WINTER 2011

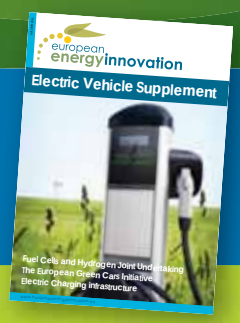
european energyinnovation

Smart Cities – Creating the renewable city

Fuel Cells

Wind Energy

Special Electric Vehicle supplement included with this issue



www.europeanenergyinnovation.eu

7&8 February 2012

Amsterdam, The Netherlands

EUROPEAN RENEWABLE ENERGY PROJECT FINANCE SUMMIT

Latest innovative approaches to make your RE project successful, lucrative and eco-friendly

Booking information:

T: +36 1 781 0522, **F:** +36 1 577 2012,
info@umievents.com, www.umievents.com

UMI
UNITED MARKET INSIGHT

Barcelona
United Market Insight
Aribau 221, Bajos, 174, Barcelona 08021, Spain

Bratislava
United Market Insight
Rontgenova 26, 851 01 Bratislava, Slovak Republic

Budapest
United Market Insight
Szent Istvan krt. 9., 1055 Budapest, Hungary

Foreword

As we go to press, delegates at the COP17 in Durban are grappling with the next stage of the United Nations Framework Convention on Climate Change (UNFCCC). The climate issues that they are debating are fiendishly complex on their own, but they have to be discussed against a looming backdrop of great financial uncertainty.

The developing nations have a case when they point out that the developed nations have largely achieved their wealth through industrialisation, and that theirs is the primary responsibility for the presence of most of the atmospheric CO_2. The Kyoto protocol sought to address that issue, and those same nations have thus far borne the cost of its provisions, albeit with mixed results. But this argument now appears to cut little ice, metaphorical or otherwise.

Cannot some mechanism be found whereby the developing nations begin to develop along low-carbon lines by using the new technology that has been developed and paid for by the industrialised ones? Any carbon debt to the environment would then surely be repaid in full.

As ever, the best way out of this situation lies surely through shared innovation. After all, nobody can escape the uncomfortable fact of climate change. The job now is to decide which nations shall play Dionysus. And which, Damocles.

Mike Edmund

Leading the development of highly efficient hydrogen production

Statoil energy park, Porsgrunn, Norway. The demonstration site for the NEXPEL PEM-electrolyser.

Seven European partners have joined forces to further develop and demonstrate next generation proton exchange membrane (PEM) electrolyser technology suitable for highly efficient hydrogen production from renewable energy sources. The NEXPEL consortium, coordinated by SINTEF, consists of leading R&D organizations and major industrial actors from 4 member states; CEA LITEN (FR), Fraunhofer ISE (DE), FuMA-Tech GmbH (DE), Helion – Hydrogen Power (FR), SINTEF (NO), Statoil ASA (NO) and University of Reading (UK).

During the NEXPEL project an efficient PEM electrolyser integrated with Renewable Energy Sources (RES) will be constructed and demonstrated. The NEXPEL electrolyser will incorporate several technological innovations, such as more active catalysts, new membrane materials, highly stable porous current collectors and bipolar plates. To further reduce cost and improve stability, an advanced stack design using components suitable for mass production and highly efficient advanced power electronics will be developed. The three main targets for the NEXPEL project are to achieve:

- Electrolyser efficiency greater than 75%
- Stack life time of at least 40 000 h
- System costs below €5,000/Nm^3 h^{-1} H^2 production capacity.

During the first two years, NEXPEL has developed a new, polyaromatic membrane with improved properties over state of the art membranes, a novel iridium catalyst which has been found to have high activity for the oxygen evolution reaction and a cost efficient stack design, capable of reducing the overall capital costs by 50%.

During the second part of 2012, the NEXPEL electrolyser will be integrated with the renewable energy infrastructure at Statoil's energy park in Porsgrunn, Norway through a highly efficient DC/DC converter. The Energy Park consists of wind turbines, solar panels and a lead-acid battery bank for energy storage. Two water electrolysers, one pressurized alkaline and one PEM, are installed. The alkaline electrolyser can supply hydrogen produced from renewable energy to the hydrogen refuelling station on site.

The outcome of the NEXPEL project will support the overall vision to establish hydrogen as an energy carrier for a wide range of applications, and contribute to meet the substantial need for increased energy storage capacity when the share of RES in energy production increases. To this end, NEXPEL is co-organizing an international workshop the 10-11 May 2012 in Copenhagen on hydrogen as an enabling technology for the introduction of large amounts of renewable energy such as wind and solar.

The NEXPEL project has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) for the Fuel Cells and Hydrogen Joint Technology Initiative under grant agreement n° 245262.

NEXPEL - "Next Generation PEM Electrolyser for Sustainable Hydrogen Production"
Duration: Jan 2010-Dec 2012
Budget: €3.4 million
Funding: €1.3 million
www.nexpel.eu

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

European Energy Innovation is published by:
Prologue Media Ltd
Bank Chambers
29 High Street
EWELL Surrey KT17 1SB
United Kingdom

Tel:+44 20 8786 3695
Sales office +44 1372 726135
www.europeanenergyinnovation.eu

Brussels representative office
145/15 Avenue Molière
B-1190 – Brussels
Belgium
Tel: + 32 2 347 70 19

To obtain additional copies please email info@europeanenergyinnovation.eu

PUBLISHER
Graham Pendred

EDITOR
Michael Edmund

DESIGN & PRODUCTION
RayHeathDesign.com

WEBSITE DESIGN
pulseart.co.uk

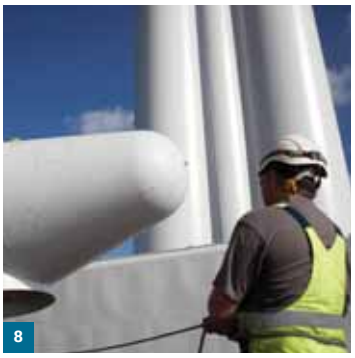
PRINT
Rowcolour Limited
Epsom, United Kingdom

Contents

1 Foreword

NEWS
6 What on Earth is happening?
Mike Edmund

WIND
8 Post 2020 Legislation Key to Maintaining Europe's Renewables Leadership
Julian Scola, EWEA



DENMARK
10 Ambitious Danes Show will to be World No 1...
I.H Nielsen, State of Green
13 Industry Would Welcome Long-Term Vision
MEP Bendt Bendtsen, EPP

FUEL CELLS
14 The Multiple Advantages of Fuel Cells for Smart Cities
Chiara Venturini, FuelCellEurope
18 Cleaner Cars Start with Chemistry, Current and catalysts
Mike Edmund

SMART CITIES
24 When Capitals Join Forces to Deliver Sustainable Energy Strategies
Vincent Berutto, Executive Agency for Competitiveness and Innovation
28 A Marathon, Not a Sprint
Mike Edmund
30 ESNA's Vision for the Future grid
Mark Ossel and Larry Cotton, ESNA
36 A Smart Energy Future in our Cities
Pedro Ballesteros-Torres, European Commission

INTERVIEW
37 Oil in 2050: Still Fundamental to Europe
Mrs Isabelle Muller, Europia, talks to our reporter

TECHNOLOGIES
39 Two Technologies : Carbon Capture and Fuel Cells
Angelo Moreno, ENEA
41 News

What on Earth is happening?

The Kyoto Protocol was finally negotiated in December 1997. Jacques Chirac, Helmut Kohl, Romano Prodi and Tony Blair led their respective countries in Europe. The Chinese leader was Jiang Zemin, the US President was Bill Clinton and the words 'Financial and 'Crisis' did not usually figure in the same sentence. The world had changed a great deal in fourteen years and the Protocol was conceived to minimise the change in at least one factor – climate: its goal, the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".

As befits the magnitude of the issue it seeks to address, the Protocol is a vast and complex document; detailed analysis is not appropriate on these pages. However, it is worth mentioning that the Protocol-defined Annex 1 countries, of which there are 37, and which might very loosely be described as "the developed countries" committed themselves to a reduction of 5.2% from 1990 levels of their production of greenhouse gases, and to do so by 2012. Dividing the countries into different groups was critical to making these commitments possible, since only these Annex I countries were seen as having the economic capacity to commit themselves and their industry at that time.

Perhaps two factors are concentrating the minds of the delegates currently attending the 17th Conference of the Parties to the UN Framework Convention on Climate Change (COP17) in Durban. The first is the very imminent expiry of the first stage of the Protocol. At this point it seems fair to indicate that data from IEA suggest that, with one or two exceptions, the European countries have not yet met their Kyoto obligations, although European leaders do have a lot on their minds at the moment, and the latest effects of the current economic situation will doubtless alter the picture yet again. The second is the question of how the non-Annex 1 countries should now be involved, if indeed they should become involved at all in reducing global emissions. At the heart of that particular debate is whether it is appropriate for the "developed" countries, having been responsible for most of the greenhouse emissions of the last century or more, to seek to deny the "developing" countries the benefits of development.

After revealing that it had not met its Kyoto obligations, Canada announced its intention not to make further reductions in its greenhouse gas emissions, and that it may

even formally withdraw from the Protocol. Russia and Japan have also said they will not make further emission cuts under the Protocol. Meanwhile, at the November meeting of the Major Economies Forum (MEF) - the body that brings together 17 of the world's biggest greenhouse gas emitters - India and Brazil joined the US in calling for a delay in beginning talks on a new global climate agreement until at least 2015. It will come as no surprise to our readers to learn that these developments are not universally popular. The Alliance of Small Island States (Aosis), among whom are many low-lying islands that might be considered most at risk if sea levels rise very far, is not prepared to contemplate any such delay; and China is particularly critical. And this is the other part of the predicament: China is now the biggest emitter on the planet, but its population is so vast that its per capita GDP is low. As you may read elsewhere in the magazine, countries such as Qatar, the United Arab Emirates, Singapore and Kuwait are classed as "developing countries", although their per capita GDP is higher than the EU average.

It seems that the future of the Kyoto Protocol is far from clear. What cannot however be ignored is the report in December 2006 that Lochachara Island in the delta of the Hooghly River had been inundated: it had simply disappeared beneath the waves. Whether sea level rise or coastal erosion was the cause is no consolation to the thousands of people who had made Lochachara their home. And Lochachara is only the first of several: other islands in the Hooghly Delta have also disappeared, although these are not inhabited. The Carteret Islands in the South Pacific, which are certainly inhabited, are also disappearing. But before they are claimed by the sea, salt in the water table makes the ground unsuitable for crops and the freshwater undrinkable. This is a rather apocalyptic image to accompany that of shrinking polar ice caps.

As US President Obama has put it: "Every nation on this planet is at risk, and just as no one nation is responsible for climate change, no one nation can address it alone." ●

by Mike Edmund

Post-2020 legislation key to maintaining Europe's renewables leadership

Julian Scola, Communication Director, European Wind Energy Association

Photo: EDP

The world's geopolitics shift slowly but surely. The "western world" of Europe and North America is no longer the absolutely dominant force it was; countries such as China, Russia, India and Brazil are wielding ever greater clout both economically and politically.

Despite this, the cutting edge of some industries remains firmly in Europe. The renewable energy industry first took off in Europe, and Europe remains at the forefront of the sector – in 2010, 41% of all new power generating capacity in Europe was renewable, and four of the top ten wind turbine suppliers worldwide were European.

In recent times there has been increasing competition from countries such as China, South Korea and India. Such competition is a good thing as it will further improve wind power technology's cost competitiveness against electricity from polluting coal and expensive nuclear power.

Over the last twenty years, wind energy technology has evolved, with turbines getting bigger and more reliable, and onshore wind energy is now competitive with other forms of power generation.

Now, the offshore sector with its vast potential has begun to replicate the growth of its onshore cousin and although it is more expensive for the time being, costs are coming down. The European Wind Energy Association's upcoming event focusing on offshore wind energy - OFFSHORE 2011 – will be the biggest yet.

In 2011, wind energy is supplying almost 6% of Europe's electricity and according to Member States' plans, it will provide 14% of our electricity by 2020. The European Wind Energy Association believes wind energy can provide half Europe's electricity by 2050.

Photo: Siemens

However, the growth and innovation so far have been enabled by legislative support at EU level for the industry – notably the binding target of 20% renewables by 2020. The future expansion depends on such legislation being in place for the time after 2020. Setting a new binding renewables target for 2030 – for example, to have 45% of EU energy from renewable sources as the European Renewable Energy Council has suggested – would send a positive signal to investors. The uncertainty in the US on a renewable energy framework, and the impact on the sector, is an example of what can happen without clear, stable and ambitious legislation. The European Commission's '2050 Energy Roadmap' due this autumn should give the sector a better idea of what to expect.

A 2030 target needs to be accompanied by ambitious and effective action to develop the European power grid and create a single electricity market. This would bring many benefits including the possibility of transporting wind energy from wherever it is produced to wherever it is needed. Recently, EWEA, with the European cable manufacturers' body, Europacable and the European electricity industry, Eurelectric, launched a statement supported by 15 associations calling on the EU institutions to act to ensure the building of such a grid and power market.

Moreover, despite the European industry's leading global position, wind energy gets very little public R&D money - far less than other energy technologies. In 2010, the EU institutions agreed to €6bn of public and private financing for wind energy research up to 2020, yet this funding –which translates as €186 million a year, just 0.15% of the annual EU budget - has still not materialised. Investing in wind energy is true value for money - creating jobs, avoiding greenhouse gas emissions, providing power. But if it does not provide the money, the EU could miss out on the value.

Europe's renewables industry is a top example of a home-grown industry which has boomed, which is constantly innovating and which remains a world leader. But this leadership will be put at risk without the necessary stable policy framework at EU level, properly interconnected European power grid and the necessary R&D support. With the right policies, the EU can provide a much needed signal to European industry that we are in this competition for the long-term, thereby maintaining and even improving the global position of European wind energy companies. ●

For more on EWEA OFFSHORE 2011:
www.ewea.org/offshore2011

Ambitious Danes show will to be world no 1 with new energy plan

By Iver Høj Nielsen, Head of Press, State of Green

The Danish Government has launched an energy plan to make Denmark independent of fossil fuels by 2050. An important part of the plan is to create economic growth and green jobs in the private sector, which foresees huge opportunities in the transformation to a green economy.

Two of the biggest challenges facing the world at the end of 2011 are to create economic growth, wealth and jobs – and to conquer the challenges of climate change. At the same time.

It might seem impossible, but in Denmark it is a general feeling that it is possible to make the country sustainable within the next couple of generations. In November, the Danish Government presented its new energy plan 'Our Energy' which will help the country to 100 percent renewable energy use by 2050. That means 0 percent fossil fuels.

It is an ambitious plan, by far the most ambitious in the world. But with the initiative, Denmark again shows the world that she takes responsibility and leadership to strengthen a greener world economy. With her own policies as well as with initiatives like the annual Global Green Growth Forum, where governments and global business leaders work closely

Photos by Bjarke Oersted

together to catalyze green initiatives.

The long-term goal of 'Our Energy' is to implement an energy and transport network that relies solely on renewable energy sources. By 2020, the initiatives will lead to extensive reductions in energy consumption, making it possible for half of the country's electricity consumption to be covered by wind power. Coal is to be phased out of Danish power plants by 2030. And by 2035, all electricity and heating will be generated using renewable sources.

The cost? According to Danish Minister for Climate, Energy and Buildings, Martin Lidegaard, 'Our Energy' calls for spending 5.6 billion kroner in 2020 on such initiatives as improved energy efficiency and expanding the use of renewable energy. Not included in that figure are the billions of kroner businesses and households are projected to invest in renewable energy and more efficient technologies. The decreased consumption that results from these investments will lead to lower overall energy costs. By 2020, the savings is projected to amount to 6.9 billion kroner, but would be even larger if the cost of fossil fuels increases.

Since the 1973 oil crisis, Denmark has almost doubled its BNP while energy consumption has been restricted to the same level. The cooperation of visionary policy makers, an inventive private sector and an engaged population has made this possible.

Today, Denmark can show the world a wide range of green solutions, created and produced by world leading companies as well as smaller and even very small companies. These companies are ready to support the implementation of the initiatives that will turn Denmark green. But decades of experience in sustainable solutions is also attractive to new projects in other countries and on other continents. The Danish vision will secure energy resources, no matter how oil prices will change. But the vision is also to inspire the world – and to show that a renewable future is actually realistic. State of Green is a public-private partnership that supports the Danish vision and encourages political and commercial decision makers worldwide to 'Join the future. Think Denmark'. There should be every reason to do that.

Founded by: UNIVERSITÀ DEGLI STUDI DI PERUGIA — ENEA, Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile — Supported by: UNIVERSITÀ DEGLI STUDI DI NAPOLI "PARTHENOPE"

PIEROLUNGHI 11

EUROPEANFUELCELL

CONFERENCE&EXHIBITION

DECEMBER 14-16, 2011 A.D.
ROME, FONTANA DI TREVI CONFERENCE CENTER

CHAIRMAN: ANGELO MORENO - ENEA

"Hydrogen and fuel cell applications are strategic European energy technologies contributing to a low carbon (urban) energy and transport system. They are among the technologies needed to put Europe on the path towards sustainable growth, as stated in the Europe 2020 strategy."

[The European Strategic Energy Technology (SET) Plan]

Be Strategic, Take part at EFC11 !

:: Policies and Market focused Plenary Session ::
:: Scientific Parallel Session :: International Exhibitors ::

europeanfuelcell.it

Industry would welcome long-term vision

MEP Bendt Bendtsen, EPP

It was only natural that the Liberal-Conservative government - after 10 years in the hot seat - lost power in the October elections. It will be interesting to follow the new socialist government, not least when Denmark takes over the Presidency of the European Union on 1. January 2011.

At the national level the government wants to cap emissions reductions with 40% in 2020, even though an ambitious target for 2030 would most probable have been a wiser step, which would to a larger degree foster market-driven investments into energy efficient products. The 2020 target is to be reached e.g. by a congestion charge in the city of Copenhagen. Both themes are not necessarily supported by the public and caused some disquiet within the Government parties.

I would prefer both Denmark and the Commission to concentrate on introducing long-term targets for 2030, and not introduce new taxes for consumers, but instead focus on market-based instruments, such as the ETS and, the new energy saving obligation scheme proposed by the Commission is the new Directive on energy efficiency.

The big problem has been financing of the low-carbon economy. Everyone agrees that it is important to cut emissions, but it is necessary to discuss who should pay.

Either we re-direct public funds from education or infrastructure, or we try to create incentives for industry to get involved. This is the most obvious choice I think.

In that respect we need new tools at the European level and at the national level. At the European level we should introduce project bonds i.e. covered bonds which are backed by EU Funds to attract investments. These should direct investments to projects which contribute to reaching the EU's headline targets in climate and energy, and is of strategic interest to the EU as a whole.

The hardest part is creating up-front investments for energy efficiency. At the national level, there is a need to leverage investments by using funds dedicated to energy efficiency measures.

These things are only possible over the long run, and necessitate a major change in a number of areas. These are not necessarily complete by 2020, and therefore, I would urge national politicians to not only think about 2020, but to think about how we become more energy efficient towards 2030 and 2050.

The multiple advantages of fuel cells for smart cities

By Chiara Venturini, FuelCellEurope

As three quarters of European citizens live in urban areas, cities have a key role to play in the achievement of the 20-20-20 targets. Most of our cities' Greenhouse and pollutant emissions come from the transport and building sectors, whose decarbonization represents one of the biggest challenges for the coming years. Fuel cells represent a very promising option to address this challenge.

A fuel cell is an electrochemical device that produces electricity through the combination of fuel and oxygen from the air. This process takes place with no combustion phase, which means it is quiet and clean compared to other power sources. Fuel cells are quite flexible and can run on a variety of fuels, including methanol and biogas, but are most effective in combination with hydrogen.

In this case, in fact, they generate no harmful emissions: their only by-products are heat, water and oxygen. In particular, the heat generated during the electricity production can easily be recovered and reused: this combined heat and power solution (co-generation, or CHP) is an excellent option for all residential and commercial buildings, as its total energy efficiency reaches 85%. Tri-generation is also possible if the oxygen is reused as well, a very useful application for hospitals.

Transport for London, the authority managing public transport in the largest urban zone of the EU (over 8 million people), has chosen a fuel cell solution for its head office: the Palestra building in the city is now powered by the UK's largest fuel cell power plant, which will allow a 40% reduction of CO2 emissions and cost savings of £90,000 per year. In addition, the fuel cell system makes the building completely independent from the grid, a

very good asset for an authority which is also responsible for emergency controls and therefore needs a secure energy supply.

Together with the building sector, transport accounts for most of a city's CO2 and pollutant emissions: in this case as well, fuel cells offer a viable solution. Several successful urban projects have focused on the deployment of bus fleets with hydrogen-powered fuel cells: the HyFLEET:CUTE project, for instance, has coordinated the implementation of a total of 47 fuel cell buses in nine cities, including Amsterdam, Barcelona, Berlin, Hamburg and London. Between 2006 and 2009, over a million litres of diesel were replaced by hydrogen, with significant reductions in emissions and energy consumption. Fuel cell solutions are not limited to road transport, as fuel cell vessels are already active on the Amsterdam canals and the Marseille Calanques.

Another critical area of action for cities is waste management. Again, a solution is offered by the combination of fuel cells and hydrogen. Municipal waste and wastewater, in fact, can be used to produce hydrogen, which will in turn power fuel cells. The city of Basel has recently put in place a scheme to power with hydrogen the cleaning trucks used to collect the waste, which can then be used to produce the hydrogen itself.

The Smart Cities initiative, officially launched in June by the European Commission, can represent a further boost to the wider uptake of the technology: enhanced collaboration between local communities represents a powerful tool to help achieve the economies of scale needed to make fuel cells more competitive. This, in turn, will allow cities to take advantage of a constantly improving technology, whose key advantages in terms of emissions reduction and energy efficiency will become a fundamental asset in the effort to decarbonize Europe.

About FuelCellEurope

FuelCellEurope is the European association representing the fuel cell industry. It works to accelerate the development and market penetration of fuel cell technologies in Europe, to position fuel cells as a key solution for a sustainable European energy system, and to obtain a more favourable regulatory environment for fuel cells.

For further information and contact:

FuelCellEurope
Tel.: +32(0)2.211.34.11
secretariat@fuelcelleurope.org
www.fuelcelleurope.org

Zeolite membranes for efficient production of fuels and chemicals

Over the past decades, the interest in membrane separation technologies has increased significantly. The main reasons for this are sustainability, high efficiency and low energy consumption of membrane based separation processes. Our research group in Chemical Technology at Luleå University of Technology in Sweden is developing zeolite membranes for a variety of industrial processes to allow more efficient production of fuels and chemicals.

Our membranes are as small as a 2 EURO coin.

Zeolites are inorganic crystalline materials with a very well-defined pore structure. The size of the pores is comparable to the size of molecules of many gases and liquids. This allows the zeolites to act as a molecular sieve in some applications and very selectively separate molecules from a mixture. Furthermore, zeolites are rather durable materials having high chemical and thermal stability which provides them with an advantage over polymers. The amount of a substance going through the membrane surface per time unit is given by the flux, and for high separation efficiency, it is very important with high flux and at the same time, the selectivity must be sufficient. Since zeolite membranes are porous, they can potentially give much higher flux than the commercially available polymeric membranes, which are dense. Our research group has developed the thinnest zeolite membranes in the world, and consequently our membranes are exhibiting world-record flux. To reduce the amount of defects, the membranes are prepared in a clean room (see Photo). We prepare quite small membranes of practical reasons and our current membranes have a diameter corresponding to a two EURO coin. We use a commercially available microfiltration alumina disc as support and grow a zeolite film with a thickness of about 0.5 µm on top of the support.

The table shows a few examples of the separation performance of our membranes for different mixtures. *p*-Xylene is a raw material for the synthesis of several polymers such as polyethylene terephthalate (PET) polymer, which is used for the production of PET bottles and Dacron sails etc. However, the catalytic process for xylene production results in a mixture of xylene isomers. Thus, in order to isolate *p*-xylene, an

A few examples of separation performance of ultra-thin zeolite membranes developed at Chemical Technology at LTU.

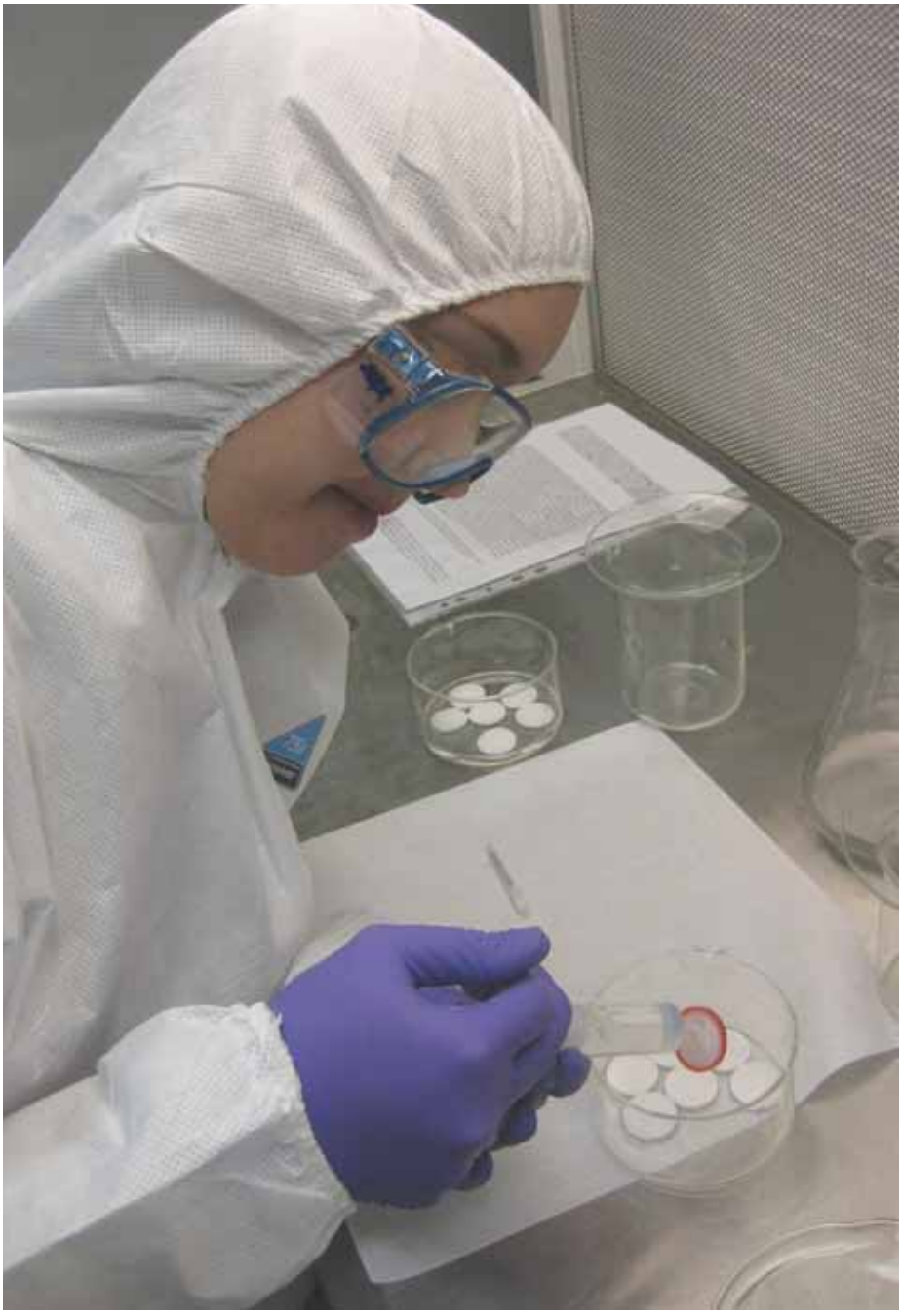
System	Separation factor	T (°C)	Total pressure difference (bar)	Flux (kg m^{-2} h^{-1})
p/*o* xylene	17	400	12	1.3
CO_2/H_2	17	25	20	600
water/ethanol	409	50	1	1.5
n/*i*-hexane	227	400	12	2.6
n/*i*-butane	9	25	12	20

effective separation process of the isomers is required. We have demonstrated that our membranes can effectively separate *p*-xylene from the other isomers by molecular sieving at 400°C. A *p*-xylene flux of 1.3 kg m^{-2} h^{-1} at a pressure difference across the membrane of 12 bar was observed, which should be sufficient for commercial applications.

Another potential commercial application of our membranes is for removal of carbon dioxide from synthesis gas. Synthesis gas is used for synthesis of bulk chemicals such as ammonia and methanol, and carbon dioxide removal from the synthesis gas is an important but costly step with current separation techniques. Polymeric membranes are commercially available for CO_2 removal from natural gas but not from synthesis gas. We have recently demonstrated great separation performance of our zeolite membranes for the removal of CO_2 from synthesis gas. A CO_2/H_2 selectivity of 17 and a CO_2 flux as high as about 600 kg m^{-2} h^{-1} at a total pressure difference of 20 bar was observed. With such a high flux, a relatively small membrane area would be sufficient to purify a large stream of synthesis gas.

We have also prepared ultra-thin zeolite membranes for removal of water from ethanol. Pure ethanol is required for the use of ethanol as a fuel in gasoline engines. The membranes are very selective towards water and display a water/ethanol separation factor of about 400 and a flux of about 1.5 kg m^{-2} h^{-1} at a total pressure difference of 1 bar.

Recently, we have started a project focused on development of larger membranes with tubular shape. Fabrication of such membranes can facilitate the scale up and commercialization of our high flux membranes. ●



One of the membrane synthesis steps (In the photograph: Linda Sandström).

Cleaner cars can start with chemistry, current and catalysts

Welshman Sir William Grove is the man widely credited with inventing the first fuel cell in 1839, although others (most notably Sir Humphry Davy and Christian Friedrich Schönbein) had explored the concept earlier. Grove already knew that passing an electric current through water would produce hydrogen and oxygen by electrolysis: he successfully reversed the process, producing electricity and water from hydrogen and oxygen from a device that he called the 'gas voltaic battery'. This was introduced to the world in the February 1839 edition of The Philosophical Magazine and Journal of Science. Fifty years later, scientists Ludwig Mond and Charles Lang worked on a practical design for the production of electricity, and coined the term fuel cell.

Many types of fuel cell have since been developed for a variety of applications, but they are all based upon Mond and Lang's original design. They contain two electrodes; an electrolyte (which may be solid or liquid) that carries ions from one electrode to the other; and a catalyst, which accelerates the chemical reactions that occur at the electrodes. Oxygen and hydrogen can indeed be made to combine to

form water and electricity in a controlled, continuous fashion, but unlike in internal combustion engines, the fuel is not burned; energy is released instead by a chemical reaction. An important feature of this reaction is that it is exothermic: it releases heat.

Modern fuel cells are usually classified by the temperature at which they operate and by the electrolyte they use. Of all the types of fuel cell, perhaps two have attracted most interest.

POWER ON THE MOVE: POLYMER EXCHANGE MEMBRANE FUEL CELLS (PEMFC)

This most promising of fuel cell technologies possesses a high power density (i.e. a fuel cell unit is relatively light) and a relatively low operating temperature (60 to 80 degrees Celsius). These two particular characteristics make it particularly suitable for use in vehicles, but perhaps what makes the fuel cell so attractive in this setting is the notion that its only exhaust product is water. Effectively, the fuel cell uses hydrogen from a tank as a fuel, combining it with oxygen from the air to create the electricity to power the electric motors that drive the car's wheels. These are therefore electric vehicles that do not have the range drawbacks of battery-powered equivalents, and which can be refuelled in a matter of minutes

POWER AT HOME: SOLID OXIDE FUEL CELLS (SOFC)

This type of fuel cell operates at between 700 and 1,000 degrees Celsius, making it particularly suitable for co-generation of heat and power in so-called CHP units. Here, the steam produced by the fuel cell can be channelled into turbines to generate more electricity, improving the overall efficiency of the system. More than 10,000 residential CHP units have been installed throughout Japan to provide homes with power and heating, so it seems that the technology can be made to work on a population scale.

+Twenty-six years after his innovation, Grove would doubtless have heard news of the 18-hour road trip between Le Mans and Paris, made by a steam-powered vehicle constructed by Amédée-Ernest Bollée and called L'Obéissante. Grove may never have made the connection between L'Obéissante and the gas voltaic battery, but he would surely have approved of a car exhaust pipe that emitted only water vapour.

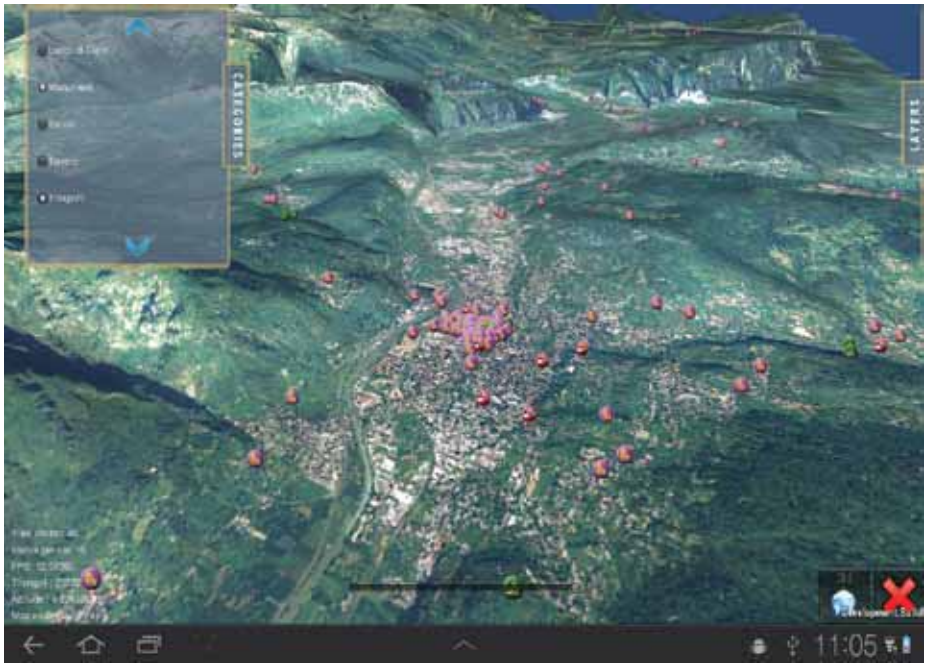
Today's vehicular fuel cell technology certainly appears to bear impressive environmental credentials: even better, it can achieve efficiencies of 60%, while a typical diesel-powered internal combustion engine runs at about 40% efficiency. Better still, a home CHP fuel cell can be run at 80-95% efficiency. But there are one or two extra details. One is the small matter of producing, distributing and storing hydrogen. Another is that of producing the catalysts for these cells: one, platinum, can be expensive, to say the least. And as yet, neither process is particularly green; nor is there yet a hydrogen infrastructure to speak of.

But it is hard to forget that exhaust pipe image...

by Mike Edmund

Can Islands be Smart?

By Prof. Marc Bonazountas



"YES they can", is a straight reply, although the definition of a "smart island" is far broader than perceived from the two simple words according to **Prof. Marc Bonazountas**, National Technical University of Athens, Greece.

An island is an isolated self-contained territory with a capital and a network of smaller cities and villages. Mediterranean islands are small, numerous, lacking infrastructure whilst impacted by seasonal tourism, thus far from the definition of smart. The infrastructure of future cities needs to support vibrant, innovative and entrepreneurial communities such as the community of an island that takes advantage of the digital environment and realizes the potential to become smarter argues **Mr. Iraklis Karampourniotis**, Vice President of Informatics, Epsilon International, SA.

A "smart-island" goes above and beyond to provide its inhabitants and visitors with services based on ICT/IST in a variety of sectors such as mobility, tourism, leisure, real estate, weather, yachting, environment and other. Sustainable management & livability improvement on the Mediterranean islands can be achieved via smart web-services scheduling needs in smart ways (e.g., booking a mooring slot) whilst offering maximum safety and environmental protection (e.g., fire-fighting) and services to residents (e.g., smart retailing) and to visitors (e.g., smart 3D-aerodrome), says **Dr. Giorgio Saio**, GISIG, Italy.

Current SDIs for islands and services do not cover the main characteristics of a "smart island". The geographic datasets & databases are not integrated or harmonized according to INSPIRE procedures. Thus, such web-services, designed from a-to-z via current technologies on INSPIRE principles and operationally open so to accommodate any island & service on a standardized platform, do not exist for Mediterranean Islands, explains **Prof. Joerg Schaller**, Technical Director, ESRI Deutschland GmbH.

The Smart-Islands project (www.smart-islands.eu) aims to offer services on multiple mobile/non-mobile devices by delivering a Geo-platform/ Globe with 8 integrated smart web-services specifically tailored to Mediterranean islands. However, the platform can have an EU-wide and international applicability and value once delivered to the market in 2013 by featuring "plug-ins" architecture to accommodate additional services and application developed after project closure. The Web-services cover the 8 applications: (1) 3D Smart-Yachting, (2) 3D Smart-Aerodrome, (3) 3D Smart-Leisure, (4) Smart Real-Estate (5) Smart Statistics for Planning (Infrastructure), (6) 3D Forest Fire Fighting, (7) Smart- Retailing, (8) 3D-Weather, but more can be added says **Mr. Tim Camilleri**, iSYS Ltd, Malta being a "show islands" in this project.

But, to present a Smart Island and make services easily accessible over the Internet you need tablet or smart-phone applications, and according to **Dr. Raffaele De Amicis**, Fondazione GraphiTech, Italy, who is in charge of s/w development, "... you need to

SMART-ISLANDS Modules/Services	Nicosia (CY)	Malta (MT)	Santorini (GR)	Skiathos (GR)	Agistri (GR)	HSIN (GR)	Majorca (ES)	Sardinia (IT)
Smart 3D Yachting		✔	✔	✔	✔	✔	✔	
Smart 3D Aerodromes		✔	✔	✔				
Smart 3D Leisure	✔	✔	✔	✔		✔		✔
Smart 3D Real Estate		✔	✔		✔	✔		
Smart 3D Statistics		✔	✔			✔		
Smart 3D Forest Fire					✔		✔	✔
Smart 3D Retailing		✔	✔		✔	✔		
Smart 3D Weather	✔	✔	✔	✔	✔	✔	✔	✔

make it sexy so that it intrigues the curiosity of the user to see more…". Tablet or smart-phone devices provide the hardware background but it is up to the creativity of the designer to make "a good" application that teases the user to play with it for long, explains **Dr. Giuseppe Conti** at Fondazione GraphiTech.

The interface is one thing but supporting it along with the services themselves is another. The Smart-Islands geo-database is developed according to the INSPIRE specifications set by **Dr. Giacomo Martirano**, who reported "…it is essential to be compatible to the INSPIRE directive and build upon interoperable patterns because this makes it easier to support the project and build future applications without worrying about compatibility and interoperability…"

The project is geared to implement smart web-services in multiple sectors (table) ranging from yachting to retailing, most of which use a smart weather app service says **Dr. David Caballero**, MeteoGRID, Spain.

But we have to keep in mind that marketing and commercialization of such a project is not straight-forward, and according to **Dr. Nadia Theuma**, Paragon-Europe Ltd, Malta, who is in charge of the project marketing, "…modern day tourists and especially younger demographics are interested in using e-services to cover for their needs and thus presenting to them a digital set of leisure or other relevant information is a head-start…"

Smart-Islands is a product aimed to sell services based on a plan to be released prior to project closure (2013) with the aim to recover partners investment within two years after project closure (2015) according to **Dr. Evelthon Iacovides** from Epsilon Cyprus ltd. The long-term viability, sustainability & scalability after the end of the project are almost guaranteed as based on the proven concept established with similar EC/FP7 projects, i.e.: establishment of an European Economic Interest Group, EEIG, or Company aimed to further improve, expand and operate the project after closure, says **Mr. Lefteris Kechagioglou**, President, Hellenic Small Islands Network, based on his vast experience in managing small islands promotional programmes.

Project Contacts:
Mrs. Despina Kallidromitou
Mr. Iraklis Karampourniotis
Epsilon International SA
Monemvasias 27
GR-15125, Marousi, Greece
T: +30 210 68 98 618
F: +30 210 68 21 220
smart-islands@epsilon.gr

E3SoHo – Energy efficiency in European social housing

BACKGROUND & OBJECTIVE

E3SOHO BACKGROUND

The E3SoHo project is part of the CECODHAS Housing Europe strategy which promotes the right to decent and affordable housing for all in Europe.

CECODHAS Housing Europe is the federation of public, co-operative and social housing. Together its 45 national and regional members in 21 European countries manage 25 million dwellings representing 12% of the total housing stock. Together, CECODHAS members are working to:

- reinforce the European social model and promote the values, successes and the vital future role of our members within that model;
- promote integrated approaches to sustainable urban development, stressing that the work of social housing providers is the backbone of social cohesion in European cities;
- protect the fundamental rights of all individuals as well as access to quality social services.

E3SOHO OBJECTIVE

The objective of E3SoHo project is to implement and demonstrate in social housing pilots an integrated and replicable ICT-based solution which aims to bring about a significant reduction of up to 25% of energy consumption in European social housing.

The services will:

- provide tenants with feedback on consumption and behaviour patterns of energy use;
- reduce overall energy consumption and encourage the use of RES (Renewable Energy Sources) by informing tenants, owners, and managers about energy efficiency cost, comfort, and environmental impact.
- provide stakeholders with the best possible information upon which to make energy management decisions (e.g. retrofit, maintenance, incentives, etc.)

E3SOHO STAKEHOLDERS

E3SoHo will empower inhabitants, owners, and managers alike through access to energy data in the following ways:

- End-User (or renter): By providing an intuitive and user-friendly interface which will allow the user to monitor and make decisions to adjust their dwelling's environmental parameters.
- Owner of Social Housing: Through access to accurate energy consumption data in real time, thus having a support tool to take decisions about the need of refurbishments or installing new systems.
- Energy Services Companies: By connecting each dwelling to a networking platform that allows the monitoring of energy consumption, device performance, and social behaviour patterns of each group.

E3SOHO TECHNOLOGY

The E3SoHo technological solution will consist of the following ICT enablers:

- A common service platform: The base for developing the different sub-services to be developed within the project;
- Power consumption measurement devices: Different sensor options for sub-metering and smart metering the parameters affecting energy efficiency at different levels (e.g. building, floor, dwelling, room, system, appliance).
- Power generation measurement for RES devices.
- Water consumption measurement devices
- Comfort sensing: Temperature, light, humidity, and air quality
- Control: Smart plugs for remote control of appliances or any other electrically powered device.
- User interface: Offering feedback to the different stakeholders by mean of appropriate interfaces; display console for instant access; web-based application for remote access; database server.

Contact José Luis Burón Martínez
Telephone +34 91 791 20 20
joseluis.buron.martinez@acciona.es
E3SoHo Project web address www.e3soho.eu

E3soho
Energy Efficiency in European Social Housing

Top: Genova, middle, Warsaw and bottom: Zaragoza

E3SOHO PILOTS

• Zaragoza, Spain

The pilot building is located in the North of Zaragoza city. Its 43 flats are inhabited by a diverse cross section of young people, individuals, families, and retirees representative of the social housing in general. The flats of one level of the building are sheltered flats reserved for women who are under a Social Intervention Program offered by the Municipality to help them.

• Genova, Italy

The pilot building is located in Genova, on the West part of the city in the so called San Pietro district on Pegli's hills. It is composed of 340 dwellings, and there are more than 500 inhabitants.

The building is divided in four main blocks. Each of them is composed in three parts: a high block, a lower block and a centre block of apartments that span a large change in elevation called "The Steps". The Genova pilot has a small shopping centre, one common area, a large parking, and it is served by public transportations.

• Warsaw, Poland

The pilot building in Warsaw was constructed in 2007 and has 48 apartments inhabited by 111 persons. Almost half of the apartments are inhabited by low income families with children.

When capitals join forces to deliver sustainable energy strategies

Vincent Berrutto

At first sight there is little in common between the capitals of Bulgaria and Croatia. However they do share something valuable: a strong commitment to push their energy agenda forward. Since 2011 these two capitals collaborate to deploy a comprehensive sustainable energy action plan throughout their territory. These plans help them identify energy savings potentials and launch cost-effective measures.

Sofia and Zagreb are not alone in their endeavours. They have teamed up with other public authorities - some with longer experience in the development of local energy policies - to exchange tips, tools, and lessons, thus saving time and resources on their path to a cleaner energy future. 'Experienced' cities act as motivators, mentors and experts to the 'learning' cities, which have only just begun, or are yet to begin, to address the required changes in their local

energy regime. At the centre of this team is the UK Town and Country Planning Association which coordinates all activities and makes sure that the work across national borders leads to greater benefits than separate actions at local level.

This collaboration is made possible through a grant from the Intelligent Energy Europe programme (2007-2013); an EU funding scheme, complementary to structural and research funds, dedicated exclusively to sustainable energy and supporting actions that trigger investments in smart and proven technologies rather than investing directly in these technologies. By mobilising the relevant stakeholders and overcoming the market barriers that impede the uptake of sustainable energy technologies, this programme acts as a catalyst to investment decisions.

In the 'Leadership for Energy Action and Planning' project (LEAP) where the two capitals are involved, it is foreseen that the sustainable energy action plans endorsed by the local councils will lead to savings of more than 200,000 toe/year. However it is not just savings. By endorsing the plans, the cities play an exemplary role and encourage their citizens and businesses to follow suit.

This project is amongst one of the most recent of the ca. 500 projects already supported by the Intelligent Energy Europe programme (http://ec.europa.eu/energy/intelligent). So far more than 3000 organisations have received support to tackle the classical barriers to the uptake of energy efficient technologies and the wider use of renewable energies, including the lack of expertise and resources to prepare successful energy strategies at local and regional levels.

In addition, far more organisations have been impacted by the programme. All the projects have produced tools and guidebooks which have been made freely available. The programme is also offering permanent services to help local authorities become more environmentally friendly in their energy use.

The Managenergy initiative (www.managenergy.net) for instance offers information resources and training sessions for the public sector and their advisers working on sustainable energy at local and regional level. The European urban mobility portal ELTIS (www.eltis.org) and the BUILD UP portal (www.buildup.eu) offer similar services but focus respectively on sustainable transport and energy efficient buildings.

In addition, cities and regions which are more advanced and already have their sustainable energy action plan, have access under the programme to funding for technical assistance ("ELENA" and "Mobilizing Local Energy Investment" instruments) to help them move one last step further toward actual investments. These instruments cover a share of the cost for technical support that is necessary to prepare bankable projects ready for funding by the European Investment Bank or other financial institutions.

All these services, as well as the Intelligent Energy Europe programme as a whole, are meant to engage stakeholders like Sofia and Zagreb and then help them move on to more concrete actions.

These actions are instrumental to achieve the EU energy policy goals and thereby contribute to a more secure, more competitive and cleaner energy landscape.

Vincent Berrutto works for the Executive Agency for Competitiveness and Innovation (EACI) as Head of Unit in charge of Energy Efficiency for the Intelligent Energy - Europe programme.

Sustainability of neighbourhoods

Green Building is an established concern – will green neighbourhoods be next?

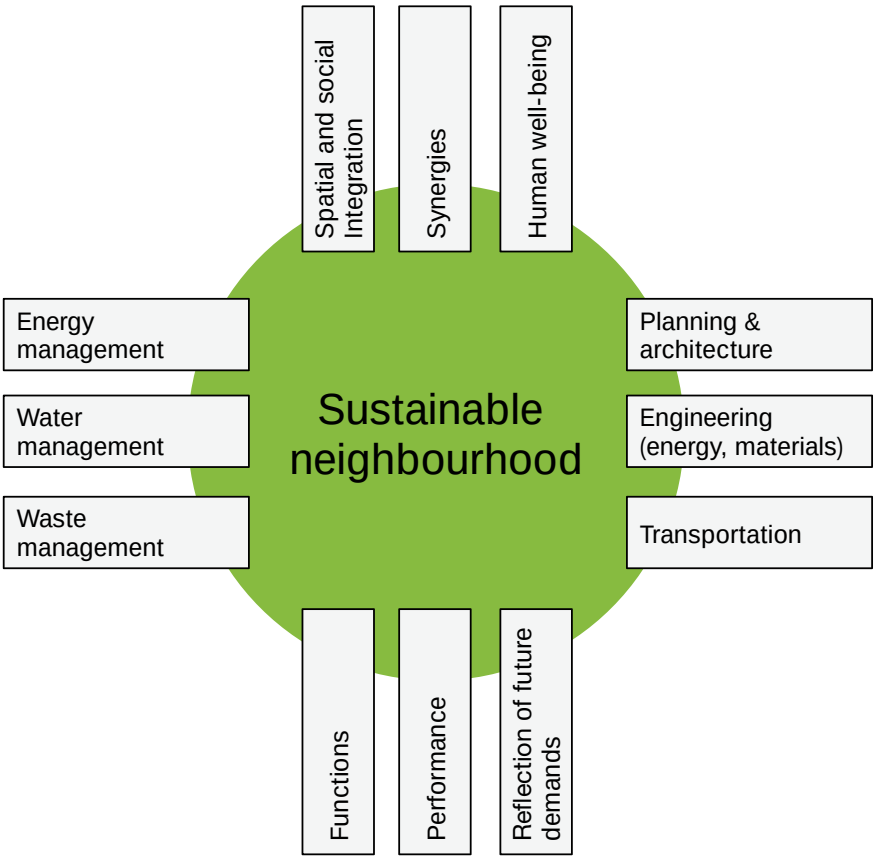
Wolfram Trinius, PhD

In recent years, the consideration of sustainability aspects in the design, construction and operation of buildings has become an established subject. Green building labelling systems aim to provide a reference frame as well as a measurement tool to assess and present sustainability aspects. With their primary intention to assess building qualities, these systems aim to focus on building performance and tend to treat neighbourhood aspects at a lower level of concern, or with neglect.

Reflecting the appreciation that sustainability will consist of the performance of individual buildings embedded in a local context, we see a clear call for reference documents establishing sustainability aspects for neighbourhoods. No surprise then, that both LEED, BREEAM and DGNB are providing labels not only for individual buildings but also for neighbourhoods, or communities.

The relevance of addressing sustainability aspects of neighbourhoods is highlighted by:

- People experience the quality of neighbourhoods much more than the one of individual buildings, unless they are the users of these buildings
- Social life takes place largely in neighbourhoods, providing us with functions and qualities all relating to our individual and collective well-being
- Neighbourhoods and their infrastructure define the preconditions for efficient and sustainable buildings to a significant extent
- Neighbourhood can enable synergy effects
- Neighbourhoods are defined by the interaction of their elements
- Planning of neighbourhoods defines future quality of life aspects
- Town planners understand their profession to be at the very heart of shaping sustainability.



For the development of neighbourhoods, it is essential to identify targets for the overall performance, as well as for identified individual criteria. Based on the targets for the area, related targets for the elements present in a neighbourhood (infrastructure, buildings, green areas, etc) can identified.

The time from planning to completion is often long, and what people expect from their environment is likely to develop during that time. The neighbourhood, planned to be sustainable, is still to be perceived as a sustainability showcase when being completed. Consequently, the targets must be set ambitiously enough to meet expected future requirements. And at the

same time realistically enough from today's perspective, to allow progressing with the development.

A glance at the current target definitions in energy policies, the construction sector's share of the energy demand and the current renewal rate in the building sector stresses:

- With a renewal rate of below 1%, the building sector can not meet its share of the political targets by new construction at the current energy performance levels alone
- Even if only permitting new buildings with net zero-energy demand, the building stock must be addressed
- With the limitations to increase performance in the stock, neighbourhoods must strive to provide the preconditions for near-zero new buildings and for increased performance of existing buildings
- The overarching societal goals will not be solved on single building measures alone, but broadly involve cities and neighbourhoods

Important for achieving targets is that the elements in average contribute to the overall, and that individual elements' performance can be balanced by others. Mechanisms displaying an individuals over- or underperformance and incentives to generate "action space" are essential elements when the overall targets are to be achieved throughout the cascade of decision making processes and related responsibilities.

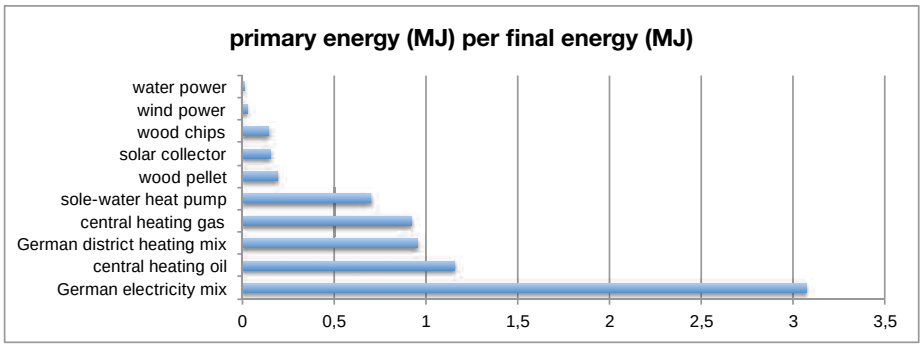


Figure 1 primary energy for different energy carriers

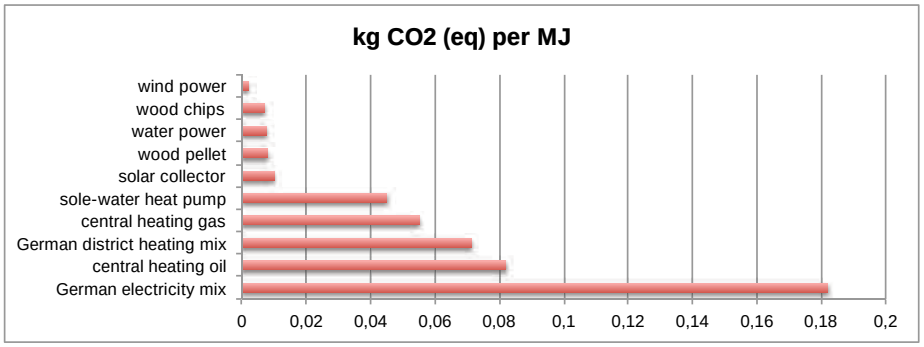


Figure 2 Emission of CO2-equivalents for different energy carriers

Already the evaluation of the Swedish building exhibition Bo01 in Malmö 2001 showed that clearly expressed targets can be managed and success to these targets can be measured and assessed. Targets with lacking measurement and assessment routines are more likely not to be achieved.

Neighbourhoods do define the preconditions for individual buildings' performance. A glance at energy infrastructure easily displays the potential of environmentally preferable solutions. Based on the same energy demand, the associated environmental impact can significantly be reduced, with the neighbourhoods infrastructure being decisive for the availability. The required additional investment at neighbourhood level can enable benefits on building level. With different stakeholders involved, barriers to implementation (one hand holds the investment, the other holds the benefit) need to be addressed.

Concluding, the established market trend towards considering sustainable building and green building labelling directly calls for sustainability aspects being addressed also at neighbourhood level. Sustainability arises at the points of interconnection and synergy.

Ingenieurbüro Trinius, Barmbeker Str. 9a
22303 Hamburg Germany

www.trinius.de, trinius@trinius.de
+49 40 2841 788 00

A marathon, not a sprint

L'important dans la vie ce n'est point le triomphe, mais le combat, l'essentiel ce n'est pas d'avoir vaincu mais de s'être bien battu ***– Pierre de Fredy, Baron de Coubertin***

In 1906, the Wright bothers were granted US Patent Number 821,393 for a flying machine. Elsewhere, revolution was brewing in Russia and the Olympic Games entered the modern era that summer in Athens. Although the London Games of 1908 effectively superseded that particular event two years later, you might say that de Coubertin had successfully recycled both an ancient Greek idea and its ideals. Now, after a century or so of industrialization, de Coubertin's world has changed almost out of recognition.

However, as Lamine Diack, President of the International Association of Athletics Federations recently observed, London has put sustainability at the heart of the 2012 Games. In keeping with the times, it seems that the concept of recycling has itself been recycled for the Games of the XXX Olympiad.

One of the simplest strategies employed by the Organising Committee has been to re-use or recycle the venues for many of the Olympic events. Some, like the Millennium Stadium, are only a few years old, while others such as Lord's Cricket Ground were actually in use long before de Coubertin was born (though this venerable institution is perhaps not as old as Olympia itself). Ambitious green targets for the Games were set early on, such as those for the proportion of renewable energy (20%) and for the average CO_2 emissions of the fleet of cars used to transport competitors and officials (less than 120 g/km). Central to this initiative is the provision of large numbers of fast-recharging points for the 200 electric vehicles involved.

As for the centrepiece of the Games, the Olympic Stadium, a great deal of innovative thinking has gone into the design, and it has been hailed as one of the most sustainable stadia ever built. Even before a single brick had been laid, almost 12 million pounds was spent removing toxic waste left by previous use of the site. To minimise construction, a bowl was excavated in the ground: the feature, reminiscent of a classical amphitheatre, is designed to accommodate 25,000 spectators. A further 55,000 will watch events from a superstructure made from surplus gas piping that has been recycled for the purpose, and which will be removed after the Games. Over 90 per cent of the construction waste was reused or recycled, such as in the low-carbon concrete that was used in its construction. Perhaps one of the most innovative ideas is to wrap the walls of the stadium in a specially designed material. Rather than a single continuous strip, the latest idea to be considered by Olympic Delivery Authority comprises 2.5 metre fabric panels of polyester and polyethylene, twisted at 90-degree angles to allow entry to the stadium at the bottom of the structure and held in place with tensioned cables.

The original games probably began almost three thousand years ago, and there has been a great deal of fanfare about the green credentials of its latest incarnation. Some of the green targets and commitments made in the London bid will be met; others may turn out to be little more than a vague mix of aspiration and PR, but they all the represent valuable steps along the way. For there can be no doubting the importance of the fight against climate change over the next hundred years; never mind the next three thousand. And de Coubertin's words do not apply to this struggle. To have fought hard against climate change will not be enough. Victory is the only thing that matters here. ●

by Mike Edmund

ESNA's vision for the future grid

How an open-infrastructure approach benefits utilities and consumers alike

By Mark Ossel, ESNA, and Larry Colton, ESNA

To ensure utilities and consumers win in the modernization of power grids across the globe, everyone in the ecosystem needs to consider all the moving parts involved. An open-infrastructure approach will rapidly lead to innovation and achievements, while limited, closed approaches will ultimately kill innovation and benefit very few. We hope this article will assist all leaders making major smart grid decisions that will serve many generations.

IT'S NOT JUST ABOUT SMART METERS

The critical issue in defining "smart metering" is that it's not just about the meter. It is really about enabling the smart grid -- an energy infrastructure that runs from generation to distribution and includes thousands of grid-connected devices and systems that consume energy. Smart metering sets the stage for a smart grid "system" offering increased functionality via built-in two-way communications and smart grid applications, many of which provide improved and expanded customer service. Thinking "beyond the meter" and toward an overall system solution delivers dramatic improvements in utility operations, reliability, and customer-service capabilities by offering detailed usage information, demand metering, detailed power-quality data, speedy outage information and flexible billing options. Smart metering systems serve as the key information-gathering source and foundation for a smart grid that helps utilities better manage their operations. The smart grid also helps customers better manage their energy use, of course. Utilities need to ensure a high level of reliability and service to their customers, and this will become more challenging in the near future because of the additions of renewable energy sources, electric vehicles and distributed generation. Smart metering and the rest of the smart grid will make it possible for Distribution System Operators (DSO) to more effectively and efficiently manage the distribution network.

SMART GRID STAKEHOLDERS – BENEFITS TO ALL

Consumers, distribution companies and retailers all benefit from smart grid development. A smart grid can improve management of the transmission and distribution assets, as well as their generation portfolio, in order to keep pace with their customers' increasing electricity usage and peak demand. For the supplier and retailer, it makes possible and accelerates the adoption of new services to help them differentiate their offerings in increasingly competitive energy markets. All of these vast benefits to utilities also mean, of course, that the consumer wins.

The many benefits associated with the smart grid should be viewed collectively. Think of them as an aggregate of benefits to all parties. It is very difficult to build a compelling business case around just one set of benefits to a specific stakeholder. Of course, the consumer, and society in general, will benefit from the smart grid in part because it provides a means to energy conservation – by raising consumer awareness of the cost and impact of electric devices in our homes and offices. The most obvious direct benefit to consumers will be in the form of lower energy bills.

ENERGY EMPOWERMENT, DEMAND RESPONSE AND SERVICES BEYOND

The true smart grid creates an energy network that will detect and address emerging problems in the system before they negatively affect service. It will be able to respond to local and system-wide inputs, provide much more information about broader system problems and, most importantly, be able to immediately react to or resolve problems that do occur. Figure 1 illustrates the basic smart grid architecture when implemented as an energy control network.

For example, demand response (DR) is becoming instrumental in managing the growing demand for energy, especially where it is combined with new and innovative pricing plans and consumer energy use portals. The combination of heightened awareness, an ability to track and manage energy use and financial incentives will give consumers a sense of "energy empowerment" that they have never before experienced. This requires smart metering and smart grid systems that offer distributed local intelligence at the neighbourhood transformer

to effectively manage the edge of the grid -- where decentralized generation, electrical vehicles and customers must constructively co-exist.

FUTURE-PROOF: THE CASE FOR OPEN SMART GRID ARCHITECTURE

In order to support the various networks and interfaces within the smart grid now and into the future, one of the most important and basic requirements is an open architecture. This is to support not only today's services and applications but also the provision of new services and meeting new market demands without replacing the core infrastructure and associated equipment.

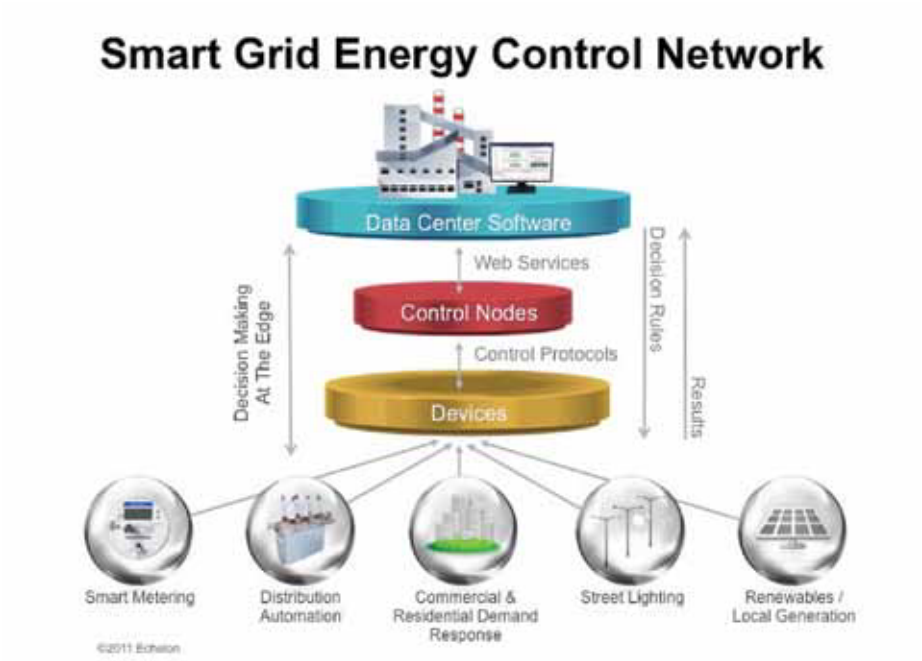


Figure 1. Smart Grid Energy Control Network – Smart devices and networks of smart devices, cooperating with control nodes for autonomous action, informed by rules provided by enterprise applications.

Interoperability is too often used as an excuse to push a particular technology, regardless of its actual suitability for the application. Such agendas manifest themselves as a "choose one standard" technology approach. Technologies will continue to evolve. Instead of requiring a single standard, utilities need a smart grid system with an open infrastructure, one that many companies have adopted and upon which they have built custom solutions. These solutions may be proprietary to each vendor, but because they're built upon a common, open infrastructure they can be mixed and matched, offering the utility competition, innovation and choice. Various EU standard initiatives support this type of approach and indicate there will be many appropriate smart metering and grid standards, not just one. However, the key factor is that interoperability will still exist at the higher levels within the systems enabling a more future-proof solution ready to adopt new technologies.

Other future-proof features required in a smart grid system include: advanced functionality in smart meters, such as power-quality measurements, remote-firmware upgrades and an open interface for interoperability with multiple home area network (HAN) technologies; open interfaces at the head-end applications via standard web services; and open interfaces along with distributed intelligence at the neighbourhood transformer. These features will allow utilities to be able to upgrade and add new devices and systems even after the smart grid system is deployed within the home, within the electric grid or at the utility head-end the network. Open Smart Grid Protocol (OSGP) is one example of standard that delivers these types of future-proof features and functionality. In addition, OSGP provides an open architecture and infrastructure supporting both smart metering and smart grid applications.

THE TRULY INTELLIGENT GRID AS A VISION FOR THE FUTURE

As utilities face increasing pressure to reduce their costs and lower their environmental impact — by reducing emissions of greenhouse gases, for example — they must fundamentally change their attitude toward power generation and resource planning. An advanced metering infrastructure approach will allow utilities to deploy a solution that lets them extend the smart grid and communications infrastructure to intelligent devices inside customers' homes, make power delivery more efficient, reliable, and safe, and help customers better control their energy use. The ideal smart metering solution will let utilities and their customers implement and access a truly intelligent smart grid — meaning one that benefits both sets of stakeholders — through a variety of technologies.

Smart metering optimises Europe's energy usage

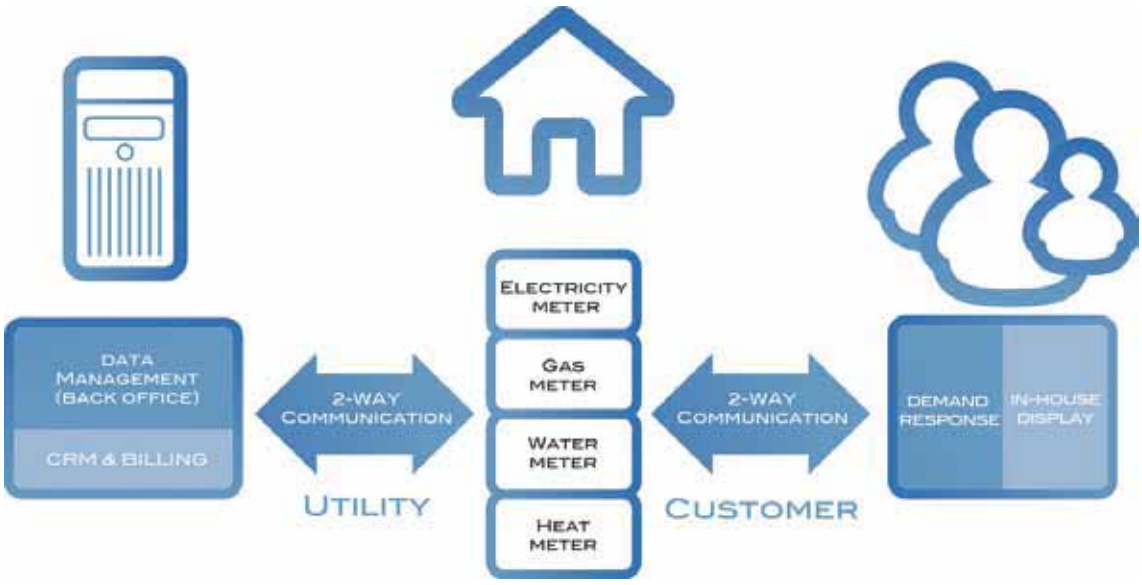
Klaus-Dieter Axt, Operations Director, ESMIG

The European Union has set itself ambitious targets with the Electricity Directive anticipating complete deployment of Smart Meters by 2022 at the latest, and 80% of consumers equipped with Smart Metering systems by 2020. As there is a lack of research that provides empirical evidence of the energy savings potential of Smart Metering technology and of likely consumer benefits, the Brussels-based European Smart Metering Industry Group (ESMIG) commissioned Finnish energy think tank VaasaETT to analyse large-scale Smart Metering-enabled programmes and make recommendations.

A key conclusion from the VaasaETT research – newly published by ESMIG as the *Empower Demand* report – is that there is an increasing number of Smart Meter installations that are monitored in order to measure their effects on energy use, on consumer behaviour and their impacts on energy management.

The proposed revision of Europe's Energy Efficiency Directive, which is currently under discussion in the European Parliament, also acknowledges the importance of Smart Metering and active consumer engagement through real-time information and more frequent billing. ESMIG believes that this Directive should lay the foundations to allow consumers and utilities to realise the full potential of Smart Metering-enabled programmes described in the report.

The *Empower Demand* report (its full title is *The Potential of*



Smart Meter-Enabled Programs to Increase Energy and Systems Efficiency: A Mass Pilot Comparison) examines the actual effects of around 100 Smart Meter-enabled pilots and roll-outs across the world; analyses which features and set-ups result in the greatest effects; and summarises conclusions for maximising energy savings and consumer benefits.

KEY FINDINGS

The report shows that significant reductions in the energy used by consumers and changes in the times of day that they use energy can be achieved by appropriate Smart Metering installations. The display of almost real-time energy consumption data on in-home devices (IHDs) has led to an average 8.7% reduction in energy consumption. Lower but still significant reductions of 5%-6% on average were achieved through enhanced, more informative bills and access to usage data on websites. The different types of dynamic pricing mechanisms used in the pilots and roll-outs have all shown that energy loads up to 16% can be time-shifted ("peak clipping") for the benefit of both consumers and utilities, who could see smoothing out of current demand spikes.

The above-mentioned results of Smart Meter-enabled programmes can be maintained over the years. Behavioural changes by consumers who make use of the potential of Smart Metering technologies can become permanent thus securing the significant and long-lasting effects necessary to achieve the European Union's ambitious energy efficiency targets. The EU's strategy for tackling climate change focuses on three targets for 2020: cutting "greenhouse" emissions by 20%; drawing 20% of energy from renewable sources; and reducing overall energy use by 20%.

ESMIG is confident that the report will encourage further research into and debate on the best use of Smart Metering technologies in Europe and beyond. Feedback and discussion on the report's findings or future research topics is very welcome and would be appreciated. The full report ('Empower Demand') is available on the ESMIG website: http://www.esmig.eu/press/brochure.

About ESMIG

The European Smart Metering Industry Group (ESMIG), headquartered in Brussels, is the Europe-wide industry association that provides knowledge and expertise on Smart Metering and related communications across the continent. ESMIG's members are the leading companies in Europe's Smart Metering market: meter manufacturers, IT companies, communication service providers and system integrators.

ESMIG covers all aspects of Smart Metering of utilities, including electricity, gas, water and heat measurement. Member companies cover the entire value chain from meter manufacturing, software, installation and consulting to communications and system integration. ESMIG is an Official Associate of the Sustainable Energy Europe Campaign: www.sustenergy.org

For further information and feedback on the report please contact:

ESMIG Secretariat
Phone: +32 2 7068257
Fax: +32 2 7068250
Email: secretariat@esmig.eu

European Smart Metering Industry Group
Boulevard A. Reyers 80, 1030 Brussels, Belgium
www.esmig.eu

OR

Jessica Stromback
Phone: +358 (0)92 516 6257
Mobile +358 (0)44 906 6821
jessica.stromback@vaasaett.com

For questions on the research please contact:
Christophe Dromacque
Phone: +358 (0)9 2516 6257
Mobile: +358 (0)4 4906 6822

How CASH was born

For several years, the city of Echirolles (France) has been focusing on Climate Change and sustainable development issues. A pioneer since 2004 with active involvement of citizens in Agenda 21, signatory of the Covenant of Mayors in 2009, involved in local intelligent energy forums, Echirolles wanted to go a step forward and contribute, at European level, to proposing new practical solutions and to promoting new policies for the Energy Efficient (EE) renovation of social housing - including housing belonging to social landlords and low income owners. This shared ambition gave birth to the European CASH network of 11 partners from 9 European countries.

ADDED VALUE?

The added value of the network comes from its analysis of lessons learned, barriers and needs, through transnational exchanges around key issues related to the topic: Technological development, Legal framework, Financial instruments, Citizens' involvement, Energy production and EE renovation project management. Key collective reflections are synthesized in tables illustrating the situation in the 9 partners' countries, which can be used for orienting programs and directives at national and European level.

As an example, the partners' legal framework table -pictured in this article- highlights most covered EE topics and pinpoints the 'orphan' ones which deserve attention.

What are the barriers to implementation? Which are the recommendations for an effective EE framework? ... are some of the questions being

SYNTHESIZED CASH PARTNERS' EE LEGALFRAMEWORK BY KEY TOPICS - Updated August 2011

	EE DIAGNOSIS & SPECIFICATIONS			ENERGY PRODUCTION & DISTRIBUTION			USERS INVOLVEMENT		R&D	FINANCIAL TOOLS / ENGINEERING				
	EE Targets + Energetic requirements of buildings	Audits + Energy performance certificates EPC of buildings + posting	Renovation labels	Energy sources	Co-generation	District heating	Condominium / co-properties	Tenants contribution to energy renovation	Clusters (industries & research institutions)	Subsidies for energy efficiency housing units renovation	Eco-loans and low interest loans	Fiscal measures	Feed-in tariffs	Funds for state & municipal buildings
Yambol BULGARIA														
Sonderborg DENMARK														
CRRA Echirolles														
Frankfurt GERMANY														
Eordea GREECE														
Tatabanya HUNGARY														
Brindisi ITALY														
Utrecht NETHERLANDS														
Bridgend UK														

answered through the network.

As regards the legal framework: coherent legal framework at national, regional and local levels with a long term vision leaving time for achieving renovation operation;, legal instruments addressing the needs of mixed properties / co-properties and covering the array of EE renovation topics; the regulation of third party financing; the scaling-up of local legal instruments which have been proved to be efficient; the integration of civil society's point of view ... are some of the recommendations which deserve being valued by policy-makers to overcome barriers.

... INTERESTED IN KNOWING MORE about recommendations regarding financial instruments and about local action plans - being developed by CASH partners - which integrate these concerns? ... visit our CASH website: http://urbact.eu/cash

Lead partner - Thierry Monel: t.monel@ville-echirolles.fr
Lead coordinator - Sophie Moreau: s.moreau@ville-echirolles.fr

Covenant of Mayors: a smart energy future in our cities

Pedro Ballesteros-Torres, Programme Manager, Energy Efficiency of Products & Intelligent Energy - Europe

The Covenant of Mayors unites Europe's ambitious cities, municipalities and regions leading the fight against climate change. Launched in 2008, this pioneering movement now includes over 3000 signatories and affects over 140 million Europeans. The potential is huge and with ever more cities and towns joining, its importance for policy-makers at European, national, and local level is on the rise.

We will not win the battle against climate change without involving our cities. The cities that signed up to the Covenant of Mayors are by definition 'smart cities', with a clear vision for their future. What makes the Covenant of Mayors stand out is the requirement for participating local authorities to develop and implement sustainable energy policies. These can be very diverse and often include innovative transport projects, deployment of renewable energy solutions, building refurbishment, district heating and cooling and local energy generation.

Each local authority knows how best to make savings on its carbon emissions. The success of the Covenant of Mayors is one indicator that local authorities are taking the lead towards curbing carbon emissions. The growing number of signatories that voluntarily join the Covenant of Mayors, sends a strong message to policy makers.

Whether at European, national or local level, policy makers can shape the framework in which the Covenant actors operate. In this regard, the European Commission's DG ENERGY launched the Covenant of Mayors and – more recently – the Smart Cities and Communities initiative. Both reach out to local authorities that place sustainable energy development at the heart of their policies. Innovation plays a key role, in organising our regions, cities and municipalities in such a way that we consume less energy without compromising quality of life.

I invite policy makers, stakeholders and industry to take a close look at those local authorities and regions that are implementing sustainable energy actions in the framework of the Covenant of Mayors, to find solutions to this challenge.

Local leaders who take the initiative to invest public funds in sustainable energy solutions deserve recognition and serve as role models to others. Climate change is a global threat that requires leaders to take bold decisions. Smart cities are governed by such leaders.

The Covenant of Mayors provides solid proof that our cities are working hard towards a smart energy future. Let's encourage them and draw inspiration from their example!

Oil in 2050: Still fundamental to Europe

European Energy Innovation is speaking with Mrs. Isabelle Muller, Secretary General of EUROPIA

EEI Good afternoon, Mrs. Muller. For the benefit of those of our readers who are not familiar with the oil industry, perhaps we might begin by asking you to tell us a little about EUROPIA, and what has given you greatest satisfaction since you became its Secretary General in 2007.

IM Currently with 17 members, EUROPIA represents the downstream oil industry (This usually refers to the process of refining crude oil, and to the selling and distribution of the resulting products, such as gasoline - Editor). Our membership comes from right across the industry, and includes globally-based corporations like Exxon Mobil, national & regional players, and specialist refining companies.

With a broad range of experience within the industry, I was given a mandate by our membership to raise its profile among European legislators. In particular, EUROPIA wishes to make visible the importance of oil refining to the European economy as a whole.

Mrs. Isabelle Muller, Secretary General of EUROPIA

EEI So why is the sector so important to Europe?

IM Currently, 98% of transport in Europe comes from oil: you might say that oil based mobility drives the European economy. And even allowing for the great uncertainties inherent in forecasting as far as 2050, it is clear that oil will remain fundamental to the European economy as a whole. This follows from the International Energy Agency's 'New Policies Scenario' forecast as far as 2030, and its 'BlueMap' scenario, which

projects forward to 2050. These IEA projections show that oil will still account for around 30% of Europe's primary energy requirements by 2030 and around 20% of those requirements by 2050. So whatever aspirations there may exist to develop alternatives, the reality remains that by 2050 Europe will be 'low carbon", but not 'no carbon'. We feel that it is essential that policymakers take account of these figures when framing energy policy.

EEI EUROPIA has certainly been very proactive in the debate. In 2009, you spoke about Competitiveness, Sustainability and Security of Supply, the three pillars upon which the 20/20/20 targets are based. Now we have your contribution to the development of the Energy Roadmap, which, as you have said, looks forward as far as 2050. Can we talk a little about why this issue is so important to European refining?

IM We have produced three main documents in the form of white papers, covering issues as Fuel and Transport, and the role for oil refining, which has culminated in "Contributions to EU Energy Pathways to 2050" a paper with six policy recommendations for consideration of the policy makers in designing the EU roadmaps for 2050. Even with the uncertainty inherent in forecasting as far as 2050, it is clear that as demand in Europe declines, the global demand for oil will rise sharply as developing countries pursue their strategies. The European industry is adapting to this decline as a fact of business life, and the social difficulties inherent to such adaptation should not be underestimated. But this means that European policymakers should take care not to create a legislative environment that drives the reduction in European refining capacity beyond what is economically necessary to adapt to declining European demand: in effect, they should take care not to drive refining capacity out of Europe.

EEI So European legislators should not view European refining in isolation from the rest of the world?

IM Definitely not. The refining industry must be viewed in a global context because the global demand for oil is still rising: any loss of refining capacity from Europe will inevitably be made up from non-European refineries, such as the one just being completed in India. Apart from the potential environmental impact of refining oil in less heavily-regulated countries, this has a number of important economic and social consequences within Europe at a local, national and international level. A particular case in point is the issue of security of supply. Since Europe will still require oil for at least 20% of its primary energy requirements and 50% for transport fuels, until 2050 at least, a competitively viable European refining industry is essential.

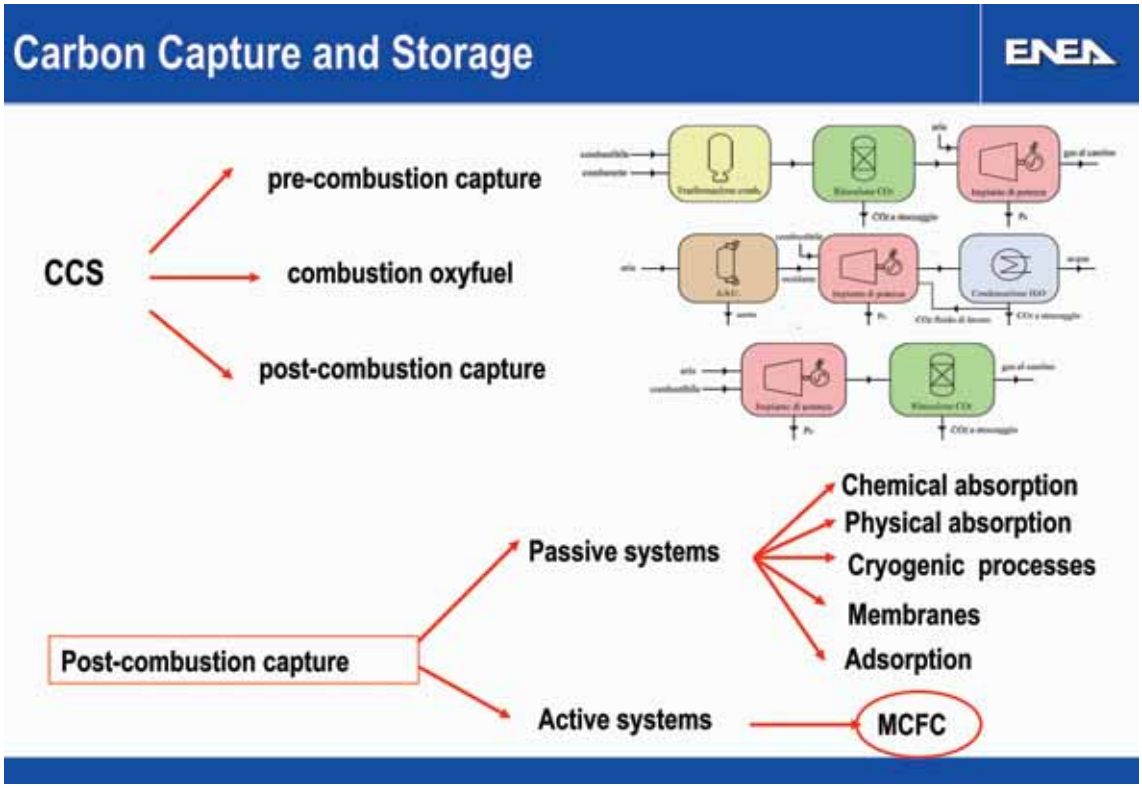
EEI Mrs. Muller, thank you very much for your time.

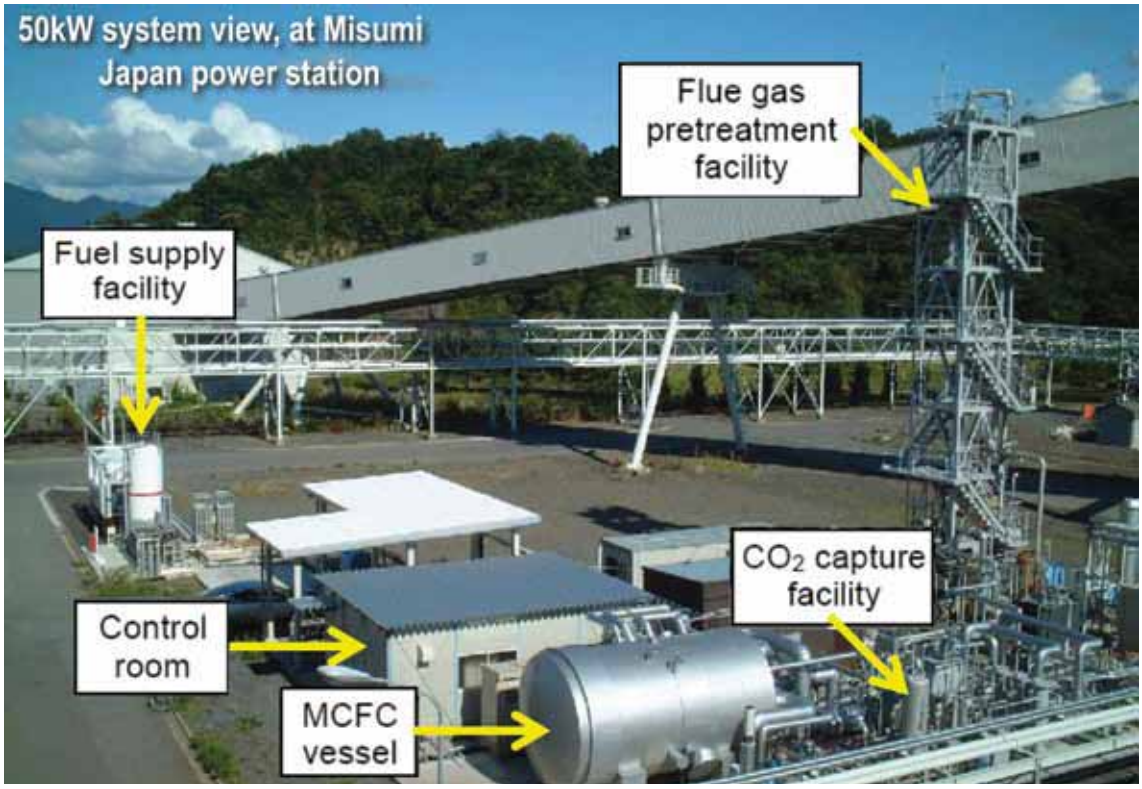
Two Technologies: Carbon capture and fuel cells

Angelo Moreno, ENEA

Fossil fuels (oil, gas and coal) are still the most used energy sources worldwide, covering over 80% of energy consumption on the planet. To their undisputed supremacy, however, is related part of the problem of carbon dioxide (CO_2), whose concentration in the atmosphere is considered the main cause of climate change. The need to meet the growing worldwide demand for energy, particularly that of emerging countries, goes hand in hand with the need to counter the risks of climate impact resulting from increased production of CO_2. Fossil fuels are expected to remain the protagonists on the world energy scene for decades. To get in the short term a significant reduction in CO_2 emission an immediate solution is needed, directly on their use. CCS (CO_2 Capture & Storage) allows to capture and sequester the CO_2 generated by the use of fossil fuels, reducing emissions into the atmosphere.

Molten carbonate fuel cells (MCFC), used alone or integrated with appropriate separation devices can be used as a post-combustion capture system. This prerogative derives directly from their particular operating mechanisms which transfers and concentrates at the anode a consistent part of the CO_2 supplied with cathodic oxidant gas. More precisely, inside the cell the electric current passes through the electrolyte due to the transfer of CO_3= ions formed at cathode, at the expense of CO_2 in the cathode





gas flow. In this way, the CO_2 in the anode exhaust gas is concentrated by a mechanism directly related to the current produced by the cell. The combustion exhaust containing carbon dioxide (3-5%) are sent from a traditional power plant to the cathode of a MCFC to obtain a flow rich in CO_2 (35-40%) at the anode outlet which can be then separated in an easier way. Is possible then to think about the retrofitting of existing traditional power plants integrated with MCFC used to concentrate CO_2 and separate it more efficiently. In order to verify the actual possibility of real integration experimental activities and proof of concept are performed in USA by FCE, in Korea, in Japan, in Italy and at European Commission level that has formed a "benchmarking taskforce" to develop a way to compare the CO_2 capture real energy consumptions of different CO_2 separation systems. A useful tool, defined by this benchmarking taskforce, is the SPECCA index (Specific Primary Energy Consumption for CO_2 avoided). By calculating primary energy consumption for CO_2 avoided, MCFC capture system showed better result compared to the conventional systems. The MCFC as a capture system is an "active " systems, i.e. MCFC will separate CO_2 from flue gases of conventional power plants, allowing the reduction of energy consumption for CO_2 capture, since electric power is produced while performing CO_2 separation. Conventional CO_2 separation systems are "passive" systems they are high energy demanding, thus the total efficiency of the systems will be significantly reduced. Ongoing experimental activities on MCFC are aimed both at demonstrate the feasibility of this system and at solving clean up problems of power plant exhausted gases.

News

First Biogas. Now Electricity from Urine

Research into producing electricity from urine has been carried out by scientists at the University of the West of England (UWE) in Bristol.

The unit claims a world first in the publication of a research paper into the viability of urine as a fuel for Microbial Fuel Cells (MFCs). The team says tests have produced small amounts of energy, but more research could produce "useful" levels of power. Dr Ioannis Ieropoulos said he was "excited by the potential of the work". MFCs contain the same kind of bacteria that is found in soil, the human gut or waste water from sewers, and these bacteria respire just like any other living organism, although their respiration is anaerobic (without oxygen) and this process gives off electrons. Those electrons are then passed through an electrode and a measurable electric current is generated. Bacteria feed on the urine, which they effectively use as a fuel to continue to respire, and to thus give off electrons. "Urine is chemically rich in substances favourable to the MFCs," said Dr Ieropoulos. "Through this study... we were able to show that by miniaturisation and multiplication of the number of MFCs into a stack and regulating the flow of urine, it may be possible to look at scales of use that have the potential to produce useful levels of power, for example in a domestic or small village setting."

During 2010, Germany quietly breaks more renewable energy records

The conservative government of Chancellor Angela Merkel has issued its annual report on the German energy market in 2010. Renewable energy generated more than 100 TWh (billion kilowatt-hours) of electricity, providing nearly 17% of the total of 600 TWh of supply. More than 70% was delivered by wind turbines and biomass; and renewables generated more electricity in Germany than gas-fired power plants, nearly as much as hard coal. Meanwhile, the installation of solar photovoltaics (solar PV) in 2010 was nothing short of startling.

Germany uses an advanced system of feed-in tariffs to pay for renewable energy generation, and has an aggressive target of meeting 39% of its electricity supply with renewable energy by 2020. The German solar PV industry installed 7,400 MW from nearly one-quarter million individual systems in 2010. In December alone, Germans installed more than 1,000 MW of solar PV, enough solar capacity to generate 1 TWh of electricity under German conditions. Although only half the total installed in June 2010, the December installations were 50% greater than total solar PV installed in the USA in 2010 and as much as that rumoured to have been installed in Japan in the previous year.

BiogasWorld 2012

Starting next year, this biennial international trade fair will take place at the Berlin Exhibition Grounds, alongside the traditional SolarEnergy and Bautec technology shows, attracting a potential 70,000 visitors from around the world on the five days of the exhibitions. Apart from the domestic German market, BiogasWorld places a special focus on the eastern European countries from Poland and the Czech Republic to the Baltic States and Russia. Poland, in particular, is seen as a land of the future as far as biogas technologies are concerned. The country's government and investors have just recently given the green light to accelerate development in this area. In the short to medium term, the aim is that decentralised electricity and heat from biogas plants will take up its fair share of the basic energy provision for the population and infrastructure requirements in Poland's rural regions.

In Germany the sales market is already stagnating in several regions and, parallel to new investment, the highly promising area of the 'repowering' of old facilities is attracting attention. However, Eastern European countries appear to offer considerable development prospects for biogas applications.

Debate in Durban

Chris Huhne, UK Climate Secretary has made a call to the UN Climate Summit for a legally-binding global treaty, whose teeth should begin to bite within ten years. In a recent speech he revealed the complexities of Climate Change debate by calling each country to pledge action appropriate to its level of development. He said "We need to move to a system that reflects the genuine diversity of responsibility and capacity, rather than a binary one that says you are 'developed' if you happened to be in the OECD in 1992." And this is where the debate begins to hot up. According to the UN Framework Convention on Climate Change (UNFCCC), Qatar, the United Arab Emirates, Singapore and Kuwait are classed as "developing countries", although their per capita GDP is greater than the EU average. Meanwhile, the G77 maintains that the western (i.e. developed) countries, which industrialised first, must bear the brunt of emissions cuts because they are primarily responsible for the extra CO_2 in the atmosphere. This fact is recognised by the UNFCCC and, according to Mohammed Al-Sabban, Saudi Arabia's chief climate negotiator, forms the basis for the differentiation between developed and developing countries. Al-Sabban has argued that the developed nations inside the Kyoto Protocol should re-negotiate future emission cuts inside the protocol's mechanisms, something Canada, Japan and Russia have made plain that they will not do. Part of the problem is that the Kyoto Protocol countries currently are not likely on their own to meet internationally agreed climate targets. Meanwhile, a recent meeting of the BASIC group of countries (Brazil, South Africa, China and India) has heard that climate targets could be met if the traditional "rich" bloc went into "negative" emissions - sucking more CO2 from the air than it emits - between now and 2050, while China does not rule out the possibility that it could begin to cut its emissions soon after 2020, rather than just restrain their rise as it does now.

UN negotiations are due to open in Durban, South Africa, in late November. It promises to be an interesting conference

Mind the Gap

Elsewhere, the UN Report "Bridging the Emissions Gap" has suggested that there is a significant discrepancy between the direction where greenhouse gas emissions are headed and where they need to be if climate targets are to be met. The United Nations Environment Programme (Unep) analysed data from 28 research centres around the world, looking both at projections of emissions growth and at what can be achieved in different sectors. It concluded that global emissions of greenhouse gases are equivalent to about 48 billion tonnes of carbon dioxide (48GtCO2e) each year, rising to about 56 gigatonnes (Gt) per year by 2020 if no changes are put in place. However, climate models have indicated that emissions need to be reduced to about 44Gt per year in order to have a reasonable chance of meeting the goal of keeping the global average temperature rise since pre-industrial times below 2C. So if nothing changes, the 2020 target will be missed; in the jargon, there is an "emissions gap" of 12Gt. The 2C target has widespread support across the international community, although many governments prefer an even tougher target of 1.5C.

However, the report also concludes that nothing particularly revolutionary is needed if every sector makes appropriate cuts. If energy, farming, forestry and transport emissions were all reduced by feasible amounts, global warming could be kept below 2C. And the cost would be small. "At the beginning, the reductions are cost-neutral - or you can gain because they include things like energy efficiency that save fuel costs," said Joseph Alcamo, Unep's chief scientist. "We didn't find that any technological breakthroughs were needed to close the gap." Nevertheless, some of the easier and cheaper options that were possible four years ago are possible no longer, according to Niklas Hohne, a lead author on the report. "All studies agreed that there is huge potential to reduce emissions associated with buildings, for example, mainly through renovating and making them more efficient with energy," he said. "But that takes time; and now, four years later, we have significantly less time until 2020 to implement these measures."

2012 Photonics Europe

16-19 April 2012

Register Today

Advances in applications of photonics, optics, lasers, and micro/nanotechnologies

Conference dates

16–19 April 2012

Location

Square Brussels Meeting Centre
Brussels, Belgium

www.spie.org/aboutpe

Technologies

- Micro/Nano Technologies
- Disruptive Organic and Bio Photonics
- Highly Integrated and Functional Photonic Components
- Advances in Laser and Amplifier Technologies
- Photonics in Industrial Applications

SPIE
Connecting minds. Advancing light.

TRA
Transport Research Arena • Europe 2012

23-26 April, 2012 Athens - Greece

Sustainable Mobility through Innovation.

Participate in the Biggest Transport Research Event in Europe

Main Conference Focus Areas:

- Governance of the transport system
- Transport, mobility and infrastructure
- Safety and security
- Energy, environment and resources
- Design and production (vehicles, vessels and infrastructure)
- Complementarities of transport modes

Contact for scientific information:
Thessaloniki Public Transport Authority
Attn Prof. Panos Papaioannou
65 Georgikis Scholis Ave.
57001 Pilea, Thessaloniki, Greece
Tel: +302310 483070, Fax: +302310 483071

www.traconference.eu

Contact for the Exhibition:
Ministry of Infrastructure, Transport & Networks
General Secretariat of Public Works
Attn Mr Sarantis Pantelias
182 Ch. Trikoupi str., 10178 Athens, Greece
Tel: +30210 66424749 **e-mail: info@traconference.eu**

CEDR Conférence Européenne des Directeurs des Routes / Conference of European Directors of Roads

ERTRAC European Road Transport Research Advisory Council

European Commission

ERRAC The European Rail Research Advisory Council

WATERBORNE

HELLENIC REPUBLIC MINISTRY OF INFRASTRUCTURE TRANSPORT & NETWORKS