal. ●

For more details on how aviation is working to cut CO₂ emissions, check www.enviro.aero/climatesolutions

ERA - in a greener scheme

By Simon McNamara (pictured)

The aviation industry has ambitious short-, medium- and long-term targets that will work towards greener skies and a more sustainable future. These

targets address aviation's impact on the environment and, as an association with members representing the entire spectrum of the aviation sector, the European Regions Airline Association

(ERA) is at the forefront of enabling these targets. ERA members take their environmental responsibilities very seriously and, as their representative body, ERA plays a key role in expert forums such as the Council for Environmentally Friendly Aviation (CEFA) which have a shared vision of more sustainable aviation. ERA chairs CEFA which is made up of aviation-related associations that coordinate industry policy and promote activities to reduce the sector's carbon footprint, improve air quality and minimise noise pollution. ERA believes that aviation environmental responsibility is not just about complying with relevant legislation but about investigating and investing in ways to build a greener future for everyone.

Aviation plays an essential role, both socially and economically, in an increasingly global world. It facilitates business, connects cultures and communities, promotes economic development and drives trade and tourism. Wherever possible, aviation works to reduce its resultant impact on the environment through the best balance of social, economic, operational and environmental policies.

Numerous initiatives are helping the whole aviation industry work towards greener skies.

Reduced fuel usage and the use of alternative fuels are both key factors in lowering emissions.

In 2008 the aviation industry agreed to the world's first set of sector-specific climate change targets. The industry is already delivering on the first target – to continue to improve fleet fuel efficiency by one and a half per cent each year until 2020. From 2020, aviation will cap its net carbon emissions while continuing to grow to meet the needs of passengers and





economies. By 2050, the industry has committed to reduce its net carbon footprint to 50 per cent below what it was in 2005 (source: ATAG).

Aircraft operators have developed many operating procedures that minimise fuel usage, for example, single engine taxiing, reduced thrust take-offs or continued descent approaches where minimum power is used in the approach profile. The reform of air traffic management, which enables fewer delays, less holding and non-direct routings caused by Europe's currently inefficient air traffic control, can also help to cut down fuel usage and the industry's overall fuel burn by as much as 10 per cent. More efficient use of fuel is also being achieved through new engine technology, lower weight aircraft and more aerodynamically efficient aircraft.

With regards to alternative fuels to jet fuel (kerosene), operators, fuel companies and regulators are working to develop biofuels as a complementary fuel source to existing carbon-based fuel. It is expected that carbon reduction from moving to alternative fuels could be up to 80 per cent compared with traditional jet fuel, but the challenge now is to industrialise the production of biofuel and ensure that the infrastructure is available to supply the fuel to the point of use at airports.

Despite progress by the industry on reducing its emissions through these three strategies, they will not be sufficient to meet the goal of carbon-neutral growth from 2020. Therefore, at least for a period of time, there will be a need to turn to a market-based measure to meet that cap on aviation's CO₂ emissions. The industry has argued since 2008 that any market-based measure for air transport must be global in scope, to reflect what is a truly global industry.

The standard approach for dealing with greenhouse gas emissions from most parts of the global economy is enshrined in the United Nations Framework Convention on Climate Change (UNFCCC), of which the Kyoto Protocol is a subsidiary mechanism. The Kyoto Protocol provides limits on emissions to be placed on the developed world, while the developing world is not subject to such restrictions. In the past months the aviation industry has worked closely with governments to provide its expertise and input to the members of the International Civil Aviation Organisation (ICAO) with regards to an agreement to develop a single, global market-based measure (GMBM) for the aviation sector. The measure will be agreed at the next ICAO Assembly in autumn 2016 and be ready for implementation from 2020. The work to design such a scheme is now taking place through the ICAO process.

In Europe the main tool for aviation is the EU Emissions Trading System (EU ETS) - aviation was included in the EU ETS from 2012. The original aim was to capture all flights that arrived or departed from an EU airport. However, following huge international opposition, the EU amended the scheme and excluded international flights (outside the EU) for one year in 2012. The 'freeze' has been extended until at least 2016 but, in practice, this means that only flights within the EU are included in the scheme.

For ERA, as an organisation representing primarily intra-EU operators, the decision was disappointing for its membership. At best, the scheme will capture between 25-28 per cent of aviation CO₂ emissions in Europe which is environmentally ineffective while adding complexity and cost to European airlines to achieve

compliance and verification of emissions. Existing regional schemes capture fewer emissions than the expected global solution and a patchwork of parallel, competing and conflicting regional/national schemes and GMBMs would inevitably result in competitive distortions and unnecessary administrative complexity for operators.

In light of the above, ERA expects that the adoption and implementation of the ICAO global solution (GMBM) will replace the EU Emissions Trading System (EU ETS) legislation currently applicable to all flights within the European Economic Area (EU members, Iceland, Liechtenstein and Norway). We are confident that the EU ETS legislation can be amended to provide for an appropriate transition mechanism to ensure that operators currently subject to the EU ETS are not subject to a double scheme with separate, overlapping measures and duplicated administrative obligations.

Beside the considerable progress achieved in recent years in reducing the noise generated by aircraft, governments, industry and environmental groups have recently finalised the design of the first global certification ICAO standard for CO₂ emissions from new aircraft. This means that any new aircraft in the world will be subject to a rigorous environmental certification process before entering service.

The aviation industry is committed to addressing its impact on the environment and has made impressive progress on a number of counts. It will continue to work with governments, aircraft and engine manufacturers, airports and air navigation service providers towards enabling ever greener skies. ●



Co-funded by the Horizon 2020
Framework Programme of the
European Union



The BAMB Project : Buildings As Material Banks

The EU funded BAMB project, Buildings As Material Banks, brings 16 partners from 8 European countries together for one mission - enabling a systemic shift in the building sector by creating circular solutions.

Today, building materials end up as waste when no longer needed, with effects like destroying ecosystems, increasing environmental costs, and creating risks of resource scarcity. To create a sustainable future, the building sector needs to move towards a circular economy.

Whether an industry goes circular or not depends on the value of the materials within it - worthless materials are waste, while valuable materials are recycled. Increased value equals less waste, and that is what BAMB is creating - ways to increase the values of building materials.

BAMB will enable a systemic shift where dynamically and flexibly designed buildings can be incorporated into a circular economy. Through design and circular value chains, materials in buildings sustain their value - in a sector producing less waste and using less virgin resources. Instead of being to-be waste, buildings will function as banks of valuable materials - slowing



down the usage of resources to a rate that meets the capacity of the planet.

The project is developing and integrating tools that will enable the shift: Materials Passports and Reversible Building Design - supported by new business models, policy propositions and management and decision-making models. During the course of the project these new approaches will be demonstrated and refined with input from 6 pilots.

The BAMB project started in September 2015 and will progress for 3 years as an innovation action within the EU funded Horizon 2020 program.

The BAMB consortium consists of: Brussels Environment (IBGE-BIM) - Environmental Protection Encouragement Agency (EPEA) - Vrije Universiteit Brussels (VUB) - Vlaamse Instelling voor Technologisch Onderzoek (VITO) - Building Research Establishment (BRE) - Zuyd Hogeschool - IBM Netherlands - Sunda Hus i Linköping AB - Ronneby Municipality - Technische Universiteit München (TUM) - Universiteit Twente - Universidade do Minho - Sarajevo Green Design Foundation - Drees & Sommer - BAM Construct UK - Aurubis Bulgaria. ●

Launch of the BAMB Stakeholder Network, Brussels, May 3rd 2016

On May 3rd, Brussels Environment, had the pleasure of hosting the official Launch of the BAMB Stakeholder Network on behalf of the BAMB Project Consortium. The event was open to all actors in the building and construction industry, interested in exchanging ideas and knowledge and discussing the information and data needs necessary to enhance the European knowledge base. The official launch of the network introduced the project agenda and provided actors with the opportunity to get involved by joining the BAMB Stakeholder Network.

Extract of the speech by Brussels Environment, lead partner of the project:

We now know that resources and materials are limited and that the global linear economic model (extract-produce-consume-throw away) cannot continue. We need a new model for the way in which cities obtain, transform and use their resources (water, energy, materials, food, soil, air, etc.).

It is essential that we manage resources effectively in urban environments, particularly as almost half of the world's population lives in cities and this figure is due to rise to over 66% by 2050.

The linear economic model must now move towards a circular model in which waste no longer exists but rather becomes raw materials and natural resources in accordance with the virtuous circle principle.

Reuse, repair, recycling, eco-design, resilience, a collaborative and sharing



economy, short circuits and closing the loop ... These are some of the key words and concepts of this new circular economy.

In this context, the European BAMB ("Buildings as Material Banks") project is a practical initiative that is attempting to support the transition towards a circular economy in the built environment.

In such an innovative field as circular construction and economy, exchange of information and networking are paramount to help ideas take form. Through the BAMB Stakeholder Network, the BAMB Consortium aims to involve relevant stakeholders in the implementation and the results of the project. ●



MORE INFORMATION

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CITYkeys: Measurement matters

By Nikolaos Kontinakis, CITYkeys project coordinator, EUROCITIES

For any urban community, taking the digital leap and going green is never an easy feat. The success of a ‘smart city’ project hinges on good and solid preparation, and its execution, or evaluation of its success, must be preceded by meticulous measurements.

Enter CITYkeys. The aim of this two-year project, launched in February 2015 and funded by the European Commission’s Horizon 2020 programme, is to develop, and eventually validate, a ‘bottom-up performance measurement framework’ for monitoring and comparing the implementation of smart urban technologies. The strategic goal of CITYkeys is to accelerate the transition to low-carbon, resource-efficient cities. The method and the indicators that have been developed are to be used to evaluate smart city projects and to facilitate the replication of the successful ones in different contexts.

CITYkeys brings together the municipal authorities of Rotterdam, Tampere, Vienna, Zagreb and Zaragoza, as well as

the research institutes VTT (coordinator, Finland), AIT (Austria), and TNO (Netherlands) – and EUROCITIES. Our role is to help identify project partners’ needs and gather their feedback on the tools being developed. Additional cities have been invited to contribute in order to gather as much evidence and feedback as possible about the practical use, benefits and challenges of key performance indicators (KPIs) and smart city project evaluation frameworks.

TWOFOLD APPROACH

At the dawn of the smart city era, the European Commission decided to take a twofold approach to the development and promotion of such solutions. Within the framework of the more recent Smart Cities and Communities call for proposals, it opted for the creation of so-called ‘lighthouse’ projects, each with two or three ‘lead’ cities and a few ‘follower’ cities. Under this scheme, the lead cities or communities team up as ‘lighthouses’ to demonstrate the use of a mix of innovative technologies in specific cities and urban communities and to provide models for numerous

follow-up projects. Follower cities are defined as cities that have not yet acquired the full technical competence to become a lighthouse city. However, they need to be fully involved in the project from the beginning and have enough committed resources to deliver a replication plan of most (if not all) the solutions developed within the project.

The Commission also identified ‘horizontal activities’, which aim to support the ‘lighthouse’ projects by addressing cross-cutting challenges, such as regulatory barriers or standardisation issues. With its focus on performance monitoring, CITYkeys falls into the latter category.

At the outset of the project, the CITYkeys partners and EUROCITIES members were invited to complete two separate surveys. The aim was to assess the actual needs of the cities and their stakeholders regarding a performance measurement system. A total of 19 large cities from across Europe responded to the first survey, while around 50 stakeholders provided input on their relevant needs and

People	Planet	Prosperity	Governance	Propagation
<ul style="list-style-type: none"> •Health (3) •Safety (4) •Access to [other] services (7) •Education (3) •Diversity & social cohesion (3) •Quality of housing and the built environment (6) 	<ul style="list-style-type: none"> •Energy & mitigation (7) •Materials, water and land (10) •Climate resilience (1) •Pollution & waste (4) •Ecosystem (2) 	<ul style="list-style-type: none"> •Employment (2) •Equity (2) •Green economy (3) •Economic performance (5) •Innovation (5) •Attractiveness & competitiveness (1) 	<ul style="list-style-type: none"> •Organisation (6) •Community involvement (5) •Multi-level governance (2) 	<ul style="list-style-type: none"> •Scalability & replicability (10) •Aspects of success(8)



expectations in the second survey.

The surveys (<http://bit.ly/1IEshjS>) revealed that while 75% of respondent cities consider the 'smart city' concept highly relevant to their needs, only half actually measure their smart city performance one way or another. At city level, most municipal authorities said they intend to measure their own performance in the areas of energy efficiency; greenhouse gas emissions; transport; digital infrastructure and services; resource management; and citizen participation. At project level, they also identified environment and quality of life as relevant categories. For the citizens and stakeholders surveyed, however, the top five areas where performance should be measured were: creation of innovation and knowledge; public transportation; protection of the environment; education and skills building; and clean energy.

Respondents agreed that a city can be considered 'smart' if it relies heavily on technology; has a comprehensive approach to energy use and efficiency, mobility and infrastructure; gives priority to measures to improve performance and efficiency; strives to encourage citizen participation; enables and fosters innovation; and works to improve its social and economic fabric.

For a city to actually become 'smart', the first inevitable step is to draw up an integrated smart city strategy or action plan. One third of the cities in the survey said they already had such a strategy or plan in place, while another third were in the process of drafting it.

DEFINITIONS

As in any multi-partner collaborative project, a lot depends on how key terms and concepts are defined. In CITYkeys, a 'smart city project' is





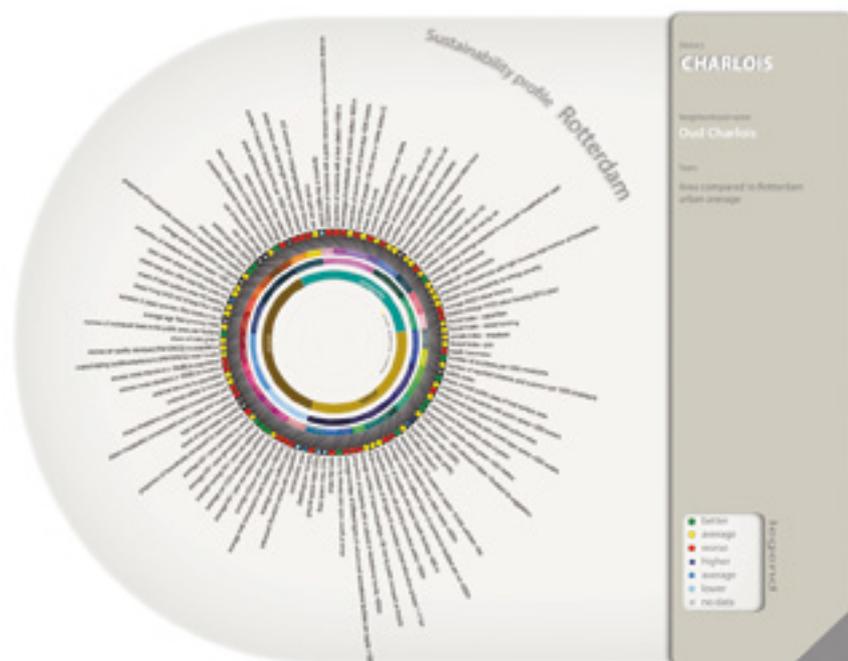
difference the project has made by comparing the situation prior to and after its implementation. KPIs can also be used to benchmark projects against each other.

To clear the ground for CITYkeys, participants were also asked to draw up an inventory of their existing KPIs and classify them into one of the triple bottom line themes of: 'people' (social sustainability), 'planet' (environmental sustainability) or 'prosperity' (economic sustainability) - also known as the '3 Ps'.

Subthemes describing major policy ambitions have also been identified. These were needed because the success - or not - of a project also hinges on how it is realised in various environments. Accordingly, the themes of 'governance' and 'propagation' (potential for up-scaling and adoption in other contexts) have been added to the 3 Ps.

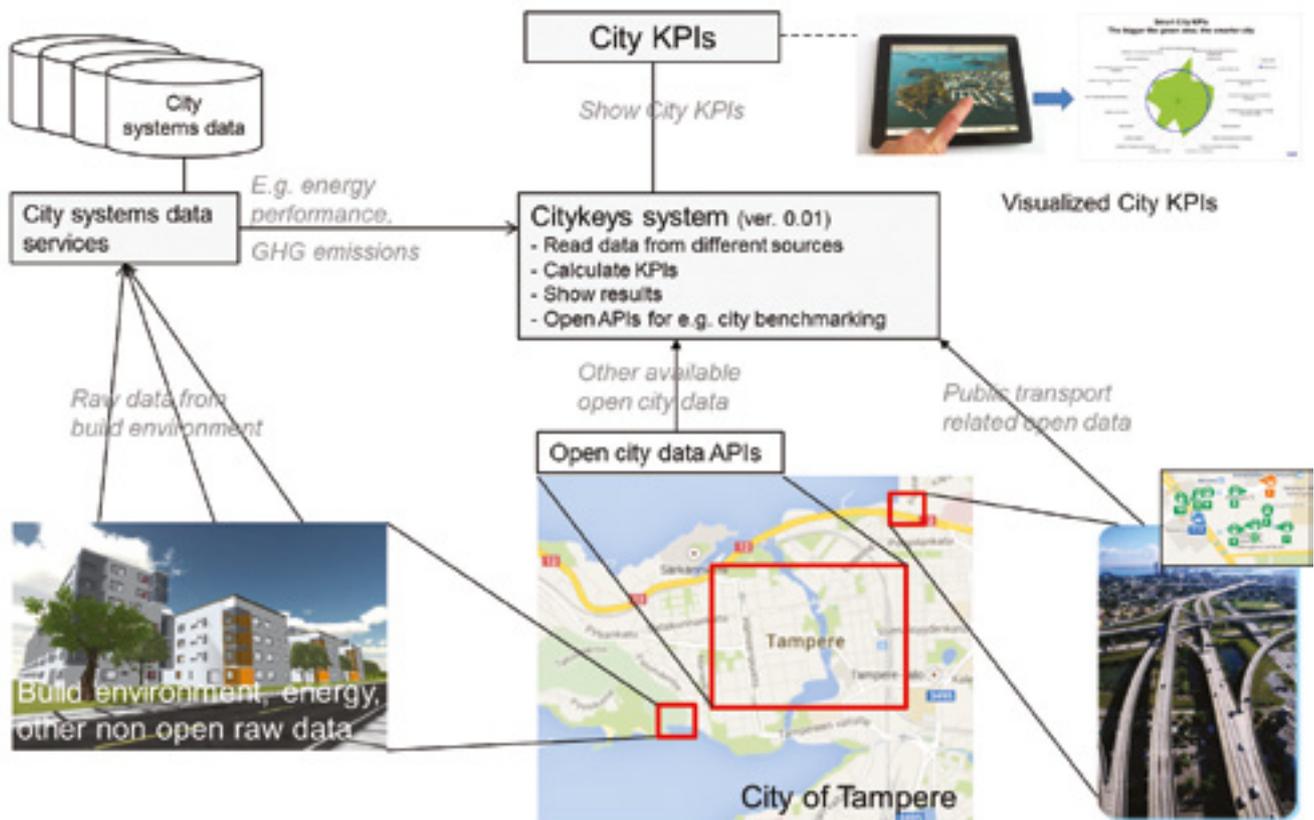
At a series of workshops, project participants, accompanied by a group of researchers, identified a final set of KPIs based on criteria such as relevance, availability, measurability, and reliability. In total, 92 project indicators and 73 city indicators have been selected (<http://bit.ly/1Sc0iys>), based on an inventory of 43 existing indicator frameworks for cities and projects (<http://bit.ly/1VXYaNg>).

Project indicators are meant for assessing the success and replication potential of smart city projects. These are usually taken from project documentation or gathered through interviews with people involved in the project. On the other hand, city indicators can normally be retrieved from statistics compiled by municipal administrations or European statistical bureaus. The list of all indicators is regularly reviewed and updated to reflect their applicability and usability.



understood to combine a variety of sectors rather than focusing on a single one; and the term 'performance measurement' is used to refer to the process of collecting, analysing and/or reporting information on the performance of an individual, group,

organisation, system, or project. Furthermore, the partners use key performance indicator metrics to evaluate factors that are deemed crucial to the success of the project. These serve to assess or evaluate individual projects and indicate the



DATASETS

The datasets relevant for the CITYkeys KPIs were identified and analysed on the basis of their availability, sources, reliability, data access methods, existing data formats, and level of confidentiality (<http://bit.ly/1Vrnq03>). During this process, special attention was paid to open datasets.

In January 2016, the availability rates in the partner cities for the datasets needed by smart city KPIs were as follows: Zaragoza 82%, Vienna 80%, Tampere 77%, Rotterdam 71% and Zagreb 52%. The average rate was 72%. The availability rate for open data varied between 1% and 25%, and was 15% on average.

In total, 116 raw, unprocessed datasets are needed to compile smart city KPIs.

Roughly 85% of these sets were either available in the municipal databases or needed to be generated or were publicly accessible but not as 'open data'. The availability of around 13% of the required datasets remains a challenge.

In general, the participating cities are urged to automate their data collection processes as well as the way they feed data into the monitoring framework. The idea is to help cities benefit more from the project and also to increase their contribution to the sustainability of CITYkeys results beyond the project's termination.

As a next step, CITYkeys will develop and offer the proposed architecture of a framework for performance measurement. This way, smart cities

across Europe will be able to identify and implement the basic ingredients needed for the implementation of an efficient monitoring and decision making system based on city data.

The CITYkeys project will formally conclude on 31 January 2017. The partners and stakeholders are all keenly aware of the pervasive and powerful role measurement plays in project management. They have a crucial role to play in how smart cities across Europe expand and evolve in the years to come. ●

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You cannot optimise what you do not measure

High energy efficiency is dependent on transparency in the distribution network as well as in consumer behaviour and in the energy performance of buildings. This makes frequent and accurate metering data part of the solution for managing and optimising energy production in an integrated and truly smart energy system.

In the future, energy consumption must adapt to the fluctuating production based on renewables, and this will require fully integrated energy systems that can bring it into balance. As renewable energy resources are more expensive to produce than traditional energy production, it is increasingly important to ensure that they are exploited as efficiently as possible. This calls for focus not only on improving energy efficiency, but also on reducing our collective energy demand.

ENERGY EFFICIENCY REQUIRES TRANSPARENCY

High energy efficiency necessitates running production as close to the limit as possible. This makes it even more crucial for utilities to continuously manage and optimise their production decisions and distribution network. It also demands increased involvement of the consumers and putting into play the energy performance of buildings. All three conditions necessitate transparency - in the distribution network as well as in consumer behaviour and in building characteristics - and the basis for that transparency is frequent and accurate meter readings.

METER DATA PROVIDES KNOWLEDGE

The use of data offers a range of opportunities. Hourly values on flow, temperature, pressure and consumption not only enable utilities to detect and reduce waste in the distribution system. It allows them to identify and help consumers with inappropriate energy consumption. Furthermore, giving consumers instant access to information on their household consumption encourages proactivity and energy conscious behaviour.

Increased amounts of data also opens up to the possibility of introducing alternative tariff models that are, for instance, based on flexibility rather than consumption, or on hourly variations of prices resulting from the balance in the total energy system. And precise data - as opposed to theoretical models - on how a building performs under different conditions, allows utilities to directly target the buildings that pose the biggest challenge in the network. This helps establish the needed correlation between buildings and the production part of the integrated energy system.



In this way, the knowledge derived from meter data gives the necessary flexibility to constantly balance the total energy system and ensure that energy is always produced optimally based on the present conditions.

"Meter data becomes really valuable when utilities use them as the basis for making decisions that optimise their business and day-to-day operations. Our intelligent metering solutions deliver the necessary data and makes it easy for utilities to translate it into knowledge that supports increased efficiency in the integrated energy system," says Steen Schelle, Head of Product Management, Kamstrup. ●



Steen Schelle, Head of Product Management, Kamstrup

INSPIRED BY BETTER

A world-leading supplier of intelligent energy and water metering solutions, Kamstrup provides utilities and energy companies with tools that enable them to make more certain, smarter business decisions and inspire the communities they serve.

Learn more at kamstrup.com

YouPower: a social platform for participation, awareness and engagement by CIVIS project

CIVIS project's back in these pages to tell you how things have been going since September 2015, when we first wrote about the project, presenting its structure, objectives and actions foreseen.

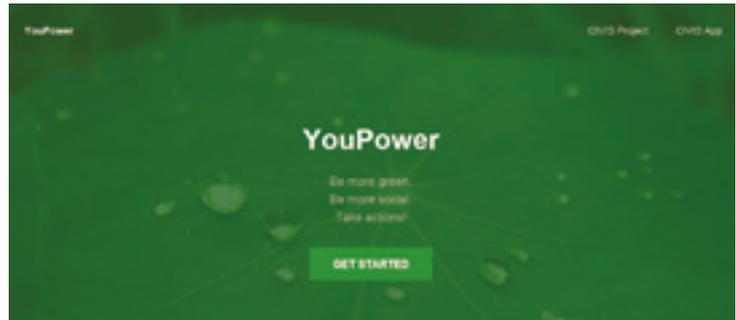
The project, co-financed by the Seventh framework programme of the European Commission, uses an experiment-driven R&D approach that involves four pilot neighborhoods, two of which are located in Italy (Trentino region) and two in Sweden (within the city of Stockholm). CIVIS's aim is to contribute to the design of a fairer, more sustainable, energy-optimised smart city. The project focuses on the ICT-enabled social dimension to harness the potential of innovation of individuals and collectives with respect to energy prosumption. CIVIS links energy, ICT and society to achieve significant impacts in terms of CO₂ reduction and new forms of social innovation.

The first part of the project has been devoted to the deep understating of the state of the art of the interdisciplinary topics included in the structure of the project: smart technologies available on the market, business models already tested, the social behavior of local communities in relation to energy-related initiatives, the possible ways social network and ICT can be integrated to local actions.

Projects partners, of course, have also taken action on the test sites, creating contacts with citizens, housing associations, energy cooperatives, local energy initiatives and have involved these subjects into our vision and experimentation.

But today we want to focus on one of the main achievement of the project "YouPower" a social smart grid platform (a hybrid mobile application) designed to explore the potential and challenges of ICT support for social participation, awareness and engagement of household energy consumers (<https://app.civisproject.eu>).

The design aims to make energy more visible, inform users' energy know-how, promote pro-environmental social norms, and to facilitate users in their day-to-day life to take pro-environmental energy actions together with online communities.



The platform consists of three interrelated parts:

- The "Action Suggestion" part is designed to provide users with easy access to practical and implementable recommendations (and tips) for energy conservation and to motivate them to learn and practice new energy conservation behaviors until they become new habits that are embedded in the specific context of their every life.
- The "Housing Cooperative" part is tailored for Stockholm (Sweden) test site where residents belong to local housing cooperative that manage the properties and related issues (including energy). It provides energy information about a user's own and other cooperatives and supports communication between cooperatives' energy managers.
- The third part, designed for Trento (Italy) test site, mainly focuses on leveraging load-shifting, maximizing self-consumption to match production peaks of locally-installed Renewable Energy Sources. A dynamic time-of-use signal in combination with a scheme for energy donations is designed to assist the shift. In order to make users aware of their consumption patterns, real-time energy consumption data are displayed at appliances (for those installed smart plugs), household and community levels. ●

FOLLOW US:

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<https://app.civisproject.eu>

How IoT will play a crucial role in slashing energy use

The main theme in this issue will focus on **energy efficiency in industry**. We want to **highlight the importance of the Internet of Things' functions to help communities and industry in becoming smarter energy consumers**.

By Mario Campolargo (pictured)



Oil prices may have bottomed out, but energy use still remains one of the highest manufacturing costs. It is also one of the most tedious to track down: where do you start when you want to reduce your energy bill? Fortunately, new ICT technologies and especially advances through the Internet of Things (IoT) are now emerging that can make a difference.

The IoT is sometimes presented as a fashionable and fuzzy concept. The reality is however that it is starting to be implemented today and to make an impact across sectors. What do we mean by IoT? The IoT represents the next major economic and societal disruption enabled by the Internet: the physical and the virtual worlds will merge into a new smart environment, which will sense, analyse and adapt. In the IoT, objects and people are interconnected through communication networks, in and across private, public and industrial spaces, and report about their status and/or about the status of the surrounding environment.

They produce data that is collected and aggregated in some IoT platform connected to Internet. Through this IoT platform, resources and solutions can then be programmed so that the connected objects and applications can be activated and operate tasks and functions to deliver specific benefits (ex: start of a machine/process at a time that minimises the energy bill). The possibilities that IoT offer are exponential. Dynamic and

responsive acquisition of data along with increasing computing power enable smart production systems to track energy consumption and optimise processes so that they adapt and operate with less resources, save energy and identify waste of energy. This offers tremendous opportunities for our economy and society.

IOT: A BIG BENEFIT FOR ENERGY MARKETS

The IoT can bring significant benefits for energy efficiency. At the level of the production of energy, smart grid sensors can improve utility operations and performance by better monitoring the energy network, so that resources are allocated more precisely and closer to the actual demand needs, avoiding energy waste. At the level of the consumption of energy, smart meters can provide a wealth of information that can help minimise energy costs, e.g. through fully automated billing based on time of use or network status, or enabling meter-to-appliance communications to help consumers change their behaviour to reduce their costs.

IoT will help industry to optimize the use of energy at all stages. It could reduce the consumption of electricity at peak hours by shutting down/ reducing the use of equipment and/ or production. Lighting/heating/ cooling will be improved depending of the operational conditions, and/ or the weather/time of the day. Taking advantage of advancements in device connectivity, manufacturers can now

track energy consumption patterns at the device level. By tracking each piece of machinery on the floor, managers get granular visibility into energy consumption, as well as actionable insight about waste, available efficiencies and more. A great opportunity for the IoT can be found in some specific application areas too.

Smart Cities is one of the examples where by using IoT technology, the distinct pillars of the modern city (energy, mobility, buildings, water management, lighting, waste management, etc.) will become part of a structured, interconnected ecosystem. IoT technologies, by gathering information that in the past was either impossible or difficult to gather, will enable optimize public transport (real-time location, utilization), environmental data, noise, monitoring of waste bins, energy consumption in public buildings, lighting, etc. Barcelona's Energy-Saving Smart Streetlights¹ is a nice illustration: sensors are installed in streetlights, enabling automatic control of brightness by analysing the levels of noise, air pollution, and population density. Result: at least 30% energy savings per year.

IoT technologies in Smart Farming will bring Precision Agriculture and Precision Livestock Farming to another level: the use of water, fertilizer or heating in green houses, in correlation to the climate or the harvesting at optimum maturity will allow a more sustainable, productive and competitive EU farm sector.

A CHALLENGING IMPLEMENTATION

The IoT is sometimes perceived as more closely linked to consumer markets, like to smart thermostats or fridges. However, less than 8% of the households have a smart device with energy-related functions. Such penetration is low, and it may be explained by a difficulty for users to understand the benefits of the IoT, or maybe worries about installing sensors in their house, for privacy and security issues. To unblock the market, the Commission has launched in 2016 a Focus Area on IoT under its Research and Innovation Programme, Horizon 2020. IoT Large Scale Pilots will be funded to test technology, business models and standards, and to test with real users how much they welcome the IoT solutions. Even though energy efficiency is not specifically targeted, it will be indirectly addressed we believe through one pilot dedicated to Smart Homes for Independent Living (with up to 20 Million euros funding) and another one on Smart Cities (with up to 15 Million euros of funding). The pilots will hopefully also give useful insights as to what barriers may exist towards a greater adoption of IoT solutions by consumers, which could eventually lead to policy proposals by the Commission.

But we find that the biggest opportunities are rather in the industrial adoption of the IoT, including for industrial machines, factories and buildings. According to a study from IDC², Smart Manufacturing is projected to be the largest potential opportunity in terms of IoT spending. Consumers

are already using (cool) devices like activity trackers, smart thermostat, drones, but the industrial IoT requires far many conditions to be fulfilled before it can widely use IoT tools: reliability is one of them. A connectivity failure between a smart thermostat and a boiler at home or between process control sensors in the steel industry do not have the same consequences. Others issues like secure authentication, standardisation, interoperability, liability need to be properly addressed. Data ownership, data location, data protection will also require action at EU level. The Commission is putting forward a set of ideas and proposals to guide this implementation forward, through notably a Staff Working Document on *Advancing the Internet of Things in Europe*.

BREAKING SILOS AND DEVELOPING A THRIVING ECO-SYSTEM

One of the key challenges is to make sure that IoT can be developed on a pan-European basis. IoT requires breaking silos and avoiding fragmentation between industrial application areas, between standards, between regions, which prevents the full IoT vision to be realised as a new cross-cutting business reality. An IoT policy has to address specific policy challenges linked to a harmonised digital single market, notably to interoperability, ubiquity, end-to-end security and trust.

Actions at EU level already identified and mapped the most promising clusters across Europe, where IoT

is developing: the Commission will launch in 2016 large scale pilots with the aim to create ecosystems and to overcome the fragmentation of vertically-oriented closed systems.

One example of an open service platform is FIWARE, supported through the Future Internet Public Private Partnership. The recently launched open FIWARE Foundation further develops FIWARE components in the context of digitising industries, starting with three business sectors domains: Smart City, Industry 4.0 and Smart Agriculture. We have therefore an opportunity to smartly build on existing open service platforms, such as FIWARE, for accelerating the industrial use of open digital platforms and reinforcing innovation ecosystems.

The Commission also launched the Alliance for Internet of Things Innovation (AIOTI): it offers a series of opportunities for stakeholders from various origins to establish links towards horizontal platforms, standards and ecosystems and to collaborate in experimenting new IoT solutions. This will help the development of a thriving IoT innovation ecosystem in Europe.

In conclusion, it is fair to say that everyone should wake up to the potential of the Internet of Things to transform our lives and improve the way we use resources, including energy. We cannot miss the opportunity of making Europe the world leading market for the IoT and this means significant opportunities for the energy sector too. ●

Mário Campolargo is Director for "Net Futures" department of European Commission, DG CONNECT, dealing with policy development and research supporting the Digital Single Market from the angles of 5G networks, IoT, cloud and data flows and conceptualising new and innovative approaches towards service platforms and next generation internet.

Previously he has been Director for "Emerging Technologies and Infrastructures" in DG INFSO in charge of Future and Emerging Technologies, ICT based infrastructures for science and ICT trust and security, experimental facilities and experimentally driven research for Future Internet.

Before joining the European Commission in 1990, he worked for 12 years in the R&D Centre of Portugal Telecom as a researcher and manager. He holds a Degree in Electrical Engineering from University of Coimbra, a Master of Science in Computing Science from Imperial College London, a Post graduate in Management from Solvay Business School Brussels and a European Studies Diploma from Université Catholique de Louvain-la-Neuve.

Disclaimer: This paper expresses the personal views of the author and in no way constitutes a formal/ official position of the European Commission

Full version of a Staff Working Document on IoT.

<https://ec.europa.eu/digital-single-market/en/news/staff-working-document-advancing-internet-things-europe>

1 More details at: <http://smartcity.bcn.cat/en/growmarker.html>

2 IDC and TXT Solutions (2014), SMART 2013/0037 Cloud and IoT combination, study for the European Commission.

Flex4Grid

Prosumer Flexibility Services for Smart Grid Management

Flex4Grid aims at creating an open data and service framework that enables a novel concept of managing flexibility of prosumer demand and generation, utilising cloud computing for power grid management and opening Distribution System Operator infrastructure for aggregator services.

MAIN OBJECTIVES

The advent of distributed power sources, such as photovoltaics and windmill plants, gave rise to energy prosumers, which generate and consume electrical energy. Energy demand and energy generation by prosumers is volatile and can impact the grid infrastructure and stakeholders, but they can be flexibly adapted to thwart those impacts.

Flex4Grid aims at creating an open data and service framework that enables a novel concept of managing flexibility of prosumer demand and generation, utilising cloud computing for power grid management and, opening DSO infrastructure for aggregator services. The system will be built up from existing ICT components that have been developed by the consortium partners over many years in research projects on IoT and Cloud computing. This high maturity allows Flex4Grid to aim for a system prototype of TRL 7.

The Flex4Grid system will include a) a data cloud service with anonymised interface and advanced security and privacy mechanisms for data exchange and service management, b) prosumer generation and demand flexibility, and c) a more viable business model to accelerate the deployment. The major innovations are a) opening the market for new entrants by secure and privacy enabling third party cloud data and energy management services, b) actionable common and multilevel data management and analytics services for Smart Grids, and c) the use of co-



creation to bring end users into the value creation process.

System validation will be carried out in real-world pilots in three live electricity networks with different scenarios ranging from deployment during smart meter rollout and retrofitting to large scale operation and federated demonstration of multi-site pilots.

REAL-WORLD EVALUATION IN MULTI-SITE DEMONSTRATORS

Three DSOs are part of the consortium and the Flex4Grid system will be piloted in their networks, including a significant number of prosumers and Flex4Grid gateways that bridge the communication between DSOs and HAN (Home Automation Network) / Building Management System (BMS). These three distribution networks exhibit different characteristics that allow validating the Flex4Grid system in different scenarios. An iterative approach will be applied in order to ensure a smooth deployment of the Flex4Grid system in settings of growing complexity and size, and to maximise the feedback on technical and business level.

EXPECTED IMPACT

The system introduced by the

Flex4Grid activity will use results from preceding research projects as baseline to transfer the results into the market and follows a business-driven approach by exploring new value-generating service offerings for customers.

Active demand response will be demonstrated in the live electricity networks of all three pilot locations. New business models will be deployed where DSOs, prosumers and the third party hosting the data manager will act as marketer. Participating companies will roll out new services to the market place to ensure business viability of the project.

The Flex4Grid system will open new markets for third parties via cloud-based services, going beyond smart meters. Applying cloud solutions (security, privacy, analytics, predictions for the customer) in the context of smart grids will strengthen the competitiveness in this sector. ●

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Driving innovation through retrofitting and BIM within Energy-efficient Buildings

By Stefano Carosio, co-chairman EeB PPP Partnership board (pictured)

The Energy Efficient Buildings (EeB) Committee within the European Construction Technology Platform (ECTP) formed a joint initiative with the European Commission to support the projects funded within the Energy Efficient Buildings (EeB) public-private partnership (PPP). The Energy Efficient Buildings PPP aims to develop affordable breakthrough technologies and solutions at building and district

scale, facilitating the road towards future smart cities.

ECTP - Energy Efficient Buildings Committee provides stakeholders with a yearly publication highlighting the progress of the 110 co-funded projects within the EeB PPP under the FP7 programme and the current 41 newly co-funded projects under the Horizon 2020 programme. The newest edition of the EeB PPP Project Review highlights current results and achieved or potential impacts of the EeB PPP projects. The projects demonstrate scientific and technological excellence, across all levels, from early stage conception to demonstration of almost ready-to-market innovations. Most notably are those projects with highly promising innovations involving retrofitting and Building Information Modeling (BIM). Both energy efficiency retrofitting and BIM have a crucial role in achieving the ambitious European targets, as the project BEEM-UP demonstrates in deep-retrofitting of buildings within the residential sector, and as the project STREAMER addresses through the use of novel BIM approaches to optimize new and refurbished hospital buildings.

RETROFITTING

The European construction sector is of considerable importance for Europe and its citizens. As Buildings are responsible for 40% of Europe's energy consumption and generate

36% of Europe's greenhouse gases, the construction sector is on its critical path to decarbonize the European economy by 2050, reducing its CO2 emissions by at least 80% and its energy consumption by as much as 50%. Due to this, future buildings are now being designed and built to far more rigorous energy efficient standards and higher performance standards than those of the past. However, 80% of the buildings that will be operating in 2050 have already been constructed. Therefore, climate and energy reduction targets in the Building Sector need to be met by adapting and retrofitting these existing buildings. With its large potential to deliver high energy and CO2 savings, the Building Sector can have a central role in a more sustainable future for Europe.

The FP7 BEEM UP project, completed in January 2015, demonstrated the economic, social and technical feasibility of retrofitting initiatives for drastically reducing the energy demand in existing residential buildings. BEEM-UP directly addressed the challenge of deep energy demand reduction in the residential sector on a European scale. The project focused on multi-family residential buildings with a tenant rental structure, which is representative of almost 18% of the European housing stock. Through 340 dwellings located in Sweden, France and the Netherlands, refurbished with high energy efficiency standards, BEEM-UP was able to

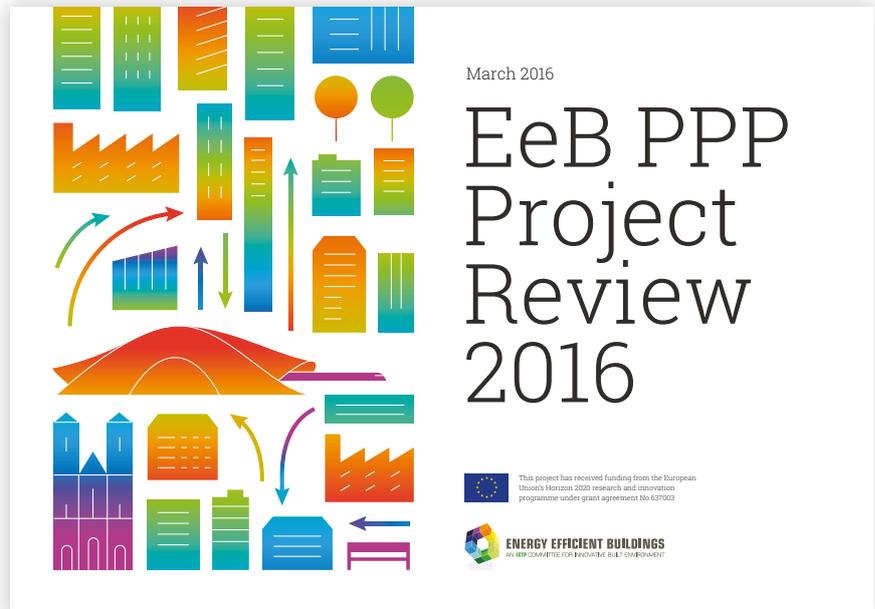


demonstrate successful approaches for deep retrofitting and has laid the groundwork for massive market uptake. The project identified and implemented cost-effective 'solution packages' and delivered approximately 75% heating demand reduction within the demonstration sites.
<http://www.beem-up.eu/>

BIM (BUILDING INFORMATION MODELING)

There are numerous projects underway that are addressing the energy efficiency of buildings and infrastructures through the use of ICT and novel BIM approaches. Building Information Modelling (BIM) appears in the context of E2B as an instrument to help the structuring, managing and integration of building projects' information, facilitating the design, simulation, analysis and operation of energy efficient solutions. BIM technology supports the building of accurate 3D virtual and parametric models of a building containing precise geometry and relevant information needed to support all the building life cycle activities. This effectively contributes to increased collaboration, efficiency (materials, costs, time) and project quality. By making virtual reality simulations possible, BIM emphasizes integrated and coordinated decision making in supply chains, providing the construction industry with an instrument to support consistent decisions throughout the building's life cycle.

The ability of BIM models to capture multiple types of building data (location, geometry, use, construction type, installations, comfort settings etc.) supports the generation of more reliable results, avoiding errors and incoherencies, saving time and effort, and minimizing uncertainties in building energy modeling processes.



The FP7 project STREAMER, to be completed in September 2017, is represented under the technology clusters Design and BIM. STREAMER addresses the design of energy efficient hospital buildings. Healthcare buildings and districts are among the top EU priorities for Energy-efficient Buildings since they play a key factor for a sustainable community. Furthermore, their energy use and carbon emission are among the highest of all building types. The project aims to reduce the energy use and carbon emission of healthcare districts in the EU by 50% in the next 10 years by enabling clients, architects, technical designers, contractors, building operators and occupants to design new and retrofitted energy-efficient buildings integrated in the healthcare district energy systems using optimized Semantic-driven Design methods and interoperable tools for Building and Geo Information Modelling (BIM-GIS). The project creates dashboards that support decision making in the early design stages.
<http://www.streamer-project.eu/> ●

For more project achievements, consult the ECTP 2016 EeB PPP Project Review at <http://www.ectp.org>

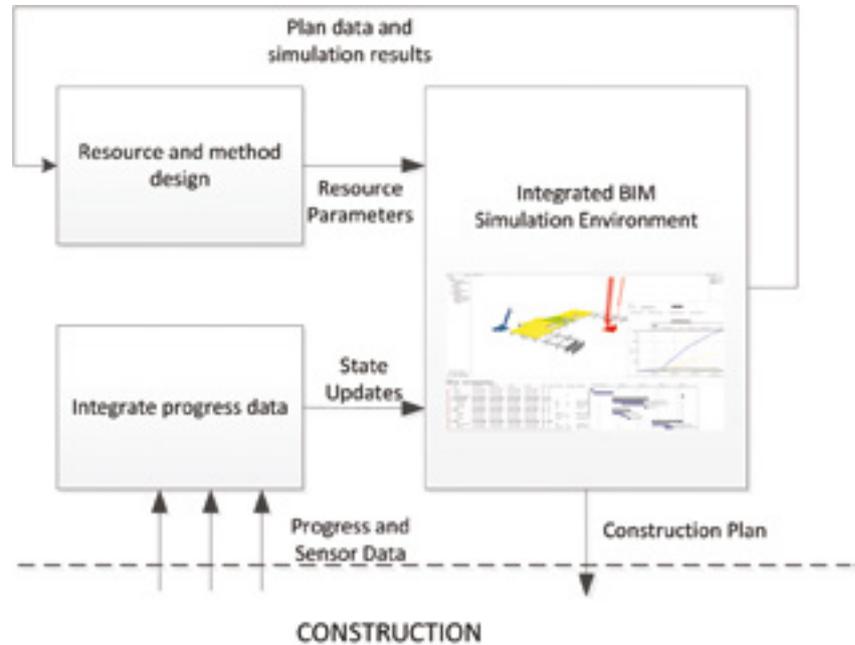
BUILD-CYCLE

Integrated analysis and visualization for advanced construction

Buildings consume about 40% of global energy and have been a major target for energy and emission reductions. While energy consumption during the construction stage has attracted less attention, due to its relatively small percentage of the total life-cycle consumption, major energy savings can be obtained by improving efficiency in the construction process. Recent technological developments, such as building information models (BIM) promise major construction productivity gains, supporting design-construction integration and improvements in virtually all functions. However, there is still a lack of effective process analysis tools for the construction stage using BIM. Model-based, detailed, and realistic analysis of construction projects is necessary to better evaluate alternatives and to make high impact decisions whilst keeping the overall perspective of the project.

BUILD-CYCLE project aims to improve the construction process analysis by providing a general purpose resource-integrated simulation platform on 3D building information models. Moreover, it aims to make this analysis easy and extensible with parametric definition of the process. To that end, it combines several new approaches.

One of the major roles of construction management on site is defining and orchestrating resources. Labour crews use various tools, equipment, and materials to perform the work. Site supervision directs crews and equipment to perform tasks in a specific sequence and at a specific target production rate. To reflect this type of construction resources, we built an agent-based simulation model for resources, where each individual crew and major equipment is an agent with specific goals and policies. By providing simple and natural policies for resources, realistic construction practices can be achieved.



With the aid of geometric techniques, we abstract spatially complex work sequences of multiple activities to complete building element locations on BIM. We analyze this construction model on BIM through a hybrid simulation approach, where discrete-event simulation model for activity sequences are unified with the agent-based simulation model for resources.

We developed a prototype software called GSimX to implement this modeling and simulation approach. In this 3D platform, planners can import data from BIM and project schedule data from common software packages, and interactively define resources and their behaviour. Users can generate method, sequence, and resource alternatives, and evaluate performance, duration and cost results as a combination of summary values, graphs, and 3D visualization. The platform supports extensions to define new equipment and crews, update resource behaviour and support new construction scenarios.

Using this approach for integrated planning and controls can benefit

various areas of construction. It helps to evaluate many alternatives for early project decisions, such as the quantity of major equipment, crews and project phasing that have important implications for the rest of the project. Moreover, the approach enables detailed project control during construction, frequently updating the plan through progress monitoring, tracking energy use, and perform forecasts and updates as necessary. Another benefit of this detailed analysis is better project logistics and interaction with project supply chains.

Model-based construction process analysis will lead to a more efficient use of project resources. This will improve not only the timing and cost of the project, but also energy consumption and greenhouse gas emissions resources. ●

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District of Future: a New Transformation of City District

Rubén Cánovas Mas, Head of Smart Cities, Manager at everis

District of the Future (DoF) is a project funded by the European Commission that aims to demonstrate how an increase in the energy efficiency of city districts can be achieved using innovative Information and Communication Technology. This has the potential to decrease a city's energy consumption and its greenhouse gas emissions. The project's goal is **to demonstrate that energy consumption and CO₂ emissions can be lowered by 30-40%** relative to the current and average building stock present in the city.



The project and affiliated research could be instrumental in providing insight and new techniques in the development of an **urban district of the future**. Every building in any city will be able to collaborate, share, and interact to improve their citizens' quality of life and to decrease public and private expenditure on energy.

The goals described will only be realised when the following infrastructure is in place:

- The use and implementation of energy efficient solutions and renewable energy sources needs to be incentivised;
- A communication infrastructure to control and optimize the operations of such devices needs to be deployed and standardized across Europe.

The DoF project started by analysing **three use case cities across Europe**. It was important to study and apply the DoF solution to different cultural, meteorological, and economic situations to understand the replicability of the DoF solution.

In the French city of **Orleans**, the performance of energy efficient technologies in public buildings is being monitored and optimised.

The Spanish city of **Sabadell** is located in the Barcelona metropolitan area. In Sabadell residential, public, and industrial buildings were tested and integrated into the DoF platform. Therefore the DoF project will include the results and achievements pertinent to the industrial, public and private sector.

Corby, in the United Kingdom, is a rapidly developing city in Northamptonshire. It was possible to analyse, for example, how a Zero Energy Bill house can significantly minimise the emissions at a district level if standardised across the district by sharing, replicating and applying their energy patterns.

DoF **demonstrates** how, by using a communication platform and optimisation algorithms, along with energy efficient and renewable energy devices, it is possible **to reduce the emissions** of three pilot cities across Europe **by 30-40%**. Having a cross European study will allow for the implementation of the DoF solution using the same methodology and procedure to other sites and locations, helping councils to achieve their decarbonisation and sustainability goals whilst bringing major costs reduction.

Due to the **heterogeneous nature of the data** and its influential relationship with citizens' quality of life, the DoF project outcomes are applicable towards a diverse range of areas external to energy efficiency. The project can also be a starting point for **future collaborations** with different partners from, for instance, in the real estate, utilities or construction sector.

To achieve a truly sustainable society, the European Union will need to encourage the deployment of smart and efficient energy equipment, and invest to foster **a sustainable future for Europe**. ●



This text reflects only the author's view and the Commission is not responsible for any use that may be made of the information it contains.

This project has received funding from the European Union's FP7 program under grant agreement No 608649. This text reflects only the author's view and the Commission is not responsible for any use that may be made of the information it contains.

Energy efficiency in shopping centres: comfort and energy savings

By Marine Faber and Roberta D'Angiolella, Buildings Performance Institute Europe

Sometimes seen as highly energy-consuming buildings, shopping centres have though the potential to be energy efficient and reach the environmental and energy goals of the EU. The retail industry's size, reach and impact have indeed a great deal of potential to be exploited. Demonstrating to policy-makers the importance of having commercial buildings as a focus in the EU building-related directives is key.

In Europe, the share of residential building floor area is 75% while the non-residential buildings make up 25%. Compared to the current renovation rate of around 1% of the whole building stock in Europe (BPIE, 2011), the annual renovation rate of shopping centres

is 4.4%, meaning that this high rate creates a window of opportunities to implement energy saving measures.

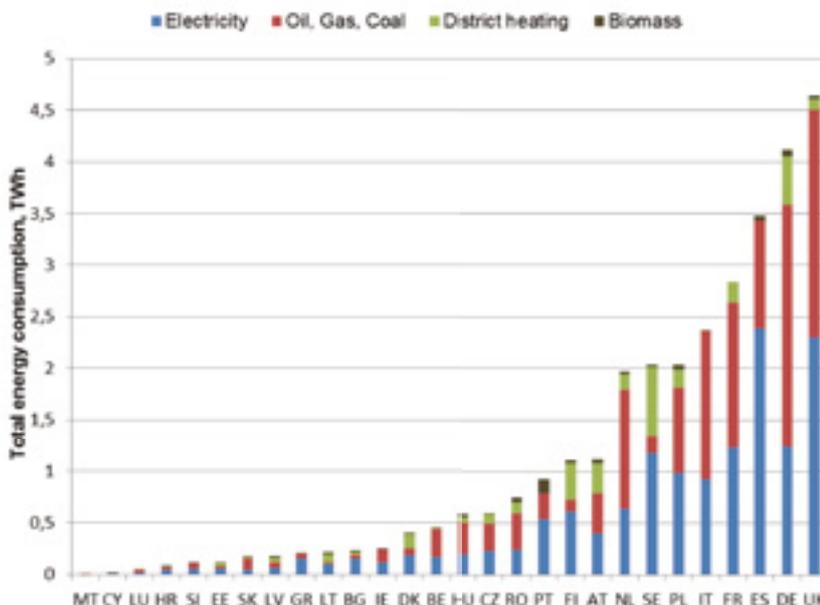
There is no regulation that specifically refers to shopping malls. In many countries the requirements extend only to some building types, usually just covering the residential sector. For example, the wholesale and retail subcategory are not included in the official definition of "nearly Zero-Energy Building" in many countries, such as Austria, Czech Republic, Croatia, Latvia, Portugal, Romania and Slovakia.

The Energy Efficiency Directive (EED, 2012/27/EU) states that every EU Member State has to adopt a National

Energy Efficiency Action Plan (NEEAP) for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private. The directive also sets inter alia a requirement on Member States to ensure the availability of efficient, high-quality energy audit schemes to identify potential for energy efficiency improvements for all final consumers, including smaller domestic, commercial and small and medium-sized industrial customers.

The European Performance of Buildings Directive (EPBD, 2010/31/EU) requires all Member States to enhance their building regulations and to gradually shift from a perspective to a performance-based approach.

FINAL ENERGY CONSUMPTION OF MALLS (Source: calculation, TU Wien)



3D simulation photo of the Modena centre





solutions and technologies to increase

European retailers are materially affected by this as it specifies binding energy standards for commercially-used buildings (new and existing buildings subject to major renovation).

The CommONEnergy EU-funded project seized the challenge to help re-conceptualising these peculiar, complex buildings and turn them into beacons of energy efficiency, the aim being to provide smart, innovative and cost-effective solutions for deep and systemic retrofitting. Eight reference buildings were identified, all representative of the EU building stock as well as three demonstration cases: CitySyd in Trondheim (NO), Mercado del Val in Valladolid (ES) and Canaletto in Modena (IT). Working with these

KEY FIGURES FOR SHOPPING CENTRES IN EUROPE:

- Shopping centres energy consumption: 32.2 TWh (EU+Switzerland&NO)
- Average specific shopping centre energy consumption: 272 kWh/m²a (EU+Switzerland&NO)
- Energy efficient retrofit offers a huge savings potential (0.85 - 2.81 TWh in 6 years)
- Shopping centres gross leasable area: 112.1 Mio, m² (EU+NO)
- Countries with the highest gross leasable area of shopping centres (larger than 5000m²): GB, FR, IT, DE and ES. With the least: CY, MT, LU, BG and LV
- Shopping centres stand for almost 30% of the EU non-residential building stock and contribute with around 11% of the EU's GDP

implied dealing with several challenges and solving practical issues, discussed with local stakeholders directly involved in the design and implementation of

the retrofitting. The status is at different stages in the demo cases:

- The 1882 old market of 2.230m² in the centre of Valladolid, 'Mercado del Val', will be the first to reopen after nearly a year and a half of works. The focus on keeping its natural essence was primordial. After simulations and discussions with the city architects, the chosen technologies and solutions are now installed. Comfort was improved for shop-owners and visitors with a multifunctional modular façade now including glass windows to let natural light enter and shutters to regulate it. Geothermal heat pumps are meeting the demand for heating as well as cold and hot water, while roof skylights provide natural ventilation. A modern energy management and monitoring system (iBEMS) will allow an optimal control of all technologies, taking appropriate decisions to reduce



Ongoing works in Mercado del Val



energy consumptions. All these put Mercado del Val as a frontrunner for renewables and natural light use.

- The “Canaletto” supermarket in Modena is located in a residential

area. Its retrofitting is included in an overall neighbourhood requalification. CommONEnergy will develop and implement innovative solutions, including ventilative cooling, sanitary water system, a

high performing envelope using multifunctional elements, natural and artificial lighting and more. The executive designs are in progress and works are planned from June to September. A LEAN construction management approach will support the construction phase to identify methods and best practises to smooth the process and avoid waste and delays. Meanwhile in Grosseto in Italy the focus will be put on electrical mobility and storage integration: an e-vehicle recharge system will be connected to a photovoltaic field on the roof of the centre (opening foreseen for October).

- In Trondheim (Norway), the 1987 38.000 m² centre was redeveloped in 2000: City Syd is one of the largest shopping centres in central Norway. The focus there is put on natural ventilation, iBEMS, as well as natural and artificial lighting.

For the other reference buildings, virtual simulations were performed and



solutions identified, such as reducing internal gains and energy consumption by installing more efficient lighting systems, reducing cooling needs by insulating the roof and installing reflective coatings, and more.

An energy-integrated approach for retrofitting is developed, including architectural, functional and technological solutions such as modular multifunctional climate adaptive façade system; ventilative cooling; internal micro-layout design to improve thermal zoning; solar reflective coloured coatings; iBEMS (intelligent Building Energy Management System); green areas, integration of energy distribution and refrigeration system (HVAC+R), and more.

Next steps are crucial to implement the retrofitting solution-sets and measure the results. The assessment will be done through energy simulations using IME and cost-benefits assessment tools. The implemented technologies will be evaluated from a sustainable and social point of view.

An energy-economic evaluation tool will allow investigating the economic feasibility of shopping centres retrofitting under different surrounding conditions and climatic zones throughout Europe.

EURAC launched an indoor environment quality measurement campaign to assess customers' thermal comfort perception and preference in the common areas (galleries and atria), using MEMO 1.0 (Mobile Environmental Monitoring), a tailor made cart carrying the required sensors, and interviews to customers in order to collect their thermal sensation and preferences. MEMO 1.0 records indoor environmental parameters such as air temperature, mean radiant temperature, relative humidity, air velocity and CO2 concentration. The model aims to find a correlation between the thermal responses of users, the inside-outside temperature difference and the duration of stay in the shopping centre. Results of this study are useful to energy managers of shopping centres in order to define more effective strategies for HVAC systems.

The Lean Construction approach, an increasingly popular management philosophy based on the Toyota Production System and Lean Production, demonstrating how the focus on processes and workflows – as well as on information and material logistics – stabilizes and accelerates work is used. In CommONEnergy, the aim is to develop and implement the methodology for Modena's centre retrofitting works as well as for the operational phase of the building itself.

Other approaches tested include building energy simulations to identify effective retrofitting solutions and the associated energy savings, power requirement profile and impact on comfort assessed.

The research leading to these results has received funding from the European Community Seventh Framework Programme (FP7/2007-2013) under grant agreement n. 608678. ●



FP7 European Union Funding for Research & Innovation



Before and after the retrofitting works, Mercado del Val

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Want to know more? Visit <http://commonenergyproject.eu/> and join us June 13 in Brussels for an Energy Day: *Smart strategies and policies for sustainable shopping centres: energy efficient and cost-competitive retrofitting solutions.*

SFERA II

Solar Facilities for the European Research Area



The EU-funded research project SFERA II aims to boost scientific collaboration among the leading European research institutions in solar concentrating systems, offering European research and industry access to some of the best research and test infrastructures. The project incorporates the following activities:

- Transnational Access: Researchers will have access free of charge to five state-of-the-art high-flux solar research facilities, unique in Europe and in the world.
- Networking: This includes the organization of training courses for industry, summer schools for the public, doctoral colloquia... The aim is to create a common training framework and provides the researchers with the necessary skills to operate concentrating solar facilities.
- The Joint Research Activities aim to improve the quality and service of the existing infrastructure, extend their services and jointly achieve a common level of high scientific quality.

What is the CSP (Concentrating Solar Power) technology that is promoted through SFERA II? CSP is a very promising renewable source of energy. The best known application so far is bulk electricity generation through thermodynamic cycles, but other applications have also been demonstrated, such as the production of hydrogen and solar fuels, water treatment and research in advanced materials.

How is the electricity produced? CSP systems concentrate energy from the sun's rays to heat a receiver to high temperatures. This heat is then transformed into electricity - solar thermal electricity (STE). When combined with thermal storage capacity of several hours of full-capacity generation, CSP plants can continue to produce electricity even when clouds block the sun, or after sundown or in early morning when power demand steps up, making it a competitive technology to mitigate climate change.

Five SFERA II Partners: PSA-CIEMAT, PROMES-CNRS, PSI, ENEA and CIESOL will provide access to their solar research facilities free of charge. This opportunity enables to realize high-quality research in the following areas :

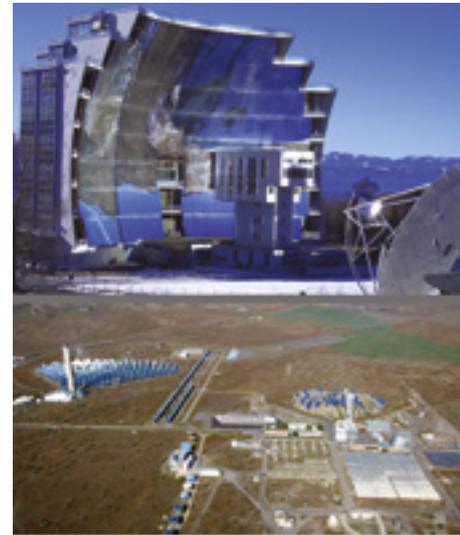
- Solar thermal electricity generation:

thermodynamic cycles, receivers, thermal storage, concentrating optics, control algorithms, etc.

- Solar production of chemical energy carriers: H₂, Syngas, etc.
- Cycles for chemical storage of solar energy: ZnO, etc.
- Solar water treatment: desalination, disinfection, detoxification
- Research in basic phenomena and nano-material production processes
- Knowledge-based high-added-value material synthesis: ceramics, glass, etc.
- High-flux photochemistry and photo-physics
- Basic knowledge of materials behaviour and aging under extreme conditions

To access the five infrastructures above, the users have to submit an application through the annual calls that are launched by the project. Travel, accommodation and access to the installations are all paid by the EU project. For the 2017 year, the call will be open from September 2016 to the end of January 2017. The access period will take place from March to November 2017. ●

SFERA II CSP research infrastructures



FOR MORE INFORMATION

You can visit our website at <http://sfera2.sollab.eu> or follow us on LinkedIn to get the latest news on the project.

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 312643.





OCEANERA-NET - supporting innovation in ocean energy

The Ocean Energy European Research Area Network (OCEANERA-NET) project is funded by the European Union through Framework Programme 7. It comprises a network of 15 national and regional funding agencies from Belgium, France, Ireland, Netherlands, Portugal, Spain, Sweden and the UK, coordinated by Scottish Enterprise. OCEANERA-NET kicked off in January 2014 and will run to the end of 2017.

The objective of OCEANERA-NET is to coordinate activity between European countries and regions to support research and innovation in ocean energy (defined as wave and tidal energy, salinity gradient and ocean thermal energy conversion).

Specifically OCEANERA-NET runs joint calls to support collaborative research and development projects which address identified challenges and promote the competitiveness of the ocean energy sector in Europe. The first joint call opened in 2014, with a total budget of €7m. 9 projects were selected for funding. Projects involve partners from at least two of the participating countries, and generally involve collaboration between industry and research institutes. Calls are particularly targeted on small and medium sized enterprises, to help them build their capacity for international collaboration and accessing other competitive funding, such as Horizon 2020. In total, 20 SMEs are involved in the selected projects. These projects cover development of wave and tidal energy devices, components, monitoring and control systems, mooring systems, electrical connections, reliability testing, decision-making tools, tackling biofouling and corrosion, and improving environmental data. A second call was launched in February and applications are now being considered. Information on all the projects will be published on the OCEANERA-NET website as they become operational.

Some of the projects funded under the pilot joint call are now underway. Reliability in a Sea of Risk (RiaSoR) will establish industry best practice in reliability testing for wave and tidal devices, standardise design guidelines and increase safety in marine energy operations. The project is led by the European Marine Energy Centre. More information can be found at



Laminaria Wave Energy Converter

<http://www.emec.org.uk/research/international-projects/>. The LAMWEC project seeks to develop and test a full scale (100kW) Laminaria wave energy device, addressing specific technology challenges including a mooring and pulley system that will support the innovative storm protection system, and a new anchor design for depths of 30 to 70 metres. More information can be found at <http://www.laminaria.be/lamwec.html>. The MOREDATAS project - Methods to Obtain Refined Environmental Data from the Seas - is a collaboration between France, the UK and Ireland. It addresses the need for better understanding and characterisation of wave and tidal energy resources, to obtain better estimates of Annual Energy Production, improve the investability of wave and tidal energy projects and provide a level of comfort for commercial lenders and investors.

OCEANERA-NET will run a series of events from autumn 2016, to promote the work of funded projects, support knowledge transfer and develop opportunities for future collaboration, culminating in a final conference in November 2017. Please register on the project website to receive information about these events. ●

For more information about OCEANERA-NET contact karen.fraser@scotnet.co.uk or visit <http://www.oceaneranet.eu>

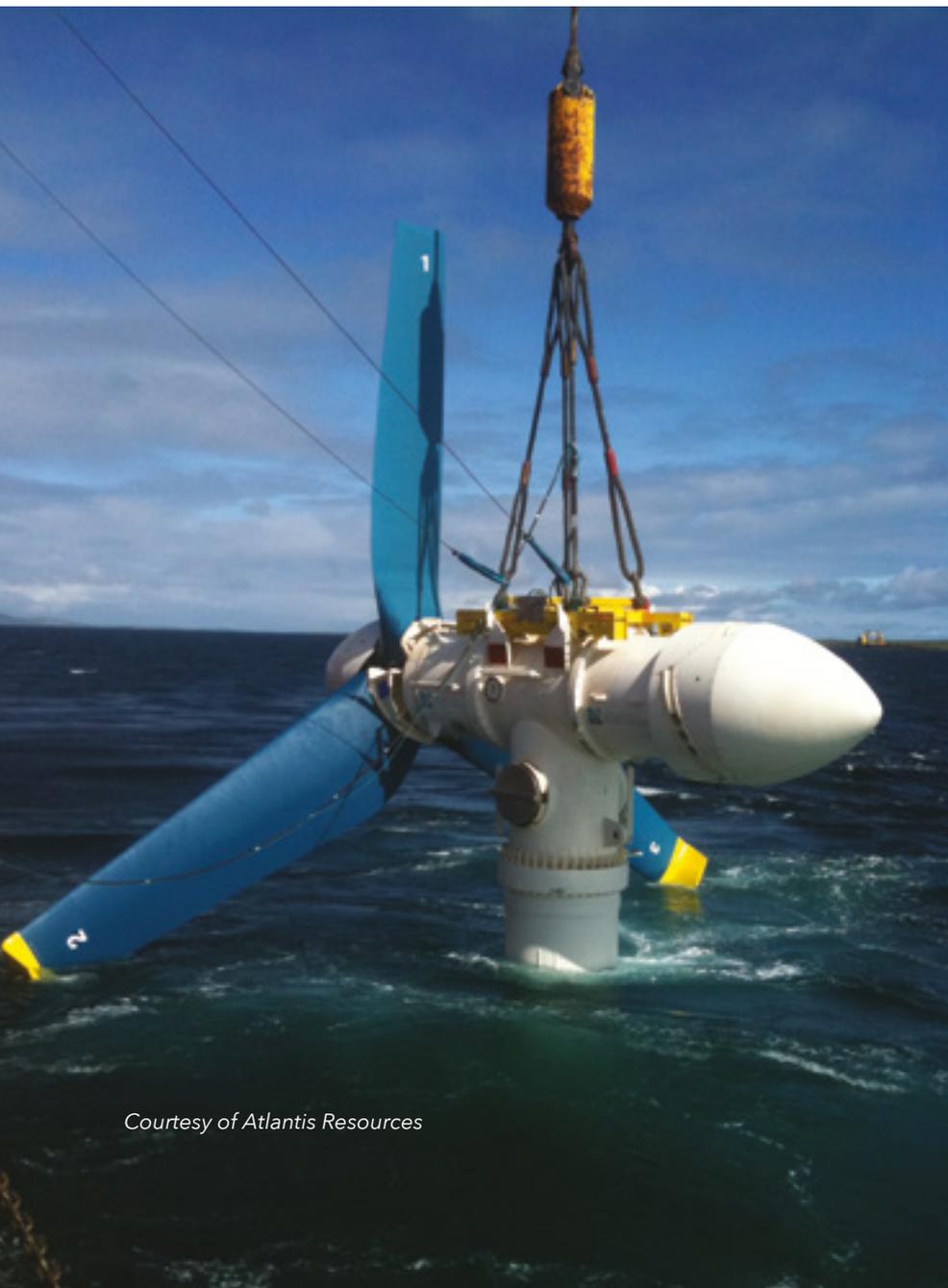


This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No.618099

Is the EU willing to do what it takes to get ocean energy over the line?

European energy policy is in flux. The Energy Union strategy, launched last year seeks to address the bloc's precarious energy security situation. EC president Jean-Claude Juncker has come to power launching an unprecedented EU-wide investment programme to unlock growth and job creation potential, with renewables as a priority. Commitments made at COP21 imply a full decarbonisation of the power sector. All of this will require new renewable energy technologies, such as ocean energy. But is the Europe willing to do what it takes to get ocean energy over the line to commercialization?

By Rémi Gruet, CEO, Ocean Energy Europe



Courtesy of Atlantis Resources

WHY DOES EUROPE NEED OCEAN ENERGY?

The size of the prize for commercialising ocean energy is huge. In Europe alone, the ocean energy industry plans to deploy 100GW of production capacity by 2050, meeting 10% of electricity demand. That's enough to meet the daily electricity needs of 76 million households. Deploying 100GW of ocean energy will also mean creating a new industrial sector based firmly in Europe, and 400,000 skilled jobs all along the supply chain.

Ocean energy has significant export market potential. European companies are the clear global leaders in ocean energy, accounting for 66% of tidal energy patents and 44% of wave energy patents globally. This puts them in prime position to capture a global market estimated to be worth 53€bn annually in 2050.

Both politically and economically, Europe needs ocean energy to reduce its overreliance on fossil fuel imports, which cost over €1bn per day. Indigenous sources such as renewables represent a 'no-regrets' option in this regard. Furthermore, ocean energy stabilises the electricity grid. In the coming years ocean energy will complement the use of other renewables like wind and solar because



Courtesy of OpenHydro

it produces electricity during different times and is very predictable.

2016: A BREAKTHROUGH YEAR FOR OCEAN ENERGY

Ocean energy is experiencing a breakthrough year in 2016, with more production capacity hitting the water than in the entire decade before.

The first phase of Atlantis Resource's Meygen project, the first tidal stream farm in the world, will come online this summer in northern Scotland. This 6MW farm will pave the way for the full 400MW project in the coming years. Similarly in Northern France, EDF's Paimpol-Brehat tidal farm will be installed in the coming months. Learnings from the project will inform larger French tidal ambitions in Normandy and the creation of an industry there.

In wave energy, the industry leaders are making steady progress towards commercialisation, while innovative new entrants are attracting a good deal of attention. Much of the activity is centred on Wave Hub in the south of England, where, amongst others, Fortum's CEFOW project will deploy three of Wello's Penguin wave energy converters in the next year.

Elsewhere, buoyed by support from the EU's NER300 programme, AW Energy are preparing to deploy their WaveRoller technology in a first-of-a-kind demonstration farm in Peniche, Portugal.

INCREASING EU SUPPORT

EU has begun to understand the timeliness of the opportunity presented by this exciting emerging sector and Political and financial support for the sector has increased accordingly: The amount of funding awarded annually to ocean energy projects has increased by 350% in Horizon 2020 (2014-2015) over its predecessor FP7.

Pushed by the European Commission, the European Investment Bank is showing a willingness to engage with ocean energy project developers for the first time. A pilot programme launched by the bank last year to fund first-of-a-kind energy projects is a step in the right direction. The industry welcomes this engagement.

Political visibility for the sector has been enhanced by the Commission's Ocean Energy Forum. Now in its final stage, the Forum proposes a six-point plan to take the industry further towards commercialisation.

STAYING AHEAD OF THE COMPETITION

Ocean energy needs the EU, the EU needs ocean energy. The size of the prize is nothing short of new manufacturing sector firmly based in Europe, something the EU has been direly lacking recently.

Actions to achieve it should be scaled accordingly, and rapidly. The EU's competition, namely China and the US, are wide awake to the same opportunities and are scrambling to claw back Europe's technology lead. ●

Rémi Gruet



Unleashing bioenergy

By Christofer Fjellner, Member of the European Parliament



One thing is certain; biomass will be at the centre stage the coming years. It will be crucial to increase the share of biomass in our energy production if we are to stop global warming. But there is definitely room for improvement. As our use of biomass increases so are the threats to it and so is the competition for raw materials. And as this competition increases more and more players will want to use politics and legislation in order to secure their own supply. We can already hear calls being raised for more and tougher regulation of biomass. For instance phrases such as 'cascading use' and 'sustainability criteria' are catching on. Because who wouldn't want to promote an efficient and sustainable use of resources?

But what they mean within the walls of the European Parliament and the outside world is two completely different things. 'Cascading use' is a sound principle for a company to apply at its own resources which the industry already does as they have an interest in maximizing profit. But in the EU context it means that politicians decide which resources should be used for what and how. And sustainability criteria might sound reasonable but all too often it is forgotten that fossil fuels have no sustainability criteria whatsoever. By wanting to protect biomass we might in fact smother it. And in most cases the alternative to biomass is fossil fuels. At the same time I can understand that countries which have no forests or other sources of biomass wants to know that what they are shifting to is in fact sustainable and not creating yet another problem which we will have to handle later on.

Obviously as a Swede this is provocative as we some hundred years ago taught ourselves how to tackle deforestation. For every tree being cut down in Sweden two new are planted and we even have support schemes for those who keep our fields open and free from forests. It stands clear that we simply do not face the same challenges as the United Kingdom or the Netherlands. But yet we are now faced with a situation where we are subjected to demands of new regulation on forestry and biomass by those who a thousand years ago cut down their forests, and still haven't figured out how to get them back. At the same time our forests are growing at a record pace. This is at least from a Swedish point of view somewhat contradictory. At the root of this problem lies the fundamental misconception that Europe is being deforested while in fact the forest area of the EU is increasing with the equivalent area of Cyprus every year. Our problem lies not in deforestation but in poorly managed forests.

It is clear that a balance between these interests needs to be struck. It is indeed legitimate to want to know that the resources being used are in fact sustainable but that must not be done in a way which hinders functioning and sustainable biomass markets. It is important to remember that when Finland and Sweden joined the Union the forested area of the EU increased by over 50 percent. The countries that live of forestry do not only have a long standing tradition in doing so but they also know how to maintain the forests to ensure that their livelihood does not disappear. We must learn from these

countries instead of trying to teach them something they already know. It is also important that we learn from already existing forums such as Forest Europe instead of creating parallel structures for forest management in the EU.

The importance of biomass will only increase as our fight to tackle climate change intensifies. It is only when we replace fossil products with sustainable products made out of biomass we best store the carbon and when we shift from fossil fuels to renewable energy sources such as biomass we decrease our impact on the climate. This applies not only to energy but also to other areas such as construction. But in order to ensure this we need rules which encourages active forestry and the use of bio-energy instead of doing the opposite. This is why it is so important that the LULUCF rules which are to be updated promote forestry and not hinder it. And this is why it is important that the Renewable Energy Directive promotes biomass instead of tying it down with unnecessary and counterproductive regulations. A tree which is not growing is not storing any more carbon and a forest which is not managed will not grow as well as it could. To use the forests and the products which come from it is a prerequisite for us to benefit from the carbon storage capacity of our forests.

The use of biomass will only increase as we continue to decarbonize our economies. We must keep our eye on the prize in order to stop climate change. Putting an unnecessary leash on biomass is in fact putting a leash on the fight to tackle climate change. ●

Cellulosic ethanol – biofuel of the future

The transport sector has one of the highest growth rates worldwide implying a significant impact on the fuel demand and level of CO₂ emissions. The EU has set targets to reduce greenhouse gas (GHG) emissions by 40% compared to 1990 levels by 2030. As transport alone is responsible for 25% of GHG emissions in the European Union, the use of already available and cost-effective technologies, such as advanced biofuels, has to be encouraged as quickly as possible.

Advanced biofuels based on agricultural residues such as cellulosic ethanol have the potential to play a key role in making mobility more sustainable. By 2030, these advanced biofuels could cover about 16% of the total fuel demand in Europe. This could create 300,000 new jobs – predominantly in rural areas – and generate additional revenues of EUR 15 billion in Europe alone.

SUNLIQUID[®] – COMPETITIVE AND SUSTAINABLE CELLULOSIC ETHANOL

The production of cellulosic ethanol is technologically mature. Clariant's sunliquid[®] technology is an innovative, efficient, sustainable, energy-neutral and economic process for the production of cellulosic ethanol from agricultural residues such as straw, corn stover or sugarcane bagasse. Highly optimized enzymes ensure effective conversion of the feedstock into sugars, which are then fermented

into ethanol by highly optimized yeast. The process converts the difficult to access C5 and C6 sugars contained in the plant material almost entirely into ethanol. The product, cellulosic ethanol, is a high quality biofuel with high GHG emission savings of up to 95% compared with fossil fuels. It does not compete with food or feed production and does not need any additional arable land. Recently, sunliquid[®] has been awarded the "2015 German Innovation Prize for Climate and Environment" from the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety.

A successfully conducted fleet test with Mercedes-Benz series vehicles using sunliquid[®] 20, a premium-grade E20 blend containing 20% cellulosic ethanol, has shown that cellulosic ethanol E20 is technically feasible. 20% cellulosic ethanol led to a significant increase in sustainability as it reduced particle emissions by 50% compared to the EU reference fuel E5 and saved around 95% GHG emissions. Clariant supplied the cellulosic ethanol from its demonstration plant in Straubing (Germany) where up to 1000 tons of cellulosic ethanol are produced annually using the sunliquid[®] process. The plant has already received the International Sustainability & Carbon Certification (ISCC).

Currently, the EU-funded project SUNLIQUID aims to confirm the



commercial maturity of the sunliquid[®] process by building and operating a first-of-its kind, large scale cellulosic ethanol production plant. The project will contribute to achieve a more sustainable energy system in Europe that is less dependent on imported fossil fuels and creates new, green jobs.

In order to trigger investments in cellulosic ethanol production capacity in the EU, a predictable and long-term policy has to be adopted. At the heart of such a framework stands a binding and ambitious target for advanced biofuels. ●

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This project receives funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 322386.

sunliquid[®] demonstration plant in Straubing, Germany



2016 will be a pivotal year for the future of bioenergy in Europe

Bioenergy often faces a lack of recognition when compared to other renewable energy solutions. However, it accounts for more than 60% of the overall renewables consumption in Europe, contributing de facto to the fulfillment of Member States' 2020 renewable energy targets. Bioenergy is concerned by several key files currently being discussed in Brussels - and there is no doubt: such topics will be high on the 2016 EU policy agenda and beyond.

By M. Jossart (pictured) General Secretary, The European Biomass Association (AEBIOM)

New frameworks and regulations will have a critical impact on the bioenergy sector as a whole and, depending on the direction set by European policy makers, the industry will be facing either challenges or opportunities after 2020. Listing all relevant, impactful existing or coming policies concerning the bioenergy sector could give the impression of a Prévert-style exercise: the *EU 2030 Climate and Energy packages*, the *EU bioenergy sustainability policy*, the *EU strategy on Heating and Cooling*, the *EU Bioeconomy strategy*, the *Circular economy package*, the *Eco-labelling revision*, *air emissions* legislation (medium combustion plants and large combustion plants directives), the *state aid guidelines revision*, the *Forest strategy implementation*, the *LULUCF decision*, the *EU market design* and the *ETS revision* are among the key policy files we could mention. However, we must not forget that the bioenergy sector still represents a small segment when compared to fossil fuels, and it remains populated by players of very different financial capacities. Therefore, we should take this into account and stay pragmatic when producing policies and legislation. Let us not risk hindering the dynamism and innovation of a key sector for renewable energy production, especially after the COP21 agreement.

Among the policies abovementioned, three ongoing discussions are focusing

all of AEBIOM's attention. Firstly, the EU strategy for Heating and Cooling (H&C), which the European Commission presented in mid-February. Until today, renewable energy policies have been almost exclusively focusing on the electricity sector. The European Commission decision to tackle the issue and decarbonise the H&C sector is therefore welcomed by the sector's professionals. In fact, biomass now represents 89% of the total EU renewable heat consumption and 15% of the total EU heat consumption. This share is expected to increase slightly in 2020, according to Member States' projections. Biomass has the potential to deliver significant and cost-effective solutions for a growing heat demand. Innovative technologies are today mature and ready to deliver for heating buildings, cities and industrial processes. This strategy, expected to focus on a reduction and decarbonisation of the H&C demand, offers important opportunities for renewable energy, including biomass. An important barrier to the deployment and competitiveness of RES today - particularly in the H&C sector - is the low price of fossil fuels and the continuous support that these receive. Fossil fuel subsidies should be phased-out urgently and carbon outside the ETS sectors should be priced, as is already the case in several Member States that have introduced a carbon tax. Overall, we need coherence and a constant eye on long-term EU climate and energy objectives (i.e. 80-95%

GHG emissions reduction by 2050) if we want to steer clear of technology lock-ins or stranded assets within a fossil fuel infrastructure (like new fossil gas pipelines).

Secondly, the 2030 Climate and Energy Framework and the new Renewable Energy Directive will establish the policy framework for renewable energy (RES) for the period 2020-2030. In fact, within the development of its Energy Union Framework Strategy, the European Commission announced a new renewable energy package for the post-2020 period, including a new



renewable energy directive (REDII) with 2030 targets. While preparing the directive, the European Commission has launched a wide consultation on the new renewable energy directive – to which AEBIOM has responded. This review was a very good opportunity to look back on achievements and lessons learnt. So far, in spite of a few specific sectoral concerns, most observers agree that the first renewable energy directive (RED) allowed renewable energy operators to develop and plan investments within a stable medium-term regulatory framework. The RED, a pioneer initiative at the time, has encouraged Member States to support RES projects, sometimes with financial incentives that were key in terms of developing a more mature sector that could face the competition of fossil-derived energy. This stability and support was a strong signal for economic operators who answered the call *en masse*, allowing to develop renewables and progress towards the 2020 20% EU target. Considering this, the RED can be considered as a solid success. However, political stimuli are short-lived and need to be renewed when the time comes. As a matter of fact, contrary to all expectations, investments in renewable energy assets in the EU fell by 18% in 2015, reaching their lowest level since 2006! Up until today, when asked about their main concerns, key European bioenergy industry players' responses are twofold: a lack of regulatory visibility after 2020 and the recent changes in some national support schemes. The latter, national support schemes, are no longer considered as secure as they once were. In this context, the outcomes of COP21 are an opportunity not to be missed, and should be used by the EU to renew its momentum. What RES market players need above all today is a strong positive message and a solid medium

term vision within the framework of this new renewable energy directive. Both RES technologies and market players are ready to deliver. With this in mind, AEBIOM has thrown its weight behind an ambitious post-2020 renewable energy package that fosters a vibrant home market with clear growth perspectives, and asserts the EU's leadership in renewables in the face of rising international competition. However, we think that the EU renewable energy sector can deliver more than the 27% of the 2030 target set so far by both the Commission and Member States. We also regret that the EU target is not implemented into nationally legally binding targets.

In addition to these key concerns, AEBIOM is advocating for a pragmatic approach meant to reassure market players: firstly, it's always good to remind ourselves that we should meet the 2020 objectives (20% RES). Secondly, we need to build on the existing RED and seek to improve it. Thirdly, the recent EU Heating and Cooling strategy is welcome, as the sector represents 50% of our final energy consumption: it could be decarbonised with RES H&C sources like biomass, and this should be taken into account in the REDII. An important role is played by the building sector here, with the residential sector representing 45% of final H&C consumption. A minimum share of RES should be required for new buildings and long-term renovation strategies of existing buildings should be established at national level to address the existing building stock.

Last but not least, in mid-February, the European Commission has announced an improved EU bioenergy sustainability policy for the end of the year. In this context, it has launched a 3 month public consultation on

bioenergy sustainability, to assess stakeholders' opinions on the risks to be addressed and the effectiveness of existing policies. AEBIOM is supporting a harmonised EU policy on sustainability that would simultaneously provide investor trust and visibility, avoid market barriers and give the opportunity to the sector to show its commitment in delivering sustainable bioenergy. The initiative would also provide a stable investment environment for energy producers and biomass suppliers. Over the last few years, the absence of such harmonisation has led to the onset of varying national sustainability rules – making trade barriers more complex. This gap has also given room for discrediting the bioenergy sector on the basis of sometimes oversimplified and stereotyped messages. An EU sustainability policy, based on a balanced and non-bureaucratic approach, would not only make sure that sufficient volumes of biomass complying with sustainability criteria will be mobilised and delivered to the market, but would also address questions and concerns from wider society.

European energy policy is like a complex puzzle. Every piece is important in order to complete the whole picture, and we need them all for smooth bioenergy market development. Many stakeholders, often with different visions and objectives, are involved in the bioenergy debate. Working together, and moving in the same direction, is becoming a challenge. Bioenergy can deliver energy security, contribute to climate change mitigation, create jobs and strengthen innovation and competitiveness, provided that sound legislation is in place. Key policies are being negotiated in 2016, hopefully for the best! ●



LpS 2016

The International Conference Dedicated to Lighting Innovations, Trends and Technologies

The 6th International LED professional Symposium +Expo in Bregenz from September 20th to 22nd reinforces creativity, innovations and new lighting solutions. The outstanding conference program will focus on "Smart Technologies for Lighting Innovations."

THE LIGHTING TRENDS, KNOWLEDGE & INNOVATION PLATFORM

The lighting sector is facing enormous challenges. The LEDification process is ongoing while Intelligent Lighting and Human Centric Lighting strongly affect future lighting developments. New stakeholders, market players and organizations play important roles in future businesses and technology opportunities. State-of-the-art knowledge, trend views and collaborations are vital for success in the highly dynamic market. In this environment the annual 3-day LpS event builds a platform to follow the latest trends, predict next generation lighting solutions, enforce collaborations and trigger lighting innovations.

4 TRACKS WITH OVER 70 TOP-CLASS SPEAKERS

The conference program will concentrate on Future Trends, Intelligent Light, Internet of Things, Light Quality, Light Sources, Intelligent Lighting, Optics, Thermal Management, Reliability, Testing, and Applications, in four parallel tracks. More than 70 international speakers from key organizations such as IBM, Johnson Controls, Bartenbach, Lumileds, Tridonic, Philips, Holst Center, Infineon, NXP, and several renowned universities, will present their findings in the opera house and James Bond film location, the Festspielhaus Bregenz, on beautiful Lake Constance.

HIGH-LEVEL LIGHTING CELEBRITIES

The LpS 2016 will be opened by Nobel Prize Laureate Professor Shuji Nakamura from the University of California Santa Barbara (the inventor of the blue and white LEDs), who will present the latest developments in



Photo: Kongresskultur Bregenz/Bruno Klomfar

LED and Laser-Diode technologies. The opening will also give insights into the strategic goals of the European Commission and LightingEurope, the voice of the European lighting industry. Secretary General, Diederik de Stoppelaar will highlight their strategic lighting roadmap 2025 in the field of intelligent lighting.

5 NEW LIGHTING INNOVATION TRIGGERS

A "Design meets Technology Forum" is planned where the needs and requirements of lighting designers will be discussed and interaction with lighting engineers and system designers will be sought. The creative lighting community will also be given the chance to present their solutions from the component up to the lighting systems in the new "Start-Up Innovators" area. Besides the technical innovations, a Light-Art Design area opens the door to lighting designers and lighting artists, presenting their objects in the foyer of the opera house. In addition, intelligent light engines will be presented in a workshop covering spectrally and tunable LED and OLED lighting. The European project HI-LED will be covering "Intelligent Solutions" for museum, horticulture and street

lighting. Finally, on day 3, EPIC, the European Photonics Industry Consortia, will offer a workshop on Horticulture Lighting and present their latest findings in plant growth system lights.

VISITORS, EXHIBITORS AND PARTNERS

The organizers are expecting more than 1,500 visitors from over 50 countries. More than 100 exhibitors will present new products, latest innovations and the current status of LED and OLED lighting technologies in a 3,000 square meters exhibition area. Over 20 media partners, about 15 supporting organizations and several scientific partners are supporting the LpS 2016 event. ●

EARLY BIRD TICKETS AVAILABLE

Online registration is open now with Early Bird tickets available until July 1st at the official event website: www.LpS2016.com

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Understanding the true costs of the heat energy we consume

By Alexandra Latham, EGENC

Whether private citizens, public authorities, or industry, heating and cooling represents a significant part of final energy consumption of every sector of society. Whilst the demand profile of each is different, all have the same basic demands: to be able to have a steady, secure, and sustainable supply of thermal energy.

This is undoubtedly possible. Renewable energy sources can already

deliver heating and cooling at a steady rate, with stable costs, local resources, and without the need to inefficiently convert energy into electricity first. The technology to turn geothermal, solar, and biomass sources has developed rapidly in recent years and can deliver energy for a huge range of applications.

For example, ground source heat pumps (GSHP) were recently recognised as one of the most efficient heating devices in the new EU energy

efficiency rating scheme because of the high ratio of the heat delivered to the total electrical energy supplied over the year, known as Seasonal Performance Factor (SPF); the ratio is today above 4 and is heading towards 5.

In innovative smart grids, geothermal resources can be used for base load district heating and district cooling, whilst CHP plants can adapt the share of heat or power produced depending on demand. Shallow geothermal can also be used, with thermal energy

Manifold of the gshp heating and cooling system in the ümraniye shopping centre, Turkey.





storage (UTES) stabilising the grid, and heat pumps providing thermal energy and storage at an individual level.

Renewables for heating and cooling accounted for 51.5% of the total renewable energy consumed in 2013, but only 16.5% of the thermal energy demand. The potential is much higher, with the possibility to meet 25% of the demand by 2020. This would more than double the number of jobs (470,000 in 2013) and save Europe €21.6 billion each year on energy imports compared to 2012.

Given the potential and the benefits we could expect the penetration of the market to be much deeper, but a lack of good quality, transparent information is holding back development.

The Levelised cost of electricity (LCoE) has long been established as a way to calculate the value of electricity by taking into consideration capital costs, operations and maintenance, performance, and fuel costs; by establishing this value, electricity from different sources could be compared. The Levelised Cost of Heat (LCoH) is now needed in order to similarly compare heat from different sources. The Fair RHC Options and Trade (FROnT) project is undertaking this task. The first step is to develop a commonly accepted methodology, which takes factors such as climatic or geological conditions, demand profiles, system performance into consideration. Next, a cost estimation tool will be developed which will allow users to compare costs online. This will be a breakthrough in providing the missing information which prevents us from making reliable estimations.

Having been neglected until relatively recently, policy making for renewable heating and cooling is nascent at European, national, and local levels. This means there is another information gap to be filled: how to build support schemes to promote the transition to a sustainable system. Some innovative schemes have been created at all levels of government, and information about these schemes now needs to be developed, assessed, and shared in order for programmes to be developed and refined, and for best practices to be transferred between countries.

The FROnT project is now studying the existing support schemes is looking at their impact in collaboration with the authorities that implement them, and the business, agencies and consumers which use them. These studies will help in identifying the key success factors for support schemes, and once that is established, it will be possible to create guidance for the creation of future policies ensuring that the best lessons have been learnt and policies are optimised.

The consumer must remain central in any discussion of how the future energy market will be developed; it is essential that changing technology and policies is in harmony with changing consumer behaviour. Current behaviour can be measured in sales trends, but now thanks to a new study we are beginning to understand why those choices are made, and what factors will influence future action. More than 4,000 consumers in the private and public sectors as well as private households have taken part in a study analysing the factors which influence their decisions about maintaining, installing, and renovating heating and

cooling systems. The results, which can be found on the front website, show for example that the residential sector is the least aware of renewables for heating and cooling, that most people seek advice from professionals with the internet and important information source for many, and that most perceive renewables as requiring high investment costs and delivering high savings- it is the same high investment costs that represent a major barrier to switching fuel sources.

This information will be used in understanding both building policies, and to help authorities and businesses to communicate their ideas in ways that accurately address the concerns of end users. The project consortium is building a range of tools for consumers based on these results to both directly improve access to information, and to build a package of information, tools, and guidance which can be built on by communicators working in all of the stakeholder groups.

Renewable heating and cooling will develop in the future- it must if we are to meet our climate and energy goals and protect the interests of European citizens. To make this growth effective and efficient, we need more information about costs are and what supporting measures work. Then, we need this information to be more readily available to all- policy makers, businesses and consumers. In this way, development will be pushed by increased demand and pull through flanking measure which enable development. ●

CONTACT DETAILS

www.front-rhc.eu

GABI, a COST ACTION for the development of shallow geothermal energy

The annual consumption of energy in the world is continuously rising, driven by increases in population, progressive urbanisation, etc. Climate change mitigation and adaptation are also challenges for the near future. In this context, the development of local sources of energy with low environmental impact is more and more necessary. Geothermal energy can play a significant role among renewable energy resources. It has none of the environmental risks

associated with fossil fuel and nuclear power, while it can be developed locally without impact on the landscape and with less land consumption and output fluctuations than solar, wind or hydro-electrical power. The **COST ACTION TU1405 GABI** (shallow Geothermal Applications for Buildings and Infrastructure) was launched in 2015 with the objective to build a new European network of researchers and engineers to address the challenges of thermoactive geostructures in terms of thermal and mechanical

design. In thermoactive structures, heat exchangers are integrated in the elements of the structure that interface with the ground, such as foundations, tunnels and diaphragm walls. This technique is also particularly attractive because of the inherent cost savings involved in combining a required structural component with the harvesting of geothermal energy. Based on multidisciplinary approaches, this group has the ambition to develop collective understanding, share techniques, facilities and data, and work jointly in disseminating the obtained results across Europe.

Heat transfer pipes in a pile reinforcement cage



Shallow geothermal energy is considered as a domestic resource, which contributes to fulfilling the energy demand both by electrical power generation and direct-heat uses. This technology only requires a generally constant ground temperature over the year. Despite seasonal fluctuations, this is satisfied in most of continental Europe, where the ground temperature at depths higher than 5-8 m typically varies between 8°C and 16°C, but remains constant, down to approximately 50 m. In such conditions, the ground operates as heat source supplying warmth to buildings during winter, whilst functioning as heat sink during summer when cooling is required.

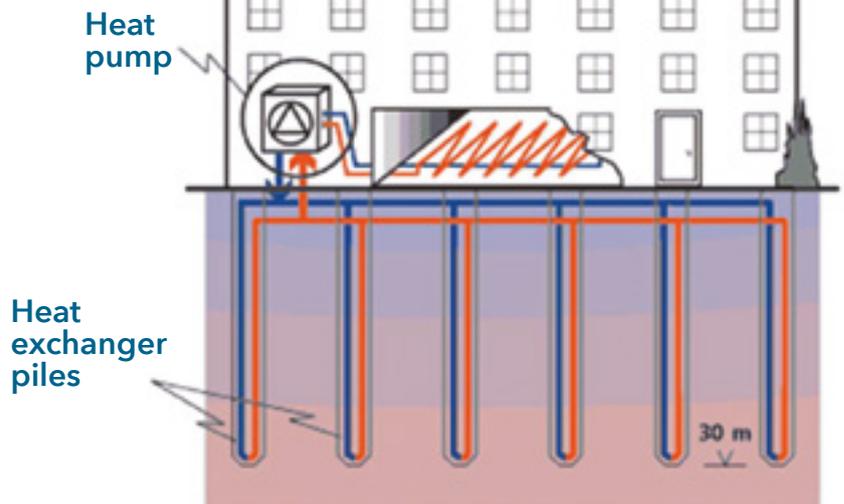
For shallow geothermal systems, since the temperature differential is relatively small, just a few degrees, a heat pump is needed, forming what are known as Ground Source Heat Pump systems (GSHP). In such applications the ground acts as heat exchanger and storage medium rather than heat source. Among shallow geothermal

systems, energy thermoactive geostructures or energy geostructures are recently experiencing exponential growth. This category includes all the ground-embedded structures, such as tunnels, anchors and linings, shallow foundations, piles and diaphragm walls, used to exchange heat with the ground. In general, a geotechnical structure can be thermally activated by embedding polyethylene pipes in its concrete body. The fluid flowing in the pipes constitutes the means to transfer heat from the ground to the buildings or vice versa thanks to heat pumps.

Since the beginning of the 1980s, geothermal energy has been increasingly obtained from foundation elements, at first from base slabs, then from piles, diaphragm walls and tunnels. Energy geostructures have been increasingly constructed in Europe. The design of these energy systems is inherently interdisciplinary and involves geology, hydrogeology, geotechnical engineering and thermal engineering. A vast amount of information across several fields is needed for a successful design: thermal, mechanical and hydraulic properties of the soil, as well as the concrete, assessment of local atmospheric conditions, definition of the operating system thermal action, and overall energy demand for the building or the facility to be conditioned. Integration of all these aspects is required to optimize the system performance.

The energy efficiency performance of these systems depends on the exchange mode between the ground and the thermoactive geostructure. Currently, heat exchange is estimated based on operating assumptions, but accurate modelling needs to be substantially improved to allow a precise calculation. The thermo-mechanical effects also need to be assessed in order to ensure system operation without affecting safety and functionality. Indeed, due to expansion and contraction of the thermoactive

Working principles of energy piles



geostructures induced by temperature variations, structural aspects should be to be considered as well.

Despite the significant number of operating energy geostructures in Europe, the development of specific design rules and dimensioning approaches has been slow. Attempts to provide a set of recommendations for piles subjected to temperature variations were carried out starting from 2005 in Switzerland, Germany, United Kingdom and France. However, most of this documentation provides only general indications and does not allow the adoption of this technology across Europe for a wider range of projects. An international comprehensive document addressing in detail the mechanical design of energy geostructures is much needed.

The heterogeneous development of applications and research on thermoactive geostructures in European countries is the main reason to launch a COST Action.

The disparities highlight the need to synthesize research and practice-based knowledge from across national and disciplinary boundaries in order to develop better understanding and more widespread use of this technology. In the future, the deeper understanding of heat exchanges in the ground and their application to a wide range of geotechnical structures can improve this technology for more efficient and streamlined application. One of the critical contributions expected is a better methodology to assess interaction among multiple thermoactive geostructures within urban districts. City managers need methods to predict the effect of multiple systems operating concurrently to minimize interferences and provide a planning guidance for permitting purposes. It is expected that the **COST Action GABI** will foster the development of thermoactive geostructures and will be a big step towards future market development and widespread usage of this innovative technology. ●

OTHER INFORMATION

COST Association web page: http://www.cost.eu/COST_Actions/tud/TU1405

COST GABI web page: <http://www.foundationgeotherm.org>

LinkedIn address: <https://www.linkedin.com/in/gabi-cost-action-69aa26100>

Facebook address: <https://www.facebook.com/GABITU1405>

Heat Transition and Geothermal Energy - A German Perspective

By Dr Martin Sabel, Bundesverband Wärmepumpe (BWP) e.V.

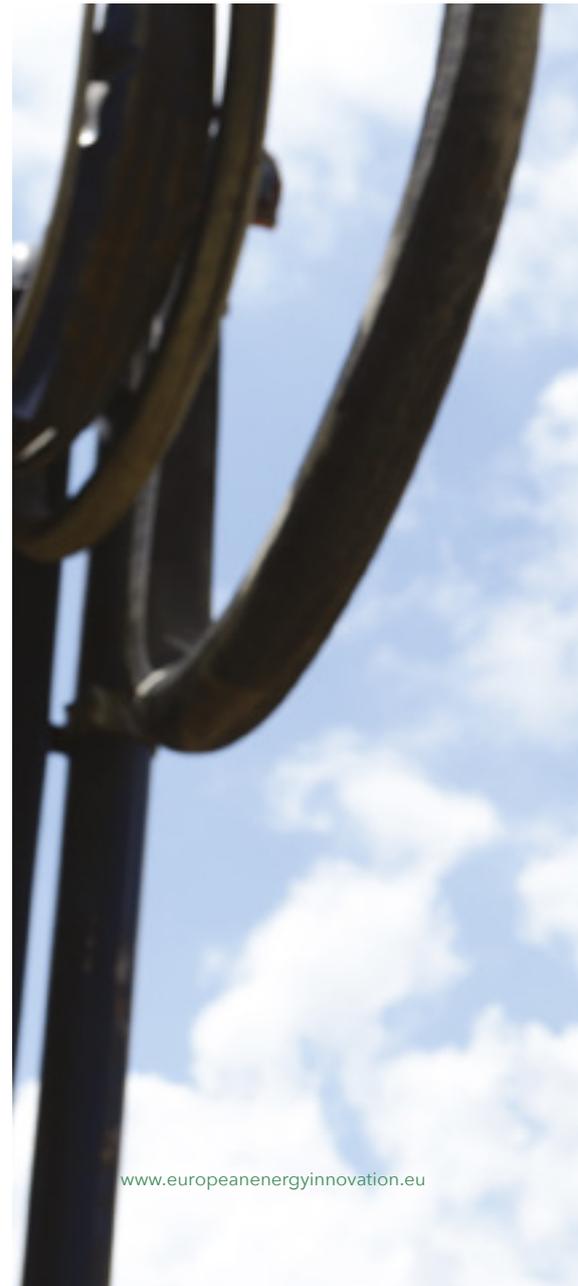
In December 2015, the world nations reached the historic agreement that global warming should be limited to 2°C, even less if possible. G7 countries had already set out on the path to a carbon-free economy several months before. Consequent action has to be taken in order to fulfil these commitments. Germany's climate and energy

transition (*Energiewende*) targets are ambitious. Beside the decision to phase out nuclear power there is a political consensus to reduce greenhouse gases by 80-95 % until 2050 compared to 1990. These goals are in accordance with the EU strategy for the transition to a competitive, secure and sustainable energy system by 2050. The conclusion of all this is as simple as it is inevitable:

Fossil fuels can play no more role in any energy sector.

The discussion of the challenges and chances of the German energy transition has been dominated by questions around the expansion of renewable electricity and the electricity grid during the past years. In 2015, renewable energy covered more than

A drill site showing the rig, the container for cuttings and a compressor in the background.



30 % of gross electricity generation. The heating and transport sector were hardly mentioned in the political discussion for a long time. As a result, the share of renewable heat has been stagnating around 12 % for several years. Today the necessity of a so called heat transition (*Wärmewende*) is widely accepted. To promote the heat transition different measures were taken:

The **Renewable Energies Heat Act** (*Erneuerbare-Energien-Wärme-Gesetz, EEWärmeG*) makes using renewable energies in new buildings mandatory. The **Energy Saving Ordinance** (*Energieeinsparverordnung, EnEV*) limits the allowed primary energy demand of new buildings. The **Market Incentive Programme** (*Marktanreizprogramm, MAP*) offers attractive government grants for renewable heating systems.

Ground source heat pumps (GSHP) are an established technology that can be used for heating and cooling in a wide range of applications, from small houses to large individual buildings or complexes. Cold district heating networks are used to supply geothermal energy on a low temperature level which is increased to a higher temperature level by decentralised heat pumps.

Drilling hammer for Down-The-Hole (DTH) drilling. The drill string rotates while the drilling hammer continuously strikes down into the rock.

Large GSHP can provide energy for conventional district heating networks. New buildings equipped with GSHP easily fulfil *EEWärmeG* and *EnEV* requirements. The *MAP* offers grants of at least 4,500 Euro for buyers of efficient GSHP if a new borehole heat exchanger is installed.

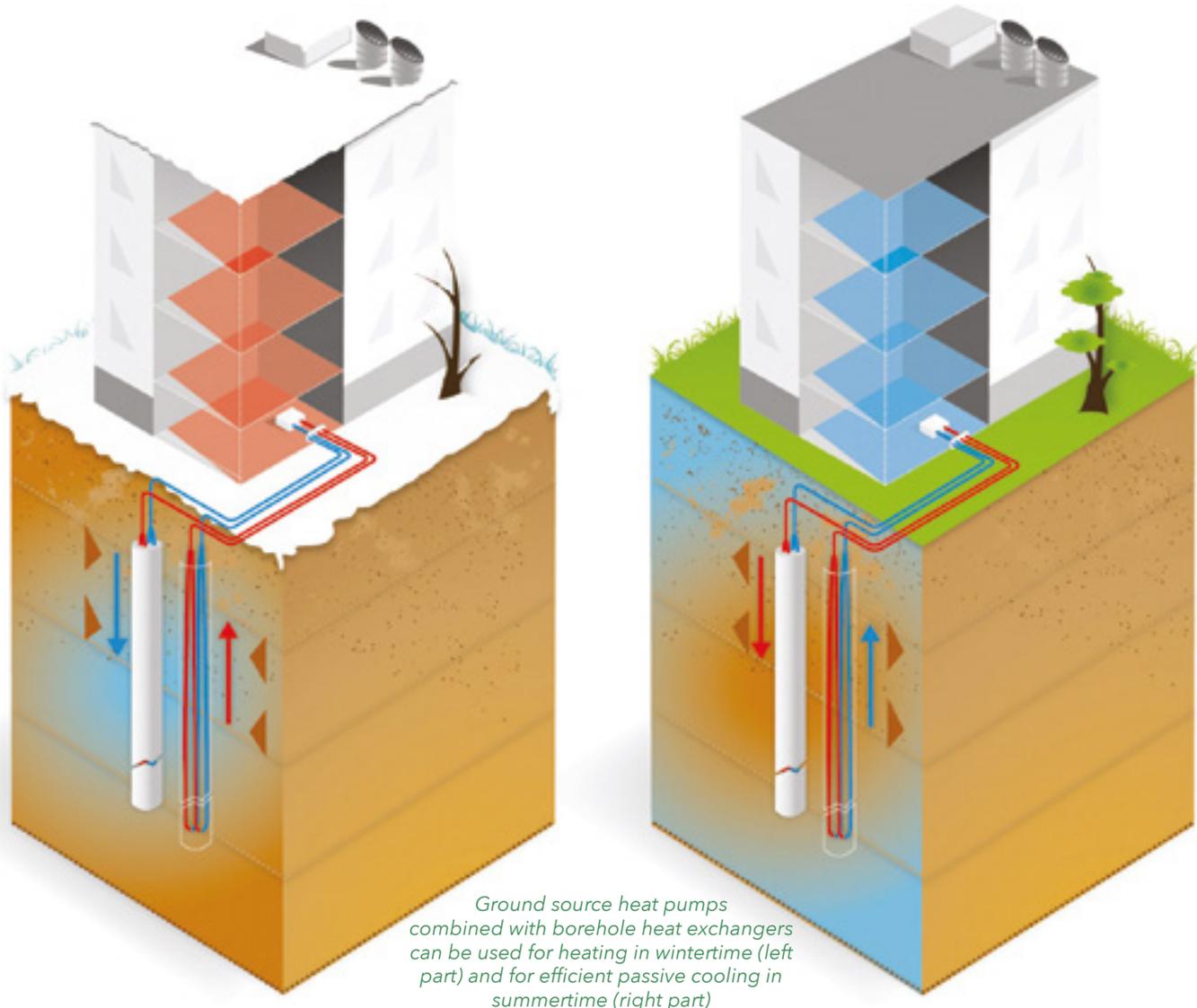
The challenges to use renewable energy in the existing stock of more than 20 million existing buildings are far greater. Existing buildings usually have a relatively high energy demand and they are dominated by gas-fired and oil-fired

systems. In addition, there are no laws that require building owners to lower their energy demand or use renewables. To compensate for this lack of legal obligations, the *MAP* offers up to 9,300 EUR if a highly efficient GSHP replaces an old fossil boiler.

There are 330,000 GSHP in Germany. That may seem a lot, yet it is only a fraction of all heating systems in our 20 million buildings. Studies suggest, 30% of Germany's buildings must be equipped with GSHP in 2050 if climate goals are to be met. Unfortunately, sale

numbers for GSHP have been dropping for some time now: from 34,500 in 2008 to 17,000 in 2015. Today, they only make up a mere third of the German heat pump market and their share of the 710,000 heating systems sold in 2015 is negligible.

The main reason why the heat pump market is stagnating are energy prices: Heating oil prices have dropped to 5,8 Cent/kWh, gas prices remain stable at 7,1 Cent/kWh, yet electricity prices have risen to 21,5 Cent/kWh. As a result, many people would save



energy and greenhouse gases when buying a GSHP, but no money. This is not the outcome of market forces but of a failed tax and energy policy: Taxes and levies make up a mere quarter of gas and oil prices, but almost 60% of electricity prices! Especially the so called *EEG-Umlage* (Renewable Energy Act Surcharge) of 6,3 Cent/kWh is a nuisance, for it finances the expansion of renewable electricity but interferes the expansion of renewable heat provided by efficient heat pumps. Even positive impulses such as the *MAP* cannot compensate for this market distortion.

There is no doubt that all efforts regarding climate protection will fail if low-carbon technologies are not an economic choice for consumers. Giving a significant price to carbon emissions would be a powerful and effective measure to push markets into the right direction: Investments in efficiency and renewable energy would pay off. Complex funding schemes would be unnecessary. Legal obligations for all market participants could be reduced to a minimum. Consumers and companies could pick technological solutions best suited to their very own needs. Public revenues would increase.

Governments should not claim to be helpless but take powerful action. If the declared goals of COP 21 are to be achieved an appropriate and effective carbon pricing should be introduced as early as possible. ●

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Qualified personal using appropriate technical equipment and material is needed to install a borehole heat exchanger properly.

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