SUMMER 2014

european energyinnovation

European Energy Innovation

Clean skies
Smart Cities
Geothermal energy
Norway energy
Energy research

Country profile
SPAIN

Summer 2014

Includes editorial contributions from:

Günther H. Oettinger
European Commissioner for Energy

Eric Dautriat
Executive Director, Clean Sky

Hervé Bernard
Chairman of EERA and Deputy CEO of CEA (FR)

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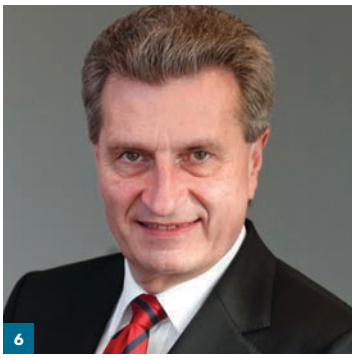
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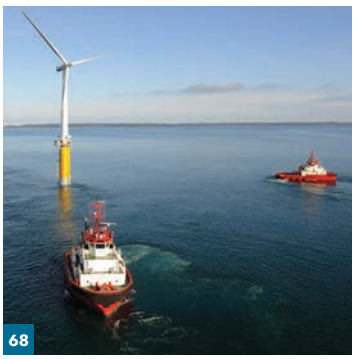
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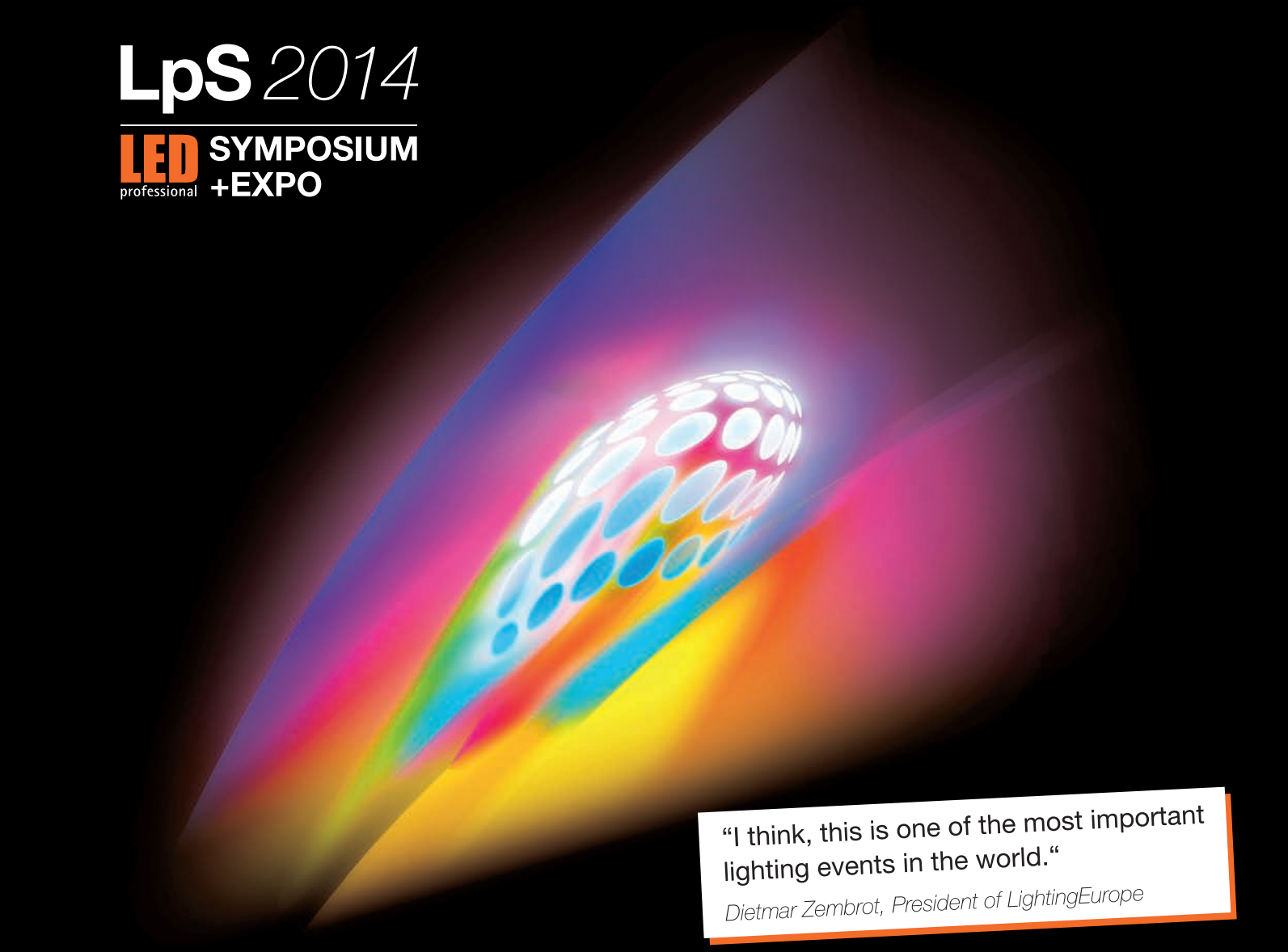

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2014: the centenary of the outbreak of the 'War to End All Wars'. The eyes of the World turn once more towards the killing grounds: to the Somme, Verdun and Passchendaele; to the rows of gravestones and the monuments commemorating those with no known grave. Old memories are burnished anew; and rightly so - "lest we forget". And yet, even as I write these words, ceremonies on Normandy's beaches and elsewhere commemorate the 70th Anniversary of an operation conceived to hasten the end of a second war that had begun only a generation after the first had ended. "Those who fail to learn from History", said Santayana, "are doomed to repeat it"; and historians have pored over the links between the two wars, even as commentators explain why a third has not begun. Not yet, at least.

Today, the news is dominated by the situation in Ukraine and there resonate several eerily disquieting echoes of that incendiary summer of 1914: geo-political alliances; secessionist movements; disputes over resources, sovereignty and territory. They form a potent and combustible cocktail, but this is no time for lugubrious prophesy of war. The European Union might recently have received a stern rebuke from sections of its electorate, but it remains a powerful force for unity (the concept features in its name and its motto, after all); and a mighty bulwark against these dangerous developments.

Energy is one of the battlegrounds (and, coincidentally, one of the weapons) of this new realpolitik. Ukraine's national gas bill and Europe's energy dependence are uncomfortably thorny issues that confront negotiators, energy planners and legislators alike, lending new urgency and sharpened relevance to initiatives such as Europe's 2030 Climate Policy Framework. And in this issue, we are delighted to feature an article from Energy Commissioner Oettinger, who explores the link between innovation and energy goals. Naturally, the 2030 framework features strongly in his thoughts. Observing the disparities in energy pricing that introduce major obstacles to international competitiveness, Commissioner Oettinger emphasises yet again the importance of the internal energy market. Koen Noyens echoes these themes when arguing for innovation to be put at the heart of the 2030 debate. Successful innovation, he contends, depends not only upon proper funding, but also an effective policy framework, which requires coordination at EU level. Giving us a little more detail, Vinicius Valente and Greg Arrowsmith explore the top ten renewable energy research priorities. Theirs is a wide-ranging list that includes what might be termed the "usual suspects": solar energy, wind energy, biofuels and CHP. But there are more far-reaching suggestions, such as advanced thermal conversion and hybrid grid and storage solutions. Eric Dautriat explains that almost 600 companies have taken part in the Clean Sky project, with the promise of reducing aviation CO_2 emissions by 2 to 3 billion tonnes over the next 35 years. Clean Sky 2 will build upon this progress with a larger budget and more ambitious environmental objectives.

Vittorio Prodi MEP discusses geothermal energy technology and today's funding mechanisms. One of the more interesting aspects of this neglected and much-underrated energy source is that each installed MW produces more electricity than either wind or solar power, offering the enticing prospect of supplying as much as 15% of Europe's energy requirements by 2050.

Marine Faber explores how cities can act for a sustainable future. Noting the growth in urban populations, their dependence on fossil fuels and the accompanying pollution, she reviews what the SMART concept means right now, while offering practical examples of what has been achieved in places such as Copenhagen and Valladolid.

Those who have taken holidays upon the sun-drenched playas of Spain might be forgiven for assuming that solar power forms the backbone of Spanish renewable energy. Not so, as Heikki Willstedt informs us: for the first time ever in any country, wind was the main source of electricity in Spain last year. The main source of electricity, you note: over 50 GWh, supplying one fifth of total demand. Sadly, changes in policy threaten both the future development of the renewable sector and Spain's ability to reach its 2020 objectives.

Quoting Alexander Graham Bell, Commissioner Oettinger observes that "Great discoveries and improvements invariably involve the cooperation of many minds." A sentiment to which all of Europe - and all of us - can aspire. If Europe can prevent a World War, it can surely help resolve a dispute in the Balkans.

And, as always, there is a lot more for you to read inside..

Michael Edmund
Editor

Europe has to be innovative to reach its energy goals

By Günther H. Oettinger, European Commissioner for Energy

There is a clear link between innovation and the EU's energy and climate targets: If we want to reach our goals, we have to be innovative. Innovation and a low carbon future for Europe are mutually dependent. We have certainly no shortage of ideas in Europe, but there is a shortage of innovation which turns into "manufacturable" and "marketable" products. This is also the major challenge of the energy innovation sector today.

On 22 January the European Commission outlined plans for a climate and energy framework for 2030. One core goal is to reduce greenhouse-gas-emissions by 40% below the 1990 level by 2030. This is very ambitious, as it implies tripling the speed of reduction in emissions in the decade from 2020 to 2030 compared to the speed until 2020. Moreover, we have to bear in mind that the EU accounts for about 11% of worldwide greenhouse-gas-emissions. Therefore it cannot afford to walk ahead without anybody else joining behind, if it wants to preserve industrial competitiveness. We need to get global partners on board in our fight against climate change.

As regards the share of

renewables in energy consumption, the Commission aims for a binding target of at least 27% at EU level. A new governance system shall ensure that this ambitious goal can be reached. Setting clear targets is important to provide legal certainty and confidence in order to trigger the necessary investment in renewables and the respective technology. We also have to renew our efforts as regards energy efficiency. The Commission is examining Member States' progress in reaching their existing energy efficiency targets, and will assess and report on this by summer 2014.

Effective energy efficiency measures will be crucial to reach the goals for 2030 – and so is innovation. Europe is still the largest market in the world for energy efficient products and services. But only a small part of our economic potential is exploited. In buildings for example, up to half of energy use could be cut with the help of intelligent and energy saving technologies.

Together with the energy and climate framework for 2030, the Commission presented a study on the drivers of energy costs and prices in the EU. It shows among others that for industry the retail price for electricity rose by 3.5 % annually from 2008 to 2012. Companies in the EU pay twice as much for electricity than their competitors in the USA.

For gas, they even have to shoulder the three- to fourfold. This is not sustainable for energy intensive European companies that face tough global competition. Hence, Europe needs to act. We need to ensure, at a minimum, that the price gap for gas and electricity does not continue to widen. The price study underlines how important it is to reach our energy and climate goals in a cost effective way.

EU Heads of State or Government discussed the Commission proposal at the summit of 21 March. An agreement on the future 2030 policy framework should be reached as quickly as possible - and no later than October 2014, in time for the climate talks in Paris in 2015. It is important that the EU acts now and thereby provides a predictable framework for companies: Investors in the energy sector consider 2020 to have taken place yesterday, and 2030 to come tomorrow.

One cannot discuss about Europe's industrial competiveness and energy policy without stressing the necessity of completing the internal energy market. Open markets are essential to encourage competitive energy prices and innovation. They stimulate the entry of new players to the market and therefore enable consumers to find cheaper and better services. The EU is taking steps to ensure that the internal market can work better, for example, by tackling distorting effects of energy subsidies and price controls.

However, a prerequisite for a properly functioning internal market is a well-developed infrastructure. In order to accelerate the completion of the gas- and electricity networks the Commission has presented a list of so-called "Projects of Common Interest" in October last year. Around 250 projects listed benefit from accelerated licensing procedures and improved regulatory conditions and may have access to financial support from the Connecting Europe Facility (CEF). Under this facility a €5.85 billion budget has been allocated to trans-European energy infrastructure for the period 2014-20. And the first call for proposals under the CEF has just been opened. The build-up of infrastructure is also an important pillar of our strategy to increase energy security: The gas crisis in 2009 has shown how important it is that Member States are well connected, so that they are able to help each other in times of need. In the light of the recent developments in Ukraine energy security is high on the agenda in Europe: The Commission will undertake a study on energy security and by June 2014 will present a comprehensive plan for the reduction of the EU's energy dependence.

One conclusion is unavoidable: In order to successfully master the challenges the EU currently faces in the field of energy, we need to further integrate our markets. A true "europeanisation" of energy policy will bring long-term benefits to both, citizens and businesses, in Europe. It is crucial to work together, be it in the field of energy, be it in the field of innovation. The great inventor Alexander Graham Bell summed it up perfectly: "Great discoveries and improvements invariably involve the cooperation of many minds."

Putting innovation at the heart of the 2030 debate

By Koen Noyens, Policy Advisor, EURELECTRIC

The electricity world of 2030 will be very different from the one we know today. Change is occurring across all three dimensions of innovation – technology, process and business models – and we will see even more of it in the years to come. Innovation, to make a long story short, is the very driver for the energy transition. What policies can best drive the move of technologies from immaturity to maturity – not only renewables, but also better performing conventional generation technologies, smart grids, storage, energy efficiency appliances?

Over the past decade the EU has been a global leader in kick-starting the energy transition. Both the EU and its member states have made significant interventions in the market to stimulate the growth of new technologies. However this progress has been achieved at high direct and indirect cost. We could have done better at less cost.

The root cause of the high cost is that the current EU energy policy mix stems from a top-down volume target for desired outcomes. This is then overlaid with national priorities and strategies for achieving the targets. Such an approach is not suited to the principles of technology innovation: it sets incentives for mass deployment (to achieve short-term targets) rather than innovation deployment (to achieve performance improvements or cost reductions). As a result, a large share of demand stimulation is directed towards mature technologies, with comparatively little innovation benefits.

The EU's traditional innovation policies in the energy field prioritised research in those technologies it deemed most relevant to the EU's climate and energy objectives for 2020. This focus led to funding R&D in isolated silos, to picking winners. But there is change on the public and on the private side, in government strategies and companies' business models. The European Commission is currently developing an Integrated Roadmap, leaving behind its traditional approach in favour of 'innovative solutions' for the European energy system as a whole. From now on it's about delivering 'light', 'heat' and 'clean transport', not 'solar' or 'biofuels'. The Commission wants to focus much more on the energy system as a whole and to extend support to the entire innovation value chain, from basic research to market roll-out.

The European electricity industry welcomes this move. We expect the new Integrated Roadmap to outline and prioritise technological and non-technological RD&D that helps address overall energy system issues and challenges. Continued development of individual generation technologies is still clearly necessary but must be synchronised with other needs across the energy system, like strengthening the role of customers. RD&D programmes should therefore include an integrated perspective that encompasses the impacts of the RD&D initiative in question on the power system as a whole.

In this respect effective EU and national funding will require more coordination at EU level. Member states, which today provide the lion's share of public RD&D funding, should coordinate their actions on innovation, based on the Integrated Roadmap. The roadmap should thus limit expensive fragmentation and ensure prioritisation and coordination, while acknowledging that different regions will benefit from different types of innovation.

However, future successful system innovation development will not only depend on RD&D funding, but will also require an effective enabling innovation policy framework. Such a framework must recognise that a large range of policies, going far beyond the traditional approach of research, development and demonstration support, contribute to innovative solutions. Innovation thus depends on a full set of enablers: a vibrant private sector incentivised by competition and entrepreneurship, functioning RD&D that is effectively linked to the rest of the innovation process, an 'enabling market setting' to underpin the business case for deployment, and a set of wider enablers, including strong

competition, effective regulation, and supporting infrastructure. All of these are fundamental to ensure a smooth integration of innovation policy into EU energy policy, key in the discussion on 2030.

The future innovation setting will require a rethink to ensure that Europe's sustainability objectives are met more cost-efficiently. The European electricity industry sees value in an 'ETS plus' approach: 'demand-pull' policies that stimulate innovation, coupled with the EU Emissions Trading Scheme (ETS) – rather than innovation incentives – as a driver of mass deployment and market uptake. The ETS is able to encourage competition between low-carbon solutions once they have matured in the innovation process, and offers built-in mechanisms for cost-effectiveness. Investors can rely on this mechanism because it preserves competition, promotes cost-effectiveness and offers stability. Striking the right balance between such 'demand-pull' innovation policies and the ETS will be key.

The big 2030 energy and climate framework debate has already started. So far innovation is missing from these discussions, although technological and non-technological innovation will be needed to create a competitive, secure and low-carbon economy. Innovation should thus be the unifying narrative that cuts across the climate, energy and industrial competitiveness dimensions of the 2030 debate.


Koen Noyens

EURELECTRIC in Brief

EURELECTRIC is the voice of the electricity industry in Europe. We represent the power sector in over 30 European countries, speaking for more than 3,500 companies in power generation, distribution, and supply. We also have affiliates and associates on several other continents. We stand for carbon-neutral electricity by 2050, competitive electricity for our customers, and continent-wide electricity through a coherent European approach. Our permanent secretariat in based in Brussels. More information on our activities is available at www.eurelectric.org.

AVIATION: Green skies

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Pratt & Whitney
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Commercial airlines can be more eco-friendly than you think

In the debate about the environment, airplanes can be the elephant in the room. Much like the elephant, their size works for and against them. They can haul several hundred people at once (the ultimate carpool), but they have a reputation for being big, loud, gas-guzzling machines.

How can they reduce carbon emissions, be more fuel efficient and cut down on the noise?

There's a behind-the-scenes revolution going on aimed at tackling these very questions. The brains behind the transformation come out of Pratt & Whitney (P&W), one of the biggest divisions of United Technologies Corp. At P&W, people are working to produce the PurePower® PW1000G Engine, a product developed in anticipation of the need for more eco-conscious solutions for the airline industry. United Technologies and P&W invested $1 billion of its own R&D money on this engine that has been 20 years in the making.

To date, the PurePower engine family has more than 5,500 orders and commitments, including options, from more than 50 global customers. The PurePower engine will be on five aircraft platforms, including the Airbus A320neo family, the Bombardier CSeries, the Embraer E-jets E2 family, the Mitsubishi Regional Jet and the Irkut MS-21 aircraft.

Here's a look at four ways the PurePower engine can help airlines be more lean and green:

Becoming more fuel-efficient: Fuel efficiency is central to the conversation on helping the environment. P&W's PurePower engine offers the airline industry a chance to get ahead by offering a product that burns up to 16 percent less fuel. This lowers fuel costs for the company and gives passengers peace of mind.

Burning less fuel over longer routes: P&W recently launched the newest addition to the PurePower engine family, the PW1135G-JM engine, a 35,000 thrust class engine for the Airbus A321neo aircraft. The engine's higher thrust allows A321neo operators to fly routes of greater distance - or out of high altitude airports - while carrying more passengers or larger payloads. This will allow airlines to open up new routes without compromising fuel burn, emissions and environmental performance.

Reducing their carbon footprint: With better fuel efficiency comes less carbon emissions. P&W's PurePower engine cuts carbon emissions by more than 3,000 metric tons – equal to planting over 900,000 trees – per aircraft per year.

Bringing down the noise: Hundreds of planes take off and land every day at the average major airport. Simply reducing the noise an aircraft makes during takeoff and landing will allow airports to extend runway hours and allow more jets to service passengers. P&W's engine reduces aircraft noise footprints by up to 75 percent.

CARE: "Green aviation is the best opportunity for our Regions"

How European Aerospace Clusters strengthen the Regions and the Industry in the Maelstrom of the Global Aeronautics Market.

AVIATION: A GROWING MARKET WITH LIMITATIONS

All aviation stakeholders mention it: the consumer demand for flying is increasing in such a way that the number of aircrafts will double before 2030. Such a context requires a fast adaptation of the full industry, from aircraft and engine manufacturers to flight control and airport infrastructures.

But in order that the expected increase is accepted by the consumer, air transport must be integrated to ensure smooth and seamless travel for the passenger, airport noise must be drastically reduced, air pollution must be lowered, flight costs should be kept as low as possible, and finally high-tech aircrafts must be dismantled and recycled to avoid waste and contamination.

That is the rough definition of "green aviation" challenges, as set in the CARE project.

WHY "GREEN" IS AN OPPORTUNITY FOR THE AVIATION INDUSTRY

The aeronautics sector benefits from one advantage: reducing the environmental impact and improving the operations costs are two sides of the same endeavor.

The objectives of environmental and operation cost improvement trigger innovative ideas and open new research avenues: eco-design of aircraft including green maintenance and end-of life management, lighter composite and metallic materials, new manufacturing processes, more electric aircrafts, new engine concepts for lower consumption, new fuels, single sky and 4D air traffic management, low-noise airport approaches, inter-modal platforms, new tools to accompany the passenger… Depending on the need for capital for each of these activities, innovation is open to SMEs or large groups, and research institutions are widely asked for collaboration with industry.

Air transport companies have a good reason to invest in innovation: with high technology, aircrafts become cheaper to operate than with lower-end technology. While in other sectors, fancy technology often justifies higher costs, in aeronautics it is the other way round. Competitiveness of aviation lies in lower operational costs and not so much in the purchase of the aircraft. As an example, today, fuel consumption represents 30% of total operating costs during the lifetime of the aircraft: saving on fuel is a green challenge with immediate economic return, with options on many technical parameters which influence the result.

THREATS FOR EUROPE: A RISK NOT FULLY SHARED

At first sight, such a growth context for Aviation, combined to the business perspective of thinking Green should leverage enthusiasm throughout the air transportation-related industry. This is true at European level, but also at global scale with more and more countries investing in the sector to take their share of the market. The competitiveness of the European industry is under

attack by newcomers offering lower wages and now-trained personnel, and driven by their strong willingness to play their part in the global aviation concert. As of today, European aviation is a confident and strong leader.

Public authorities must be aware of a second cloud in this seemingly bright sky: while aircraft manufacturers are able to sell and organize the production from Europe, they are facing growing requests to increase the share of client countries in the supply chain and assembly lines. They are also encouraged to do so to better balance costs and mitigate potential difficulties, including currency issues. Such a situation puts a heavy pressure on the European supply chain composed mainly of SMEs scattered in many European regions. In these companies lies the European employment for highly skilled workers, who will, in turn, be in competition with workers of countries rapidly ramping-up their human and technical capacities. The competition risk is therefore unequally shared between larger groups, able to invest and be present in many countries while controlling operations from their European headquarters, and the numerous SMEs of our European aviation industry rooted in their regions.

WHY REGIONS HAVE INTEREST IN INVESTING IN THE RESEARCH AND INNOVATION

The "scary scenario", with aviation industry growing globally but decreasing in Europe, is therefore not impossible. This is why companies of the aeronautics supply chain, and in particular SMEs having strong traditional skills, face an obligation to innovate, lead and remain (or become) indispensable in the aviation business.

Yet, the industry cycle is quite long: aircrafts are built to last more than twenty years, technical and safety certifications are extremely demanding, airport infrastructures have such an impact on territorial management and are so expensive that the decision-making process takes up an impressive amount of time.

WHICH SME IS READY TO INVEST NOW WITH A PROSPECT OF RETURN IN THE LONG TERM ONLY?

It is in the interest of the Regions to support the SMEs' engagement in innovation for the future, the guarantee for local employment. As for the airports and multi-modality, the Regions are directly impacted, economically and socially, by the improvement of the performance of the expensive transport infrastructures they usually co-finance.

SOLUTIONS PROPOSED BY THE CARE PROJECT

As one of the first results of the CARE project, a Joint Action Plan has been built to engage clusters into more targeted cooperation in favor of their industry and research members.

Addressing 13 priorities, a Common Research Agenda, providing SMEs with a clear view of innovation avenues and local governments with appropriate data for smart specialization strategies, is the basis of the TIGER works (Topic Interest Groups for the Emergence of Research). These industry-research working groups define joint projects tackling key aviation challenges and aiming at outstanding excellence rating. Funding of such trans-national projects will be achieved through various channels like Horizon 2020, Clean Sky 2 or the coordination of regional R&D funding schemes, which would form an innovative ERA-NET and attract additional private funding.

The CARE partners also organize events to invite more stakeholders to join the CARE initiative, in particular European aerospace clusters and international partners with which collaborative projects and business opportunities will be sought and global visibility ensured.

CARE is the foundation of a European meta-cluster for Green Aviation.

Know more about the CARE project and events through http://care-aero.eu

Get to know TIGERs, topics and people in advance through the Linked-In platform: http://www.linkedin.com/groups?gid=7435850

For more details and opportunities for collaboration, please send an e-mail to aumonier@aerospace-valley.com phone +33 (0)561 145835

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n°286560

Gearing up for Clean Sky 2

By Eric Dautriat

Greening skies by reducing the level of greenhouse gases is a challenging task for our generation. Air transport is currently responsible for 2% of CO_2 emissions. Yet, the sector is forecasted to experience sustained growth in the future and by 2050 the figures will be much higher. The European aeronautics industry is fully committed to addressing both mobility and environmental challenges. The European Union is a frontrunner when it comes to environmental protection: Clean Sky is the result of the common vision between the European Commission and the aeronautic sector to develop technological breakthroughs to reduce the environmental footprint of aircraft.

Eric Dautriat

Since it was created in 2008, the Clean Sky Joint Undertaking has mobilised almost 600 large, medium and small companies to take part in this, the largest ever aeronautics research programme. With some seventy percent of the programme completed, sixteen Calls for Proposals already launched and hundreds of topics covered, Clean Sky is well on track. At present, 'testing' is more and more a key word, with several important dedicated test facilities ready to support on-ground and in-flight demonstrations. Out of the many demonstrators of variable size to be run, the first two are already a reality - a turboshaft engine and a large aircraft engine.

PROMISING RESULTS

The progress of the environmental objectives is periodically monitored through a "technology evaluator" at different levels of aggregation: aircraft, airport, global fleet. Clean Sky is delivering the goals initially set in details for each category of aircraft; in summary it is estimated that the technology developments already made or in progress could reduce aviation CO_2 emissions by 20% to 30% with respect to baseline levels, i.e. the situation in the year 2000 (an aggregate reduction of 2 to 3 billion tonnes of CO_2 over the next 35 years). Clean Sky is working in all technological disciplines linked to its objectives, i.e. most of the disciplines involved in the aircraft design: improving propulsive efficiency, improving aerodynamics, designing lightweight structures, defining more efficient on-board energy management, optimising mission and trajectories.

Examples of large aircraft, regional aircraft, rotorcraft, engines, systems and eco-design are now available. One flagship project of Clean Sky is the counter-rotative open rotor. Another is the wing natural laminarity demonstrator. In addition to these, two full engine demonstrators have already been started: a large engine (Trent family by Rolls-Royce), with new low-pressure spool and integrated dressings, which will be flight-tested this year, and a turboshaft engine, aiming at a 15% CO_2 reduction and a Diesel engine for light rotorcraft aiming at a CO_2 reduction of 35%.

Clean Sky also involves a series of activities in the field of more electric aircraft, mainly focused on bleedless engine enabling technologies: development of electrical environment control system technologies, anti-icing, de-icing electro-mechanical technologies and also, on a different mode, green taxiing.

Not least, Clean Sky is developing composite structures for regional turboprop aircraft with a significant impact on aircraft weight, leading to reduced fuel consumption.

CLEAN SKY 2 – HEADING EVEN FURTHER

With an even larger budget, improved environmental goals, and an expected positive impact on European competitiveness, Clean Sky 2 is ready to take off. The new programme involves

€4 bn of research activity within a coherent programmatic approach. Both the European Commission and the aeronautics industry have made an effort to raise the bar and give ourselves the means to meet our ambitious objectives.

From a technical viewpoint the programme will introduce further integrated demonstrations and simulations of several aircraft systems at the aircraft platform level. Innovations from Clean Sky 2 will underpin advances in the next generation of aircraft by mastering the technologies and the risks in time to meet the next market window to replace the current fleet. Clean Sky 2 will be a core European programme which will be leveraged by further activities funded at national, regional and private levels. This will allow us to fully realise the environmental objectives of the Advisory Council for Aeronautical Research in Europe (ACARE) for 2020, which are to demonstrate technologies at the highest possible maturity to reach the 50% CO_2 reduction target. Clean Sky 2 will bring these technologies to a still more complex and more representative level of integration at engine and aircraft levels. Beyond this, Clean Sky 2 will pave the way for the next generation of breakthroughs, reaching for a 2035 horizon in accordance with the new ACARE's Research and Innovation Agenda.

Clean Sky 2 is certain to deliver benefits for European citizens, for the EU economy, for the scientific community, for the Member States, and for the aeronautics sector and small and medium companies (SMEs) in particular.

The programme offers more opportunities for innovative research centres and SMEs. For countries without an established aeronautic industry, Clean Sky 2 will still represent an important opportunity. Increasing numbers of entreprises with a non-aerospace focus are successfully finding their way into the innovation chains via the Calls for Proposals thus creating new fields of opportunity for the SMEs and also creating new potential supply chains for the established industry players.

Clean Sky will be present at ILA Berlin and Farnborough Airshows in May and July not only to showcase its results, but also to introduce the new programme to all those interested. Get involved!

Contact details:

www.cleansky.eu

Towards greener regional aircraft

The Fluids, Vibration & Acoustics Research Group in the School of Engineering in Trinity College Dublin has pioneered research for many years in modelling and analysis of flow/structure interaction including aeroacoustics and vibroacoustics. The group has participated in all the framework programmes and to date has been involved in 18 European research projects relating to aircraft noise reduction.

Most recently the group has become involved in the most ambitious aeronautical research programme ever launched in Europe, namely the Clean Sky Joint Technology Initiative. Clean Sky's mission is to develop breakthrough technologies to significantly increase the environmental performance of aircraft and air transportation, resulting in quieter and more fuel efficient aircraft, hence making a key contribution to achieving

Members of the WENEMOR consortium with Project Officer Andrzej Podsadowski (Clean Sky) and Topic Manager Massimiliano Di Giulio (Alenia Aermacchi)

the Single European Sky environmental objectives.

Within the group the Clean Sky research team is led by Dr. Gareth J. Bennett and Dr. John Kennedy. The team is currently coordinating three major international research projects issued as calls for proposals from the Green Regional Aircraft domain of the Clean Sky program. The first of these projects: WENEMOR, has investigated the noise implications of an innovative, fuel efficient engine design which employs a counter rotating open rotor (CROR). This technology was rejected in the past partly due to noise level concerns but with advances in airframe and engine design is it now possible to reap the benefits of this more environmentally friendly technology. The experimental database produced by the project is the most extensive available and is currently being used to validate advanced numerical codes simulating CROR acoustics.

In addition to the redesign of aircraft engines it is also possible to reduce noise through the application of advanced noise abatement technologies to the airframe. ARTIC and ALLEGRA are also projects coordinated by Trinity which aim to reduce landing gear noise which contributes up to 30% of the overall noise emission of an aircraft during the take-off and approach phases. These projects are investigating multiple low noise technologies applied to full and half scale landing gear models in two of Europe's leading aeroacoustic wind tunnel facilities.

The advancement of European society is dependent on safe, efficient, and environmentally-friendly technologies. It is an on-going challenge for European aerospace industries to meet customer and legislative requirements, satisfy societal demands and sustain competitiveness in the global arena. Clean Sky is a dedicated funding program which helps industry address these challenges.

By acting as coordinator universities such as Trinity College Dublin have shown that they can not only provide solutions to these issues through fundamental scientific research but that they can also successfully manage these ambitious collaborative engineering projects. In addition, activity within these projects is integrated with world leading graduate level education at TCD. This enables researchers to develop skills targeted at the needs of the European aerospace community and by linking with SME's we can help build the necessary skill base to meet these challenges over the coming decades.

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WENEMOR
Call - SP1-JTI-CLEAN SKY-2010-4
Topic - JTI-CS-2010-4-GRA-05-005

ALLEGRA
Call - SP1-JTI-CLEAN SKY-2011-3
Topic - JTI-CS-2011-1-GRA-02-017

ARTIC
Call - SP1-JTI-CS-2013-01
Topic - JTI-CS-2013-01-GRA-02-021

May the Force be with you!

By Luc Tytgat

Thrust is a reaction force described by Newton's laws when a system expels mass in one direction, the accelerated mass will cause a force of equal magnitude in the opposite direction on that system. Powered aircraft use this flight principle by pushing the air mass out of the back of the engine and where Thrust overcomes Drag allowing aircraft to move forward and therefore creates wing aerodynamic Lift to cancel out the aircraft's Weight for vertical suspension.

Basically, overall efficiency can be determined by the aircraft configuration as a whole by considering airframe, jet engine and fuel used under specific operational context. As a long standing strategy to address movement of cargo and people, hydrocarbon based fuel coupled with oxygen combustion principle are at the heart of the aeronautical industry concerns as aircraft is developed and supported according to systems that use air contained oxygen to convert liquid fuel energy into mechanical energy to perform work.


Luc Tytgat

This context applies to piston and jet engine aircrafts that use combustion of hydrocarbon fuels and since the introduction of commercial aircraft in the 1950s, the struggles to challenge gravity and aerodynamics, the recent issues of environmental impacts (in term of CO2 and noise emissions), the transportation demand, the evolution of operational use and the rising fossil fuels costs, all of these have contributed to driving aviation innovation towards new frontiers. Since then, it is well recognized by experts that, nowadays, aircraft's overall efficiency has improved by 70% and the prospect for further gains of 1.5% annually up to 2020 is foreseen by engine manufacturers. However, the 1.5% annual target sparked controversy on the limited and finite technological improvement and I can't resist highlighting that improvement has somehow stagnated over the past two decades underlining the too optimistic prediction. Arguably, this stagnation reminds us that aircraft can never achieve zero fuel consumption and this suggests that air-breathing propulsion (combustion) is at a critical crossroads as an old concept was made better with new technology which has rather reached its limits for improvement.

It would not be fair to say nothing has changed over the last few decades; earlier improvements were unnoticed because they focused on building better and quieter engines with higher performance and improved fuel consumption. There have also been breakthroughs in computer controls and fly-by-wire systems, which make a big difference to the pilot and aircraft performance, but not to the passengers. And in recent years, the biggest development has been the use of strong, but lightweight plastics and composite materials rather than metals, reducing the weight of planes and the amount of fuel burnt. Both giants Airbus A380 and Boeing Dreamliner are now representative of these innovations.

As far as the core part of the aircraft is concerned, i.e. the powerplant, engineers have put their biggest efforts into tackling new requirements and challenges, still through using conventional force: CFM aero-engine manufacturer developed exclusive powerplant for Boeing 737 Max family where fuel efficiency is optimized in maintaining reliability and maintenance costs legacy of the CFM56 family. General Electric sets new standards for low cabin noise, low emissions and fuel consumption performance. Pratt & Whitney is matching fuel efficiency and ease maintenance. Rolls Royce minimizes operating costs and carbon emissions for the latest aircraft family from Airbus. SAFRAN developed

and optimized emerging requirements in the business aviation market with simplified architecture, reduced parts and maintenance costs, lower specific fuel consumption with associated benefits of low noise and emissions (open rotor).

One thing that strikes me is why are there no other propulsion forces commercially available? What are the perspectives for a new force other than the one generated by combustion phenomena?

At a first glance, we are all bound by the basic Lavoisier's law where nothing gets lost, nothing gets found and everything gets transformed, therefore propulsion force is not taken for granted. If there would be a new force, it should make up our minds to accept new concepts at acceptable costs and safety levels or new systems that are out of the conventional way for propulsion and this would pave the way forward to transform the so called conservative aviation landscape in which most airliners have combustion engines, two wings, a cigar-shaped fuselage and a trio of vertical and horizontal stabilizers at the tail. To achieve a radical step change in the commercial aviation, one must reconsider the powerplant as the conditional parameter at the heart of the equation.

Engines that are under investigations range from the extreme to the slightly more conventional. As examples, the idea to complement core powerplant with electric power source (hybrid propulsion) for small aircraft has been conceptualized and studied by EADS and Rolls-Royce on a new type of propulsion system: Distributed Electrical Aerospace Propulsion (DEAP) to cut noise and CO2 emission levels, as well as dramatically reduce fuel. Similarly, Boeing's Sugar Volt concept, for example, would also use a hybrid-electric propulsion system that combines fuel-burning (turbine) engines, electric motors and electrochemical storage batteries, a propulsion concept not totally unlike that inside a Toyota Prius. The hybrid system would allow airlines to choose to draw engine power from the turbines or the batteries, whichever provides the most benefit for the specific segment of the flight (taxiing, take-off, landing, cruises, and so forth). Studied by MIT (Massachusetts Institute of Technology), electrode ionic wind thruster uses ionized air to produce thrust more efficiently (electrodynamic thrust) without any moving parts.

Other promising propulsion methods are conceptualized by the aerospace industry like nuclear/fusion/antimatter propulsion. These have significant energy efficiency advantages but also present major drawbacks: High energy photons are gamma rays (like X-Ray) which are harmful to molecules in human cells. The problem will be overcome by developing newer materials to put as much shielding on the powerplant and by designing the aircraft's servicing equipment to thereby reduce radiation to a negligible amount. Another potential alternative propulsion for the future is the development of electromagnetism engines that would result in major technological advantages, notably, oil free operation with no air requirement, no bearing contact, less or no noise, less maintenance, operational capabilities in extreme temperature environments and active control. The magneto-plasma-dynamic (MPD) thruster is known as the most powerful form of electromagnetism propulsion in converting electric power into thrust.

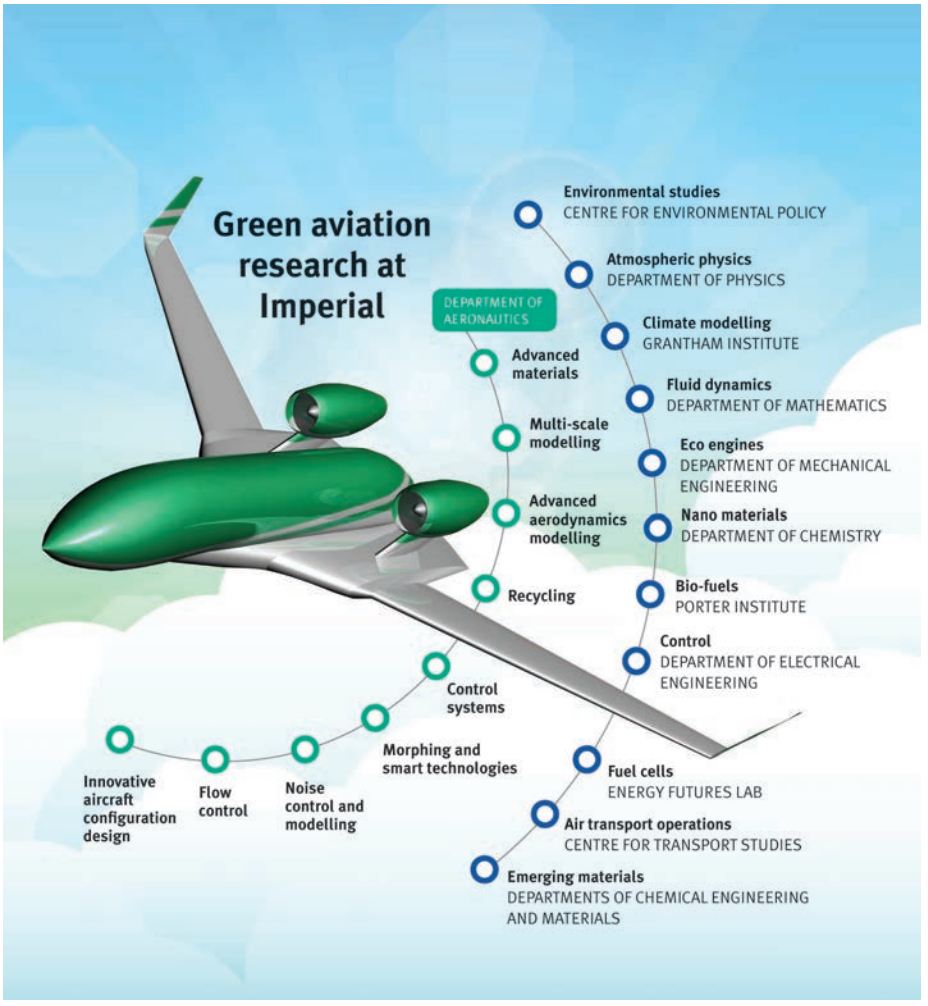
Given the new concept of engines(other than conventional propulsion) that needs to be considered, the technical difference between current engines and the new type being envisioned could be so significant that one could not just replace standard engines with new ones; instead a whole new class of aeroplane would have to be designed around new engines. In the long run, the aeronautical industry would adopt a new concept of airframe and accept to adapt and integrate avionic systems to the potential new concepts of propulsion. In fact, overall the technology seems to be there and while test and exploratory research programs were successful, there were other programs which were not. This is evidenced by a number of programs that were begun at a large cost of time and funding and then dropped when the programs went through one of its many reorientations. Therefore, as lessons learnt, we should determine which technologies are worth pursuing in light of what would be the future operational picture of commercial aviation; those that might get us somewhere near our goals.

Green Aviation Research at Imperial College London

By Professor Paul Robinson, Director of Green Aviation, Department of Aeronautics, Imperial College London

Imperial College London has been at the forefront of aeronautical research since the very early days of powered flight and much of the current research is focussed on the development of technologies that will deliver greener air travel for future generations.

This research draws on the expertise and facilities of College's internationally leading Aeronautics Department together with those of its other pre-eminent engineering and science departments and its specialist cross-disciplinary centres in areas such as transport systems, composites, climate change and bio-fuels. The research is extensively supported by national and European funding bodies (including EPSRC, TSB & EEC), and by industry, and addresses such diverse topics as active and passive drag reduction, air traffic management, modelling for advanced composite airframes, optimisation of jet engines, climate change modelling, structural health monitoring, suppression of combustion instabilities for quieter engines, biofuels and the development of next generation multifunctional composite materials.

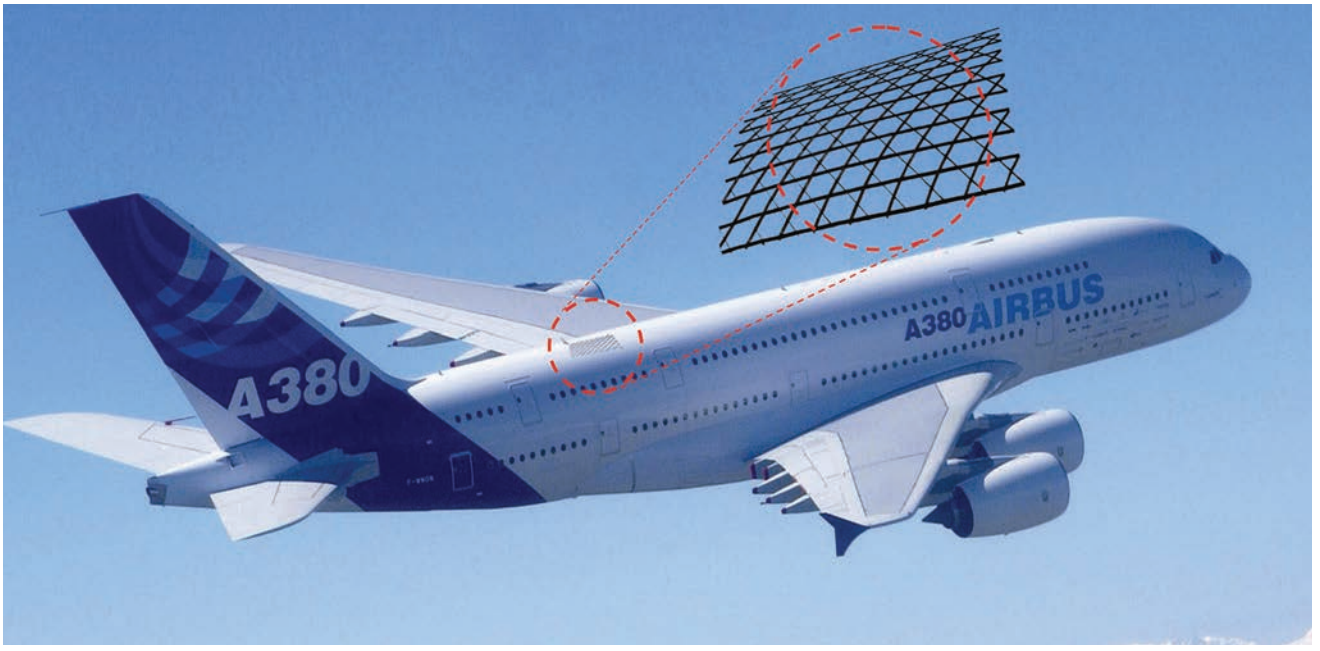


INVESTING IN FACILITIES

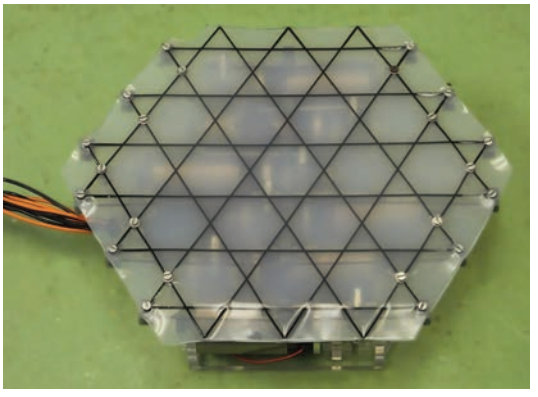
The Department of Aeronautics has state-of-the-art facilities to support these green aviation research activities including high quality wind tunnels equipped with advanced instrumentation, specialist manufacturing, testing and inspection facilities for composite materials, and advanced equipment for low and high velocity impact. These facilities have received a significant boost with the success of a £13m EPSRC proposal led by the Aeronautics Department for the establishment of a National Wind Tunnel Facility to keep Britain at the forefront of experimental aerodynamics research. £4m of the award will be used to enhance the wind tunnels at Imperial.

Improving aircraft efficiency with dynamic skins

A) Friction between the air and the skin of an aeroplane accounts for about half the fuel consumption. Finding new ways to reduce skin friction is an important step in making aircraft more efficient.



B) The Kagome lattice pictured (right) has unique properties which make it highly suitable for propagating vibrations in a controlled way. These vibrations modify turbulence and help to reduce drag.



TRAINING THE DESIGNERS OF FUTURE GREEN AIRCRAFT

The Aeronautics Department at Imperial is the UK's leading provider of aeronautical engineering training at undergraduate level and also runs flagship postgraduate MSc courses in computational techniques for fluid mechanics and fluid-structure interaction, and in the science, technology and engineering of advanced composites. Both of these MSc courses produce graduates with specialist knowledge and skills essential for addressing the demanding environmental issues facing aviation. This year an Advanced Aeronautical Engineering MSc course has been launched to train existing engineers in the fundamentals of new enabling technologies required for 'greener' aircraft.

Imperial has a large population of PhD students engaged in green aviation research and this has been expanded recently with the award of a prestigious EPSRC Centre for Doctoral training in 'Fluid Dynamics across Scales'. Over the next five years this centre will train 75 additional PhD students many of who will focus on computational and experimental aerodynamics for more efficient future aircraft.

ENGAGING WITH THE GREEN AVIATION COMMUNITY

The Green Aviation Forum at Imperial led by the Department of Aeronautics has run two very successful symposiums (Green Aviation 2011 & 2012) in which aviation sector leaders have addressed large audiences of specialists from industry, academia, government and the press on the steps being taken to reduce the environmental impact of future air travel. The next symposium is to be held in Beijing in collaboration Beihang University. There will be speakers from a selection of Chinese aviation organisations and from leading international aerospace companies to ensure a truly global perspective.

Further information

www.imperial.ac.uk/greenaviation

New horizons in aviation

By Dr Naresh Kumar, ACARE Communication Group Chair

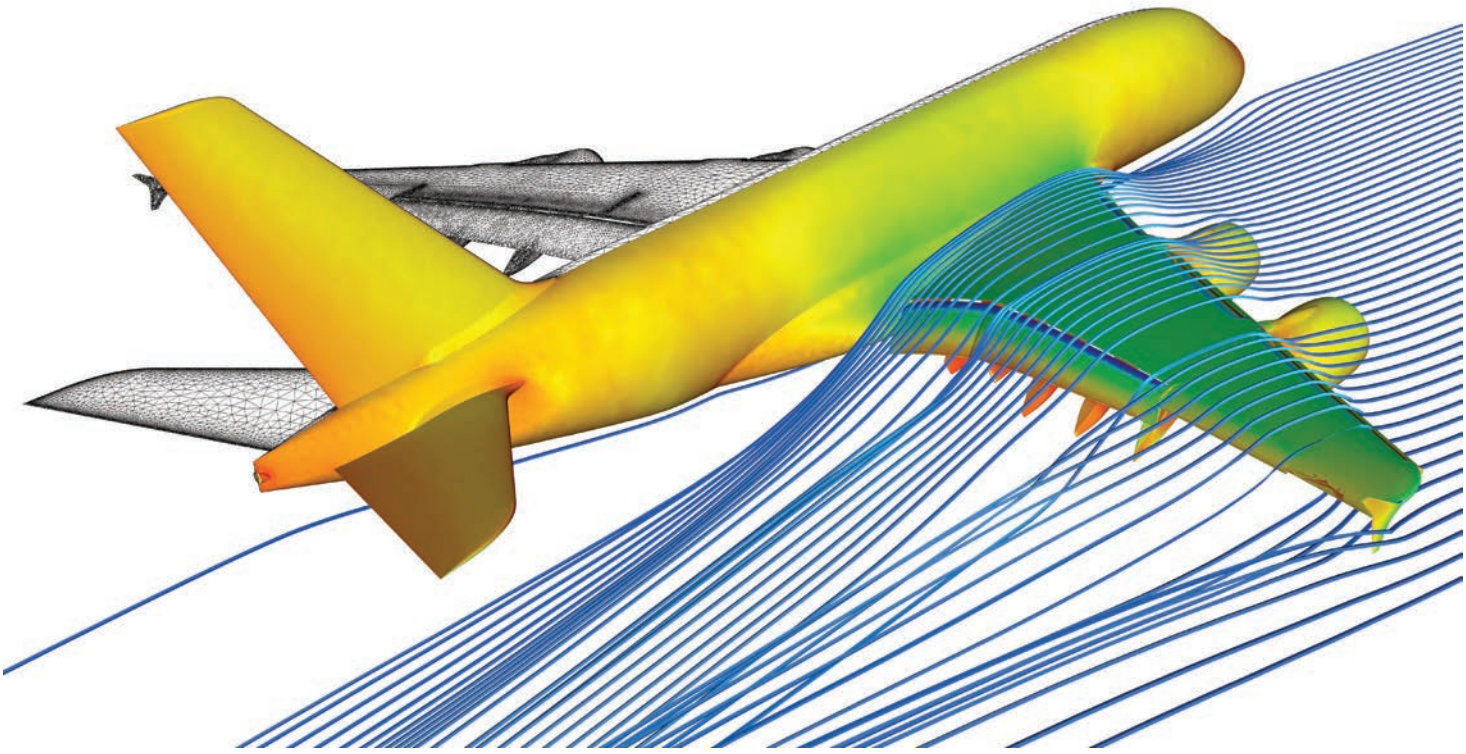
Back in the nineties the aviation community realised that the anticipated increase in aviation traffic could not be supported by existing systems, particularly in Europe without profound and unacceptable penalties.

Launched in 2001 to serve as a platform for aviation stakeholders, the Advisory Council for Aviation Research and Innovation in Europe (ACARE) has come a long way in addressing two top-level objectives: to meet society's needs and achieve global leadership in aviation for Europe.

Substantial results have been achieved since the formation of ACARE with hundreds of wide ranging projects[1] conducted in Aeronautics and Air Transport across the European community. ACARE continues to play a pivotal role in providing strategic advice to the European Commission's Aviation Platform, which includes strengthening the competitiveness of the European industry by expanding the market to a common aviation area with the neighbouring countries, determining and planning priorities for future air transport policy initiatives, analysing challenges and solving problems to ensure the development of the sector.

Flightpath 2050[2], published in 2011, describes the vision for aviation. It underlines the need for further emissions reductions, recommended maintaining and extending Europe's leadership, improving safety and security as air transport needs grow as well as developing excellent research infrastructure and education for the sector. The goals include such challenges as "90 per cent of travellers within Europe able to complete their journey, door to door, within 4 hours" and "Air Traffic Management to be able to handle 25 million flights per year", compared to around 10 million today.

In 2012, ACARE stakeholders published the Strategic Research



and Innovation Agenda (SRIA), containing a detailed roadmap that enables the aims of the vision for aviation to be achieved.

Aviation today provides close to nine million skilled jobs, directly and indirectly, and contributes 600 billion Euros to Europe's Gross Domestic Product. Home to some 450 airlines and over 700 airports, European aviation plays a key role in serving society's needs for safe, secure and sustainable mobility – in Europe and all over the world. Continued growth in European demand for air transport is anticipated for the foreseeable future. More than ever, sustainable mobility is at stake and it is essential that travel become even safer, secure, reliable, affordable and environmentally responsible.

In particular, aviation has an important role to play in reducing environmental emissions. Although it is responsible for around 2% of human-induced carbon dioxide emissions globally it plays an important role in mitigating greenhouse gas emissions, noise and local air quality issues. Demand for air transport continues to increase, meaning that air travel in the future will look very different than today to ensure that this growth is addressed in a sustainable way.

Competition is fierce and increasing, not only from established regions but also from new, strong challengers and regulatory and taxation environments within and outside Europe have not yet fully converged and so do not yet provide a global level playing field. Maintaining global leadership for aviation in Europe and meeting the needs of citizens thus remain the top level objectives addressed by 'Flightpath 2050.

The aviation industry is currently experiencing several issues which can largely be resolved through technological innovation. The immediate priorities for ACARE are as follows but not limited to: Enable future growth (addressing Seamless and affordable ATM processes; Airport capacity; Passenger experience and door-to-door mobility/intermodality); Reduce environmental impact (by reducing the CO2 footprint and mitigating air transport related noise); and, Excellent skilled and motivated staff in order to continue the track record that ACARE is established since its formation.

The task now for ACARE is to stimulate the implementation of the SRIA - through the excellent European research and innovation capabilities and to deliver measurable benefits in phases to 2020, 2035 and 2050. This is an exciting phase for ACARE and as in the past progress will be monitored and reviewed so that adjustments can be made where required as changes occur in the market place and society's expectations develop further and, of course, as discoveries from research emerge.

To find out more visit: www.acare4europe.org

1. See "Success Stories and benefits beyond aviation" on www.acare4europe.org
2. Flightpath 2050, Europe's vision for Aviation (http://ec.europa.eu/transport/modes/air/doc/flightpath2050.pdf)

Fuel Efficiency For Cost Reduction And Increased Profitability: The Role Of Aviation Software

AVIATION: A GROWING MARKET

When Siim Kallas, Vice President and Commissioner for Transport, spoke to the European and Economic Social Committee in May, he emphasised the importance of aviation to Europe's peoples and its businesses. Underlining his observations, global passenger numbers increased by almost a quarter during the period 2007-2012, with IATA forecasting them to rise by over 30 percent over the next five years. Accompanying this growth is a relentless rise in the consumption of jet fuel (see figure below), the price of which is also rising (see figure on page 25). Fuel currently represents as much as one third of airline operating costs, a proportion that has more than doubled since 2001, increasing further the pressure on profit margins and creating a major incentive to improve fuel efficiency.

ENVIRONMENTAL IMPACT

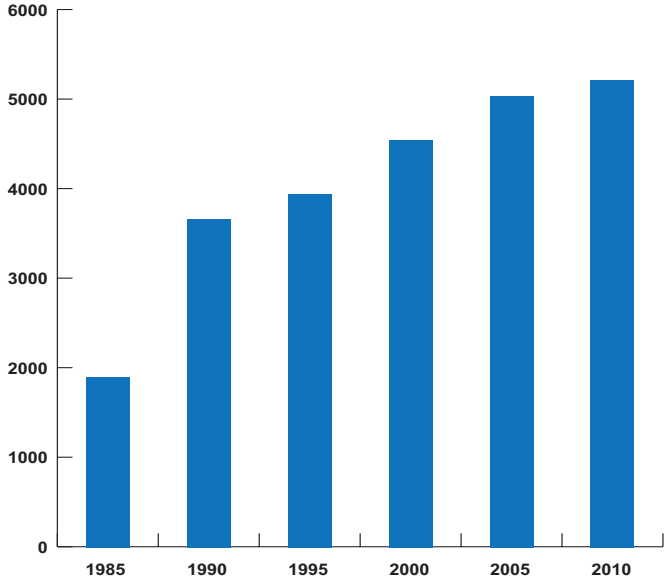
One return flight from London to New York generates roughly the same emissions as heating the average EU home for a whole year, and aviation now accounts for about 3% of total EU emissions. Global CO_2 production by this sector (some 689'000'000 tonnes in 2012) is expected to grow sharply: the ICAO estimates that the level of emissions produced in 2010 will double by 2020, triple by 2030 and be six times higher by 2050 if no measures are taken to control this growth.

THE RESPONSE OF THE AIRLINE INDUSTRY

Operators seeking to benefit from the growth in air traffic now face strong legislative, environmental and economic pressures, including numerous energy-related initiatives such as the European Emissions Trading System (EU-ETS). In response, IATA has proposed a Four Pillar Strategy based upon Technology, Operations, Infrastructure, and Economic Measures (see figure on page 25).

Of the IATA four pillars, operations improvements such as increased fuel efficiency are attractive because potentially rapid returns can be made on relatively limited investment. According to IATA, airlines with successful fuel efficiency programmes "can reduce their overall fuel budget by 3% to 5%", which is significant when compared to the usually thin airline profit margins. To help airlines significantly reduce fuel consumption and CO_2 emissions, and to set-up efficient fuel conservation programmes, IATA has compiled its Guidance Material and Best Practices for Fuel and Environmental Management (currently in its 5th edition). In this book, IATA highlights that the availability of appropriate analytical tools and statistics is essential for a successful fuel conservation programme. In order to save fuel, the first requirement is transparency on how fuel is spent. By analysing data related to fuel consumption, an airline is able to discover areas of operations having fuel saving potential. Second, ongoing monitoring of different fuel saving initiatives helps to determine if what is planned is actually being delivered. Where there are deviations, countermeasures need to be initiated in a timely manner addressed to the responsible stakeholders.

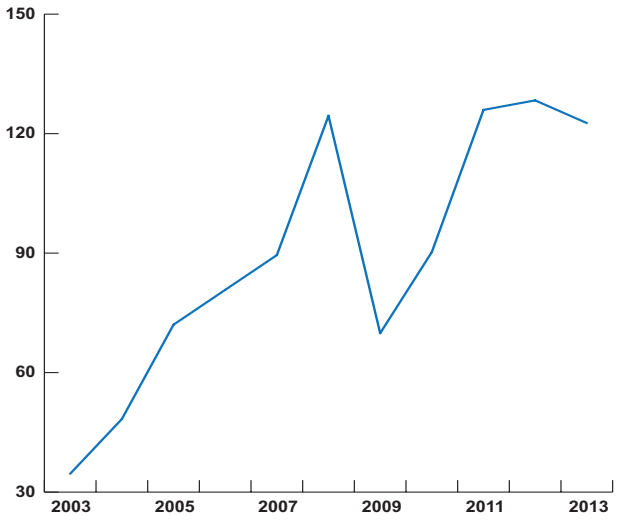
World jet fuel consumption (thousand barrels per day)
Source: United States Energy Information Administration



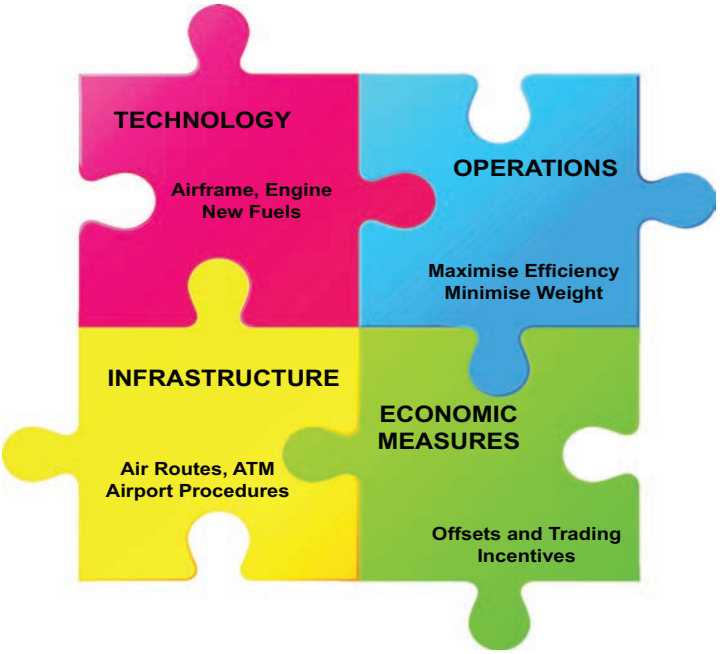
Several software companies specialise in the development of airline fuel efficiency solutions. The leading provider in terms of technology, number of airline clients served, and total number of aircraft monitored is Switzerland-based Aviaso (www.aviaso.com). "Transparency is key to successful fuel saving programs", says Rudolf Christen, CEO of Aviaso. "We help airlines save fuel by pinpointing the areas where savings could be achieved and then we monitor the implementation progress in time."

The Aviaso Fuel Efficiency software is essentially a data warehouse that collects data from various airline IT systems including data coming directly from the aircraft such as FDM/FDR data. More than 1000 parameters are stored in the database for each flight. Airlines perform very many flights per year with their many aircraft. Comparing several years of such data then results in a huge volume of data of up to several billion of data elements. This data is thoroughly checked by the Aviaso software for quality, and erroneous data can be either corrected or excluded from analyses. Then, powerful analyses are available to help airlines discover their true fuel savings potential. Based on these analyses, airlines are selecting which fuel saving initiatives to implement. Finally, the software continuously monitors the initiatives to ensure that the airlines are really achieving their fuel savings.

JET FUEL PRICES (US Gulf Coast Jet Fuel) (USD/barrel)
Source: United States Energy Information Administration



IATA Four Pillar Strategy to address climate change



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DATA SOURCES

http://europa.eu/rapid/press-release_SPEECH-14-385_en.htm
http://www.atag.org/facts-and-figures.html
http://ec.europa.eu/clima/policies/transport/aviation/index_en.htm
http://www.icao.int/Meetings/a38/Documents/WP/wp026_en.pdf
http://www.iata.org/pressroom/facts_figures/fact_sheets/pages/environment.aspx
http://www.aviaso.com

Setting the targets for sustainable growth in aviation

By Haldane Dodd, Air Transport Action Group, Geneva

In the aviation sector, fuel efficiency and cost reductions run hand-in-hand. As Haldane Dodd of the Air Transport Action Group explains, the incentive for the industry to run more efficiently is more than just a sense of environmental obligation.

Fuel makes up over a third of airline operating costs – the world's carriers spent over $211 billion on jet fuel last year and the long term trend on the fuel price is upwards. There is a definite fiscal incentive for airlines to reduce the largest of their expenses.

Aircraft designers, too, have long strived for fuel efficient new models of plane and the major sales pitch between manufacturers is the efficiency of each new design. In fact, aircraft entering today's fleet are well over 70% more fuel-efficient than they were in the 1960s and most of the industry's current research and development (R&D) initiatives are dedicated to ensuring this trend will continue for generations to come.

The investment is significant. It is estimated that the civil aerospace industries in Europe and North America alone spend over $20 billion each year on R&D, most of which will bring about emissions reductions. Over the next few years, a new range of lean-burning engines will enter the market along with lighter but stronger airframe materials and electrically-driven aircraft systems which will replace today's heavy mechanical and hydraulic power units – lowering fuel costs further. There is an important spin-off to this economy drive – each tonne of fuel saved also means 3.15 tonnes fewer carbon dioxide (CO_2) emissions.

While airports and air navigation service providers have been working on reducing emissions from their own operations (see, for example, the excellent Airport Carbon Accreditation programme), there is no direct financial incentive for an airport or air navigation service provider to help an airline reduce fuel costs – despite emissions from aircraft operations making up over 95% of the industry's impact. However, in the last five years, we have seen a phenomenal increase in efforts by all parts of the aviation sector to work with each other to reduce emissions… and it all started at the top.

SETTING TARGETS

Our track record on fuel and emissions reduction is one of which we can be proud. Technology and operational measures deployed since 1990 alone have allowed the industry to avoid over five billion tonnes of CO_2. But with the growth in passengers and traffic, the industry realised a more strategic focus was needed to reduce emissions further.

At the 2008 Aviation & Environment Summit in Geneva, industry leaders took the unprecedented step to sign an agreement on our path forward for reducing emissions by working in partnership across the industry. This declaration was followed by a set of comprehensive targets, the first for any sector:

(1) From 2009 until 2020: average 1.5% efficiency improvement per year

The industry is using a four-pillar strategy (see below) to further increase its fuel efficiency by a further 17% over the first decade. One of the most important parts of that strategy is the introduction of new technology – the biggest impact of which comes through replacement of older aircraft in the fleet with newer, more efficient ones. This is not cheap. To keep to the 1.5% fleet efficiency improvement target, the world's airlines will need to invest in around 12,000 new aircraft by 2020 at an estimated cost of $1.3 trillion.

(2) From 2020: Capping emissions growth from aviation

The aviation sector has agreed to cap its net emissions at the 2020

level. From this point on, any emissions the aviation industry is unable to reduce through operational, technological or infrastructure measures, or by using sustainable alternative fuels, will need to be offset by market based measures.

(3) By 2050: halving net emissions based on 2005 levels

After 2020, the industry will start seeing some of the larger emission reduction possibilities of advanced technologies and sustainable aviation fuels. These two major factors, as well as continuing work on infrastructure and operations efficiency, will allow the industry to aim for the most ambitious goal: to ensure that net carbon emissions from aviation in 2050 will be half of what they were in 2005, or 318.5 million tonnes of carbon, despite the growth in passenger numbers and cargo.

FOUR STEPS TO CUTTING AVIATION CO_2

1. Technology innovation. Each generation of aircraft is around 20% more fuel efficient, and over the next decade airlines will invest $1.3 trillion in new planes. Sustainable alternative aviation fuels, already being used on a small scale in commercial flight, will have the potential to cut emissions by up to 80% compared to traditional jet fuel.
2. Operational improvements. We're making the current fleet lighter and more efficient and using new air traffic control techniques to save emissions. For example, landing using a continuous descent into an airport saves at least 150 kg of CO_2 per flight. Adding wingtip devices to an aircraft can reduce fuel use by 4%.
3. Infrastructure efficiencies. Shortening flying times by a minute saves at least 100kg of CO_2 per flight. Reformed air traffic management systems in the United States and Europe will significantly cut emissions, as long as there is the political will to carry them out.
4. Smart economic measures. Economic measures are a part of our strategy until technology and more efficient operations achieve our targets. We are working with Governments to design a global market-based measure through the International Civil Aviation Organization that accounts for emissions only once and ensures that passengers do not face multiple layers of taxation.

SUSTAINABLE GROWTH

Efforts to stablise and eventually reduce emissions from air transport are a priority for the global aviation industry. While some outsiders point to the fact that aviation contributes some 2% of global emissions as an excuse for not making aviation a priority focus, industry leaders have agreed that taking decisive and long-term steps to reduce emissions are an important part of securing the sector's permission to grow in the future – an important growth factor in many economies worldwide.

With air transport currently supporting over 58 million jobs and $2.4 trillion in global economic activity, the growth of air transport provides a catalyst for economic development in other areas of the economy. Over a third of world trade by value is sent by air cargo. Over three billion passengers and 52% of international tourists travel by air each year. And in recent analysis by Oxford Economics for the Air Transport Action Group, air transport is forecast to support over 100 million jobs in 20 year's time. So a clear message we have been sending to governments is to support the growth in air transport, but that growth must be accompanied by sustainable growth strategies and with the necessary international and local building blocks in place.

For more information, readers might be interested in the website www.aviationbenefits.org

FANTASSY Project

Future Aircraft design following the carrier-pod concept as an enabler for co-modal seamless transport, passenger safety and environmental sustainability

Air transport has essentially been "shrinking the planet" and changing the landscape in terms of economic and societal conditions for the last 100 years. The anticipated growth of air transport carries along challenges and opportunities in various aspects of life, from economics to the environment. Currently, one of the most challenging areas of aeronautical research is the air-vehicle itself, mainly in what concerns its form and operation as passenger aircrafts have kept more or less the same basic design since the 40's.

For the air-transport of the future several pioneering ideas meant for introducing radical changes in the air-transport system have been proposed. The idea investigated within the frame of the FANTASSY project is the design of the aircraft as a combination of a "carrier" and a "passenger pod". The carrier is a wing platform with aerodynamic and stability devices and the passenger pod is an "independent", detachable fuselage structure where the passengers are placed. The concept follows the fundamentals of modular design, developing pods which can be utilized by both railway and aviation. The benefits from such a concept are multiple:

1. Inter-modal passenger transport. The passenger/ cargo modules will be engineered in order to be compatible with both rail and air transport modes.

2. Increased flexibility in aircraft configuration and fleet management.

3. De-centralized airport facilities - Expansion of hubs by operating from runways reachable through a rail system, which are distributed around large metropolitan areas.

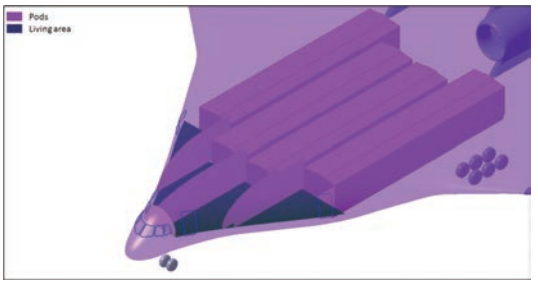
4. Faster and easier passenger loading.

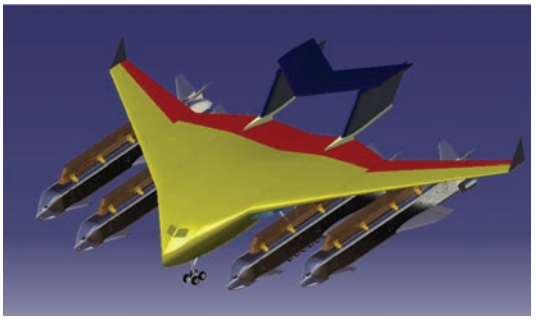
5. Evacuation of the aircraft in case of an emergency that threatens the survival of the craft and its passengers. The "pods" could be released and safely landed using various measures (parachutes, air-bags etc)

6. Increased flexibility in maintenance as the carrier and pod may enter scheduled or un-scheduled maintenance independently leading to a smoother operation of the overall system.

7. Energy efficient door-to-door transport services and greening of the overall transport system

From Conceptual to Preliminary Design, many aircraft layouts were investigated, in terms of weight distribution, efficiency, emissions and fuel consumption. The final layouts are 2 aircrafts with different characteristics. The Internal Pod Configuration (IPC) is a blended wing with high aerodynamic efficiency as the pods are located inside the carrier, suitable for Long range operations. The External Pod Configuration (EPC) is a blended wing with externally attached passenger pods,





suitable for regional destinations. It is envisaged that pods can be released in flight in extreme emergency situations and land safely using a fly by wire avionics system. Powered versions of the pods can be also considered that will distribute the passengers in different destinations. The pods can be adjusted to the current European railway/subway, improving the transportation in Europe.

The project consortium consists of the Applied Mechanics Laboratory/University of Patras (GR-coordinator), the National Aerospace Laboratory of the Netherlands - NLR (NL), INASCO SA (GR) and Piaggio Aero (IT).

Project funded by the EU under FP7-AAT-2012-RTD-L0, GA no:309070

Towards greener skies

By Simon McNamara, Director General ERA

The aviation industry is committed to addressing its impact on the environment and has set itself ambitious targets to work towards greener skies. 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 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.

It is important to remember that, despite an often, negative public image, aviation plays an essential role, both socially and economically, in an increasingly global world. It facilitates business, connects cultures, 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. These include reduced fuel usage, the increasing use of alternative fuels, carbon offset programmes, efficient air traffic management systems, innovative aircraft and engine design and the reduction of noise pollution.

Reduced fuel usage and the use of alternative fuels are both key factors in lowering actual emissions. Airlines have adopted a voluntary fuel efficiency goal to reduce fuel consumption and CO_2 emissions (per revenue tonne kilometre) by at least 25 per cent by 2020, compared to 2005 levels (source IATA).

Simon McNamara

The aircraft operators have developed many operating procedures that minimise fuel usage, for example, single engine taxing, 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. Studies have shown that in Europe a more efficient air traffic management system could reduce the industry's overall fuel burn by as much as 10 per cent.

Improved technology is also vital in reducing the carbon footprint of aviation. As fuel comprises such a large amount of direct operating costs aircraft and engine manufacturers invest considerable time, effort and money in developing technology that reduces fuel burn which, in turn, reduces CO_2 emissions. Each kilogram of fuel saved reduces CO_2 emissions by 3.16 kg (source, IATA). More efficient use of fuel is being achieved through new engine technology, lower weight aircraft and more aerodynamically efficient aircraft.

With regards to alternative fuels to jet fuel (kerosene) bio fuels are the only possible alternatives. Operators, fuel companies and regulators are working to develop bio fuels as a complimentary fuel source to existing carbon-based fuel. Flight demonstrations have taken place, but the challenge now is to industrialise the production of bio fuel and ensure that the infrastructure is available to supply the fuel to the point of use at airports.

Market-based measures, while not always the most effective method of improving an operator's carbon footprint, also have a role to play globally in combating aviation's negative impact on the environment. 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 recently been extended until at least 2016. 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 20 per cent or less of aviation CO_2 emissions in Europe meaning that itwill be environmentally ineffective while adding complexity and cost to European business for airlines to achieve compliance and verification of emissions.

The environmental impact of aviation noise is often concentrated within local communities and there are various initiatives under way to reduce noise nuisance from aircraft.

Considerable progress has been made in recent years in reducing the noise generated by aircraft, driven by technological and design improvements and control of operations at airports. For example, lining up aircraft with the runway as far as 70km away from the airport and then approaching in a continuous descent can more than halve the acoustic energy that reaches the ground, according to an international research consortium.

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.

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instituteofaviation
warsaw, since 1926

The Institute of Aviation

The Institute of Aviation takes part in numerous projects promoting a green aerospace industry.

Novel aircraft configurations are investigated at the Institute in a search for more efficient aerodynamics. New composite materials, their design techniques and manufacturing procedures are developed to decrease vehicle mass. Both types of efforts lead to reduced fuel consumption and lower pollutants emissions.

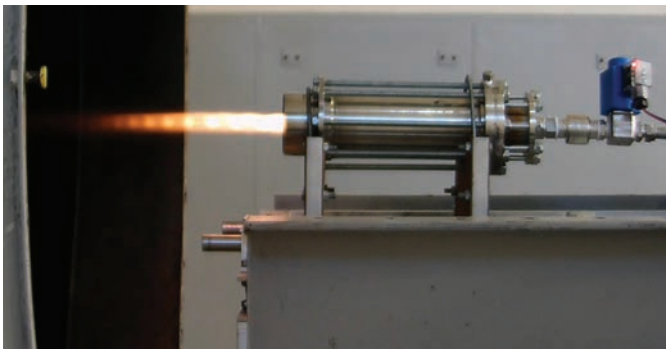
New concepts of multimodal transport are analysed at the Institute. These include the Small Aircraft Transport subsystem, which aims to enable energy-efficient, door-to-door travel, within 4 hours, between any two locations inside the whole EU, including areas where rail and highway transport is not justifiable due to very sparse passenger streams.

Advanced combustion processes are also investigated, detonation combustion in particular. This is much more efficient than the conventional process, so it should help decrease greenhouse gases emissions.

The Institute also works on developing green propellants technologies, including biofuels for aircraft and high-test peroxide for spacecraft. The former decreases the fraction of fossil fuels used by aviation, while the latter reduces the amount of toxic propellants applied in rockets and satellites.

Moreover, image analysis methods for pictures taken from air and space are developed to investigate the health of forests and other green areas. Such activities help protect the environment around Europe.

Right: Hybrid rocket engine using hight-test peroxide. Below: The Institue of Aviation. Bottom: Novel aircraft configuration investigated in the wind tunnel.



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The EERA: Aligning national energy research programmes within the ERA[1]

By Hervé Bernard, Chairman of EERA and Deputy CEO of CEA (FR)

The European Energy Research Alliance (EERA) supports the coordination of European energy research for a low carbon Europe. This is done by bringing research organizations to work together in the framework of the alliance's 15 EERA Joint Programmes (JPs). EERA has worked towards this direction since its birth in 2008 and during this time we have grown from the 10 founding organizations to more than 250 participating organizations actively involved in our 15 JPs.

Hervé Bernard

Today, EERA and its Joint Programmes is an acknowledge stakeholder in the SET-plan and the implementation hereof through Horizon2020. And beyond Europe, several of our JPs have also established themselves as important interlocutors for research and industry stakeholders from around the globe.

What is the reason for our success so far?

First of all EERA has benefited from being a recognized part of the SET-plan since its beginning. As the official public research pillar of the SET-plan, EERA has profited from having a clear policy framework and the visibility that it provides. As part of this, EERA has always benefited from a good and constructive dialogue with the European Commission including the Commission's financial support for the EERA secretariat.

Secondly, EERA has from its beginning had a unique focus on coordinating our research activities based on the institutions' own resources. The European Commissioner for Research and Innovation, Mrs Máire Geoghegan-Quinn stated at last year SET-plan conference in Dublin that

By aligning and coordinating the institutional and competitive funding committed under national research programmes, which accounts for 88% of the public research investments in Europe, we can better exploit our resources for maximum societal impact.

This is what EERA is all about: supporting research activities based on excellence criteria in order to focus partners' strengths where they are most efficient. Throughout the year, our Joint Programmes' participants are actively working together, meeting in formal steering committees, in scientific workshops or working together on pilot projects or updating each other on current state of the art in the various technologies. Through these activities we are providing our contribution to a better use of resources and to speed up the societal impact of our individual research activities.

In this way, European structuring for energy research seems to make good progress; we can

1. European Research Area.

find some promising indications thanks to the EERA activities. The EERA has accompanied the creation of national energy alliances in several countries: Spain, Italy, Belgium, The Netherlands and France. Those alliances contribute to the reflection about national energy programs, which are needed to build joint programming on the European level. A second positive indication is given by the recent reinforcement of the dialogue between the EERA and the Member states, represented by the steering group of the Set-Plan. Those links are of utmost importance to gain the support of national authorities for the alignment process of research programs. And last but not the least, we are really taking care that all the activities led inside EERA are relevant towards the whole innovation chain, especially with the European industries situated downstream of our research activities and with whom we are closely collaborating.

So far, so good. But EERA, the European Commission and the member states involved in the SET-plan steering committee all recognize that now it is time to take coordination in EERA to a new level.

The question is how and what impact EERA wants to achieve and through which additional means? What are the outputs expected from the EERA programmes? The discussion is currently ongoing at the EERA Executive Committee level and EERA is now defining its strategy and expected impact for the next years. Then, the EERA will have to select the right funding process to combine national contributions with the European Commission funding to support research activities as well as to implement an internal organization able to take over our new responsibilities.

The real challenge is that we have built a new instrument for European coordination. It is working, but we can do better. We – all EERA members, the European Commission, the Member states and all other stakeholders – have to make sure that we do not spoil the opportunity we have today to create an original and efficient tool answering to the challenges that Europe faces in ensuring secure sources of low carbon energy, the technological independence of Europe and the supply of critical materials for new technologies.

Of course, EERA knows that it will have to compromise with political requirements, sometimes opposing ones. EERA has to convince researchers and stakeholders that the chosen options are the right ones. This will be one of the major challenges for the two forthcoming years. But, we remain confident and open to all constructive debates.

About EERA

The European Energy Research Alliance (EERA) was launched in 2008 to support the implementation of the European Commission's Strategic Energy Technology Plan (SET-plan). EERA is a formally recognized pillar of the SET-plan together with the European Industrial Initiatives, the SET-plan Steering Committee as well as SETIS.

The EERA Joint Programmes are bottom-up initiated programmes aligned with the SET-plan priorities. Each Joint Programme brings together research communities in areas such as Smart Grids, Photovoltaics, Wind Energy, Geothermal and Smart Cities. In the Joint Programmes researchers exchange knowledge and collaborate on research projects.

For more information about EERA please visit www.eera-set.eu

The top ten research priorities for renewable energy

By Vinicius Valente & Greg Arrowsmith

The upcoming SET-Plan Integrated Roadmap (IR) will focus on the development of innovative solutions to address the needs of the European energy system for the forthcoming years. This strategic document, announced in May 2013 in the Communication from the European Commission on Energy Technologies and Innovation, intends not only to provide guidance to the second Energy Work Programme of Horizon 2020, but also serve as a basis for national action plans to be developed between the EC and EU Member States.

Representing leading research centres in renewable energy across Europe, EUREC has been involved in the process through the association's President, Dr Keith Melton, who is a member of the IR Coordination Group offering guidance on the evolving document.

This exercise has involved the updating of the individual SET Plan technology roadmaps in an attempt to cover the whole innovation ecosystem around different energy technologies. Once the Integrated Roadmap is finalised and published (expected in June) the onus will be on Member States to define the contribution they will make to implementing it, by providing funding and by ensuring that between them they cover all of the research actions proposed. In early 2015 a further Communication is expected outlining how far that process has got.

In meetings in Q1 2014 between Dr Melton and the European Commission staff involved in the SET Plan, it became apparent that the Commission was interested in boiling down the heap of input it was receiving into a list of priorities. To assist that process, EUREC presents below a list of current top 10 research priorities for renewable energy, aligning with the association's mission to promote and support the development of innovative technologies and human resource development to enable a prompt transition to a sustainable energy system.

The list below is not any particular order. These ten topics are considered priorities with respect to all other possible areas of energy research.

- **System integration of renewable energy and demonstration of innovative control systems at the domestic and district level.**

Improving network planning with a multi-network approach, including electricity, heating and cooling. An integrated network both at transmission and distribution levels is essential to account for new generation technologies based on renewables, innovative power technologies including electricity and thermal storage and network monitoring/control techniques.

- **Improved cost and performance of PV cells, modules, systems as well as new products for Building-integrated (BIPV) applications**

Advanced PV technologies and applications need to be developed to maintain technology competitiveness.

Emerging technologies need to demonstrate their added value in terms of cost, performance or unique application options and their viability in terms of manufacturability and stability.

- **Cost reduction and improved performance of Concentrated Solar Power (CSP) systems**

Heliostat field costs represent about 50% of the total CSP plant cost. Therefore, a significant cost reduction in the heliostat field will represent LCOE (levelised cost of electricity) cost reduction of 15 – 20% from CSP systems. Increasing not only the efficiency in the thermo-dynamical cycle but also the cost effectiveness of the thermal storage is a priority.

EUREC
The Association of European Renewable Energy Research Centres

www.eurec.be

- **Testing and validation of low cost wind turbines and components**

Cheaper wind turbines with longer lifetime will contribute to the increase of the market penetration of wind energy. LCOE reduction from new concepts is expected to be at least 10%.

- **Improved energy storage systems**

In all areas: chemical, electrochemical, mechanical or thermal.

- **Improved wind and solar modelling and forecasting**

Enhancing wind models and assessing uncertainties of wind conditions in the atmospheric boundary as well as in complex terrains, extreme atmospheric conditions, land-sea interaction and combined wind-wave and current conditions. Also, increasing module electricity production is a key player to bring down the cost of PV electricity.

R&D along the whole value chain is therefore needed to improve module and system performance.

- **Testing, validation and cost reduction of innovative ocean energy devices and components**

Ocean energy is not very far down the cost curve. Testing and validation in controlled conditions (i.e. wave tanks) allows ocean energy projects to progress and increases investor confidence when the device eventually goes to sea.

- **Increase efficiency, reduce emissions and improve feedstock flexibility of micro, small and large scale biomass based CHP, as well as enhance sustainable, innovative and cost-efficient advanced biomass feedstock supply**

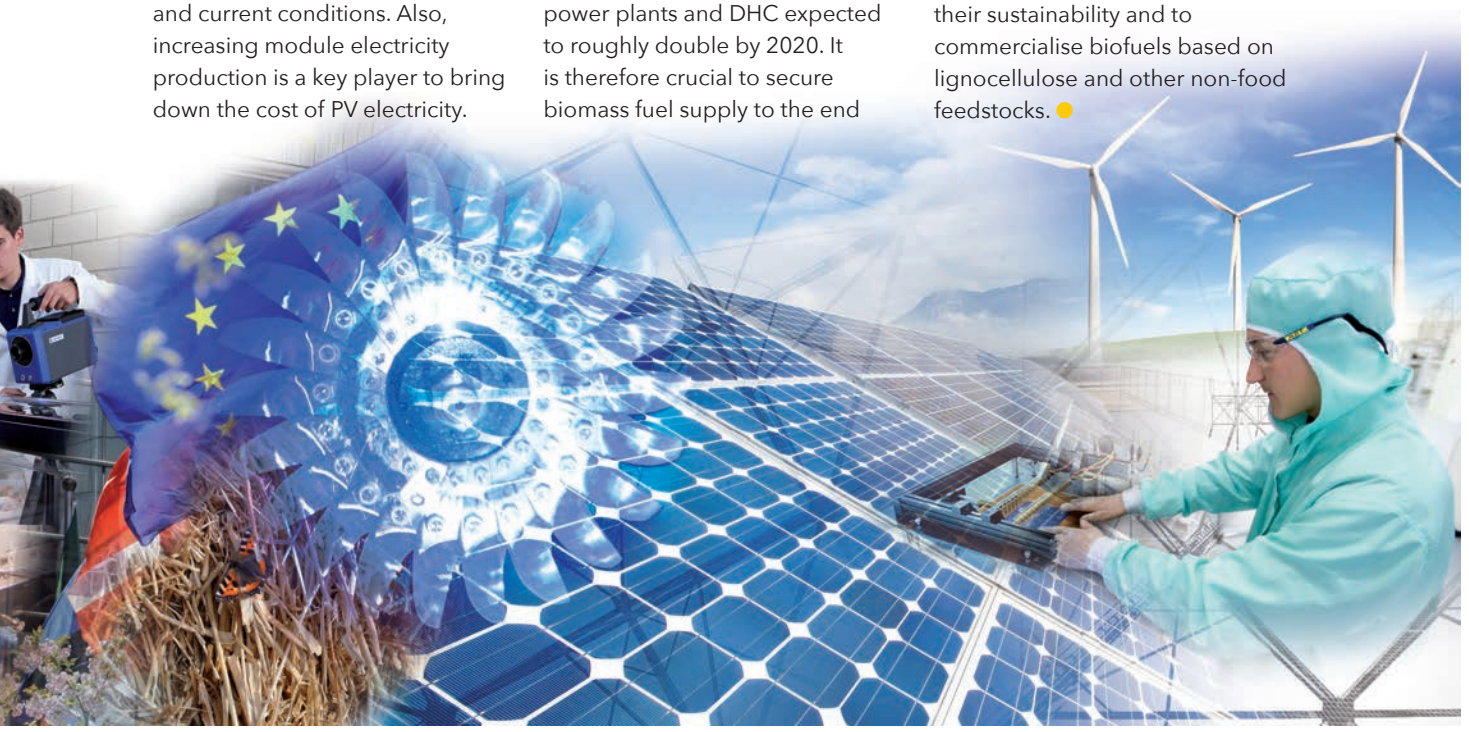
Bioenergy use in industrial power plants and DHC expected to roughly double by 2020. It is therefore crucial to secure biomass fuel supply to the end consumer, increase efficiency, sustainability, reducing also dust emissions and costs.

- **Development of hybrid electric/heating/cooling grid and storage solutions in order to enable system integration of increasing amounts of local and remote renewable sources**

Integrated solutions including consumer demand, distributed generation, storage and market players to support a secure, stable and responsive system.

- **Development of advanced thermal conversion solutions and 2nd/3rd generation biofuels**

Comprehensive actions are needed to foster the development of advanced biofuels and alternative fuels in this key sector, to ensure their sustainability and to commercialise biofuels based on lignocellulose and other non-food feedstocks.



SOME LIKE IT HOT

By Vittorio Prodi

In an environment of high and unstable energy prices, geothermal source offers cost-effective, renewable and clean energy, displacing oil, gas and electricity. It is flexible because of its inherent storage capacity, and can provide base load electricity thus complementing other variable renewables. Another important characteristic of geothermal energy is a high load factor: each MW of capacity produces significantly more electricity during a year than a MW of wind or solar capacity. Last but not least, the integrated generation of heating and power has been shown to have a significant positive effect on job creation.

Geothermal energy represents a sustainable solution to reduce greenhouse gas emissions and dependence from fossil fuel. 24 countries in the world produce geothermal electricity, while 70 exploit geothermal sources for heating. In Europe, the market is mainly concentrated in Italy, Turkey and Iceland.

Since the construction of the first commercial dry steam power plant in 1911 in Italy, a wide range of energy conversion techniques allow geothermal resources to be used in many ways: heat pumps and district heating to heat and cool buildings; flash steam power plants; binary source power plants (the most common type of geothermal plant being developed today); and more recently, Enhanced Geothermal Systems (EGS, also known as Hot Dry Rock), that enable the

exploitation of the Earth's heat at remarkable depths, but require enormous amount of water.

Despite the multiple benefits it provides, geothermal energy has long been misunderstood in Europe. It is only in the 1990's that the European Union started to support the sector. At that time, geothermal power was not even considered a renewable resource in all Member States. The EU Programme THERMIE, provided financial support to 44 geothermal projects in ten Member States, ranging from district heating and electricity production to agriculture, desalinisation and balneology.

In 2000, the European Union published a Blue Book on Geothermal resources with the aim of identifying measures which could effectively promote the use of geothermal energy and increase the presence of European operators in the world market. Under the 6th Framework programmes, EUR 20 million were dedicated to seven projects and several initiatives were launched to stimulate the creation of consortia in the field of geothermal energy. The sudden enthusiasm for this promising technology, however, faded away under the 7th framework programme which covered only two projects, aiming at understanding the seismic risk associated with deep well drilling.

Yet, given the right conditions, geothermal resources could potentially supply 15% of European global energy by 2050. With the introduction in 2009 of legally binding renewable energy targets, most Member States have experienced significant growth in renewable energy consumption, but geothermal energy has been neglected in the national energy plans. Today, it accounts for only 4,4 % of the renewable energy consumption in EU. Significant barriers to the development of geothermal energy need to be overcome.

The main obstacle remains the high cost of drilling, which accounts for at least one third of the total cost of a geothermal installation. Subcontractors' remuneration has a heavy impact on exploration cost, given the competition with the oil and gas industry for drilling expertise. The economic viability of geothermal energy projects is also strictly affected by site-specific conditions (climatic conditions, local heat demand, temperature or source depth) and the type of application used. Part of the solution lies on financial incentives, tax exemptions, reductions or incentives along with the funds by EU programmes as well as raising the level of information for policy makers, public and private operators, investors and the public.

Furthermore, geothermal energy carries a relatively high commercial risk because of the uncertainties involved in identifying and developing reservoirs that can sustain long term fluid and heat flow.

Advances in this area are urgently needed so as to enable market actors to drive down these costs, through improved research, industrialisation of the supply chain and more efficient policies and support schemes. The UE must act now in order tap the potential of geothermal energy and not to lose the competition with non-EU operators in the sector. North and Central American and South East Asian players are, in fact, quickly expanding: most of the new global geothermal capacity was added in the US, Nicaragua and Indonesia in 2012.

13 Member States presently offer geothermal electricity feed-in tariffs, ranging from 25 to 300 €/MWh. Furthermore, complex administrative procedures for geothermal exploitation are creating significant delays for obtaining the necessary permits and licences, thus generating uncertainty for investors. Energy regulators and competition authorities, at EU and national level, need to act decisively to ensure that all companies are treated equally ensuring a level playing field. Uniformity across Member States is a prerequisite for the completion of an open, integrated and flexible market whose dynamics will drive investments rather than subsidies. This requires a real integration of Europe's energy networks and systems, and the further opening of energy markets to ensure the transition to a low carbon economy where geothermal resource has a key role to play.

Geothermal Energy – Energy for the Future

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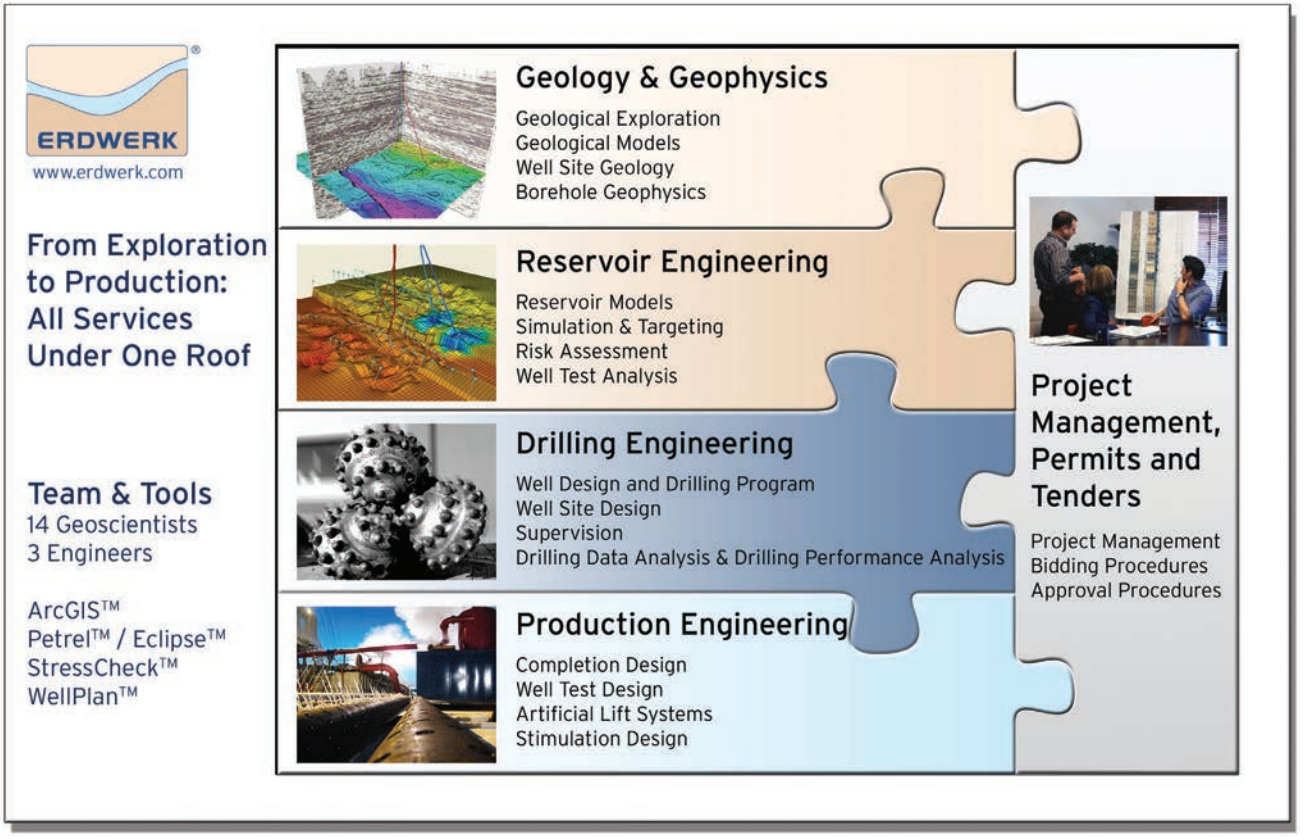

Geothermal heating and cooling: where we are and where we should be

Geothermal energy has the potential to deliver sustainable, reliable and secure supplies of both electricity and heating and cooling right across Europe thanks to new and emerging technologies. The industry is growing but the potential is still widely underestimated and the resource under used.

The reasons for this vary according to the type of energy and final use. Geothermal energy use can roughly be divided into three categories: shallow geothermal used for heating and cooling, deep geothermal used for direct uses, notably district heating and cooling, and deep geothermal used for electricity production or Combined Heat and Power.

Shallow geothermal energy is the most widely deployed and there are very few areas in Europe where it is not in use. The EGEC Market Report 2013-14, bringing together studies from across Europe, shows that around 1.3 million geothermal heat pumps are installed, with a capacity of 17,000 MWth.

Around 64% of this European installed capacity is in Sweden, Germany, France, and Switzerland. These mature markets are projected to see the greatest increase in terms of installations 2010-2015, whilst the highest growth rate will be seen in Italy, Poland, and the Czech Republic.

After a long period of fairly steady growth, markets are beginning to slow and juvenile markets are not progressing as they should. Lack of awareness continues to be a cause for this slow progress, but two new issues have emerged. Firstly the economic crisis and low construction rate in Europe has naturally had a negative impact on this cost efficient but capital intensive technology, although we could expect this trend to reverse as construction and renovation rates rise. The second issue is more complex; whilst shallow geothermal systems can be completive, they struggle in a distorted European market which can make the use of gas and other fossil fuels financially favourable. European fuel dependency is largely gas

for heating dependency, and a reassessment of this situation should lead to a greater future role for geothermal heating and cooling.

More positive news comes from the Geothermal District Heating sector, which looks set to see rapid and dynamic expansion in the coming years- in 2013 alone eight new systems were installed in Europe. Historically, the Paris and Munich basins have seen the most development, but there is now increasing interest in Central and Eastern Europe.

To reap the full benefits of the technological developments in Geothermal District Heating, non-regulatory barriers need to be broken down. The GeoDH project, co-funded by the EU, is working juvenile, transition, and mature markets in order to understand both market needs and best practices, and develop tools which can help Geothermal District Heating to develop everywhere. Key areas of work are regulatory frameworks, financial models, training, and awareness raising.

The project has recently developed a Web-GIS which shows the District Heating potential in 14 the project countries. We know now that thanks to technological developments, Geothermal District Heating systems could be developed in all EU-28 countries, become available to 28% of Europe's population.

A lack of adequate regional policy and regulation concerning District Heating has been a significant barrier, but, following an assessment of existing regulatory frameworks and consultation with stakeholders, proposals for regulations in Europe have been put forward and are available at geodh.eu

Geothermal District Heating gives a secure and stable supply of heat with fixed, long-term prices, however it is capital expensive and requires specialised business models. Various models are in place across Europe, depending on market maturity, but PPP are growing in popularity throughout the continent. An investigation into financing models, and investigation into support schemes, and a model for financiers will be published by the GeoDH project in the coming months.

Although geothermal heating and cooling remains underexploited, the outlook is generally positive. The Renewable Heating and Cooling sector in general, and geothermal in particular, has suffered from poor recognition and understanding in the past. Now, the changing geopolitical environment combined with a necessary reassessment of the market as well as increased research and development should see geothermal for heating and cooling playing a more central role in Europe's future energy system.

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The benefit of photonic technologies in rural areas

By Judith Ibáñez Sánchez and Carlos Lee (pictured below), Director General at EPIC- European Photonics Industry Consortium

What can be done to bring light to the 20 percent of the global population that is still lacking electricity? What is the role of photonics and in particular photovoltaic and energy efficient lighting?

Sunshine reaches the Earth as radiation in the form of millions of high energy particles called photons. Thanks to the invention of solar photovoltaic (PV) technologies it is possible to generate electrical power by converting solar radiation.

PV technologies have brought numerous advantages to rural and isolated areas, being especially attractive in rural regions when it becomes difficult to supply electrical power due to the scattered population and hard accessibility to the national power grid.

In recent years a considerable research and development activity has been initiated to energize such areas through renewable energy sources, which are the best candidates for supplying energy in decentralized mode. As an alternative to the use of fossil fuels, solar technology lessens exposure to oil price volatility and address climate change, contributing to a healthier and sustainable clean environment.

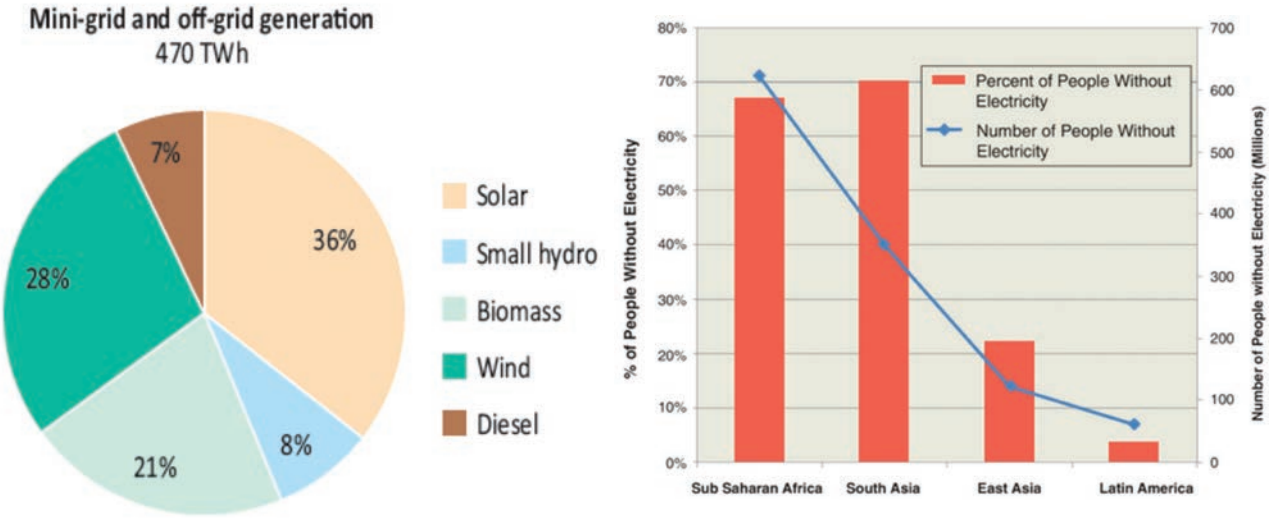
PV systems have become widely popular due to the market price reduction and reduced cost of PV technologies. In addition to PV, several generation resources are used in micro-grids such as wind, hydro, diesel and biomass. Hybrid combinations of PV with wind generators and hydropower plants are used, in conjunction with energy storage equipment (batteries) due to the intermittent nature of renewables to meet the required consumer demand.

The off-grid renewable energy sector has been already stepping a foot in the market for a long time but is still far from reaching its potential. There are still more than one billion people, around 20% of the global population lacking electricity access, most of it concentrated in rural areas of Sub-Saharan Africa and developing Asia. According to the World Energy Outlook achieving universal energy access by 2030 would increase global electricity generation by 2.5 %, and in the case of mini-grid and off-grid generation, more than 90 % is provided by renewables, with solar being the biggest contributor with 36 %.

The success of small-scale distributed energy solutions has attracted the attention of diverse members of the European Photonics Industry Consortium (EPIC). Many of these institutions contribute nowadays to the research and development in the area of rural electrification.

PV has been widely used to provide people living in remote areas with several essential utilities. “Access to electricity has a positive impact on a wide

Left: Aditional electricity generation in the Energy for All Case, 2030. Right: Electricity Access (% of population) Source: IEA, World Energy Outlook 2013



range of factors influencing rural communities, from improved health to better educational facilities and improved standard of living" says Tanja Winther from Solar Transitions of University of Oslo.

Solar Panels in rural areas of Bangladesh Source: MicroEnergy International

Lighting up households and hospitals has become possible thanks to energy efficient lighting such as LED (Light Emitting Diodes) combined with renewable energy sources. This is a clear example of how photonic technologies are driving energy efficiency, in the form of solar lanterns, solar batteries and other inventions.

There exist a vast number of applications that PV technologies can serve, solar-power pumping systems to supply clean water for drinking and irrigation purposes; "we develop small decentralized water treatment plants with autonomous energy supply for disinfecting and desalinating the water" states the Fraunhofer Institute for Solar Energy Systems in Germany.

Solar water heaters, solar-based cooking facilities and cold storage for food and vaccination are more examples of beneficial utilizations. Solar-thermal energy represents other alternative capable of generating high temperatures

by using mirrors that concentrate the sunlight. TNO in The Netherlands has developed "a tube solar cooker, enabling high temperature cooking and rural electricity as a way to prevent deforestation in development countries" affirms Dorrit Roosen.

There is an implicit technological challenge for the photonics community to continue increasing the list of possible applications that PV can assist. In order to fulfill the sustainability criteria, each technology must be adapted to the particular scenario and application, ensuring durability and ease of use and maintenance. Besides the technical appropriateness of the technology, economic and social aspects must be taken into account as well.

Financial services are fundamental for people in the rural area to cover their energy needs. "We have been working by supporting microfinance institutions in the process of developing and providing green micro-loans, financial products that help clients finance a renewable or efficient energy system for their home or business" says Sebastian Groh at MicroEnergy International from Germany.

The cost and availability of spare parts is also indispensable for the proper operation and maintenance of projects, and is only possible with the full support of rural communities. Institutional arrangements are therefore essential for the long term sustainability of rural electrification projects. "Around the world, the single greatest challenge to sustainable rural

Solar Lanterns used to read in the evenings
Source: Solar Transitions, University of Oslo
By Matthew Rix Whiting

electrification in the last decade has been the establishment of institutional arrangements for maintenance of installed systems. It is imperative that programs consider these social and economic arrangements, and not just the technologies used to provide energy services", says Matthew Dornan from the Australian National University's Development Policy Centre.

The fact that energy poverty involves the lack of access to modern energy services is not breaking news. But, the massive segment of global population without electricity access and its massive market opportunities seems to have remained invisible. Knowing that energy needs can be met by working under the right policies and appropriate resources, the photonics community has the chance to spread and adapt the use of photonic technologies and increase awareness for international energy cooperation.

Investments in durable, reliable and sustainable PV innovations should be well worth it, not only as the way to bring people out of poverty, but as an opportunity to rethink in sustainable models for use in the resource and energy markets of the developed world.

Who is taking the lead to make this revolution happens? Please contact me at carlos.lee@epic-assoc.com

Energy and environment science and technology in Castilla-La Mancha

By Julián Garde, Vice-Chancellor of Research and Scientific Policy and Francisco J. Sáez-Martinez, Coordinator of CYTEMA

Nowadays University is central to a model of social and productive change based on the knowledge triangle: education, research and innovation. In this context and in line with our commitment to promoting excellence, the University of Castilla-La Mancha is developing its Energy and Environment Science and Technology Campus –CYTEMA-, awarded the status of regional "Campus of International Excellence" (CIE) by the Spanish Ministry of Education. The objective of this project is to make the University of Castilla-La Mancha a reference point in Europe for energy and environment science and technology by 2020.

CYTEMA is a commitment by the UCLM to teaching, research and innovation in energy and the environment. This project utilises the strengths of our university in energy and environment R&D&I. The university has fifteen research institutes, more than fifty research groups and more than 500 researchers working on energy and the environment in the fields of engineering, experimental sciences, social and legal sciences, architecture, the arts and humanities and health sciences.

The following graph shows the main activities developed in CYTEMA, grouped in three strategic axes:

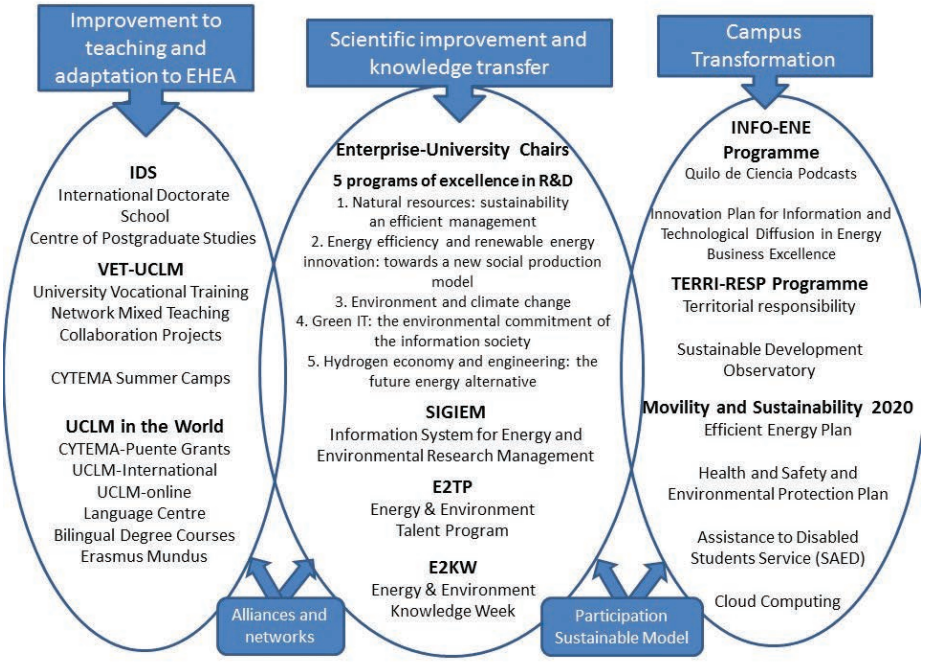
- Improvement to teaching and adaptation to the European Higher Education Area
- Scientific improvement and knowledge transfer
- Transformation of campus and interaction with the community.

Regarding the first of these axes, **Improvement to teaching and adaptation to the European Higher Education Area**, the most important activity is the creation of the International Doctorate School – IDS –. Furthermore, in order to increase the number of internationally recognised doctorates specific grants have been created, as part of the CYTEMA-PUENTE programme, to give PhD students access to study at prestigious international centres in the field of energy and the environment.

As part of links with vocational education and training (VET), the *University Vocational Training Network* was created as a network comprising all the agents involved in a higher level VET college specialising in Energy and Environment.

Finally within the framework of the action "UCLM in the world", a series of actions have been developed, aimed at consolidating language training, bilingual qualifications, and the creation of dual qualifications, as well as increasing the geographical sphere of influence of CYTEMA.

Actions of the Energy and Environment Science and Technology Campus



With regard to the second strategic axis **Scientific Improvement and Knowledge Transfer** it is important to note that UCLM has 6 university-company chairs related to subjects from the Campus of Excellence: the Innovation and Enterprise Development Caja Rural de Castilla-La Mancha Chair, the ELCOGAS Chair, the INDRA Chair, the Santander Chair of Corporate Social Responsibility, the Manuel de las Casas Lafarge Foundation Chair and the ENRESA Chair. The activities developed under these agreements allow other members of the community to be integrated in the aims and objectives of CYTEMA and they foster the development of research and knowledge transfer activities.

Among the actions conducted within the framework of the second strategic axis we highlight the development of 5 programmes of excellence in R&D: Natural resources: sustainability and efficient management; Energy efficiency and renewable energy innovation: towards a new social production model; Environment and climate change; Green IT: the environmental commitment of the information society; Hydrogen economy and engineering: the future energy alternative. These programmes have been divided into 28 specific actions, coordinated by UCLM research groups and in which researchers from outside Castilla-La Mancha have participated. The wealth of science provided by the diversity of national and international groups and institutes, working together on the same programme, has boosted the viability and originality of the results and the media capacity to transmit the results to the scientific community and the business world. The development of these programmes, together with the initiative and research quality of the groups comprising CYTEMA has meant that despite the economic hardships, in terms of science production, the results have maintained the highest level. UCLM has managed to position nine scientific disciplines among the ten best in Spain according to the I-UGR ranking of Spanish Universities according to Scientific Fields and Disciplines (4th edition 2013): Chemical Engineering (3rd), Ecology and Environmental Sciences (4th), Veterinary Science and Livestock Breeding (4th), Statistics, Electrical and Electronic Engineering, Civil Engineering, Industrial Engineering, Geography and Town Planning and Neurosciences are also among the top ten.

Additionally, the Conference Energy and Environment Knowledge Week - E2KW- has been celebrated. This international, multidisciplinary congress will celebrate its second edition in Toledo in October 2014 presenting cutting edge research in all aspects of the energy and environment science and technology. Prestigious researchers will be in attendance as well as leading companies in the application of efficient energy systems.

Finally, the third strategic axis, **Campus Transformation and Community Outreach** has involved the development of, among others, a series of actions as part of the *INFO-ENE Programme* such as the participation in *the Plan for Innovation in Information and Technological Diffusion in the Field of Energy Business Excellence*. This project aims to inform about, publicise and promote a model of business excellence based on energy efficiency and technological innovation, which will continue to increase the competitiveness of the industrial framework of Castilla-La Mancha, making economic growth compatible with sustainability. Furthermore, as part of the Responsible Territory Programme, *TERRI-RESP*, the *Sustainable Development Observatory* has been created.

To conclude, the action *Mobility and Sustainability 2020* has led to the creation of a series of measures aimed at improving campus sustainability. The most important action is the *Energy Efficiency Plan* which has notably reduced energy consumption and expenditure in university buildings and campuses.

The CYTEMA initiative is encountered in the Research and Innovation Strategy for Smart Specialisation (RIS3) developed by the Regional Government of Castilla-La Mancha where the UCLM has a crucial role.

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Spanish electricity reform: the breakdown of european legal security

By José Donoso, General Director of UNEF (Spanish PV Union, representing 85% of the PV industry in Spain)

New photovoltaic (PV) capacity installed globally last year hit an all time annual record of 37,048MW, bringing the cumulative figure to 136,700MW. Around 55,000MW of new capacity is expected in 2014.

But all revolutionary change sparks reactionary opposition and PV is now experiencing a lash back across the world from electricity sector stalwarts. Politicians are beginning to bow to old guard lobbyists by ushering in regulations to raise economic barriers to PV development; measures that contravene market and individual liberties. The paradox is overwhelming: conventional sector agents previously attacked solar power for being uncompetitive but, now that it is competitive, they are putting obstacles in its way.

Spain is suffering the starkest expression of this reaction. Renewables in general and solar PV in particular are up against a process of regulatory reform aimed at changing the ground rules. And the changes are retroactive, undermining basic principles of legal security not only in Spain but also, by association, across Europe.

The reform ends the off-take support system for renewables, based on a kilowatt-hour production incentive. In its place, it plans a completely different system, with support paid in accordance with installed capacity. The rate varies based on a government-devised standard for investment costs, which bares little resemblance with reality.

Even before the government's reform proposals, the PV industry had already been pushed to the limit by a series of drastic cuts, by which profits slumped to around 6%, stretching the payback period to 15 years.

The system proposed now, illogically based on a standardisation of 576 different cases, is arbitrary. Its application will leave some plants experiencing a 20% cut in revenue and others a cut in excess of 50%. In all, the regulation will slash Spanish PV sector revenues by €920 million against forecast income at the time of making investments.

The cuts will prevent owners of 30-50% of installed capacity from even being able to refinance debt—unless the banks are prepared to write off around 60% of that debt. By that score, the government's intention seems not simply to modify incomes for these plants but, rather, to close them down entirely.

The reform is supposedly spurred and justified by the need to slash a tariff deficit across the electricity sector. Yet, according to data from regulator Comisión Nacional de la Energía (CNE), only 22% of the deficit derives from the so-called special regime—which as well as renewables, includes CHP and waste treatment. Nevertheless, the brunt of the cuts falls upon renewables.

The government also justifies cuts by citing excessive profits for renewables to date. Yet other profitable sectors are left unscathed, highlighting the discrimination at play. For instance, grid operator REE, with a turnover of €1.8 billion in 2013, has an EBITDA of €1.3 billion and a net, post-tax profit of €600 million, translating to a 34% profit on sales; way beyond the 6% the government deems "reasonable" for PV producers.

Reform to self-supply PV applications is also discriminatory. The Spanish government has introduced a levy—a kind of "sun tax"—making it economically non-viable for citizens to install PV power for self supply in their own home; a frontal attack on individual liberties. The "sun tax" cuts the average payback period from 12 years to 35 years for a domestic self-supply system or from 7 years to 13 years in the case of a small business. In addition to that economic barrier, the reform prohibits energy storage.

To highlight the degree and scope of discrimination against solar power, owners are obligated to register their self-supply PV systems or face a fine of up to

€60 million. The sanction—aimed at dissuading anybody from dodging the "sun tax"—is totally disproportionate. By contrast, the maximum fine for a nuclear plant failing to report a radioactive leak is just €30 million.

Overall, the reform clearly does not, as the government claims, seek "reasonable profit" for renewables operators. Rather it aims to dismantle the Spanish photovoltaic industry.

Furthermore, the reform hides up its sleeve a trump card, which, every three years, enables all the rules to be completely changed. The uncertainty regarding potential changes in future laws removes any predictability regarding returns on PV plant investments. Those plants also become non-sellable—except to the type of market sharks that buy such assets for one euro a piece.

The question for the EU is whether its institutions should accept what is happening in Spain. Clearly, the electricity reform goes against European directives and energy objectives for 2020 and 2030. It also undermines basic principles of legal security with blatantly retroactive measures that recalculate and reduce revenues made in the past, altering the logical and reasonable expectations of investors.

If such basic principles can be undermined in one of its member states, the same can happen anywhere in the EU. Without intervention in the Spanish energy reform, the credibility of Europe as an attractive place to invest is in jeopardy.

Environmental sustainability

Development through demonstration in Puertollano IGCC Power Plant

By Francisco García Peña, Engineering R&D Director, and Pedro Casero, R&D Department, ELCOGAS S.A.

Puertollano, March 1998. The main coal gas control valve started to open while simultaneously closing the natural gas valve, and after 1 minute of this process (called "switch-over"), the Puertollano IGCC Power Plant officially started the production of electricity through gasification of **autochthonous coal and refinery residue**. This event marked a world milestone in clean energy production from fossil fuel: the biggest (317 MWe) single-train Integrated Gasification Combined Cycle Plant (IGCC), which uses exclusively **European technology**.

EC considers this installation as a "demonstration plant", a label that recognizes its high technological risk. For 16 years ELCOGAS, the company created by European utilities to build, exploit and technologically develop this plant, has worked to make it cleaner, more efficient, and more economically sustainable. A **net efficiency of 42.1%** has been demonstrated, higher than any other existing technology with similar fuel. **Emissions performance** has surpassed both designed values and current legislation (see picture). **Other environmental benefits** have also been demonstrated, such as: inert process residues (most of them by-products), zero liquid discharge, and ease of blending biomass, municipal wastes, and other industrial residues together with the usual fuel.

This venture also offers relevant insight on economic values, the main outcome being the efficient use of fuels, which leads to the remarkably low **variable cost of 21.2 €/MWh** (2013 average), unrivalled by any other thermal production alternatives. Moreover,

ELCOGAS is the clear example showing this type of plant cannot be viable by itself. A 1st generation demonstration plant has a capital cost which is 30-50% higher than subsequent generations, and also has an extra cost derived from the valuable but costly learning process gathered during its lifetime. This, in many cases, can be only applied to following designs. That is, it requires a regulatory support rewarding the positive features of the technology, as happens with renewable energies, carbon capture & storage, and other technologies in development. During the gestation of ELCOGAS, the strategy designed to overcome these hurdles consisted of a partial funding from the EU during its construction and the support of the Spanish **regulated market**.

Unfortunately, this strategy encountered major difficulties in 1998 when the transition to a liberalized market entered into force. Since then, the different formulae ruling the energy market in Spain have led ELCOGAS' shareholders to absorb recurring economic losses, and now no formula at all is defined beyond 31st December 2014. The regulatory support required is in the range of 70-90 €/MWh, which is at the **lower end of the most recent support** allocated in Spain to efficient technologies or **renewable energies** (80-350 €/MWh) to reward their environmental performance or by reason of their development stage. Without this support ELCOGAS will not be viable.

And who **truly benefits from this support?** Neither the operator nor the owners, but European suppliers such as Air Liquide, ThyssenKrupp, Siemens, Johnson Matthey, and a large list of European technological companies, as well as, European, national and local services companies and research centres. Ultimately, European entities who can export knowledge-based products.

Wind energy in Spain makes Europe's dream come true

By Heikki Willstedt, Energy Policy Director of the Spanish Wind Energy Association (AEE)

Wind power was the main source of electricity in Spain last year for the first time ever in any country. It covered 20.9 percent of total demand and wind farms produced a record 54,478 GWh, an increase of 13.2 percent over 2012.

It is no easy task to identify a business activity that has progressed so much in the last 15 years as the wind industry in Spain. It has achieved a highly prominent position in economic terms as a result of the efforts of the companies operating in it, its contribution to the creation of value (GDP growth) and jobs, and the vitalizing effect that this business has on other economic sectors.

Moreover, the wind energy industry is making a major contribution to sustainable development in Spain, since its characteristics are in tune with the main substance of EU's energy and environmental policy, namely the reduction of greenhouse gas and other polluting emissions, increased use of renewable energies and reduced energy dependence through lower fossil-fuel imports.

How did it happen?

The problem of energy dependence and the common objectives of the European Union are behind this extraordinary feat. Spain has to import more than 70% of the energy it consumes. And the cost of that imported energy has multiplied by 6 from 2000 to 2013. But thanks to wind power, Spain saved 3 bn € in 2013 in imports of fossil fuels, money that has been spent in the local economy. The amount of CO2 emitted to the atmosphere for each kWh produced has gone down from more than half kilogram to less than 240 grams in the period.

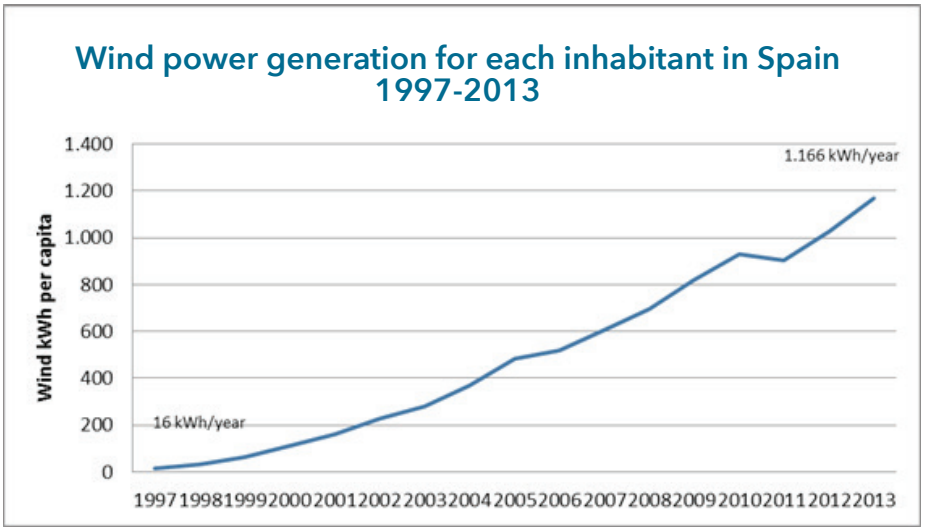
These achievements were simply unimaginable twenty years ago. Thanks to the vision two decades ago of the Government, companies, research centers and Spanish society in general, wind power has become an industrial reality.

The technology itself started at the end of the 80s as a promising experimental technology, but it wasn't until the 90s that commercial installations were connected to the grid. In 1996, the European Union took the decision that, given the two central problems of rising energy dependence and increasing global warming, the development of indigenous renewable energies should become a priority for its


Heikki Willstedt

Let there be energy!

As can be seen in the graph, wind has become an important source of energy thanks to the development and deployment of wind energy technology. Where there was only wind now there is enough electricity to cover the demand of 90% of all Spanish households. And without emissions of CO2, or of classical air pollutants like SO2, NOx or particles.



member states. This significance for renewable energy sources was established in an objective for 2010 to achieve a penetration of 12% of these resources in terms of primary energy consumption.

The Spanish Government incorporated this goal into its legislative framework in 1997. It was obvious back then that regulatory stability was fundamental to achieve a long term goal of deployment of capital intensive technologies, like wind power. A feed-in-tariff incentive system was established and kept until 2013, with certain improvements like the establishment of the feed-in-premium system to integrate wind power installations into the daily power market (this system is now being proposed by the European Commission as the model to gradually harmonize all national incentive schemes in the next decade).

With long term goals set by the EU and the Spanish Government, and thanks to the stability of the incentive system, the cost of capital went down rapidly at the beginning of the century. Both developers and manufacturers developed into a reality that goes beyond European borders. Thanks to the cost competitiveness of wind power (in 2007 a study by the EC rated Spain as the EU most cost efficient country in the development of wind power), Spain was able to comply with the EU objectives for 2010 and was looking with confidence to the attainment of the 2020 EU objective of reaching 20% of renewables in final energy consumption.

But this successful EU story is in danger.

Unfortunately, the change in the Government in 2012 has been the harbinger of new policies that go against all that has been achieved under the common European objectives: first, a moratorium in the further development of wind power and other renewables. Afterwards, a new 7% tax on the production of electricity that affects disproportionately wind installations. And in 2013 a change in the support system for existing installations that entails a retroactive cutback in the incentives for wind farms that could be a fatal blow for many installations.

With these new policies, it is doubtful that Spain will be able to reach the EU objective for renewables for 2020, and it is quite possible that the costs of future installations will rise due to the legal insecurity that these decisions have imposed on investors.

The Spanish wind power sector has been actively asking the Spanish Government and the EU Commission to stop these erroneous policies that go against the recommendations on regulatory changes that the EC itself has made public at the beginning of 2014. But time is running short and if the new regulatory system is finally approved it will be a blow to the entire European wind energy sector and the common goals of the European Union.

The main message from the sector is that economic rationality and dialogue should be the main tools to reach a solution for the sector in order not to harm the industry's long term potential and its ability to continue creating prosperity in Spain and Europe.

Red Electrica de España (REE)

RED ELECTRICA DE ESPAÑA (REE) is the solely Spanish Transmission and System Operator (TSO) and has been the pioneer entity (since 1985) in assuming these responsibilities as such segregated activities. The constant seek for excellence over the years is clearly reflected in the strong commitment of REE with innovation which is currently performed in the framework of the Innovation and Technological Development Plan 2012-2016 (Plan12-16).

The overall objectives of Plan12-16 are to acquire the necessary know how to master those technologies that might be key in TSO business from medium to long term, to consolidate REE's international leadership and to improve the company performance in its present activities.

With this aim, the Plan12-16 was designed by the end of 2011, with the involvement of all the technical areas, taken into account three strategic pillars: (1) the REE group strategic plan for 2011-2015, (2) the EU Energy Policy for 2020, and particularly the principles of SET Plan, and (3) the 2020-2030 long term prospective assessment. It includes a set of indicators and tools to measure its added value (from project results to the contribution of R&D activities to the achievement of corporate strategic objectives).

During the last years REE expenditure in R&D has increased amounting € 14.5m in 2013 which represents a 0.84% of the annual regulated revenue.

Following some of the most representative projects are outlined:

Representatives from European Commission, Spanish Ministry of Economy and Competitiveness, local authorities, manufacturer and REE staff visiting the equipment developed in ESP-LIDER at Torres de Segre 220kV ES

TWENTIES: In TWENTIES project, supported by 7th EC Framework Program, REE has acted as Project Coordinator of the 26 companies involved with a budged amounting to €57m during 42 months. The overall objective of this project was to advance in the development of new technologies to the massive incorporation of wind power in the European electricity system and thereby contribute to the achievement of the EU goals on energy by 2020. This has been done through six full scale demos in different countries (Spain, Denmark, France and Belgium) and the results have been analyzed in deep to evaluate the economic benefits of the tested solutions as well as their potential scalability. The project has concluded in September 2013 and the results are available in the project website (www.twenties-project.eu)

ALMACENA: The project consists of the field installation of an energy storage system, specifically a lithium-ion prismatic Battery, with a power in the range of 1 MW and a capacity of at least 3 MWh, with the aim to evaluate the technical performances and characteristics this type of facilities currently offers as a tool to improve the efficiency of the operation of power systems. After the successful set up in operation of the system, two functionalities are being tested aimed at favoring the integration of renewable energies and the improvement of operation services (load curve modulation and power-frequency regulation). In later phases, the installation will serve as a test platform in order to evaluate the possible contribution of this technology to other operation services, the increase of grid flexibility, the stability of the system, etc. The system is in service since the end of 2013. (http://www.ree.es/en/red21/rdi/rdi-projects/almacena)

ESP-LIDER: This project aims to design and manufacture a Static Synchronous Series Compensator (SSSC) type FACTS device for its field validation. This is the first experience with this type of device in Spain at a voltage level of 220kV. Furthermore, the project will yield the studies, models and simulations necessary to develop power electronics in the Spanish electricity grid thus providing the necessary knowledge to the research sector (both public and private). The project receives funds from domestic R&D supporting program, INNPACTO (http://www.youtube.com/watch?v=DXLvtBph7aE&feature=youtu.be).

The Spanish renewable energy sector at a critical point

By José Miguel Villarig, Chairman of the Spanish Association of Renewable Energy Companies, APPA

The imminent approval of the Royal Decree regulating the activity of electric energy production from renewable energy, co-generation and waste sources is a further step in the bullying and destructive strategy that the Partido Popular Government has been implementing since it came into power and its debut with a first Royal Decree law that was a moratorium for renewables. The Association of renewable energy companies – APPA – will appeal the Royal Decree and all the Government's regulations to the European Commission and at all judicial levels, both nationally and internationally.

The new Royal Decree radically changes all the conditions under which investments were made and submerges the sector in an absolute legal insecurity that is inappropriate in a developed country, as it applies retroactive measures that have made Spain the country with the most international lawsuits in the world. The final nail in the coffin, that could take the Spanish renewables sector to the verge of extinction, would be publication of the Order for payment parameters that is currently in the pipeline.

At APPA, we ask ourselves once again what interests are served by a Government that, in its aim to end the so-called tariff deficit and with the excuse of lowering electricity prices, has only been acting against technologies of the already extinct Special Scheme and, in particular, against renewable energies which are the chief victims of their supposed energy reform. Paradoxically, it is precisely renewables that, when coming onto the market, are the technologies that significantly reduce electricity prices. As the diagnosis was incorrect, in considering that renewables were the main culprits for the deficit and levying all kinds of cutbacks on them, the Government is not managing to wipe out the tariff deficit which, up to March, was already up to €2,098 million Euros.

With public and private efforts, the Spanish renewable energy sector managed to become a model for success used as an example worldwide. The figures are eloquent. The sector closed 2013 with an installed capacity of 50,689 MW, which involved 113,575 GWh of electricity production which was the main source of electricity generation as it covered 41% of the demand for electricity. The sector's input into Spanish GDP reached 1% in 2012, with a total contribution of €10,563 million Euros, with positive tax and trade balances, helping to reduce the Spanish energy deficit which was €41,000 million Euros in 2013.

Nevertheless, the regulatory framework, devised since 2009 by the previous government and the current one, has meant that Spain is irrevocably losing its hard won position of worldwide leadership in the renewables sector.

The legal insecurity and regulatory chaos in which the sector is immersed have placed it in a critical situation that endangers its future. This is all because the Government has taken on board the diatribes of the electricity giants intent on maintaining their oligarchy and has identified the feed-in tariffs for renewable energies with the tariff deficit. It is actually quite the reverse, the problem with the deficit lies in the lack of competition in the electricity market and the excessive payments to nuclear power stations and hydroelectric giants, denounced by the European Commission and the old National Energy Commission.

Some details: In 2012 renewable energies lowered the OMIE daily market price by €4,056 million Euros, with a saving on the daily market of €18.12 for each MWh purchased. The net accumulated price drop (savings less feed-in) for the period 2005-2012 was €5,639 million Euros, with the tariff deficit that could have been generated being reduced by that amount. Therefore, it can be clearly stated that renewables have not been the cause of the tariff deficit.

The drop in demand for electricity caused by the crisis meant that traditional electricity companies could not integrate all the generation from their combined cycle gas plants into the electricity system. These were developed as free business ventures over the last decade until they reached more than 27,000 MW, much of which was unnecessary, and received a grant for 40% of the investment.

Taking the standpoints of the traditional energy lobbies as its own, the Government debuted with a first Decree Law, in January 2012, which brought with it a moratorium on renewables. Since then, all of the energy legislation that has been passed has been the fruit of constant improvisation and has had renewables as the chief victims of its electricity reform.

In spite of this, any analysis looking to the future, environmentally and economically, backs renewable energies regardless of the obstacles that are put in their way. This is the view of the European Parliament, which has approved an objective for 30% of member states' consumption to be from renewables by 2030. The Spanish government has, once again, demonstrated its lack of commitment by supporting the less ambitious proposal from the Commission and that the commitment be global and not specifically by country. However, one thing is clear. The renewable energy sector will have to play a fundamental role in Spain complying with its environmental commitments and in the fight against climate change.

José Miguel Villarig

Sustainable shopping centres as a reflection of modern society

By Cosmina Marian, for the Buildings Performance Institute Europe (BPIE)

Shopping centres – such as the Grand Bazaar in Istanbul, and galleries have been around for many centuries but developed in their modern form in Europe only over the past 50 years. They have become very important in Europe as they provide economic benefits for the community and represent a unique real-estate asset for investors. Shopping centres are also trying to respond to social needs by embracing environmentally-sensitive building practices. This isn't just smart for business but owners and managers also want to meet a social responsibility in their communities.

A BRIEF INTRODUCTION OF THE EUROPEAN SHOPPING CENTRE

Shopping centres began their European modern history in the 1950s in Sweden, only to quickly spread throughout Europe in the 60s and 70s, initially in the UK and France. The rising number of centres is strongly tied to rising incomes, increased consumer mobility and the occurrence of new retail chain stores. As a result of changing needs of society and economic growth, the retail industry has had to adapt. In the beginning, shopping malls were an indication of the economic wellbeing and vitality of a town.

More recently, a surge of shopping centres also has appeared in new EU Member States as they have grown economically. Today shopping centres can be found in every European country. They are a vibrant source of commerce, development and growth. The retail industry's size, reach and impact have a great deal of potential which can be exploited in order to make a difference and transform shopping centres into best-practice cases for sustainability.


Paris Défense

MIRRORING SOCIAL NEEDS AND TRENDS

Because of their visibility and status within communities, shopping centres have the potential to act as represent beacons for energy efficiency investments. Their best practices set an example for other actors to take action and improve the energy performance of buildings. Whilst the energy consumed by commercial developments pales in comparison with residential buildings, the public visibility of shopping centres makes them perfect drivers in the field of energy efficiency.

For some retailers, sustainability was built-in from the very beginning, for others it had to be incorporated into their practices later on. In any case, sustainability has become a key consideration for the retail industry and it's now affecting many facets of the business – from strategy, operations, workforce engagement to connections to consumers and communities.[1] The sustainability aspect touches upon many issues such as reducing energy, greenhouse gases, waste and chemicals. The scope of these practices is so wide that there is also a high demand for innovative practices and technologies.

The retail industry is thus in need of more tools and knowledge

to efficiently act and engage in sustainability. While a lot of progress has already been made there is still work to be done in order to reduce energy consumption and greenhouse gas emissions.

The FP7 project CommON*Energy*[2] (www.commonenergyproject.eu) offers retailers the know-how and toolkit to facilitate the transition from energy hungry set-ups to more energy efficient architectures and systems. Roberto Lollini, Project Coordinator from EURAC Accademia Europea Bolzano, said the following about the project's importance and scope:

"Shopping centres generally present high levels of energy demand, so the market offers ample room for improvement both in terms of efficiency growth and carbon emissions reduction: this is why the European Commission is encouraging actions involving commercial centres, that currently represent 28% of the total non-residential building stock.

In addition, due to their high visibility, they could represent a positive example for customers and visitors. CommONEnergy partners will develop tools and solutions, not only specific technologies (such as lighting, ventilation, refrigeration, etc.) but, even more important, also methodologies: the objective is indeed to implement a systemic retrofitting able to integrate different technologies, while taking into consideration the environmental and social contexts".

Courtesy of CitySyd, Trondheim, Norway

RE-CONCEPTUALISING SHOPPING MALLS FROM CONSUMERISM TO ENERGY CONSERVATION

CommON*Energy* focuses on existing shopping centres to be refurbished as well as on buildings with a different original function that have been redesigned to become commercial entities. The objective is to re-conceptualize shopping centres through deep retrofitting using a holistic systemic approach taking into account innovative technologies and solution sets as methods and tools to support their implementation. Thus, the project foresees to address all the steps of the transformation from design of solutions to implementation measures and

1. RILA, 2012 Retail Sustainability Report Successes, Challenges, and a Vision for the Future
2. Re-conceptualising shopping malls from consumerism to energy conservation (CommONEnergy). The project has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under Grant Agreement 608678. www.commonenergyproject.eu

Waasland Shopping Center, Sint-Niklaas, Belgium. Courtesy of Devimo Consult (http://www.devimo.be)

even practical applications. The effectiveness of these solutions will be tested on three demonstration cases in Italy,

Norway and Spain where consumption levels will be reduced, comfort conditions improved and environmental impacts estimated through life-cycle assessment.

CommON*Energy* favours deep systems retrofitting compared to single-action refurbishments. This approach has higher benefits, allows for more ambitious performance targets and covers more aspects. With regard to the performance objectives taken into consideration by the project it assume:

- Up to 75% reduction of energy demand (factor 4),
- Power peak shaving,
- 50% increased share of renewable energy source favoured by intelligent energy management and effective storage,
- Improvement of comfort and health conditions for occupants and visitors.

CommON*Energy* sets out to achieve these targets with a short pay-back time (below 7 years), as the financial consideration often weights substantially when investing in improving energy performance.

As a result, 10 to 20 systemic-solution-sets will be developed within the project allowing for replication and transferability to a wider range of cases. To make sure that this is achievable, CommON*Energy* has a network of supporting shopping centres that will be involved in the modelling process of the solution-sets in order to measure the energy savings. The network is made up of *Donauzentrum*, (Vienna, Austria), the *Grand Bazar* in Antwerp, the *Waasland Shopping Center* in Sint-Niklaas (Belgium) – shopping centres managed by Devimo -, Katané (Catania, Italy), and others. Another aspect that is meant to assure transferability of experiences relates to the training of practitioners.

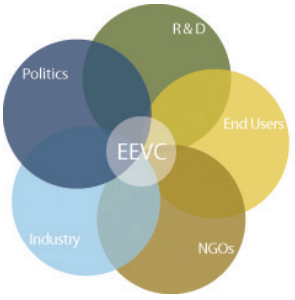
As mentioned before, the needs of the community can be reflected in the choices of shopping malls owners and managers to opt for sustainable practices. This project aims to impact a broad audience and create awareness among customers. It's about changing mind sets in order to adopt more sustainable consumption by making people responsible for their own decisions.

As an integral part of modern society, shopping centres hold a great deal of untapped energy efficiency potential. As long as retailers continue to make progress towards carbon neutrality and to recognize all the benefits it brings, others will follow with carbon neutrality commitments. The CommON*Energy* project was set up to further push this process. In order to advance even further, retailers should consider setting energy or climate goals to gain buy-in throughout the organization, communicate long-term plans and build a relationship with customers based on their environmental accountability.

EEVC-2014

European Electric Vehicle Congress
Brussels, 2nd - 5th December 2014

The European Electric Vehicle Congress strengthens its position as the premier global platform to foster exchange of views between R&D, the industry, the authorities, the end-users and the NGO's, to develop synergies in the field of eMobility.



As motivations and constraints are different for each of them, the objective of EEVC-2014 is to help define and select the most promising solutions, taking into account progress in research and development, as well as the environmental and economical constraints.

Feedback from past and current experiences will also be discussed and analyzed so that best practices & best ways for a daily introduction of eMobility can be identified.

Once again Brussels is the venue, thus ensuring optimal connection with the representatives of the European Institutions who consider Battery, Hybrid and Fuel Cell Electric Vehicles to play an important role in lowering atmospheric pollution and reducing oil dependency.

Policy aspects, new mobility concepts, noise and health factors will also be issues which will be discussed.

On the day prior to the Congress, an EU Project Day will be organized to provide the audience with a complete overview of various programs supported by the European Authorities (FP7, Horizon 2020, IEE, EUROSTAR, INTEREG, …) as well as related funded projects dealing with eMobility, so as to identify possible actions, overlaps, synergies and/or gaps.

Abstracts to be submitted by 15th July 2014.

All info at www.eevc.eu

Contact: info@electri-city.mobi

How can cities act for a sustainable future?

By Marine Faber from the Buildings Performance Institute Europe - BPIE

By 2050, more than 6 billion people will live in cities. The urban population now outnumbers the rural one for the first time in human history.

As it appears, cities are facing the same broad range of issues and challenges. High dependency on fossil fuels, high greenhouse gas (GHG) emissions, pollutants from cars, buildings and industry creating smog, all require urgent action. Some questions arise continuously: what to do with the urban sprawl? How to accommodate and feed people in cities? How to maintain a balance with nature? Cities see opportunities to meet these challenges, becoming even more productive and efficient, becoming "smart". Acting at the city level appearing easier, mayors are seen as key players in the process.

Mercado Del Val, Valladolid
© BPIE

Developed as a marketing concept by IBM in 2004, the "smart city" is now more than ever a challenge to meet. What exactly are "smart" cities? Are they sustainable? Digital? Well, they are both and more. Using efficiently their resources thanks to innovative approaches, they have a holistic vision combining smart governance and people with smart mobility, environment, economy and living (**Boyd Cohen** model[1]). It seems these cities have got it all: they attract more funding, businesses, residents and tourists.

A smart city thinks and acts collectively, is coherent (liveable, workable and sustainable), sober (in terms of energy consumption and GHG emissions), digitally connected and puts the focus on humans. But technology is not just what makes a city "smart". There is more.

Smart cities are able to understand their citizens and communicate with them. Citizens become consumers and producers of everyday information (through apps and social networks). Being part of the planning dialogue, they can for instance support mapping, spot and report potholes or broken street lights (with innovative apps such as FixMyStreet or Tripzoom for informed travel decisions). This data can then be brought to the policy discussions. Besides, if citizens are not involved, they will do so themselves. There are many examples developed at the community level: websites to report problems, cycle lines being painted on the pavement, people gathering in the *Let's do it*[2] movement to clean their streets… Social media and crowdsourcing are paving the way to public engagement and therefore to change.

Initiatives are being replicated to change the thinking that cities should be designed around cars. Resources are made more accessible: vertical farming / urban gardening, multimodal (shared) transport and digital participation are some examples.

More than half of GHG emissions in cities come from buildings, making them a key area to work on to deliver an immediate and impactful change. Reconverting and refurbishing old or abandoned buildings, as well as the construction of positive or net zero energy buildings are the cornerstone of a sustainable city. There is a need to improve the way buildings are designed and monitored, as well as a need to enable active participation in their management through smart metering for instance.

In Europe, most cities are already

Mercado Del Val, Valladolid
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built and have to find solutions to maintain their development whilst minimising impacts. European mayors exchange knowledge and gather public and private players in a coordinated effort. Exemplary cities (or communities) are developing roadmaps setting out possible actions that respond to the challenges that cities of the future face: job security, health, GHG decrease and mobility. The same cities are usually highlighted: Vienna, London, Paris, Berlin and Copenhagen (the European Green Capital 2014, it aspires to achieve carbon neutrality by 2025). But other cities are doing great and have demonstrated high innovation capacities.

The Spanish cities Valladolid and Palencia have developed an interurban brand, *Smart City VyP*[3], to market their ambition and projects. The objectives are: an increased cooperation and international visibility, improved service quality and citizens satisfaction, innovation and secured sustainability. Working groups were created (Energy and Environment, Mobility, Citizens and eAdministration) leading to the emergence of specific projects. The *Mercado del Val* rehabilitation aims at showcasing existing technologies available to make commercial spaces less energy demanding and GHG emitting. This renovation is part of CommON*Energy*[4], a European project investigating the integration of innovative technologies into three shopping centres in Spain, Norway and Italy.

"The collaboration among both municipalities with CARTIF as technical secretary has allowed the development of other innovative proposals to renovate residential urban spaces and buildings, testing project pilots "video-to-video" for the provision of services to citizens and the use of ICT to optimise the energy usage of public spaces.[5]*"*, say Ana Quijano from CARTIF and Teresa Redondo from the Valladolid's City Hall.

Cities are uniting to be stronger. More than 40 European cities have signed the *Green Digital Charter* committing them to work with other cities on ICT and energy efficiency. This initiative launched in 2009 allows them to learn from one another and share information. Another alliance representing more than a thousand cities, *Energy Cities*, recently asked the EU Council President for binding 2030

1. Boyd Cohen's 6-components model explained in details: http://www.boydcohen.com/
2. Let's do it world: http://www.letsdoitworld.org/
3. Valladolid Smart City www.valladolidadelante.es
4. CommONEnergy FP7 Project www.commonenergyproject.eu
5. R2CITIES FP7 Project ; http://r2cities.eu
   Campus 21 FP7 Project ; http://www.campus21-project.eu
   LIVECYTY CIP Project: http://www.livecity-psp.eu

targets for energy efficiency and renewable energy.

"The Energy Cities network strongly believes in a multi-level and multi-stakeholder approach to manage the necessary energy transition. To this regards, the Covenant of Mayors' governance model[6] *has proven successful. Smart cities are not only using their local resources, be they human, financial or technological, in a clever way. They also need to be smartly supported"*, says Claire Roumet, Deputy Executive Director of Energy Cities.

In the US, cities are no exception to this collaborative approach. A recent project developed by the *Institute for Market Transformation* (BPIE's US partner) and the *Natural Resources Defence Council* will engage cities in a multi-year effort to promote efficient building operations and transparency about their energy consumption, as well as encourage private investment and city leadership. *The City Energy Project*[7] has selected cities with diverse characteristics and sizes willing to act fast to demonstrate that any city can be bold. Energy efficiency will be expanded in large existing structures with results such as lowered energy bills, local jobs support and environmental impacts reduction. One full-time advisor per city will help create plans specific to each city's needs.

"The City Energy Project will ramp up energy efficiency initiatives in 10 cities around the US," said Cliff Majersik, executive director of IMT. "Each city will work hand in hand with its local business community to find approaches that are not just bold, but also pragmatic, and tailored to the local market. Having more information on the energy performance of their building stock will make these cities smarter—so they are able to target their resources and work in a more strategic way".

Cities have tools to reinvent themselves. They can group themselves (such as the *C40 Cities Climate Leadership Group* or the *Covenant of Mayors*, networks of cities taking actions to reduce their GHG emissions), they can count on industries consortia and initiatives (*Vivapolis, SmartCitiesCouncil.com, Veolia*) and on media to provide them with information on products, solutions and best practices (*theguardian.com/cities, the Sustainable City Network, The Big City, The Sustainable Cities Collective*).

But for all these to work, one must highlight the importance of the reaction and adaptation speed. The technologies are available. They need to be applied, multiplied and, above all, training and support must be developed. You may give a thousand tools to citizens, but if they don't know how to make use of them efficiently the action is doomed.

There are several aspects to focus on in the coming years. Cities are growing as more space to work and live is needed. City planners must build a sustainable and resilient metropolis and put citizens at the core of the process. But maybe the smart part must come from policies. Leadership challenges are indeed seen as a key barrier to smart cities, together with financing. "Smart" cities need "smart" politicians acting differently and courageously to make change happen.

Mercado Del Val, Valladolid - Future plans
© CommONEnergy

6. EU Mayors: www.eumayors.eu
7. City Energy Project www.cityenergyproject.org

Shaping energy intelligent cities of tomorrow

By Dieter Reiter, Lord Mayor, City of Munich

Europe's resilience to face the future will depend on its cities. How can we balance increasing energy demand with environmental, economic and social concerns? Munich is one European city taking a leading role in addressing our growing energy consumption. As the Bavarian capital, host of this year's EUROCITIES annual conference, we have launched various projects, initiatives and activities to help us achieve this goal.

'Energising cities – energy-intelligent cities of tomorrow' is the theme of EUROCITIES 2014 Munich. European cities must prepare their energy infrastructure for the future. This means more than simply modernising energy systems and promoting energy efficiency, it means managing the everyday demands of living, working, shopping, and leisure in a modern urban context.

The next 20 years will shape the cities of tomorrow: cities will need to respond to climate change and natural resource management, economy and job creation, social equity, demographic change, citizen engagement, and in particular youth engagement. Cities must adapt if we are to meet the expectations of our citizens and provide the services they need. At EUROCITIES 2014 Munich, politicians from major European cities will discuss how this urban transformation will define how Europe as a whole responds and adapts.

To manage this change, cities must think about the bigger picture. We need to explore new sources to meet growing energy demand, and combine the need for energy, housing and transport with meeting strict environmental standards. We must make economic and social concerns an integral part of this process.

The Europe 2020 strategy sets clear goals for the EU on climate and energy, aiming to reduce CO_2 emissions by 20% by 2020. With 70% of all of Europe's energy consumed in cities, local action is pivotal for meeting climate targets. Many cities are setting themselves more ambitious targets – through the Covenant of Mayors, for example, cities commit to improving energy efficiency and increasing energy uptake from sustainable sources beyond the Europe 2020 goals.

But beyond 2020, how can we make our cities energy intelligent? We must consider the implications for wider urban planning if we are genuinely to reduce energy consumption and lower CO_2 emissions, while improving quality of life for growing urban populations.

We will explore these issues and more at EUROCITIES 2014 in Munich, including designing the built environment, greening the wider community through collaboration with businesses and citizens, and developing new business models and partnerships. We will demonstrate our own ideas and projects through workshops, inviting participants to share their own experiences too.

Our workshop on urban development will take place in an area where two sharply contrasting urban districts meet. Freiham, a new district developed using a modern, sustainable energy concept, is set to become a model for low carbon development. Its geothermal district heating plant is at the cutting edge of heat generation. Neuaubing, meanwhile, is an

Dieter Reiter

Munich's local hydropower plant

older district, due to undergo complete energy system modernisation. Here, energy efficient urban development must meet the energy and technical requirements of older buildings on one hand, and urban development, economic and social criteria on the other.

Another workshop will showcase two hydropower plants on Munich's river Isar. Discussions will revolve around decentralised energy production, smart grids and alternative fuels. These plants are central to Munich's strategy to provide the whole city with green electricity by 2025, which also includes energy from wind, water, sun, organic substances and geothermal sources. Managed by Stadtwerke München (SWM), our city-owned utilities and service provider, one of the hydropower plants uses sophisticated technology to generate electricity from water, while the other is one of Europe's most modern small hydropower plants, with an underground turbine working silently in a natural environment.

A central focus of our discussions will be energy intelligent urban mobility. Munich will open its first mobility station during the conference – at the Münchner Freiheit public transport interchange. It brings together underground train, bus, tram, car-sharing and bike-sharing in a central location, making it easy for users to combine different modes of transport.

Successful multimodal transport systems are about more than just providing good public transport, cycle paths, foot paths and vehicle sharing schemes: They should bring all these elements together and complement them with information, advertising and tariffs. Could our approach work in other cities? How are other cities making mobility attractive and energy intelligent? Delegates from European cities, North America and Asia are invited to join the discussions in Munich this November.

Cities have the potential to develop new technologies, broker new partnerships, create incentives, change behavioural patterns and provide the right framework for citizens and others to co-create and take action themselves. Together, we can then make a crucial contribution to reducing CO_2 emissions. Cities have the power to dramatically reduce Europe's energy consumption.

EUROCITIES 2014 Munich:
www.eurocities2014.eu

SMN

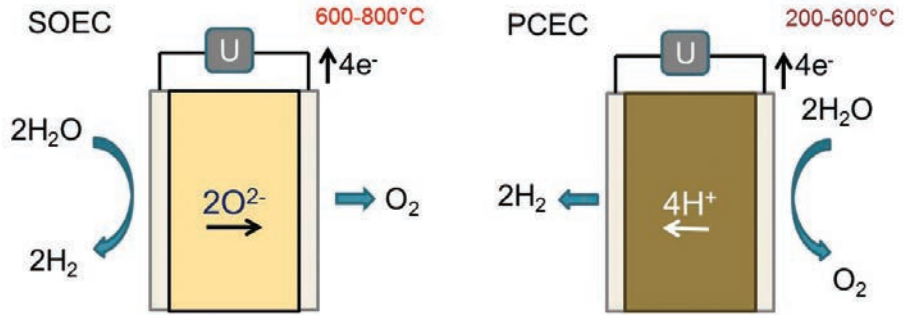
The Centre for Materials Science and Nanotechnology (SMN) is an interdisciplinary initiative at the Faculty of Mathematics and Natural Sciences, with a vision of promoting cutting-edge research related to functional materials and nanoscience for applications within environmental and energy technologies. SMN is and has been the coordinator of a number of large EU-projects.

ELECTRA

One of the latest projects in our portfolio is the recently started FCH JU funded project ELECTRA, focusing on novel concepts for high-temperature electrolysis. UiO together with six other partners from Spain (CSIC and Abengoa), France (MARION), Iceland (CRI) and Norway (SINTEF and Protia), seek to produce hydrogen more efficiently than competing technologies.

The intermittency of renewable energy (like solar and wind) dramatically increases the demand for energy storage, and hydrogen represents a promising solution to this challenge. Current technology generally requires a trade-off between efficiency and robustness. ELECTRA will develop the use of more efficient proton conducting ceramic electrolytes in a novel generic module of tubular cells that enables better robustness and lifetime economy. The main objective of the project is to reach scalable fabrication of cells and modules to produce pure, dry, pressurized H_2. Additionally, a proof-of-concept for CO_2 and steam co-electrolysis into syngas ($CO+H_2$) and further to liquid fuels will also be demonstrated.

A traditional solid oxide electrolyser cell (SOEC) produces hydrogen on the steam side, while ELECTRA's novel proton ceramic electrolyser cell (PCEC) produces dry hydrogen directly.



UiO Energy builds on the University's strategic ambition to *achieve key research policy objectives and meet societal needs for new knowledge in health care, the environment, sustainable energy and the effects of global climate change* (Strategy2020). Designed to address the complex transition towards secure and sustainable energy systems without compromising with the living conditions of future generations, UiO Energy aims to strengthen and support energy research, education and innovation across disciplinary divides and between research teams at the University of Oslo and international as well as local partners. UiO Energy is a collaborative effort between Faculty of Social Sciences, Faculty of Mathematics and Natural Sciences, Faculty of Law, Faculty of Humanities and the Centre for Development and the Environment. The initiative is oriented to respond to visions formulated and priorities as set in national and European energy, research and technology policy documents, such as the SET plan, Energy 20-20-20, EU Roadmap 2050, and Horizon 2020.

For more information:
www.mn.uio.no/smn/english/research/projects/electra/
www.uioenergi.uio.no/english/

Maintaining the edge: Energy Innovation in Norway

By Terje Lien Aasland, MP, Vice Chair of the Norwegian Standing Committee on Energy and the Environment

A combination of abundance of natural resources, political will and innovation has made Norway a key player in the European energy sector. Entering the 19th century as one of Europe's poorest countries, the Norwegian turnaround is closely linked to energy and industrial innovation.

The successful and innovative development of the Norwegian energy sector was the result of long term planning, both from industry and policymakers. We need to apply the same long term, rational and innovation oriented approach to the great challenges we face in the climate crisis. New reports from the International Panel on Climate Change (IPCC) underline the dramatic seriousness of ongoing climate change and global warming. The urgency of finding smarter and more climate friendly ways of generating and consuming energy makes climate change the major challenge facing our generation of policy and decision makers.

LONG TERM THINKING NEEDED

The long term political thinking underpinning the energy sector growth in Norway is based on a few key objectives: Firstly, the energy resources (both fossil and renewable) belong to the people, and the people should get its fair share of the revenues from the harvesting of such resources. Secondly, Norwegian actors in the energy sector should take part in the competence building related to energy. This has been a success. Accordingly, regarding

petroleum services Norway has moved from importing a majority of services and competence in the 1970'es to being a formidable knowledge hub and exporter of petroleum services today. We hope to build on the competencies in this sector to take a larger share of the growth also regarding renewable energy.

Today the Norwegian electricity mix is almost 100 percent renewable, thanks to huge investments in hydropower capacity. Access to cheap and reliable hydropower provides a competitive edge to the power intensive industries, which grew on the basis of hydropower development.

We need to apply the same long term thinking that has worked so well in petroleum and hydropower to solving tomorrow's energy challenges. Climate change, energy security and competitiveness are the foremost energy related challenges in Europe and Norway.

Putting a price on carbon emissions is the best and most efficient way of reducing emissions. In Norway approximately 80 percent of CO_2-emissions are submitted to some form of carbon pricing, either the EU-ETS quotas or as a straightforward carbon tax, in some cases both. There has been a carbon tax on the petroleum production on the Norwegian Continental Shelf (NCS) since 1991; this has resulted in emission reductions on the shelf. One example is the carbon sequestration and storage at the Sleipner field, earlier this year they celebrated having stored more than 20 million tons of CO_2.

EMISSION REDUCTION

Both prices and regulations yield energy innovation. The Norwegian ban on flaring in normal conditions on the NCS has also resulted in large emission reductions. On a global scale emissions from flaring in the oil and gas sector emits more than 250 million tons (2011), thus approximately the emission from a country like Spain. Accordingly, reducing flaring worldwide would be an effective climate policy.

A combination of regulation, price on carbon and subsidies are needed to provide the innovation in energy and the energy services we will need to create a climate friendly energy system. For me, one of the key areas for future innovation is the use of energy in industry. The history of emission reductions in Norwegian industry is impressive. During the last decade emissions from industry have been in a steady decline, at the same times as industrial production has increased. This is a result of foresight from managers and workers, political facilitation and increased automation. We aim to continue to support good emission reduction projects in the Norwegian industry, as it provides for smarter use of energy, economic competitiveness and reduced carbon emissions.

Facing the need to reduce emissions Norway has a very good track record of cooperating with industry on voluntary commitments. In order to reducing emission of NOx-gas, these voluntary commitments meant that the industry paid money into a special fund for supporting emission reduction projects, instead of paying tax on the emissions. This model has been very successful, and we are now discussing continuing this model for another period of time.

Projects in industry are funded through the state agency Enova. They report having supported projects that contribute to 1.2 million tons of annual CO_2-emission reductions over the last 10 years.

Replacing fossil energy with renewable energy is crucial in solving the climate crisis. Innovations in renewable energy, increased energy efficiency and emission reduction require a productive cooperation between the state and private actors. In areas such as research, development and demonstration, as well as direct project support, government support can unlock new opportunities and provide a secure investment framework for private actors.

Long-term political frameworks, active governments and ambitious industrial actors play a significant role in enabling a shift to a more climate friendly energy sector. We have worked closely with the energy sector to increase the generation of renewable energy, and to help the power intensive industries to consume less energy, and to be smarter regarding their energy consumption. This will lead to lower emissions, and higher competitiveness. Our emissions are falling, but not far enough and fast enough.

In Norway we would like to be a team player in shaping the future of the European energy sector, by contributing knowledge and MW.

Oslo Region taking a leading role on hydrogen for transport

The Oslo Region is among the world-leaders for the introduction of zero emission transport. With sales share of battery electric vehicles surpassing 15% of new car sales in 2014 and with hydrogen related research and development, the region is now aiming to be among the leading regions for early use of fossil-free hydrogen fuel for transportation. The Norwegian Capital region is a cornerstone for the build-up of

Akershus Energy Park is host for the innovative Hynor Lillestrøm Refueling Station, and test center for hydrogen technologies, currently from solar and hydro powered electrolysis, advanced steam methane reforming delivered by ZEG Power and thermal metal hydride compression delivered by Hystorsys. Institute for Energy Technology based at Kjeller Science Park is a central R&D contributor. Small picture: Fuel cell electric vehicle and bus at the refueling station.

OREEC
OSLO RENEWABLE ENERGY AND ENVIRONMENT CLUSTER

hydrogen refueling infrastructure in Northern Europe, paying an important contribution to the phasing out of fossil fuels and cutting emissions in the European transportation sector.

The density of hydrogen refueling stations in the Oslo region is among the highest in Europe, with five stations for passengerx cars and one for buses. There are 20 fuel cell electric vehicles and 5 fuel cell buses in regular traffic by the Oslo-Akershus public transport authority Ruter.

The County of Akershus and the City of Oslo have contributed extensively with co-financing and framework build-up for the regional hydrogen engagement, and have recently approved a Regional Hydrogen Strategy covering the period 2014-2025. The targets for fleet growth are set at 350 cars and 30 buses in 2018, and 10000 cars and 100 buses in 2025.

OREEC has also been an important contributor by initiating hydrogen projects in the region. Several concept initiatives have led to larger investments, with Hynor Lillestrøm, an R&D oriented refueling station and competence centre as one example. OREEC also hosts the secretariat for The Norwegian Hydrogen Forum and Hydrogen Council.

Another important project in OREEC is Interreg (Next Move), which has engaged municipalities and regions in Southern Scandinavia (ØKS-region) to be early adopters of fuel cell electric vehicles. Out of 20 newly procured vehicles in Oslo, Skåne and Copenhagen, 10 of these came through Next Move and have received ERDF funding. The cars, all Hyundai ix35 FCEV have been driven extensively with feedback of outstanding performance.

Next Move commenced in 2011 and runs until Septemerb 2014. A follow-up project is planned for the new Interreg program period, looking at new business models, energy system integration and new public vehicle fleet arrangements.

For more information regarding our hydrogen activities see: www.oreec.no/hydrogen

OREEC is a triple helix cluster of companies, industry, R&D institutions and universities within the field of cleantech in the Oslo region, Norway. The main objective is to increase pace of innovation and business development.

Our activities:

- Matchmaking. We regularly facilitate networking events and make direct connection between relevant actors.
- R&D and Innovation. OREEC initiates and facilitates projects that contribute in technology development and innovation.
- International cooperation.
  - Trough OREECs membership in International Cleantech Network (ICN), we have direct access to world leading cleantech clusters.
  - ICN-partners in Europe started in 2013 the COOLSWEEP-project funded by EUs 7th FP. The aim is to increase inter-cluster collaboration on waste-to-energy and increase R&D and business opportunities within this field. See www.coolsweep.org
- Competence-development. OREECs partnership-base fosters a strong link between industry and universities to increase competence development and recruitment.

For more information about our projects and our team look at www.oreec.no or contact: eva@oreec.no

THE EUROPEAN UNION The European Regional Development Fund

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NEXT MOVE

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Effective 3D Float in offshore wind power

By Mette Johnsrud

The Norwegian coastline has huge wind resources due to good wind conditions. The wind researchers at IFE are working with offshore wind to provide a technology that uses wind resources effectively. They are especially interested in the design of turbines.

LONG EXPERIENCE

IFE has been doing wind energy research for more than 30 years.

- In the recent years we have focused on offshore wind turbines, and are one of the founders of the large Norwegian offshore wind energy research project named NOWITECH (http://www.sintef.no/projectweb/nowitech/), says senior scientist at IFE, Roy Stenbro.

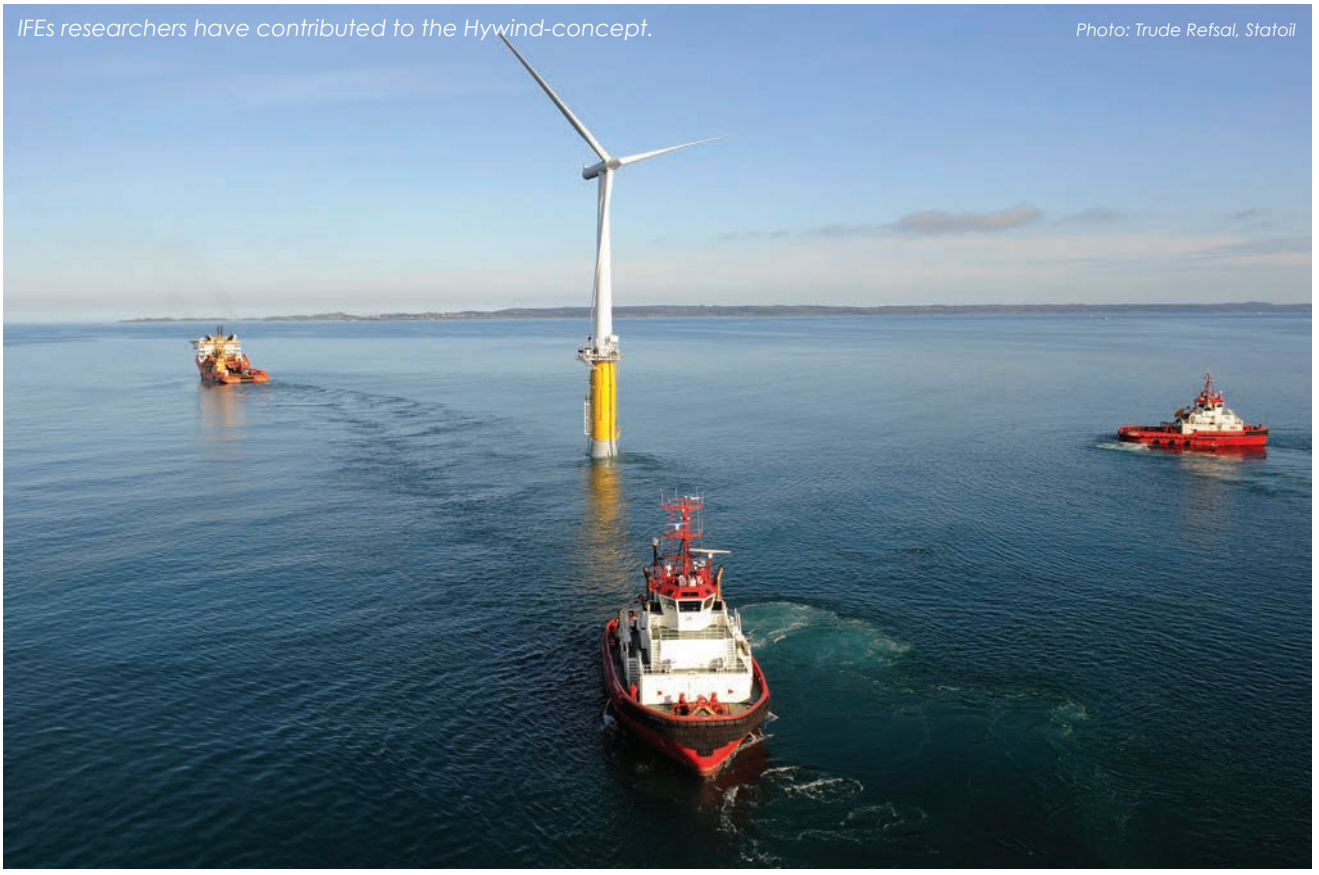
MAIN FOCUS ON 3D FLOAT

For wind power, the main focus for IFE is the continued work with a 3D modelling tool called 3D Float. 3D Float can simulate the behaviour of floating wind turbines offshore, by measuring how waves, wind, currents, turbulence and icing affect the wind turbines. The tool can therefore make it much cheaper to build wind farms, compared to building expensive new full-scale models. 2012 saw the start of planning a pilot floating turbin in cooperation with other well known research institutions in Norway. The pilot will be installed in 2015.

With this pilot we can integrate 3D models with the actual measurements, and make the model more precise and exact, says Stenbro. It is perhaps the most important technical tool for industry and R&D organizations.

The 3DFloat is state of the art software for integrated simulations of wind turbines on land, offshore bottom fixed or floating. This includes:

- The environment of sea and air
- The forces generated by the sea and air on the turbine



IFEs researchers have contributed to the Hywind-concept. *Photo: Trude Refsal, Statoil*

Scientist Jacobus Bernardus de Vaal coordinating users to develop the open source code for the 3D-program.

- The structural loads and the motion of the turbine, including rotor, tower, sub-structure and mooring lines.
- Turbine control system

OPEN SOURCE CODE

In 2013 the 3D Float developers made an open source code of the program, enabling more users and developers to make use of the code. As for now, students and part of the industry are contributing in the work of developing the software program.

"This enables us to increase the value of the 3D modelling tool", says Stenbro.

COST-EFFECTIVE CONCEPTS

Reducing the costs of energy is vital for offshore wind, and lies at the core of IFE's wind energy research. The offshore wind industry is still young, and it is not known what the best designs are. IFE therefore focuses on developing and evaluating promising cost-effective concepts.

-We for example have experience with monopile, jacket, tension leg buoy (TLB), semi-submersible and spare buoy designs. Examples of tasks are optimized design of rotor, tower, sub-structure and mooring, and analysis of dimensioning loads and fault conditions, says Stenbro.

About IFE

IFE is an international research foundation for energy and nuclear technology. The institute was founded in 1948, and is today an independent foundation. The annual turnover is approximately NOK 850 million, and IFE has about 600 employees. IFE's vision is to be an internationally leading energy research institute. IFE's mandate is to undertake research and development, on an ideal basis and for the benefit of society, within the energy and petroleum sector, and to carry out assignments in the field of nuclear technology for the nation. The institute strives for a more climate friendly energy system based on renewable and CO_2-free energy sources.

Clean energy by the fjords

Mr. Leidulf Bogstad on the outside of one of his powerplants, beautifully located by the fjord. (Below) The size makes no difference. Even in a small hut you can find room for a generator.

In Norway many farmers have found a new outcome producing clean, renewable hydroelectric power. One of them is Leidulf Bogstad farm the small village of Aardal located by a fjord in western part of Norway.

In Aardal all of the 15 neighbours and farmers cooperated to build two power plants in the river that runs through the village. Now they own and operate the plants themselves as a part time project.

- The owners of the waterfall and the powerplants are the same people. In a process like this the people with the biggest parts of the waterfall have to give something to find a good solution for everybody. We have worked together in a positive way ever since the start of the project, says Leidulf Bogstad, one of the owners.

In Aardal the powerplants have created new optimism in the village which is located right in the "middle of nowhere" on a shelf in the mountain overlooking the fjord. The two powerplants have been producing clean energy since 2008 / 2009. The waterfall from the water-intake on top of the mountain down to the fjord is 561 meters. The water comes from a mountain area19,6 square kilometers in size. Each year the generators produce approximately 20 GWh. According to mr. Bogstad they are very happy with the technical solutions so far.

Over the last ten years many plants like this have been built in rural parts of Norway. The conditions are especially good in the western parts of the country where you will find vast height-differences between the mountains and the fjords beneath them.

- Many farmers have taken the opportunity to make money from their own power-resources. This is good for the climate, but also good for the local villages as a way to secure their further existence, says Mr. Knut Olav Tveit, head of the Small Hydropower Association that organize 250 privately owned, small powerplants.

Though the powerplants in Aardal haven't got elcertifikates an important reason for the building of many small powerplants is the common Swedish-Norwegian elcertificate market

The elcertificate market is a technology neutral, market-based support scheme for power generation from renewable sources, organised by Statnett, the system operator for the Norwegian energy system.

The common Swedish-Norwegian elcertificate market started on the 1st of January 2012. Norway and Sweden have a common goal to increase power generation from renewable energy sources with 26,4 TWh before 2020. The common elcertificate market is a politically motivated instrument to reach that goal.

Each country finances 13,2 TWh through the quota obligation.

Production devices included in the support scheme receive elcertificates that can be sold on the common Swedish-Norwegian elcertificate market.

Power suppliers and certain types of power consumers with their own power procurement are obliged to buy elcertificates out of a certain amount of the power they sell or consume each year.

This picture is from Brunstad powerplant in western Norway. The sign says: "Show caution!e The river is a source of drinking water". First the local people make clean energy out of the water. Then they drink it.

We bust boundaries

By Gro Brækken, CEO, Norwegian Oil and Gas Association

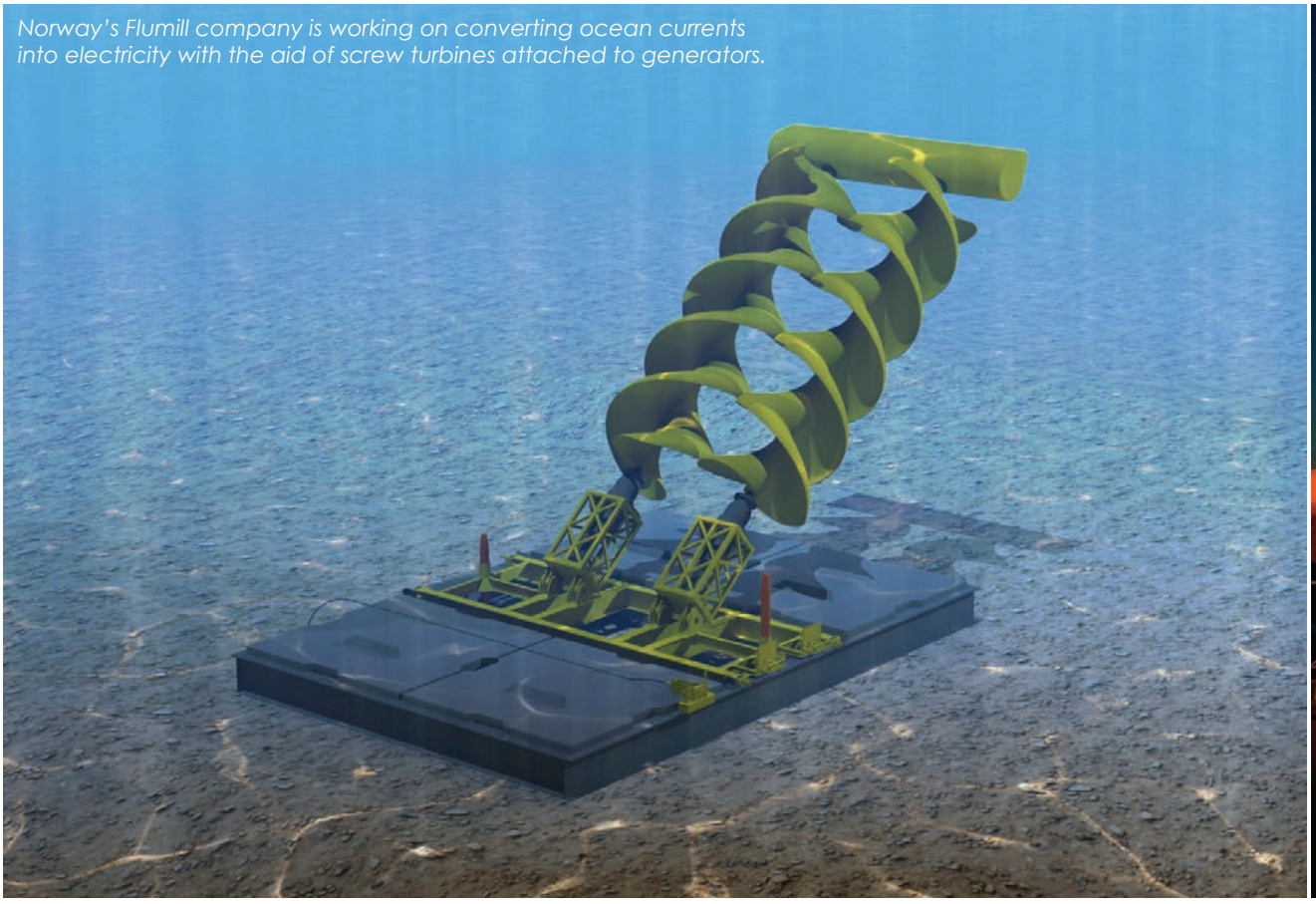
Norway's petroleum industry currently employs 250 000 people, directly or indirectly. The supplies – or oil technology – business ranks as the largest mainland Norwegian industry and its largest export sector after oil and gas.

It employs almost 200 000 people in 4 000 companies, and has annual sales of more than NOK 360 billion. Companies in this sector pursue extensive innovation and technology development, utilised both on the Norwegian continental shelf (NCS) and in the rest of the world.

Technology and solutions from these companies are not only exported to other countries and new markets, but have also been passed to other sectors. We have compiled a report on Technology transfers from the oil and gas sector in cooperation with Rambøll. A total of 26 examples include health care, space exploration and renewable energy:

Health care: A system developed to keep an eye on offshore drilling has also proved effective for risk scrutiny at stockbrokers and observing cardiac patients.

A spin-off from the Norwegian University of Science and Technology (NTNU) in Trondheim, Verdande Technology originally developed its monitoring system



Norway's Flumill company is working on converting ocean currents into electricity with the aid of screw turbines attached to generators.

for the petroleum sector. This solution is based on tracking real-time data combined with knowledge transferred from earlier incidents. With 92 drilling rigs worldwide currently using the system, experience from the oil and gas sector indicated to Verdande that its solution could be useful in other sectors.

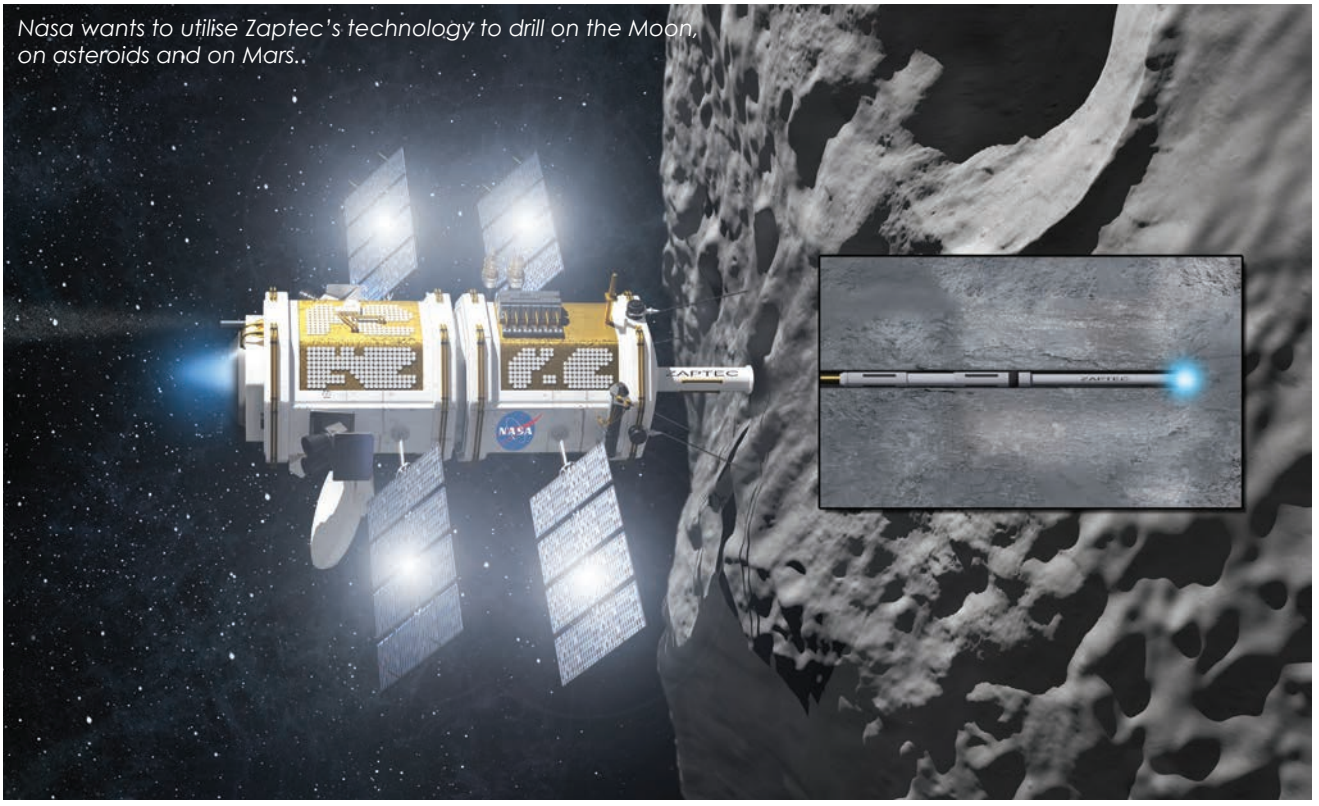
One is health care. The company is now developing a system in cooperation with Houston Methodist Hospital, which has one of the USA's leading heart clinics. This version collects sensor data from patients before and after they have been operated on, monitors symptoms and compares them with earlier cases.

Verdande's approach has also proved useful in the financial services industry. It is used by stockbrokers, for example, to check if clients are taking inappropriate risks.

Space exploration: Miniaturised power electronics developed to cope with tough conditions encountered in North Sea drilling and wells have proved useful for space research and charging electric cars. Small, light, robust and intelligent, this solution was originally developed for use in tools which require more power and higher voltage when working downhole in oil wells.

Stavanger-based company Zaptec AS has achieved a good dialogue over the past year with manufacturers of electric cars, and the response has so far been very positive. Infrastructure for battery charging is a big challenge in the electric vehicle sector. Zaptec's miniaturised electronics can help to overcome this by adapting to the grid voltage and thereby ensuring swift and simple charging. Furthermore, the charging stations can communicate with power companies, homes and cars, and thereby become part of an intelligent power network.

Nasa has also shown interest in the company's technology, since the high voltage from the transformer is incorporated in a plasma-based drilling system.



Nasa wants to utilise Zaptec's technology to drill on the Moon, on asteroids and on Mars..

The US agency wants to utilise this to drill on the Moon, on asteroids and on Mars – initially to map minerals, geology and water resources on the Red Planet and to search for life below ground. In the next phase, drilling could be relevant for producing and processing resources in outer space, particularly from the Moon and asteroids.

Renewable energy: Technology and experience from Norwegian subsea operations play a key role in turbines which can convert tidal currents into green energy. Established in 2002, Norway's Flumill company is working on converting ocean currents into electricity with the aid of screw turbines attached to generators. Tidal flows offer a very stable source of power if they can be properly exploited. They operate continuously and are highly predictable.

When the turbines are rotated by the current, the electricity generated is transmitted to land via submarine cables. The technology has been analysed and model-tested at up to 25 per cent of full scale over the past three years, with good results. A two-megawatt full-scale system is the next step.

Given that this development involves a subsea energy technology, drawing on experience from the oil industry has been a natural approach.

Such transplanting of technology, knowledge and production methods from one industry to another is generally termed technology transfer. Ensuring that innovations benefit a broad range of products and people worldwide, it represents a very important tool for progress.

The petroleum sector plays a key role in all scenarios for future energy supplies. We're part of a global technology industry which is moving the world forward. Our technology and our expertise will and must play an important role in determining the best way to recover the resources both in deep water and in more extreme climates.

That's when the opportunities will come. That's when innovation will happen. That's when we become part of the solution.

Because we bust boundaries.

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