



# European energyinnovation

## Green ports & energy efficiency

### Gas

### Carbon capture & storage

### Energy efficient buildings

### Country profile Belgium

Includes editorial contributions from:



**Günther Oettinger**

European Commissioner for Energy



**Evelyne Huytebroeck**

Brussels Minister for the Environment, Energy and Urban Renewal



**Philip Lowe**

Director General, European Commission, DG ENER



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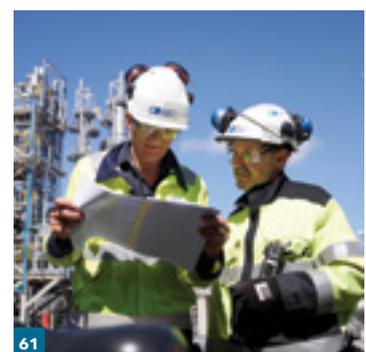
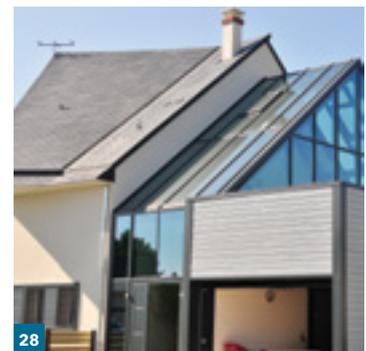
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# Foreword

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

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1a Shire Lane  
Chorleywood  
Hertfordshire WD3 5NQ  
United Kingdom

Tel: +44 1923 286238  
[www.europeanenergyinnovation.eu](http://www.europeanenergyinnovation.eu)

## HEAD OF BRUSSELS OFFICE

Sophia Silvert  
145/15 Avenue Molière  
B-1190 – Brussels  
Belgium  
Tel: +32 2 413 0387  
Mob: +32 4737 30322  
[sophia@europeanenergyinnovation.eu](mailto:sophia@europeanenergyinnovation.eu)

To obtain additional copies please email  
[info@europeanenergyinnovation.eu](mailto:info@europeanenergyinnovation.eu)

## BUSINESS DEVELOPMENT DIRECTOR

Philip Beausire  
[philip@europeanenergyinnovation.eu](mailto:philip@europeanenergyinnovation.eu)

## EDITOR

Michael Edmund  
[editor@europeanenergyinnovation.eu](mailto:editor@europeanenergyinnovation.eu)

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It looks as if 2013 has produced a sufficient number of sufficiently divisive issues to keep Europe's politicians, legislators and negotiators sufficiently well-exercised. Among other things, I am thinking of the Nabucco and TAP pipelines, and of the strategic role of gas. This situation has recently come sharply into focus as the Ukraine attempts to decide between continuing to look eastwards and drawing closer to the west. Divisions between the EU and China over photovoltaic technology seemed, initially at least, to have implications for the German automotive and French wine industries as well. Elsewhere, recent developments suggest a thaw in relationships with Iran that will surely resonate through both the nuclear and oil sectors. Meanwhile, the impact of the shale gas revolution has certainly not been confined to the borders of the US. Its emissions are declining (from a very high level), having effectively been exported to the EU and elsewhere. Here, low coal prices relative to gas threaten a renewal of the upward trend in emissions unless we can resolve divisions over green energy subsidies, even as the financial outlook begins to look less bleak, with the return of the industrial growth that will surely add to pressure upon the icecaps. And all of this against a backdrop of the IPCC's recent warning about Climate Change. This most fundamental of issues should serve to unite us all; and to sharpen both our 20.20.20 endeavours and our efforts to produce an energy strategy for the years beyond 2020.

Our contributors address many of these issues in this edition. From DG ENER, Commissioner Guenther Oettinger examines energy strategy, while Director General Philip Lowe thoughtfully explores the evolving Gas market, perhaps a pivotal one in the circumstances. One technology that has arguably received too little attention is carbon capture; an imbalance that we are pleased to redress with excellent contributions from Chris Davies, who sounds an important warning about attitudes to CCS, while the theme of urgency appears in Theo Mitchell's prescription. Fiona Riddoch explores the potential of another interesting technology that supplies 11% of Europe's energy and 15% of its heat. Greek MEP Niki Tzavela examines the potential role of gas in a low carbon future and presses for urgent clarification of EU policy, while Bertrand Cazes elegantly makes the case for glass to be considered a product of choice for sustainable building design. Meanwhile, Jaroslaw Kotowski from the European Commission examines the role of the TEN-T programme and its potential impact upon the environmental performance of maritime transport. Our country feature casts an eye over Belgium, at the heart of the EU; an excellent article by Evelyne Huytebroeck discusses the initiatives behind rapid progress being made in the Brussels-Capital Region. One of these, the "Maison de l'Energie" or Energy House, offers its services to all Brussels residents. As Goethe once observed, "Divide and Rule" is a sound motto, but "Unite and Lead" is a better one. Let that be a thought to carry forward into 2014.

Oh, and there is a lot more for you to read inside...

**Michael Edmund**

Editor

# Secure our future: towards a European energy strategy

By Günther H. Oettinger, European Commissioner for Energy

**E**nergy is the lifeblood of our society. Our way of life is inconceivable without reliable and affordable supplies of energy: electricity, heat and fuel. Never before has the world needed so much energy: we use almost twice as much as in 1980. If this trend continues, it will be difficult to avoid a major energy crisis, with electricity cuts, petrol or gas shortages.

**WE CANNOT AFFORD TO WAIT**  
The energy challenges are among the greatest tests which Europe has to face: We have to act to prevent global warming. At the same time, we need affordable energy prices as our economic competitiveness depends very much on competitive energy

prices and a reliable energy supply. Growing EU dependence on imports from third countries is also a matter of great concern, in particular for oil (85 %) and gas (65 %). All these challenges must be addressed and require strong action.

## A NEW STRATEGY FOR THE NEXT DECADE

National policies are not sufficient anymore to allow a strong economic recovery and maintain our welfare. Any decision taken by one Member State has an impact on the others. Fragmented markets undermine the security of supply and limit the benefits of a fair competition while our investments for the future will only be profitable and efficient within a continental market. We must promote a common energy policy serving our joint policy objectives: competitiveness, sustainability and security of supply.

An example of the need to think internationally is gas supply. Many Member States are reliant on gas imported from Russia. We all agreed that diversifying our gas supply will benefit citizens and businesses across the EU and we are looking to bring new, additional gas from the Caspian region to the EU. In the past few years, the EU Commission has held continuous talks with governments and companies alike to convince them to deliver gas from this region to Europe. And in June, this European effort will finally bare fruits. In Azerbaijan, the final decision will

be taken on how much gas will be delivered to Europe and which pipeline project will be chosen for the first ever direct supply of Azeri gas to the EU.

In very general terms, I see 5 pillars for action to the benefit of all Member States and citizens.

## FOCUS ON ENERGY SAVINGS

First, there is a vast amount of untapped potential to save energy, which would save money for individuals and businesses alike. Faced with commitments to reduce drastically our emissions and achieve the objective to increase energy efficiency by 20% by 2020, action on energy demand has the most potential with immediate impact for saving energy, reducing waste and maintaining our competitiveness. To this end, the EU has adopted a new energy efficiency directive which obliges Member States to implement binding measures such as an obligation scheme for energy companies to cut down energy consumption at customer level and an obligation for Member States to renovate annually 3 per cent of the central government's building. It also encourages energy audits for SMEs and an obligation for large companies to assess their energy saving possibilities.

## A STRONGLY INTEGRATED EUROPEAN ENERGY SINGLE MARKET

We should no longer tolerate barriers which impede energy flow within the EU. National



borders can threaten the benefits of the Single Market, the competitiveness of our industry and the supply of basic needs to all our citizens. Fair competition, quality of service and free access must be guaranteed. The full and proper application of EU legislation is a must. But the existence of the adequate infrastructure is a condition sine qua non. It is time energy is given comparable pan-European infrastructure, as other sectors of public interest such as telecommunication and transport have enjoyed for a long time: by 2015, no Member State should be isolated from the European internal market in energy supply. This means that we have to concentrate our efforts on concrete projects necessary to achieve our goals: solidarity, an inter-connected market, new power capacities, an "intelligent grid" and large scale production of renewable available to all at competitive prices. A single European Energy Market will also increase the competitiveness of renewables, allowing excess energy generated in the sunny South to power homes in Northern Europe during times of light wind or vice-versa on blustery days in the North for cloudier days in the South.

#### **CITIZENS FIRST**

These efforts should always focus on the impact on citizens. Consumers should benefit from wider choice and take advantage of new opportunities. Energy policies have to be more consumer-friendly and this will require further transparency and information: I would like all tools, like the Consumer Check List, to be improved and applied more widely. This also implies that all consumers enjoy their right to basic energy needs at all times,

including in a supply crisis.

EU energy policy also aims to achieve more transparency, access to better and more information, better functioning of the retail market, development of adequate infrastructure and safety nets for vulnerable consumers. This is in addition to constant efforts for more safety and security in energy production and processing. Today, the EU represents a decisive added-value for all citizens by ensuring that the highest standards are applied in all Member States for nuclear safety and security, offshore oil and gas extraction or the development of new energy technologies. We must keep on track and continue to be vigilant.

#### **TOWARDS A TECHNOLOGICAL SHIFT**

In energy technology, we must consolidate and extend Europe's lead. I would like to develop a European reference framework in which Member States and regions can maximise their efforts to accelerate market uptake of technologies. Europe has some of the world's best renewable energy companies and research institutions: we need to keep this leadership. Beyond the implementation of the Strategic Energy Technology Plan, we have already launched a few large scale projects with strong European added-value:

- Smart grids to link the whole electricity grid system to individual households and give better access to renewable sources of energy,
- The 'smart cities' innovation partnership to promote throughout Europe integrated energy systems at local level and facilitate energy savings.

#### **STRENGTHENING THE EU LEADERSHIP IN THE WORLD**

The EU should be a favoured partner in international negotiations. The present situation, where external partners can "divide and rule", is untenable. The EU has the world's largest regional energy market - 500 million people. It accounts for one fifth of the world's energy use. We import on average around 3 million tonnes of oil equivalent every day. The EU is also the world's biggest economic trading block. We must exploit our geopolitical weight in the world and enjoy the benefits of the Single Market. Every time that the EU has spoken with one voice, for instance in the nuclear international cooperation, it led to results. The integration of energy markets with our neighbours is a must which contributes to both our and their security. But our international relations must go further and should aim at establishing strategic partnerships with key partners. A common European policy is a strong leverage to strengthen our position in difficult negotiations and secure our international leadership.

#### **TIME FOR ACTION**

This year we will discuss our energy and climate goals for 2030. We will decide whether we choose three targets as we did for 2020 - CO2 reduction, increase of renewables and energy efficiency - or just one or two, and whether they should be binding or not. We must decide it this year to allow Member States to prepare and to give certainty to investors in industry. As Jean Monnet said: "Where there is no vision, people perish". Our generation must take the opportunity to make of this strategic vision a reality. ●

# Energising change

By Tony Robson, Group CEO of Knauf Insulation

**The solution to the world's complex energy problems is simpler than we make it. We just need to learn where to look.**

**Y**ou know what, sometimes solutions to the world's most complex problems are the simplest.

Even better, they are often right in front of us. The challenge is just to make sure that we can see them clearly.

Take the issue of energy. We all need it, but volatile pricing, dwindling supplies, and increased demand are creating a hugely complicated set of problems that are not going anywhere soon.

So how's this for a simple solution: why don't we just save energy rather than waste it.

It's hardly rocket science.

In Europe alone we squander a staggering €500 billion every year as a result of wasted energy.

Every time we turn on our heating or air-conditioning we instantly pump hard-earned money straight out of our homes into the bulging pockets of energy suppliers abroad.

Remember that's €500 billion.

Imagine what we could do with that money. Think about the jobs we could create, the possibilities for improving society, the opportunities we could develop, the lives we could change for the better with €500 billion every year.

Energy efficiency has often been called the 'hidden fuel' but it's right in front of us, 'hiding in plain sight' as the International Energy Agency has aptly put it.

And the IEA should know. In its recent Energy Efficiency Market Report covering its 11 member countries, the IEA found that energy efficiency measures have already saved the energy equivalent of US\$420 billion from 2005 to 2010.

If those measures had not been implemented those countries would have ended up consuming and

paying for two-thirds more energy than they are currently using.

No wonder energy efficiency markets worldwide attracted investments of US\$300 billion in 2011. And no wonder the IEA's Executive Director Maria van der Hoeven questions whether energy is not just a hidden fuel, but rather the world's first fuel.

On every level, energy inefficiency is wrong. It damages the environment, decimates competitiveness, devastates growth and on a human level leaves people increasingly vulnerable.

That's why tackling wasted energy has to be at the heart of the European Union's 2030 framework for EU climate change and energy policies. Putting energy efficiency first will achieve climate targets, improve competitiveness, safeguard energy security, create jobs, reduce costs and give people the comforts they deserve.

We have so much to gain. The IEA believes that two-thirds of the economic potential for energy efficiency is set to remain untapped in 2035 unless 'market barriers are overcome'.

So how do we overcome these barriers? Start introducing energy saving legislation and start showing people how to save energy.

A key factor that drives energy efficiency is legislation. And Europe is exceptionally good at legislation. We've been doing it for centuries. Good laws ensure we're safer, healthier and live better lives.

And there are easy gains to be made everywhere. The building industry, for example, is responsible for a staggering 40% of lost energy in Europe with more than 80% of buildings energy inefficient.

There are 220 million buildings in the European Union today and 160 million are still going to be around in 2050.

So, this is a vast energy-efficiency problem that will be

inherited by our children and grandchildren unless we introduce deep renovation regulations that ensure these buildings save energy rather than squander it.

Additionally, according to a report commissioned by the Renovate Europe Campaign, a campaign that Knauf Insulation actively supports, energy-efficient renovation of the EU's existing building stock could create up to 1.48 million new jobs and boost GDP in the period up to 2017 by up to €291 billion while delivering permanent annual benefits to public finances of up to €39 billion.

I'm proud that Knauf Insulation has taken a pioneering role in the area of deep renovation innovation. Take Urbanscape for example, it's our new green roof solution that cuts energy consumption by 25% for heating and 75% for cooling as well as reduces storm water run-off and CO<sub>2</sub>.

We are also piloting a one-stop 'Energy Response Corps' in the US and 'Energy Response Force' in the UK to help show people the simple changes they can make to their homes to ensure they are more energy efficient.

Additionally, we have developed products such as our new blowing wool that is non-intrusive for homeowners but extremely time-efficient for installers and created flexible sealants that, combined with insulation, effectively close energy-draining gaps in buildings.

Knauf Insulation also likes to show rather than just tell. Earlier this year, we carried out energy-efficient renovations in every building of Australia's most isolated town, Birdsville where temperatures can top 49°C, to demonstrate how insulation not only saves energy but can also transform lives.

Many companies in Europe excel at innovation. And this is where everyone can benefit. Insist on more energy efficiency in a trusted regulated environment, set legally binding targets and Europe's energy-saving innovations will flourish as the private sector competes to offer new solutions.

Ultimately energy efficiency is not difficult to understand, but if we continue to simply ignore it, our future problems will become increasingly complicated. ●



*Tony Robson, Group CEO of Knauf Insulation and Chair of the European Alliance to Save Energy*

#### **Contact details**

Siân Hughes  
Head of EU Public Affairs and Corporate Communications  
Sian.hughes@knaufinsulation.com

# Energy efficiency: Essential component of climate policy or dangerous mirage?

## The answer's in the eponym

*"Efficiency is doing things right; effectiveness is doing the right things" - Peter Drucker*

By Mike Edmund

**O**n 8th April 1773 two canal boats laden with coal navigated the newly-constructed section of the Grand Canal from Bingley to Skipton. The emissions of the horse-drawn canal boats clearly posed no threat to the Earth's climate but, though it was not known at the time, the same could not be said of the coal they carried; coal that was sold at half the price it had previously commanded. It was of course coal that fuelled the Industrial Revolution, a development that lies at the very

heart of the climate debate today.

That debate took new turn with the recent press release from the IPCC. "Warming in the climate system is unequivocal", it solemnly intones; and it is "*extremely likely* [my emphasis] that human influence has been the dominant cause." The IPCC also offers a glimpse into the future, and it is even less encouraging: "As the ocean warms, and glaciers and ice sheets reduce, global mean sea level will continue to rise, but at a faster rate than we have experienced over the past 40 years."

### **IS EUROPE'S 20-20-20 CLIMATE PACKAGE MAKING ANY DIFFERENCE?**

According to the most recent assessments, Europe has cut emissions by 18% since 1990; it also exceeded the 20% reduction in primary energy consumption target in 2009 and in 2011. The share of energy generated from renewable sources stood at 13% in 2011, putting the magic 20% figure within reach.

Now Europe looks to increased energy efficiency to maintain



progress: the Energy Efficiency Plan addresses renovation in the building sector and improvement in the energy performance of households. More efficient use of electricity makes each kilowatt-hour work harder, and so the bitter taste of more expensive energy will be sweetened by the need to buy less of it. But is this a cruel illusion? Nineteenth Century economist William Jevons observed that Watt's invention of a more efficient steam engine made steam technology economically viable in many situations where it had not been so before. Overall, demand for coal rose, even though the amount required by each new engine was lower. This apparently counterintuitive outcome is named the Jevons Paradox; and its relevance to energy as a resource was examined by economists Daniel Khazzoom and Leonard Brookes, who argued that increased energy efficiency tends to lead to increased energy consumption. For example, modern more fuel-efficient aircraft have allowed cheaper air fares. The result has been a growth in air travel - and, of course, in the demand for aviation fuel. And so to the Jevons paradox can be

added the Khazzoom-Brookes postulate. And though from the science of Chemistry, to these can be added the Le Chatelier Principle. This has a valid economic interpretation that may be translated as "Any change in status quo prompts an opposing reaction in the responding system."

Recently, respected academic Horace Herring has further challenged the view that improving energy efficiency will reduce national energy consumption and national CO<sub>2</sub> emissions, contending instead that efficiency lowers the implicit price of energy, so making it more affordable and stimulating greater use of it: the 'rebound' or 'takeback' effect.

Today, the rapid development of LED lighting technology has opened up enormous new lighting opportunities. Designers can incorporate LEDs into the structure of everything from buildings to furniture to fashion. Where new uses are found for it, or when lighting is incorporated where it was not before, the situation begins to look remarkably similar to when

Watt's new steam engines were developed two hundred and fifty years ago. Case closed: energy efficiency is not a good thing.

Not so. Herring also makes the profoundly important observation that "energy efficiency is not an end in itself, but a means." *This* is where the politicians and the legislators should direct their energies. It is the crux of the whole matter, where economics, climate and the environment come together with consumer aspirations. Energy efficiency is important, but history suggests that it should come with a 'health warning' not to squander its benefits. It buys Mankind a little breathing space (I use the term in all its meanings); precious time to develop sustainable energy alternatives. For if we do not transform our energy systems, we invite a future in which transport is horse-drawn once more. Or worse: the oil *will* run out one day, but perhaps not before the IPCC's predictions become reality and our climate is irretrievably degraded. ●

*The full version of this article appears on our website [www.europeanenergyinnovation.eu](http://www.europeanenergyinnovation.eu)*



# Technology and policy are putting wind at the heart of the electricity system

By Jacopo Moccia, Head of Political Affairs, EWEA - The European Wind Energy Association asbl/vzw

**E**urope has a world-leading industry that is supplying Europeans with 7% of all their electricity needs today. Europe has a world-leading industry whose exports are worth almost €9bn a year. Europe has a world-leading industry that employs around 250,000 people and contributes over €32bn a year to its GDP, as well as investing 5% of its turnover in research and development. Europe's world-leading industry is wind energy!

What's more, this industry is set to grow.

According to the European

Commission's 2050 energy roadmap, wind energy will be the backbone of the EU electricity system. By 2050 it could be supplying half of all of the EU's electricity.

There is, however, an important hurdle that needs to be overcome for wind energy to deliver on these ambitious expectations: reducing costs.

Cost reductions will come through a combination of two main factors, technological innovation, of course, and critically, stable long term regulatory frameworks.

A stable policy framework for wind energy is essential to ensure investments. Current EU energy and climate policies have been successful in creating a safe environment for investment in wind energy. However, the crisis that has hit Europe is shaking the very foundations of these policies. This regulatory instability has driven the cost of capital, in certain countries, to over 30% of project costs.

Stability and clarity on energy policies and targets beyond 2020 is needed quickly, for the wind industry, but most importantly for energy consumers.

A stable and long-term view will also encourage continued investment in R&D. After all,

who would put money towards R&D without knowing what kind of possibilities there will be to market the product in the future?

The EU supports research in wind energy through its European Wind Initiative (EWI) that brings together the industry, through the Wind Energy Technology Platform (TPWind), the Commission and representatives of Member States.

With a budget of €6bn for the 2010 to 2020 period, made up of both public and private funds, the EWI is the single most important EU programme for wind energy R&D funding. Its priorities are drawn from the work of a technology platform (TPWind) which brings together some 180 wind power professionals.

The Technology Platform is set on bringing down the levelised cost of producing electricity from both onshore and offshore wind farms. In doing so it is shaping the future of the industry. Bigger but lighter turbines, more efficient turbines at low wind speeds and in difficult terrains, streamlined manufacturing and installation processes and optimal interaction with the electricity grid.

With both a farsighted policy framework and active, cutting-edge research from companies and universities, wind energy will be at the heart of the European electricity system of tomorrow. ●



## INNOVATION FOR A BETTER HEALTH AND CARBON FOOTPRINT

In Belgium, gas infrastructure company Fluxys pushes ahead with partners to develop the infrastructure allowing cars, trucks and ships to fill up with natural gas. Why? Because switching from petrol, diesel or heavy fuel oil to natural gas brings immediate improvement in air quality and health:

- 20% less CO<sub>2</sub> on average;
- at least 50 to 60% less nitrogen oxides;
- the amounts of sulphur and fine particles released are negligible.

### ROAD TRANSPORT

Compressed natural gas (CNG) is the alternative by excellence to traditional fuels for cars, vans, buses and commercial vehicles such as refuse trucks. As the CNG market in Belgium is scarcely out of the egg, Fluxys examines with local distribution operators the best approach to invest in CNG filling stations.

For long-distance haulage trucks, in turn, the alternative to diesel is liquefied natural gas (LNG). The market, though still limited, is expanding swiftly and Fluxys is working with a partner on a pilot project to build an LNG filling station in Belgium. At the Fluxys Zeebrugge LNG terminal, tanker trucks can already load up with LNG to supply ships and LNG filling stations for trucks.

### SHIPPING

At present, the use of LNG as fuel for ships is largely confined to Scandinavia. However, it is likely to spread Europe-wide in the near future as sulphur emission standards in shipping from 2015 are to become very sharp in some seas, including the North Sea, the English Channel and the Baltic Sea.

Against this backdrop, Fluxys is building a second jetty at its Zeebrugge LNG terminal to make it further develop into a hub for the supply of LNG for ships. As from 2015, the facility will be able to receive small bunkering barges and feeder ships for loading LNG. From Zeebrugge, they can ensure refuelling of LNG-powered ships and intermediate storage sites in all ports in Belgium and the major ports in North-Western Europe. Fluxys is also willing to co-invest with partners in additional infrastructure in order to further develop the logistical supply chain.



# The more we share, the greater our value

By Victor Schoenmakers - Director European & International Affairs, Port of Rotterdam Authority and  
Nico van Dooren - Manager Energy & Procesindustry, Port of Rotterdam Authority



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## PORT COMPASS 2030

*"In 2030, Rotterdam is Europe's most important port and industrial complex". It's a strong combination of the Global Hub and Europe's Industrial Cluster, both leaders in efficiency and sustainability".* This is how the long term vision of the Port of Rotterdam kicks-off in Port Compass 2030. One of the six characteristics of the Port of Rotterdam as Europe's Industrial Cluster by 2030 is integrating business and production activities.

Through sheer scale and innovative strength, the Port

of Rotterdam can offer great potential for further integration. More than ever companies exchange raw materials, heat and residual products: co-siting; thereby cutting their costs and increasing efficiency.

By further investment in pipelines between biobased- and petrochemical plants and terminals, comprehensive supply chain integration is promoted. Companies can exchange heat and steam through a pipe network and reduce their energy costs and CO<sub>2</sub> emissions.

## DELTAPLAN ENERGY INFRASTRUCTURE AND NATIONAL ENERGY AGREEMENT

The importance of sustainable growth facilitated by an integrated energy infrastructure has recently been formalized at national level with the 2013 National Energy Agreement. Furthermore, the so-called Deltaplan Energy Infrastructure sets out concrete steps that follow on from the National Energy Agreement and collects all current opportunities to promote and facilitate the use of industrial

waste energy such as residual steam, heat and CO<sub>2</sub> in the Port of Rotterdam and the province of South-Holland. The Rotterdam port area with its cluster of power plants and energy intensive industry is an opportunity to realize further energy- and CO<sub>2</sub>-reduction targets on national- and EU level. The large area of the port also offers unique possibilities for supplying residual streams of CO<sub>2</sub>, heat, etc. to large scale greenhouses for the growth of crops and flowers and to extended district heating networks in multiple surrounding residential areas.

**STEAM PIPELINE NETWORK**

On the 1st of May 2013 grid operator Stedin started operating the first two kilometers of steam pipeline available in the Rotterdam Botlek area. The first steam exchange takes place between waste processor AVR, as steam supplier by burning non-recyclable waste, and chemical company Emerald Kalama Chemical (EKC), as steam user and producer of preservatives, raw materials for flavors, fragrances and softeners. The first phase of the steam pipeline network in this area will transport the generated steam from approximately

450,000 tons of waste per year. By connecting the companies, yearly millions of cubic meters of fossil natural gas are saved. The steam pipeline network between AVR and EKC is only the beginning: Stedin, the grid operator, can extend the network significantly by connecting multiple large companies. This can lead to a reduction of approximately 400.000 tons of CO<sub>2</sub> in Rotterdam. With this impressive reduction potential, the steam pipeline network is bringing the Rotterdam Climate Initiative reduction target closer: a 50% CO<sub>2</sub> reduction in 2025 compared to 1990. ●



# Green Ports and energy efficiency within the TEN-T Programme

By Jaroslaw Kotowski, Project Manager, TEN-T Executive Agency (TEN-T EA), European Commission

Exhaust system on new Fjordline LNG fuelled ferry



**T**he TEN-T Programme contributes significantly to improvement of environmental performance of maritime transport, especially in terms of co-funding new energy saving and eco-friendly solutions in ports and shipping. The Programme is managed by the Trans-European Transport Network Executive Agency with a mandate from the European Commission.

Over the current financial perspective almost 150 million euros have been allocated from the TEN-T budget to port and Motorway of the Sea actions which aim at greening the image of maritime transport. Around 135 million euros come from the Motorway of the Sea instrument. Most of the investments take place in the Sulphur Emission Control Area in order to assist the region in meeting the international obligations related to reduction of sulphur emission as of 1 January 2015, however one can notice more and more voluntary interest coming from the Mediterranean region, too. The co-funded projects include studies, pilot actions testing and validating innovative solutions for ports and shipping as well as works projects with a view of providing more visible outcome. It should be stressed that the Programme has recently taken aboard a few promising pilot actions which will hopefully generate positive wider benefits for the whole maritime industry and contribute to overcoming technological barriers for

**The complete list of the currently TEN-T supported maritime projects with specific environmental dimension**
**On-going Motorway of the Sea Project portfolio:**

Project Code	Title	Action type	Planned duration (years)	Estimated End Date	Initial total costs (€M)	TEN-T support (€M)
2010-EU-21112-S	LNG infrastructure of filling stations and deployment in ships	Studies/Pilot	3,2	31/12/2013	26,8	9,6
2009-EU-21010-P	Baltic Link Gdynia-Karlskrona	Works	4,8	31/10/2013	85,5	17,1
2011-EU-21005-S	LNG in Baltic Sea Ports	Studies	3,0	31/12/2014	4,8	2,4
2011-EU-21007-S	COSTA	Studies	2,8	31/12/2013	3,0	1,5
2011-EU-21010-M	Green Bridge on Nordic Corridor	Mixed (studies & works)	4,0	31/12/2014	84,6	19,8
2012-EU-21003-P	LNG Rotterdam Gothenburg	Works	4,0	31/12/2015	171,36	34,3
2012-EU-21006-S	SEAGAS	Studies	4,0	31/12/2015	2,0	1,0
2012-EU-21009-M	LNG Bunkering Infrastructure Solution and Pilot actions for Ships operating on the Motorway of the Baltic Sea	Studies/Works	4,0	31/12/2015	74,5	23,1
2012-EU-21010-S	PILOT SCRUBBER - New Generation Lightweight Pilot Scrubber Solution installed on a Ro-Ro Ship operating on the Motorway of the Baltic Sea	Studies/Pilot	4,0	31/12/2015	13,5	6,7
2012-EU-21017-S	Methanol: The marine fuel of the future	Studies/Pilot	3,0	31/12/2015	22,5	11,3
2012-EU-21023-S	Sustainable Traffic Machines - On the way to greener shipping	Studies/Pilot	4,0	31/12/2015	12,9	6,4
<b>Total</b>					<b>501,5</b>	<b>133,2</b>

**On-going port portfolio:**

Project Code	Title	Action type	Planned duration (years)	Estimated End Date	Initial total costs (€M)	TEN-T support (€M)
2011-ES-92138-S	Blue Corridors enHance through the Application of Natural Gas Energy	Study	1,3	31/12/2013	2,2	1,1
2011-EU-92151-S	Green technologies and eco-efficient alternatives for cranes & operations at port container terminals (GREEN-CRANES)	Study/Pilot	1,9	31/05/2014	3,6	1,8
2011-EU-92079-S	Make a Difference	Study	1,2	31/12/2014	2,5	1,2
2011-FR-92026-S	Technical and design studies concerning the implementation of a LNG bunkering station at the port of Dunkirk	Study	2,4	31/12/2014	2,3	1,1
2011-SE-92148-P	Fjalir project	Works	1,2	31/12/2013	1,3	0,3
2012-ES-92034-S	Flexible LNG bunkering value chain in the Spanish Mediterranean Coast	Study	1,4	31/12/2014	2,0	1,0
2012-ES-92068-S	LNG hub in the northwestern Iberian Peninsula	Study	2,9	31/12/2015	1,2	0,6
2012-BE-92063-S	Shore Power in Flanders	Study	2,9	31/12/2015	2,2	1,1
2012-DE-92052-S	Tackling the environmental impact of shipping: Pilot implementation of a shore-side electricity supply for ships with increased energy demand (market innovation)	Study/Pilot	2,9	31/12/2015	7,1	3,5
<b>Total</b>					<b>24,4</b>	<b>11,7</b>

**On-going inland waterways projects with partial maritime dimension:**

Project Code	Title	Action type	Planned duration (years)	Estimated End Date	Initial total costs (€M)	TEN-T support (€M)
2012-EU-18067-S	LNG Masterplan for Rhine-Main-Danube	Studies	3,0	31/12/2015	80,5	9,6

You can obtain more information about all the green port projects on the TEN-T website:  
[http://tentea.ec.europa.eu/en/ten-t\\_projects/ten-t\\_projects\\_by\\_transport\\_mode/water.htm](http://tentea.ec.europa.eu/en/ten-t_projects/ten-t_projects_by_transport_mode/water.htm)

introduction of alternative fuel solutions for ships.

The scope of the co-funded projects ranges from supporting the introduction of on-shore power supply solutions in both ports and aboard vessels, through preparation and deployment of alternative fuel infrastructure for bunkering ships (LNG and Methanol) to other alternative emission reduction technologies such as installation of scrubbers and reception of scrubber waste deposits in ports. The TEN-T intends to continue supporting the projects with a green maritime dimension also under the new TEN-T Guidelines and the Connecting Europe Facility instruments. The support will be available to all EU core ports and other eligible entities through the Motorways of the Sea instrument, which from 2014 onwards is becoming a maritime pillar of the Transeuropean Transport Network.

Some examples of the key green port projects co-financed by TEN-T:

**1. Baltic Link Gdynia-Karlskrona** includes on-shore power supply installations for ships in Karlskrona Port as well as on board of two Stena Line vessels operating on this link.

**2. Tackling the environmental impact of shipping:** Pilot implementation of a shore-side electricity supply for ships with increased energy demand (market innovation) - deals with testing a pioneering, innovative shore side power supply system for ships with high energy requirements such as container or cruise vessels in the Port of Hamburg.



*Stena Line ferry connected to on-shore power supply in the Port of Karlskrona, Sweden*

### **3. LNG Gothenburg-Rotterdam:**

The Action will create 'break bulk' infrastructure for smaller-scale LNG supply for ships in the Ports of Rotterdam and Gothenburg. The LNG facility in Rotterdam will additionally provide a truck loading bay, which enables ships to bunker LNG in the port using trucks.

**4. Fjalir project:** deals with constructing a first LNG bunkering barge operating in the Port of Stockholm. The barge will supply LNG to a Viking Grace ferry operating between Stockholm and Turku but can also be used by other customers. This upgraded vessel will be a flexible alternative to other state of the art technologies as well as larger scale, land based LNG fuelling infrastructure.

**5. Green technologies and eco-efficient alternatives for cranes & operations at port container terminals (GREENCRANES):** The project is testing three prototypes aiming at reducing fuel consumption and greenhouse gas emissions at selected European

port container terminals (PCTs). Pilot 1 will test the first LNG powered terminal tractor in Valencia Port. Pilot 2 will deploy an Eco-RTG crane retrofitted with low power generator equipment enabling lower fuel consumption. Pilot 3 taking place in Koper Port will design and test a real time energy monitoring system to control energy consumption in PCT operations. Dual-fuel technologies (including LNG, hydrogen or bio-fuels) applied to reach stackers will be tested at Livorno Terminal as pilot 4.

**6. Methanol:** The marine fuel of the future - Methanol as a new possible fuel for shipping will be tested aboard Stena Line largest ferry operating between Kiel and Gothenburg. In addition appropriate port infrastructure for the supply of methanol for bunkering such as a bunker vessel and a storage tank will be built in the servicing ports.

**7. LNG Masterplan for Rhine-Main-Danube:** The

Action's overall objective is to prepare and to launch the full-scale deployment of LNG as environmentally friendly and efficient fuel in the inland navigation sector within the Rhine/Meuse-Main-Danube axis. It is a combined effort from sea and inland ports, authorities and barge and terminal operators, as well as logistic service providers, which will remove market barriers and take the first steps in realising a new LNG supply chain.

**8. COSTA:** The Action aims at developing framework conditions for the use of LNG for ships in the Mediterranean, Atlantic Ocean and Black Sea areas. It will result in preparing an LNG Masterplan for short sea shipping between the Mediterranean Sea and North Atlantic Ocean as well as the Deep Sea cruising in the North Atlantic Ocean towards the Azores and the Madeira Island. The Action involves administrations, shipowners and a number of ports from the concerned regions. ●



# How Cavotec's innovative technologies are making port operations cleaner and more efficient

**As the global ports industry takes steps to reduce its environmental impact, the Cavotec engineering group's innovative automation and shore power systems are driving improvements in environmental performance and operational efficiency. In this article, we profile Cavotec's shore power systems.**

## Switching on to a cleaner alternative

Ships in port need electrical power to run on board services for cargo handling and passengers such as heating, lighting and food preparation.

"While the majority of vessels currently run their engines to generate power while docked – generating sulphur and nitrogen oxide – increasingly stringent controls on vessel emissions are encouraging the adoption of shore power systems," explains Luciano Corbetta, Cavotec Group Market Unit Manager Ports & Maritime.

Also referred to as "cold ironing", shore power systems connect ships to grid-generated electricity, enabling ships' engines to be switched off. Electricity produced for the grid, even by conventional means, is considerably cleaner than power generated by burning the low-grade oil used by ships.

In close cooperation with shipping lines and port authorities, Cavotec has developed its shore power systems – Alternative Maritime Power (AMP) – since the 1980s. Cavotec's AMP units consist primarily of cable management systems and connectors installed in or on the quayside, or on board ship, that connect vessels to grid-generated electricity.

"There are currently more than 500 AMP units installed, or currently being installed on ships, while ports across North America, Europe and the Far East also use the technology," says Corbetta.

"The majority of Cavotec's existing AMP systems are installed at container, bulk and tanker handling applications, and cruise ship and passenger ferry berths," he adds.

## A world-class, world-first innovation

Cavotec is also supplying the world's first fully integrated AMP and automated mooring system for two passenger ferry berths in the Norwegian fjords.

The system will be used by another world first: a battery powered, catamaran ferry. MoorMaster™ automated mooring units, manufactured by Cavotec, will be integrated with a shore power connection using a state-of-the-art Automatic Plug-in System. This will first moor and then connect the ferry to electrical power to charge its batteries.

The mooring system will signal to the AMP unit when the ship is secure, and sensors will then guide the AMP connector to a hatch in the side of the vessel, connect to the ship's battery and start charging.

With around 6,000 calls made annually on the route, the air quality improvement and fuel cost savings compared to using conventional mooring and power systems is considerable.

## A cleaner, more efficient future

"As the shipping industry faces intensifying pressure in the form of these and other legal requirements, and from public sentiment to reduce emissions from ships, the benefits of AMP look set to be increasingly widely recognised," concludes Corbetta.

In addition to AMP and MoorMaster™, Cavotec manufactures a range of systems that help ports and shipping lines reduce environmental impact. These include Panzerbelt cable protection systems, crane controllers, marine propulsion slip rings, power chains and connectors, radio remote controls and motorised and spring driven cable reels.

# Shared efforts towards a greener maritime sector

By Dimitrios Theologitis and Jakob Slot

**A**s 74% of all goods to or from the EU zone are carried by ship, European ports are essential to the region's economic recovery and growth. In support of this, the impact assessment of the Commission's proposal for a regulation of the port sector – currently in co-decision process in Parliament and the Council – shows that for every additional one million tonnes of cargo handled in a port, an average of 300 new jobs are created in the port and its surrounding area. At the same time, the amount of cargo handled in European ports is expected to grow by 50% by 2030 which would put a strain not only on port capacity but also on the environment.

By Dimitrios Theologitis



It is no secret that increased economic activity often has negative external effects on the local environment as well as the climate, and the challenge, therefore, is to strike the right balance between economic development and the promotion of green measures. As much as anywhere, this is the case with ports which are often not just in close proximity to dense urban areas but completely integrated in the city surrounding it, since ports often played a key role in the very prospering and growth of the city in the first place.

Importantly, though, this apparent trade-off between economy and environment is far from inevitable. Technologies that reduce the use of fossil fuels, for example, have the dual impact of promoting economic efficiency of ships, while reducing the sector's environmental footprint. We need, therefore, a strong focus on green innovation within the maritime sector, also in view of long-term competitiveness.

Examples of such innovation can be found in the ability of cranes to store the energy released when lowering a container, or in the use of engine heat in vessels to regulate the temperature on board. Implied here is also the obvious fact, that when we talk about the greening of the maritime transport sector, it is important to look at both the port side and the vessels actually moving the cargo.

This dual approach is aptly

illustrated by the current aspirations to move, slowly but surely, to greener vessel fuels, such as LNG (Liquefied Natural Gas) or methanol. On the one side, it requires shipping lines to invest in the appropriate equipment, while on the other comprehensive bunkering systems must be installed on-shore. The same can be said for other measures such as shore side electricity supply for moored vessels or the efficient and environmentally safe disposal of scrubber residue.

The port sector is – of course – at the centre of our common ambition to move towards greener maritime transport. Therefore, I welcome very much voluntary sector initiatives; for instance the ESPO "Green Ports" effort of publishing guides to best practice solutions to be implemented in the daily operations of ports throughout Europe. This is a very positive step towards more efficient and consistent management of air quality, waste and energy conservation. And I am pleased to note that a number of ports have already embarked on this course towards reducing their environmental impact.

If such initiatives are to be effective, however, it is important that not only the port authority or the managing body of the port is pulling in a greener direction. The port community as a whole – e.g. terminal operators, shipping companies, administrations – needs to be behind the project.

With a view to underpin this kind of collaboration, the Commission, in the proposed ports regulation, has included provisions for regular consultation among the many stakeholders of a port. It is the ambition that these consultations will act as forums for, inter alia, the development of a shared green agenda for the port as a whole.

The Commission also encourages the application of differentiated port charges to promote the development towards greener fleets. Through this instrument, ports can reward shipping lines implementing green technology, ahead of legislation, and encourage operators to opt for energy efficient short sea shipping. Of course, such a scheme will have to be transparent and based on fair and objective criteria, which is why the Commission supports a European or regional approach, especially in order to establish a common categorisation of environmental standards for vessels building on existing work done at international level.

A more concrete regulation on the vessel-side of the maritime sector is the gradual reduction of sulphur content in marine fuel in the SECA areas (Sulphur Emission Control Areas), following from the implementation of the IMO's MARPOL-convention. In order to prepare the sector for the introduction in 2015 of a limit on the sulphur content of 0.1% in the designated areas, the Commission has announced the establishment of the European Sustainable Shipping Forum (ESSF). With the ESSF, the Commission intends

to bring together Member States and maritime industry stakeholders in order to exchange best practices and coordinate actions, while providing the opportunity to discuss various issues that may arise as early in the implementation process as possible.

Regarding infrastructure - within ports and for hinterland connections - a landmark was reached with the historic agreement on the TEN-T network and the €26 billion funding through the CEF for transport projects towards 2020. Environmental considerations will play a key role within these programs, both in relation to a transfer of goods to greener transport modes, such as shipping and inland waterways, and to developing and implementing green technologies.

Also, with the new 2014-2020 budget of close to €80 billion for

"Horizon 2020", the EU's tool for financing research and innovation, there are plenty of possibilities to promote further the green innovation agenda, including in the ports and maritime sector. Horizon 2020 has the kind of strong focus on bringing together the academic world and industry - theory and practice - that are so essential to the development of new solutions that are environmentally sustainable and economically viable.

The present and the years to come are indeed interesting times that hold great potential for the greening of a sector that is so economically important for Europe. For this to happen, however, a great deal of determination will be needed from all actors involved. The Commission is ready to do its best to promote this development and encourages the Member States and the sector to join this effort. ●

**Dimitrios Theologitis**

Head of Unit "Ports and Inland Navigation"  
 European Mobility Network Directorate  
 Directorate General for Mobility and Transport

European Commission, DM28 6/88  
 B-1049 Brussels  
 Belgium

Tel. +32 2 2995582  
 dimitrios.theologitis@ec.europa.eu  
[http://ec.europa.eu/transport/index\\_en.html](http://ec.europa.eu/transport/index_en.html)

Born in Athens, Greece, 1955. Civil Engineer (National Technical University of Athens) specialised in transport - and languages.

In the European Commission since 1984. Various Head of Unit posts including Road Safety, Maritime Security, Maritime Transport and, since 2008 Ports and Inland Navigation.

Main domains are the development and implementation of a new European ports policy to promote further growth and the further development of the policy framework to support and optimise the functioning of inland waterway transport.


**CNSS**

Clean North Sea Shipping



# Clean North Sea Shipping

**T**he shipping industry is currently at a crossroads. Regulations limiting air emissions are getting tighter and ship owners need to take steps in order to improve their performance. At the same time the pressure is on port owners and authorities to develop an appropriate infrastructure and provide alternative energy and power sources for ships calling at their ports.

## CNSS KEY TOPICS

The Clean North Sea Shipping (CNSS) project (<http://cnss.no>) is part funded by North Sea Region Programme (Interreg IV B). The project is currently working on a list of recommendations which pull together a range of different experiences within the key areas of clean shipping technology, ship emissions - status and

scenarios - and policy options.

## LNG AND OPS - THE WAY FORWARD

The clean shipping technology work has looked into a range of different technologies as a means to reduce air emissions. These include water addition at different stages in the combustion process, engine modification, concepts for post-emission treatment such as Scrubbers and Selective Catalytic Reduction (SCR), and the utilisation of alternative fuels. It is evident that Liquid Natural Gas (LNG) fuelled engines have the best overall performance having 60% reduction of NO<sub>x</sub>, 90-100% of SO<sub>x</sub>, 90% of particles (PM) and 0-25% of CO<sub>2</sub>. This option is only rivalled by Onshore Power Supply (OPS) for ships while at berth, which reduces emissions of NO<sub>x</sub>, SO<sub>x</sub> and PM by more than 90% compared to the conventional auxiliary engine approach. Undoubtedly, OPS and LNG are proven as the way forward for the reduction of noxious emissions as well as greenhouse gases. However, this is only the beginning of the road towards zero emissions and there will be plenty of challenges to overcome in the future.

## EMISSIONS AND SCENARIOS

The CNSS project has developed air quality models that couple ships' activities within the North Sea region and their emissions with meteorological data to determine not only the produced

emissions, but their travel in the air and aggregated densities in urban areas and ports. In a conducted scenario, using CNSS' simulation model, it was revealed that the contribution to the NO<sub>x</sub> emission from shipping will be escalated by 28%, if NO<sub>x</sub> Tier III regulation is delayed by another 5 years. The project is currently analysing the impact in terms of increased concentrations for different regions.

## INDICES

The project has in particular analysed two key indices, namely Environmental Ship Index (ESI) and Clean Shipping Index (CSI), in detail. A number of strengths and weaknesses of each has been highlighted.

This study has identified the need for a unified indexing scheme considering real ships' exhaust gas emissions both at sea and near population centres and hence the need to develop incentives capable of delivering real environmental benefits for good shipping practices.

## WHERE ARE WE HEADING?

CNSS will present its conclusions and recommendations at the final conference in March 2014 in Bergen, Norway. The recommendations will address a range of different topics including infrastructure, incentives, environmental indices, emission management practices for ports and more. ●



Photo: © [www.mediaserver.hamburg.de](http://www.mediaserver.hamburg.de)

For further information, check our web site <http://cnss.no>

The Clean North Sea Shipping project (<http://CNSS.no>) focuses on the reduction of air pollution and greenhouse gas emission from ships. The project partnership includes ports, industry, regional public authorities and research institutions.

# Green Ports and Energy Efficiency

By Philippe De Backer, MEP

**E**nergy production, energy security and innovation - in all its aspects - should be central in European strategic thinking. Together with sustainability, efficiency and global competitiveness, it is absolutely necessary to generate future growth throughout our economy, both at the national and the European level.

Energy policy and innovation can take many forms. As a Member of the European Parliament heavily involved in transport policy, I acknowledge the need for European transport to become more energy efficient. The White paper "Roadmap to a Single European Transport Area - Towards a Competitive and Resource Efficient Transport System" called for breaking the oil dependence of transport and set a target of 60% greenhouse gas emissions reduction from transport by 2050. We need to do more at European level to achieve these targets and this has to be done together with the Member States.

Take for example ports, which play a crucial role in our transport network. Today they account already for 74% of imported and exported goods in and from the EU and 37% of the internal EU trade. With an ever increasing globalisation of business, industry and services, their importance will grow. In Europe, we do have some top ranking ports, but there are others too. Increasing efficiency in ports should therefore be a priority for the EU. This can be done in several ways.

A rethinking of our transport infrastructure is absolutely

required. For instance, connections to the hinterland of ports are in many Member States still very much based on the use of roads. It is however of utmost importance for Member States to develop those connections with all transport modes. Investing in railways, inland port infrastructure and multimodal platforms is necessary to cope with the ever increasing growth in traffic of goods. The new TEN-T guidelines and the Connecting Europe Facility provide funding for ports in order to develop diversified and multimodal connections.

Within ports, stimulating the greening of ports can help to increase the efficiency and the competitiveness of those ports. Shore side electricity supply for waterborne vessels is not ideal in all ports, but it is definitely interesting in many ports to improve the air quality and reduce noise levels. Together with investments in waste management, optimising supply chains and the use of alternative fuels, this leads to higher environmental standards and efficient use of resources.

The work currently done in the European Parliament on the Commission proposal on the Deployment of alternative fuels infrastructure will also stimulate further developments. The new directive will create frameworks for the market development of alternative fuels and should ensure minimum infrastructure build-up for alternative fuels, including the implementation of common technical specifications. Electricity, hydrogen, and natural gas (CNG and LNG) are covered in the proposal.

It is good that Europe lays down technical specifications and develops standards. But when drafting legislation and guidelines, we have to keep in mind the international dimension of the transport sector and especially for maritime transport. For ports at the Mediterranean and Baltic Sea for example, the non-EU ports are very close.

If the EU exaggerates with the environmental legislation and ignores the global developments, there is a risk that we will lose traffic to non-EU ports and that will harm our economy heavily. The new sulphur directive, that sets new sulphur limits in the European waters, goes further than what the IMO proposed. It is a good example of the difficulties that environmental maritime legislation brings with. It shows that new legislation can only work if the legislator receives sufficient support from the industry.

Transport, environmental and energy policy are thus very much interlinked. An integrated European energy strategy is therefore necessary. The creation of a consumer-oriented market, based on transparency and smart technologies should be the priority. Investments in infrastructure need to be encouraged through a stable, innovation-friendly and predictable regulatory framework. Horizon2020, the EU framework programme for research and innovation, and the Connecting Europe facility can stimulate investments in the necessary innovative infrastructure supporting ports to become greener. ●

# ESPO Green Guide: Towards greener and energy efficient ports

By Antonis Michail, Senior Advisor - Environment, Health, Safety and Security, EcoPorts Coordinator

ESPO launched in October 2012 its "Green Guide; towards excellence in port environmental management and sustainability". Far from being a merely promotional tool of the evidence-based progress that European port authorities have achieved over time, the Green Guide establishes a common framework for action while respecting port diversity.

The Guide first establishes five long standing principles that guide the efforts of the European port authorities in addressing their environmental challenges:

- Achieving voluntary self-regulation that raises standards

beyond regulations through a bottom-up approach

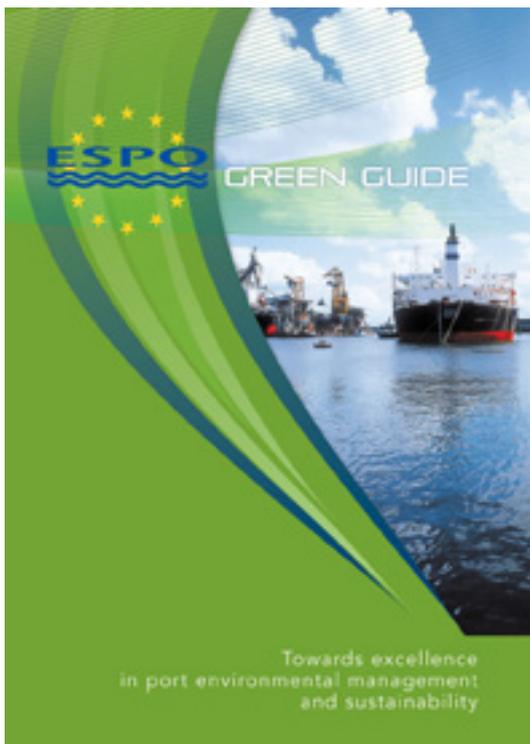
- Cooperating and sharing of knowledge and experience on environmental matters
- Serving in parallel the interests of both the business and the local communities aiming towards the sustainable operation of port areas
- Applying a systematic approach to port environmental management through appropriate structures that enable continuous improvement of performance
- Being transparent in communicating and reporting on the ports' efforts and environmental performance.

The major innovative element though is the introduction of a common framework for action that demonstrates the range of options that are available while respecting port diversity. Concretely, the Green Guide calls upon European port authorities to continuously work towards improving their environmental performance through focused action on:

- **Exemplifying:** Setting a good example towards the wider port community by demonstrating excellence in managing the environmental performance of their own operations, equipment and assets

- **Enabling:** Providing the operational and infrastructural conditions within the port area that facilitate port users and enhance improved environmental performance within the port area
- **Encouraging:** Providing incentives to port users that encourage a change of behaviour and induce them to continuously improve their environmental performance
- **Engaging:** with port users and/or competent authorities in sharing knowledge, means and skills towards joint projects targeting environmental improvement in the port area and the logistic chain
- **Enforcing:** Making use of mechanisms that enforce good environmental practice by port users where applicable and ensuring compliance.

A common approach does not necessarily result in a common level of responsibility for all port authorities. It is for each and every port to assess its own responsibilities regarding the specific nature of the challenges it faces. Recognising the need for individual flexibility, the Green Guide leaves enough room for individual port authorities to define their own policies and to implement actions, relative to their respective position in terms of governance, financial means, competences and market power.



The 'five Es' framework is applied to five selected environmental priority areas, namely air quality management, energy conservation and climate change, noise management, waste management and water management. Guidance is provided in terms of potential response options under Exemplify, Enable, Encourage, Engage and Enforce. Therefore, the way that ports can respond to the identified challenges by making full use of their competences as landlord, infrastructure manager, service provider, area manager or regulator, is systematically addressed. Furthermore, the Green Guide is accompanied by an online annex of exemplary response options and good practices that are implemented in European ports. The examples demonstrate evidence and application of the theoretical 'five Es' framework in practice. The annex is dynamic, subject to ongoing review and available online through the ESPO website ([www.espo.be](http://www.espo.be)).

The European seaports have been identifying their top environmental priorities since back 1996 through dedicated periodic ESPO surveys. Energy consumption has entered for the first time in the top-10 of priorities in 2009 and gained significance in the last review 2013. Hence, the specific reference and attention in the ESPO Green Guide through the dedication of a separate chapter on energy conservation and climate change.

In consistency, several good

**Table 1: Evolution of the environmental priorities in European seaports (1996-2013)<sup>1</sup>**

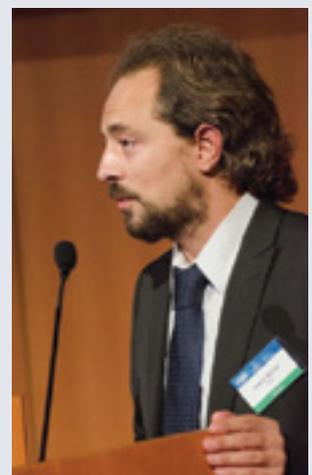
	1996	2004	2009	2013
1	Port Development (water)	Garbage / Port waste	Noise	Air quality
2	Water quality	Dredging: operations	Air quality	Garbage/ Port waste
3	Dredging disposal	Dredging disposal	Garbage / Port waste	Energy Consumption
4	Dredging: operations	Dust	Dredging: operations	Noise
5	Dust	Noise	Dredging: disposal	Ship waste
6	Port Development (land)	Air quality	Relationship with local community	Relationship with local community
7	Contaminated land	Hazardous cargo	Energy consumption	Dredging: operations
8	Habitat loss / degradation	Bunkering	Dust	Dust
9	Traffic volume	Port Development (land)	Port Development (water)	Port development (land)
10	Industrial effluent	Ship discharge (bilge)	Port Development (land)	Water quality

practice examples were contributed by European seaports in the relevant fields of the online good practice annex. Those vary from state of the art energy passive office building (Port of Ghent, port of Aalborg), to consistent carbon footprint monitoring, reporting and action taking (Port of Antwerp, port of Rotterdam, port of Valencia), proactive energy management planning (Port of Amsterdam, port of Dover, ports of Bremen and Bremerhaven, port of Setubal) and applying solutions for improving efficiency (Port of Gothenburg, port of Hamina

Kotka). The annex contains a wealth of information that demonstrates the good ongoing projects in European ports.

European ports authorities commit to the principles and the approach of the ESPO Green Guide. In addition, through the good practice annex the ports actively share knowledge and experiences and work bottom-up towards enhancing a level playing field on environmental matters. In that way, the ESPO Green Guide is seen as the sector's vehicle towards the operation of greener and more energy efficient ports. ●

Dr. Antonis Michail is an engineer in background (Technical University of Crete - 2001), holds a Master in environmental management (University of Amsterdam - 2003) and a Doctorate on the environmental management of the logistics chain (Cardiff University - 2008). Being involved in EcoPorts since 2003, Antonis Michail worked within several European projects on port environmental management and he was running the EcoPorts projects office in Amsterdam (2008-2009). Since 2009, Antonis Michail joined the European Sea Ports Organisation as a Policy Advisor. Within ESPO he is responsible for all matters related to environment, health, safety and security. In parallel, Antonis Michail is responsible for the overall coordination of the EcoPorts Network and the service chain of the EcoPorts tools.



<sup>1</sup> Environmental issues that consistently appear over time are mapped with the same colour

# NANOHVAC

## Nanotechnology based approaches to increase the energy efficiency in ducts and systems contributing to a healthier indoor environment

**T**he NanoHVAC project is developing an innovative approach for ducts insulation while implementing novel cleaning and maintenance technologies, all enabled by cost-effective application and nanotechnology. NanoHVAC is funded by the European Union Seventh Framework Programme under grant agreement 314212 and has a duration of 36 months, starting in September 2012.

Buildings account for around 40% of total energy consumption and 36% emissions in Europe. Specifically, Heating, Ventilation and Air Conditioning (HVAC) systems represent almost 33% of the energy use in commercial facilities (14% space heating, 10% space cooling and 9% ventilation).

While HVAC equipment is subject to continuous improvements, the ducts are a rather conservative

sector. Poorly insulated HVAC ducts can lose through conduction up to 50% of the energy used for heating and cooling.

The main expected result from the NanoHVAC project is the development of an improved system by the application of novel technologies able to improve the energy efficiency without compromising the price and comfort.

During the first year of the NanoHVAC project, the first tests have been carried out showing promising results.

AIDICO is coordinating the development of highly insulating foam which incorporates nanoclays. This insulation can be applied automatically during the ducts production.

On the other hand, nanoparticles from NanoPhos and ICAA are being tested for the development of a cost effective pathogen and allergenic removal coating for filters.

INL, SIRRIS and POLIMI will support the characterization and testing of the nanoparticles to be used.

In addition, Farbe is currently testing nanoparticles provided by ICAA to incorporate in an injectable polymeric matrix to cover the interior of the ducts to develop an efficiency and low cost duct cleaning procedure.

For the activation of the photocatalytic coatings, NTUA has developed an optimum lightening system which consumes less than 1% of the total HVAC energy consumption. This system is robust, free of hazardous heavy metals and with long operation life.

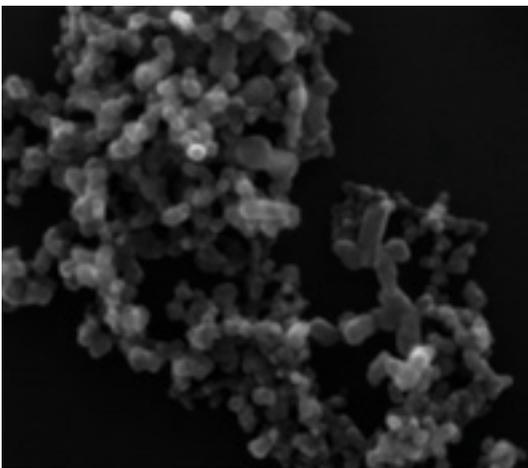
Finally, DAPP will evaluate the Lyfe Cycle Analysis (LCA), Lyfe Cycle Costing (LCC) and Health, Safety and Environment (HSE) analysis.

The coordinator of the NanoHVAC project is Vento, a company specialized in the production of profiles for rectangular air ducts and particularly of stamped ductwork fittings for circular air ducts. All products are manufactured in their factory and it is used a fully automated, robotic controlled warehouse system which allows large scale production.

Acciona Infraestructuras, a leading European construction company based in Spain, will support the prototyping of the nanoHVAC system at lab and is leader of the full scale validation at building scale. For this, it will be used two demo-buildings placed in his facilities. A monitoring system specifically designed for the NanoHVAC project will be implemented attending to the thermal and energetic measurements.

The NanoHVAC product will be installed during one year under harsh conditions

*Nanoparticles used for the photocatalytic coating*



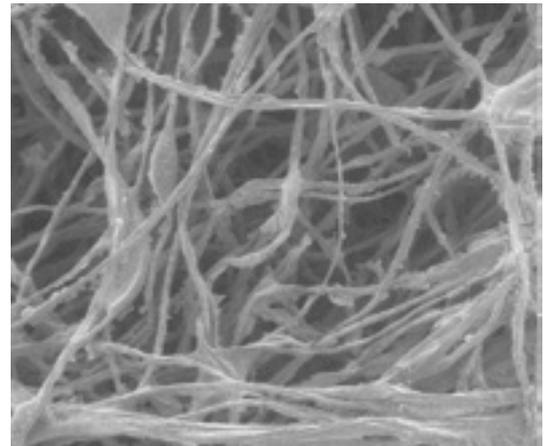


(humidity, extremely low or high temperatures), extracting information in terms of energy consumption and air quality. Moreover, the temperature distribution as well as the antimicrobial activity and antiallergenic potential of the HVAC system will be studied. On the other hand, the experience got from the installation and use phases will contribute to the needed information for future users.

Thanks to the demonstration activity, it will be compared the NanoHVAC system to a traditional

installation placed under the same conditions. The expected result is a system with antifungal and antimicrobial activity during at least 15 years due to the improved filter and the automatic covering of ducts. Moreover, the improvement of the insulation will guarantee a 50% saving in energy losses and reduction of 45% of the duct costs in comparison to conventional insulated ducts. ●

*This article reflects only the author's views and the Union is not liable for any use that may be made of the information contained.*



Coated filter

Coordinator:



Partners:



**Contact details:**

Coordinator: Bart Modde  
VENTO NV  
bart@vento.be  
www.nanohvac.eu

**Author:** Mónica García Ortega  
Acciona Infraestructuras  
monica.garcia.ortega.EXT@acciona.com  
(+34) 917. 91.20.20

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<http://buildingsdatabook.eren.doe.gov>

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# Europe's transition to nearly Zero-Energy Buildings

**No one said the transition would be easy**

*By Clemens Rohde (Fraunhofer Institute for Systems and Innovation Research ISI) with support of the Buildings Performance Institute Europe (BPIE)*

**T**he building stock is one of the main drivers for Europe's energy demand. The European Union has set the path to a massive reduction in the energy demand within the building stock with the 2010 recast of the Energy Performance of Buildings Directive (EPBD). A major objective of the directive is essentially to make nearly Zero-Energy Buildings (nZEB) the norm across Europe. Besides the planned transition from fossil fuels to renewable energies, the building envelope is of major importance to achieve the

targets of a nearly zero-energy building stock in the future. The EPBD highlights the issue of cost-optimality for constructional measures. Thus, there is not only the need for sophisticated technological solutions, but for cost-effective yet still technologically advanced ones.

The building envelope consists of a complex array of opaque and transparent elements, which have to fulfil different functional requirements for the building. Besides their structural function, opaque facade elements such as walls and the roof, mainly keep the energy inside and weather outside the building. As opposed to this, windows are crucial for the solar energy gains of the building. These different functional requirements lead to a specific technical design of the different building elements.

Especially with respect to the insulation of walls and roofs, the requirements for the materials and technologies differ for existing and new buildings. For new buildings, the energetic requirements are an inherent part of the design of the building. In contrast, for a renovation, the architect or engineer has to deal with an existing building and its construction challenges. Furthermore, the integration of insulation in an existing building leads to specific requirements

for the handling of materials by the craftsmen.

In both new and existing buildings, technologically high sophisticated products such as vacuum insulation panels require highly skilled craftsmen for installation. They even raise technological challenges later on in the use phase. Innovative materials such as aerogel are superior in their installation requirements but not ready for a larger market yet. Due to their more complex production processes, those materials will have to move some steps on their way to being cost-effective.

Besides those constructional requirements, criteria like fire safety and pest resistance gain importance again also in the public perception. From the user's perspective, the windows main functionalities are the inlet of light into the building as well as the view outside. From a constructional perspective, further issues are important. Windows allow for passive solar gains, which is favourable in the winter but may become a problem in summer time depending on orientation of the building, etc. They are a potential outlet for thermal radiation energy from the building on the other hand. A modern window system has to be designed according to these sometimes conflicting challenges and fortunately, the windows



*Clemens Rohde*



*Photo courtesy of Saint-Gobain*

industry is coming out with many more energy-efficient options to help the process.

The requirements to save thermal energy in a building are heavily dependent on climatic conditions which vary significantly throughout Europe and these variations cannot be dismissed lightly. Therefore cost-optimal solutions are not the same over Europe because of these climatic conditions. On the pathway to nearlyZero-Energy buildings, cost-optimal solutions have to consider the local boundary conditions. Technological

developments will have to specialise to fulfil the different technological needs in this diverse market.

Due to the widespread continuation of traditional practices in the building sector, the dynamics are not as high as in other technological sectors. The diffusion of innovative technologies is therefore sometimes slower than in other sectors. A market stimulated by further design requirements may increase the learning curves and lead to more advanced cost-optimal solutions.

Finally, technologies are not the only solution. Having people invest in these technologies is an important part of the efforts needed but first people have to “want” them and so far this is not driving the market enough. Therefore, a wide array of policy instruments has to be developed to foster the transition to nearly Zero-Energy Buildings in Europe. There is a need to work at all levels of the buildings “market.” Within the Intelligent Energy Europe Project Entranze, innovative policies are being developed for the European Union’s member states. ([www.entranze.eu](http://www.entranze.eu)) ●

# The free solar energy to buildings is key

By Michael K. Rasmussen



Michael K. Rasmussen

**G**lobal commitments and binding targets are required to face the challenges posed by increased energy demand and climate change. The EU has set 2020 climate and energy targets to significantly reduce factors such as greenhouse gas emissions and improve energy efficiency. However, the rules and regulations are still to be fully developed and implemented.

## UNLOCKING THE POTENTIAL OF CLIMATE RENOVATION

Buildings account for 40% of all energy consumption and 36% of CO<sub>2</sub> emissions in the EU.

Furthermore, by 2050 70% of the world's population will live in cities – placing an even greater demand on the urban environment. At the same time more than 90% of existing buildings in Europe will still be in use. Energy savings through renovation



of the existing building stock is an attractive and low-cost method of meeting these challenges.

Renovation of buildings should therefore be at the focal point. Indeed, the renovation rate in Europe is to be raised from the current estimated average of 1.2% to 3% per year. To gain the full potential, however, policy makers need not only to set ambitious targets but also to develop framework conditions for sustainable buildings based on a holistic approach to how we design and renovate.

A dual focus on energy efficiency and healthy indoor climate is needed. Energy-efficient renovations leading to improved indoor climate have a positive effect on the health, productivity and learning abilities of the people living and working in buildings. This potential of *climate renovation* is to be exploited further, as it has a significant positive effect not only on the individual but also on society as a whole.

## WINDOWS MAKE A POSITIVE ENERGY CONTRIBUTION

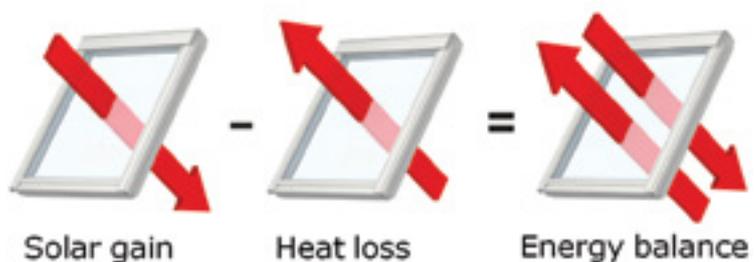
Windows are different from most other building components, as they make a positive energy contribution by letting in free

solar energy. This is a key characteristic of the window above and beyond its crucial and practical function as a source of daylight, fresh air and a link to the surroundings. Energy performance of windows has traditionally focused exclusively on heat loss; but to give a true picture, it should be measured in terms of energy balance – the difference between the heat from the free solar energy entering through the window (g-value) and the amount of heat that escapes through the window (U-value).

When we think in terms of energy balance, we take full account of the free solar energy supplied by the window to reduce the overall energy consumption of the building. This is a crucial paradigm shift – and essential if we are to attain higher energy efficiency in buildings and unleash the potential to reduce CO<sub>2</sub> emissions from buildings.

The energy balance approach encourages innovation in issues other than mere heat loss – and thereby supports cost-optimal and sustainable development.

The VELUX Group recently launched a new generation of roof windows designed to give more daylight, provide better





comfort and save energy. We have improved both thermal insulation (Uw-value) and solar gain (g-value). Among the product developments that have resulted in this improved energy balance are the innovative use of highly-effective insulation materials (Thermo Technology™) and the increase of the glazing area by up to 18%, which also reduces the need for electric light during the day.

**A BALANCED VIEW**

Applying the energy balance concept means moving away from the restrictive focus on energy loss to a more balanced view. A view that includes factors such as the energy savings gained from reduced heating costs due to free solar gain, reduced need of electric light thanks to good daylighting design, and reduced need for cooling given by intelligent screening and ventilation systems. When authorities draw up national building regulations, it is therefore paramount that the requirements and specifications for windows are based on energy balance. The same is true in relation to the expected EU Energy Labelling scheme for windows. We have already seen energy labels for windows based on the dual

energy balance approach in several European countries - e.g. France, Portugal, Denmark and the United Kingdom.

**RENOVATING WITH DOUBLE-GLAZED WINDOWS**

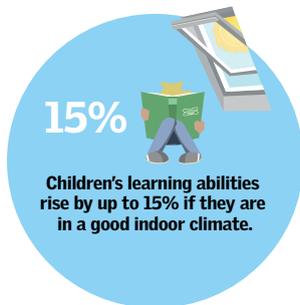
The energy balance principle is particularly relevant when renovating existing buildings. A building to be renovated will generally be less energy efficient than a new building, making the common choice of triple-glazed windows less sensible. Compared to double-glazing, the extra layer of glass in triple-glazing, understandably increases the cost and the environmental footprint. Instead, high performance double-glazed windows are better suited for renovation projects

as they reduce the climate payback and make the effective solution affordable. The VELUX Group therefore recommends double-glazed units with a good energy balance for renovation projects, and triple-glazed units for newbuild low-energy projects when special national and geographical situations demand it.

**THE RIGHT PATH TOWARDS A SUSTAINABLE FUTURE**

Climate renovation of the existing building stock is the most cost-effective way to meet the economic, societal and environmental challenges facing the EU. Energy-efficient window systems that provide more daylight offer a huge potential for reducing energy consumption





for lighting, heating and cooling of buildings in all sectors. Renovating with energy-efficient materials, based on energy balance principles, could be the key to improving both the energy efficiency and the quality of indoor environments in an affordable way. If we can encourage people to look at the balance between energy gains and energy losses when applying current knowledge and technologies, we will have a unique opportunity to choose the right path towards a sustainable future by transforming our existing building stock in a way that will benefit people and planet alike. ●

### **Buildings of tomorrow - today**

The VELUX Model Home 2020 examples<sup>1</sup> based on Active House Principles<sup>2</sup>, have demonstrated that it is possible to build and renovate buildings that give more than they take – and still provide a healthy indoor climate to the benefit, well-being and productivity of the people living and working in them.

1 [http://www.velux.com/Sustainable\\_living/Model\\_home\\_2020](http://www.velux.com/Sustainable_living/Model_home_2020)

2 <http://www.activehouse.info>

### **About the author**

Michael K. Rasmussen is Senior Vice President at the VELUX Group and a member of the VELUX Management Group. Mr Rasmussen has overall global responsibility for VELUX Brand Management, Strategic Marketing and Communications. He is also a member of the Board of Junckers Industrier A/S, Homecontrol A/S, and Chairman of the Board Advisory Committee, Active House Alliance.

### **About the VELUX Group**

The VELUX Group creates better living environments with daylight and fresh air through the roof. The VELUX product programme contains a wide range of roof windows and skylights, along with solutions for flat roofs. The Group also supplies many types of decoration and sun screening, roller shutters, installation products and products for remote control. The VELUX Group, which has manufacturing companies in 11 countries and sales companies in just under 40 countries, represents one of the strongest brands in the global building materials sector and its products are sold in most parts of the world. The VELUX Group has about 10,000 employees and is owned by VKR Holding A/S, a limited company wholly owned by foundations and family. For more details, visit [www.velux.com](http://www.velux.com)

# Driving innovation in construction

By Cosmina Marian, Buildings Performance Institute Europe (BPIE)

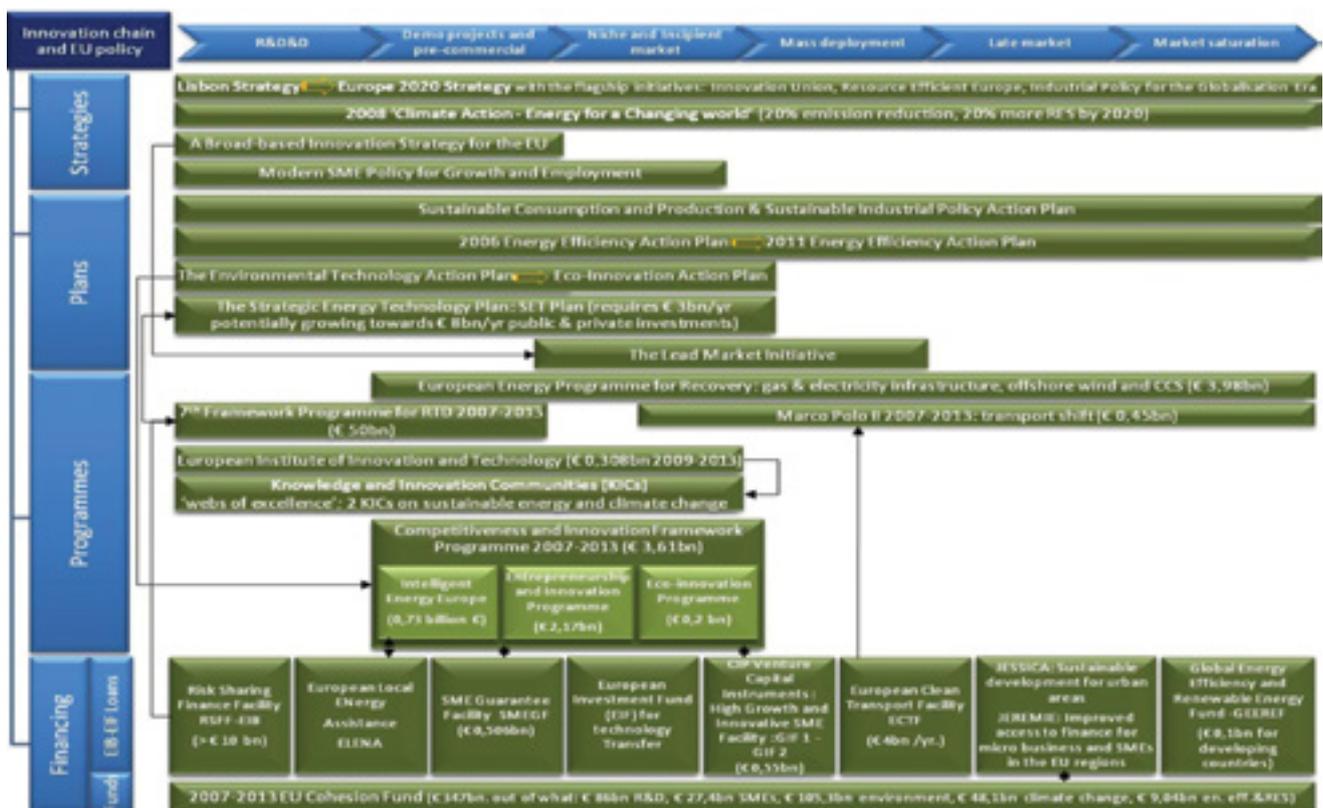
Construction is one of the largest economic sectors in the European Union, accounting for 30% of industrial employment. At the same time, the building sector is the highest energy consumer in the EU (about 40%) and the main contributor to GHG emissions. In light of these figures and considering the ambitious targets that the EU has set for itself, construction is being encouraged to shift towards sustainable practices and technologies.

The requirement within the Energy Performance of Buildings Directive (EPBD) for nearly-Zero Energy Buildings calls for a

new building design approach based on the integration of innovative technologies and systems. To stimulate the market, the EU has launched a variety of programmes and initiatives. Though technological progress is very much dependent on the legal framework and on these programmes, investment can prove to be insufficient to drive change. The market place can be a harsh environment and not always open to receiving newcomers - like providers of new construction techniques. Fostering innovation requires addressing the entire "innovation chain" and reaching a balanced approach between different

instruments. There are many ways to reach this balance, either by making use of targeted policies to encourage demand and markets for energy efficiency or by directly supporting R&D for business innovation. As such, the pillars and drivers of EU innovation in sustainable construction are outlined in the Europe 2020 Strategy with its flagship initiatives and the broad-based Innovation Strategy for the EU. The vision is translated into action through a series of plans and programmes like the Energy Efficiency Action Plan (which eventually was largely transformed into the Energy Efficiency Directive), the European Strategic Energy Technology

**Table 1: EU strategies, plans, programmes and financing sources in relation to the different stages of the innovation chain**  
 Source: IEEP report, 2011, "Innovations for a low-carbon economy - an overview and assessment of the EU policy landscape".



Plan (SET Plan) and the Lead Market Initiative (see Tables 1 & 2 for a detailed picture). The EU frameworks designed to stimulate innovation have a rather high degree of complexity as they are meant to cover the whole innovation chain. Thus a road-mapping exercise of EU priorities and policies in place would have a valuable input for future scenario development.

Another large-scale initiative covering the whole innovation chain is through public-private partnerships (PPPs). For instance, the Energy Efficient Buildings (EeB) Public Private Partnership (PPP) is a joint initiative between the European Commission and industry supporting research on sustainable technologies for the building sector. In order to

give a push to Member States and industry to invest in new technologies the European Technology Platforms (ETPs), the European Research Area and the Networks of Excellence were created. Building on the existing momentum, the SET-Plan was implemented to bring together all fragmented efforts and focus them in a coherent direction meant to accelerate innovation in low carbon technologies. However, the Research Framework Programmes and the Competitiveness and Innovation Framework Programme were the main tools thus far through which actors can cooperate in technological innovation projects.

EU innovation policy has been criticised for neglecting demand side measures, which paved the

way for the Lead Market Initiative, representing the first step towards a coordinated demand-side innovation policy approach. The purpose of this initiative is to provide a coherent action package, mostly at EU level, to facilitate demand growth for innovative products and services in several sectors including construction. Despite these efforts, there is still a call for more action through combined policy measures targeting both the supply and demand side.

Some might argue that the construction sector can evolve towards sustainability with existing technologies while others argue for more investment in the development of new technologies. Oliver Loebel, Managing Director at PU Europe,

**Table 2: Main EU policy initiatives and the relationship to the low-carbon technologies Source: IEEP report, 2011, "Innovations for a low-carbon economy - an overview and assessment of the eu policy landscape".**

	Renewable energy (RES)	Clean coal and CCS technology	Energy efficient technology	SMEs support for innovation and low-carbon technology
Europe 2020 Strategy with the flagship initiatives: Innovation Union, Resource Efficient Europe, Industrial Policy for the Globalisation Era	High	High	High	High
2008 'Climate Action - Energy for a Changing world' (20% emission reduction, 20% more RES by 2020, confirms the 20% energy savings voluntary target by 2020)	High	High	Low	Medium
A Broad-based Innovation Strategy for the EU	High	Medium	High	High
Modern SME Policy for Growth and Employment	High	High	High	High
Sustainable Consumption and Production & Sustainable Industrial Policy Action Plan	High	High	High	High
2006 Energy Efficiency Action Plan (and the announced new Energy Efficiency Action Plan)	High	High	High	High (mainly in terms of energy services companies)
The Environmental Technology Action Plan (and the announced Eco-Innovation Action Plan)	High	High	High	High
The Strategic Energy Technology Plan: SET Plan	High	High	High	High
The Lead Market Initiative	High	High	High	High
Competitiveness and Innovation Framework Programme	High	High	High	High

High  
 Medium  
 Low  
 How much the given policy addresses the particular issue?



Photo courtesy of Saint-Gobain.

points to the complexity of this particular dilemma: *“Of course, we need to stimulate research and innovation to bring better performing products to the market, improve coherence between systems and progress pre-fabrication. This is a product development issue but equally includes new building design solutions to combine different products / systems / elements (for example relating to envelope air tightness). It is also a training issue, as contractors need to be qualified to install these new solutions. Highly performing products / systems and innovative design solutions are already on*

*the market, but uptake is slow due to a certain resistance to change in the industry and, perhaps, higher initial prices. Hence, innovation also means to gain acceptance for existing solutions.”* The general understanding is that many good solutions already exist and this is then a matter of scaling up and adapting.

EU programmes usually support innovation by offering means of financing research and development but the market uptake of these new solutions should be an integrated effort. Designers and architects should become more informed

and trained with these new technological solutions that are meant to support low carbon solutions in the built environment. In addition, it would be good to reach out to researchers from an early stage - during their studies. The development of programmes based both on awareness and technological knowledge should be already integrated in academic programmes.

If we follow recent trends, Member States lean towards directing their efforts to reducing energy consumption for new constructions but also using efficiency labels for energy-using



*Photo courtesy of Saint-Gobain.*

products such as boilers and domestic appliances to encourage consumers to buy more energy-efficient products. In addition, the trend is for standards to be raised over time. From the commercial side, there are many operators on the market and most of them are focused on short-term issues such as maintaining business profitability, devoting less time to integrate new technologies in the design. On the demand side there can be a lack of knowledge and confidence which is an impediment when considering any kind of investment in low carbon solutions. All this confirms that the challenges faced by the construction sector are too complex to be solved by a single uniform action. Also, the construction industry comprises many SMEs that have low awareness and it is challenging to develop a coherent, comprehensive package that would be suitable to the entire construction industry. Riccardo Viaggi, Secretary General of the European Builders Confederation EBC points out that "for the 2 million micro, small and medium enterprises in construction, innovation in our industry is also about informally finding and implementing innovative processes. Small enterprises are starting to work together regularly and in a structured way to propose a global offer to the client. This new type of services improves the presence of small companies in the market, but can also simplify the financing of the works. This combination of forces, leading to the setting up of stable consortium are an important innovation for SMEs." This is where the need for a holistic approach comes from - an approach

that does not only consider technological aspects, but also the effort it takes to integrate them at a large scale and to take the different users into account.

Viaggi adds “the client also plays a crucial role in the sector and the question concerning his openness and readiness in front of innovation remains open. Notably in times of crisis, construction companies must ask themselves if clients want innovation and if they are ready to pay for it or not.”

Several questions still remain unaddressed when considering the existing EU programmes and initiatives. How does one incentivise innovations that optimise energy use in the existing building stock? How is it possible to make new technology attractive to customers? Is the market going through the transformation process fast enough to keep up with ambitious political targets? And, at the same time, is the building industry fully cognizant of the political targets and, thus, embracing transformation fast enough? EU requirements and incentives pertaining to energy performance might be successful up to a certain point but when they take into consideration a strategy addressing R&D innovation in combination with market uptake and information campaigns the results will be amplified.

As an illustration of the innovative spirit captured in these European projects, EASEE aims to find new technical solutions for envelope retrofitting in multistorey and multi-owner buildings. ●

## Putting innovative ideas into practice

*By Francesca Marchi and Barbara Sorgato,  
EASEE Consortium*



How to adapt the construction sector to the new realities brought about by the Europe 2020 strategy and its regulatory tools which ask for a more competitive low-carbon economy? EASEE, the European Union’s 7th Framework project, answers this challenge and deals with the retrofitting of existing residential buildings - more specifically with multi-storey and multi-owner buildings.

European buildings dated between 1925 and 1975 were built when there was little or no energy efficiency design consciousness and 10 million of them are residential multi-storey buildings with distributed ownership. This type of building is widely diffused in European city centres and presents common interesting features from the architectural and structural point of view, often having a linear façade with some 3D architectural patterns as well as cavity walls. A large part of this existing stock still needs to be insulated and the vertical envelope, being the largest surface with a high heat transfer coefficient, is the key point to achieving energy efficiency targets.

In this framework, the EASEE project aims exactly at developing a new holistic approach based on innovative technical solutions for envelope retrofitting in multi-storey and multi-owner buildings, ensuring an important reduction of building energy demand, while at the same time reproducing the original façade and reducing to a minimum the disruption for occupants.

EASEE focuses on the three main components of the envelope that influence the energy performance of multi-storey buildings, namely the outer façade, the cavity walls and the inner envelope. For each of these envelope parts, a new range of novel solutions will be developed and will be combined through a dedicated tool, called Retrofitting Planner, in order to help owners, property managers and construction SMEs to select the optimal retrofitting solutions in terms of energy consumption reduction, cost and impact on the occupants. Proposing this new approach aimed at façade retrofitting of residential multi-storey multi-owner buildings, the EASEE project will have a strong impact in terms of energy and economic savings, boosting the application of sustainable and energy efficient solutions to the building sector. The EASEE approach will allow for an overall retrofitting cost over the whole life cycle and for a total cost of ownership up to 120 Euro/m<sup>2</sup> with a return on investment below 7 years. Furthermore, EASEE will reduce overall retrofitting duration and optimise the worksite in general with direct benefits for workers and occupants, as wet processes are replaced, dust and noise generation are minimised as well as work duration and waste generation are reduced. New business opportunities in energy efficient retrofitting of existing buildings are also foreseen by the 5<sup>th</sup> year after project completion, mobilising new cooperation schemes between large enterprises and local SMEs and generating skilled jobs and new services associated with the different steps of the EASEE approach (initial building diagnostics, in situ evaluation of energy performance, etc ).

For more information visit: [www.easee-project.eu](http://www.easee-project.eu)

# NanoInsulate

## Development of Nanotechnology-based High Performance Opaque & Transparent Insulation Systems for Energy-efficient Buildings

### OVERVIEW

Nearly 40% of total EU energy consumption is due to the heat losses through buildings and windows, which is a significant contributor to the greenhouse gas emissions. The heat losses in buildings occur basically due to inadequate building insulation, or poor thermal performance of the insulation materials. Consequently, the development of novel insulation materials is necessary to meet the worldwide

envision of energy consumption reduction in buildings.

Vacuum insulation panels (VIPs) are three to four times more energy efficient than conventional insulation materials and also thinner and lighter. Furthermore, they can be used in new buildings and also for retrofitting older buildings (Figure 1). The aim of NANOINSULATE Project is the development of transparent and opaque VIPs by using new

silica aerogel composite-cores and nanofoam-cores (Figure 2), respectively. The VIPs are produced by using low cost and high volume sustainable processes, thereby addressing the zero-carbon drivers of the EU Construction and Modern Buildings sector. High barrier (against H<sub>2</sub>O and O<sub>2</sub>/N<sub>2</sub> permeation) films enabling low long term VIP thermal conductivity for a lifetime of more than 60 years need to be developed by means of low-cost production processes (Figure 3). The targeted thermal conductivity for opaque VIPs is less than 0.006 W/m·K.

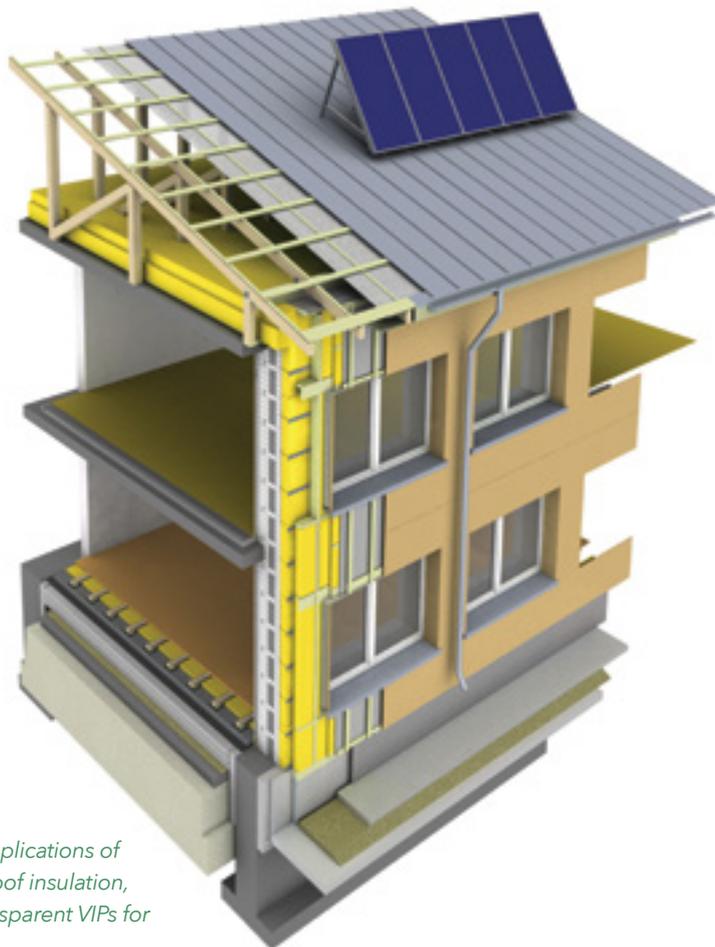
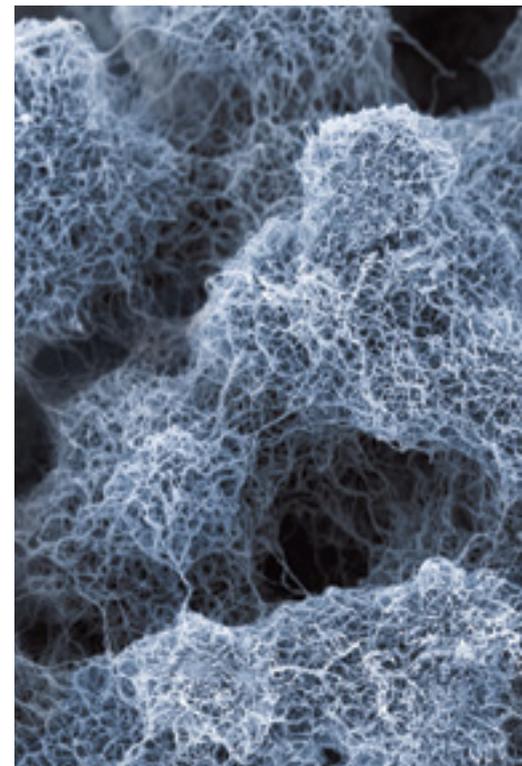


Figure 1. Possible applications of VIPs in a building: Roof insulation, walls, floors and transparent VIPs for glass facades

Figure 2. Nano-foams as filler material of opaque VIPs (Source: BASF)



**Achievement to date:**

- New organic foam core for opaque VIPs has been developed and VIP thermal conductivity deemed to be as low as 0.004 W/m·K.
- Transparent and crack resistant large-scale aerogel panels mechanically strengthened with polymeric silanes by chemical vapour deposition, can be obtained. Translucent aerogel VIPs are produced with a thermal conductivity of 0.009 W/m·K.
- Transparent and opaque high barrier films with oxygen permeability of less than  $5 \times 10^{-3} \text{ cm}^3/(\text{m}^2 \cdot \text{d} \cdot \text{bar})$  (at 23°C and 50% relative humidity) and water vapor transmission rate of less than  $1 \times 10^{-3} \text{ g}/(\text{m}^2 \cdot \text{d})$  (at 23°C and 85% → 0% RH) are produced. Transparent high barrier films are for the production of the translucent VIPs consisting of the aerogel material as core. Opaque high barrier films are for the production of opaque VIPs using advanced nanofoam or fumed silica.
- VIP fragility is reduced by integration into constructive elements (encapsulation in PIR foam, EPS, fiberglass), thereby improving their applicability in buildings.
- Demonstration activities have started at the demo-parks constructed in Madrid and Warsaw. The new panels (advanced VIPs and encapsulated nanofoam) will be installed in the Spanish and Polish mock-ups in order to monitor the behaviour during the summer and the winter time.

NanoInsulate project is funded by the European Union Seventh Framework Programme (FP7/2007 - 2013) under grant agreement no. NMP4-SL-2010-260086. ●



**Contact details:**

Dr. Esra Kucukpinar  
 Scientist  
 Materials Development  
 Fraunhofer Institute for Process Engineering and Packaging  
 Giggenhauser Straße 35  
 85354 Freising  
 T +49 8161 491 507  
 F +49 8161 491 555  
 E esra.kucukpinar@ivv.fraunhofer.de

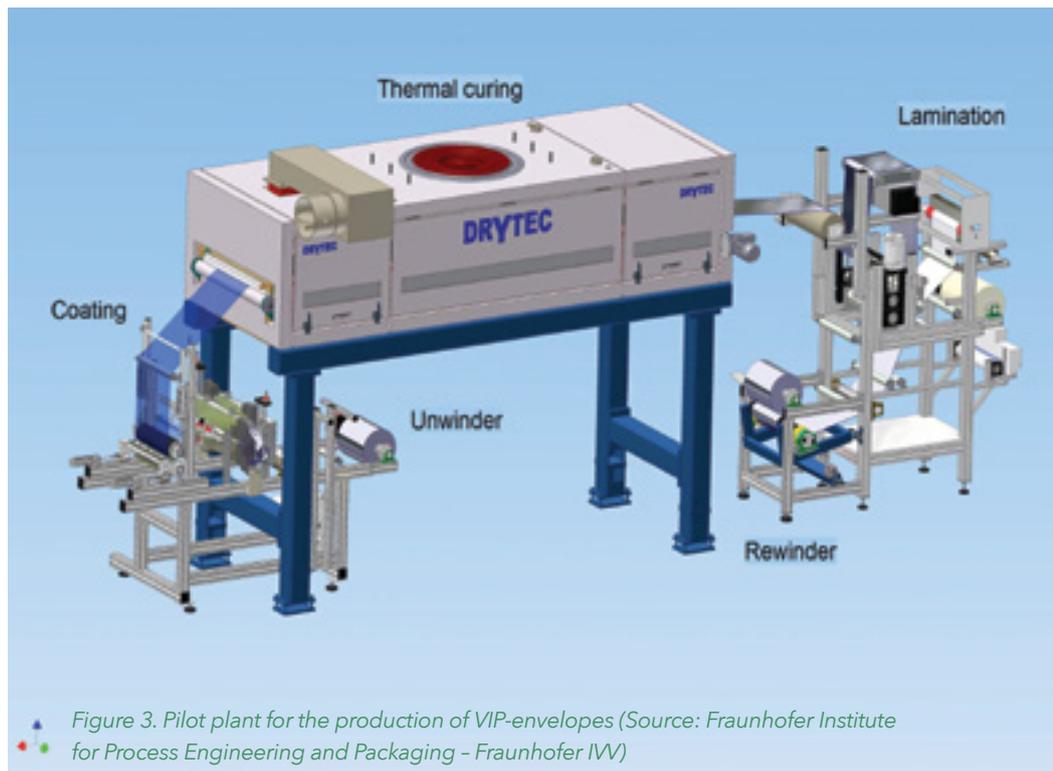
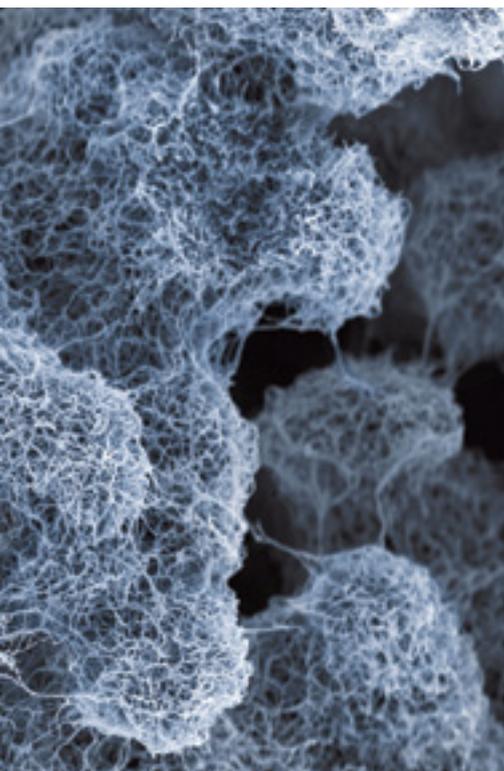


Figure 3. Pilot plant for the production of VIP-envelopes (Source: Fraunhofer Institute for Process Engineering and Packaging - Fraunhofer IVV)

# Glass in energy efficient buildings: time to abandon myth and use glass intelligently

By Bertrand Cazes, Secretary General, GLASS FOR EUROPE

**A**lthough we see glazing and see through it every day, many policy-makers, investors and landlords remain unaware of the essential role of glass products in making buildings more sustainable. Too often people wrongly believe that windows remain the biggest source of energy losses in buildings and that improving buildings' energy performance requires minimizing glazed surfaces.

On the contrary, glass products

for buildings are essential contributors to low-energy and sustainable buildings as demonstrated by the many examples compiled by Glass for Europe in its latest publication 'The smart use of glass in sustainable buildings'. This booklet gathers real-life examples of low-energy and sustainable buildings where the above-average glazed areas play an essential role in the high-performance achieved.

These buildings are located in different regions of Europe and

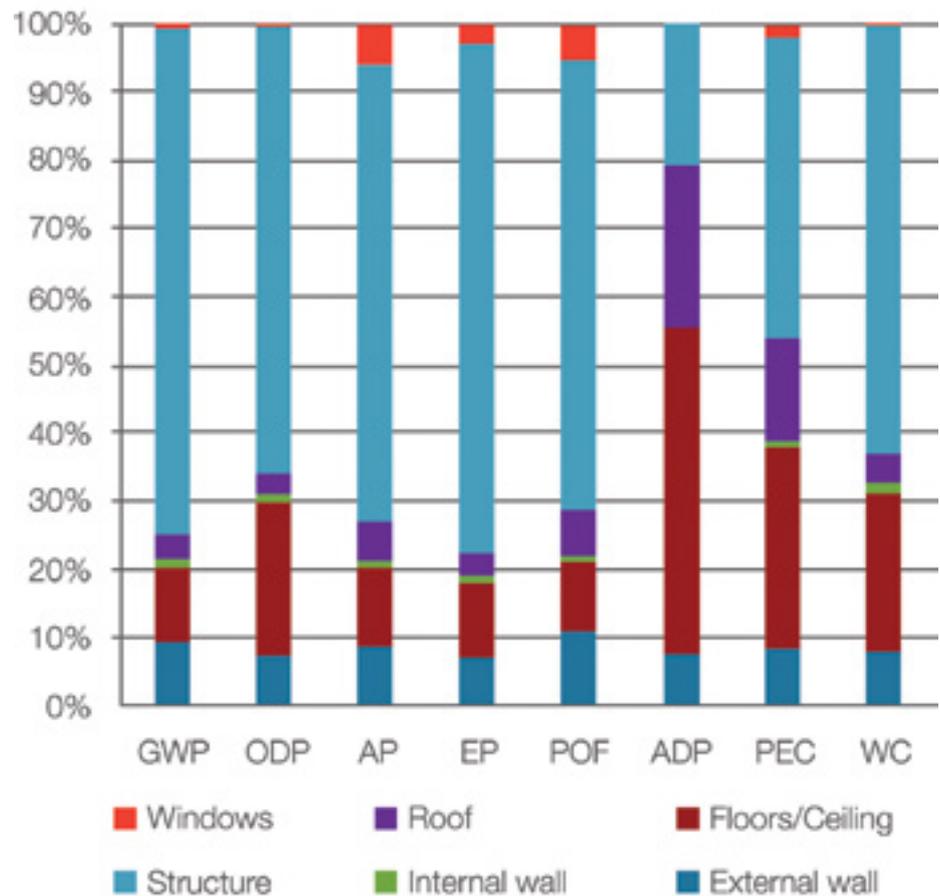
form a representative sample of the different climatic conditions, buildings and architecture met in Europe. This goes to show that for each specific situation there is an optimal glazing solution to meet low-energy standards.

Technological innovation such as the use of double and triple glazed units with inert gas between glazing panes and invisible low-emissivity coatings have significantly improved the insulation properties of windows and facades. Such glazing products allow natural daylight into buildings and maximize or limit solar heat gains, depending on the desired thermal objectives and energy balance. Improvements in the thermal performance of buildings result in a reduction in buildings' heating and cooling load thereby a reduction in overall energy consumption. Unlike any other construction material, glass also helps lower artificial lighting needs consequently reducing further energy consumption and electricity bills. As a result, many energy and thermal simulations suggest that the average glazed surface to floor ratio in buildings can be confidently increased to reduce energy consumption.

Many of the buildings showcased in the booklet have won prizes or obtained 'top grades' of sustainability certification schemes for minimal environmental impact. Indeed, increasing the glazed area



Life-cycle inventory of the construction of 1m<sup>2</sup> of office area



of building also contributes positively to reducing its environmental impact over its full life-cycle. This is because glazing represents a very minor share of a building's environmental impact as demonstrated by many life-cycle studies. It is made of abundant non-polluting raw materials, its manufacturing process is highly energy efficient, it requires low levels of water and generates little waste.

Besides, glazing products are now net carbon and energy saver over the full life cycle of the building. For instance, the total CO<sub>2</sub> equivalent emitted by the manufacturing of an energy efficient double glazing unit is offset on average within only 3 to 10 months by the energy savings realised compared to the same building equipped with sub-optimal glazing.

This overview of glazing's environmental performances would not be complete without mentioning that glass products used in buildings are fully recyclable and can help save even more raw materials and energy when new glass is produced.

However, there is more to a building than its level of energy consumption and its environmental impact. Given that we typically spend over 80% of our lives inside buildings, the latter should be designed to meet their occupants' needs, to improve their quality of life or working conditions. In this respect,

adequate daylight provision and visual connection to the external environment are critical to our quality of life. As such, glazing fulfils many functions like no other construction materials and these translate into direct benefits for buildings' occupants in terms of human health, wellbeing, learning capabilities, productivity and even in boosting sales in retail establishments.

'These distinctive benefits of glazing were recently compiled by Pr. David Strong in a unique study that reviewed all existing medical

research and evidence on the benefits of daylight and outside views inside buildings.'

By providing natural daylight and its benefits to occupants into buildings, reducing building energy demand for heating, cooling and lighting, while generating minimal environmental impact, glass is a product of choice for sustainable building design. ●

To learn more about 'The smart use of glass in sustainable buildings', download Glass for Europe's booklet and check out the video on [www.glassforeurope.com/en/issues/building-glass.php](http://www.glassforeurope.com/en/issues/building-glass.php)

**Contact details:**  
 GLASS FOR EUROPE  
 Rue Belliard 199/33 - B1040 Brussels  
 Tel: +32 2 538 43 77  
 Fax: +32 2 280 02 81  
 Email: [info@glassforeurope.com](mailto:info@glassforeurope.com)  
[www.glassforeurope.com](http://www.glassforeurope.com)

# A window to save resources and supply energy

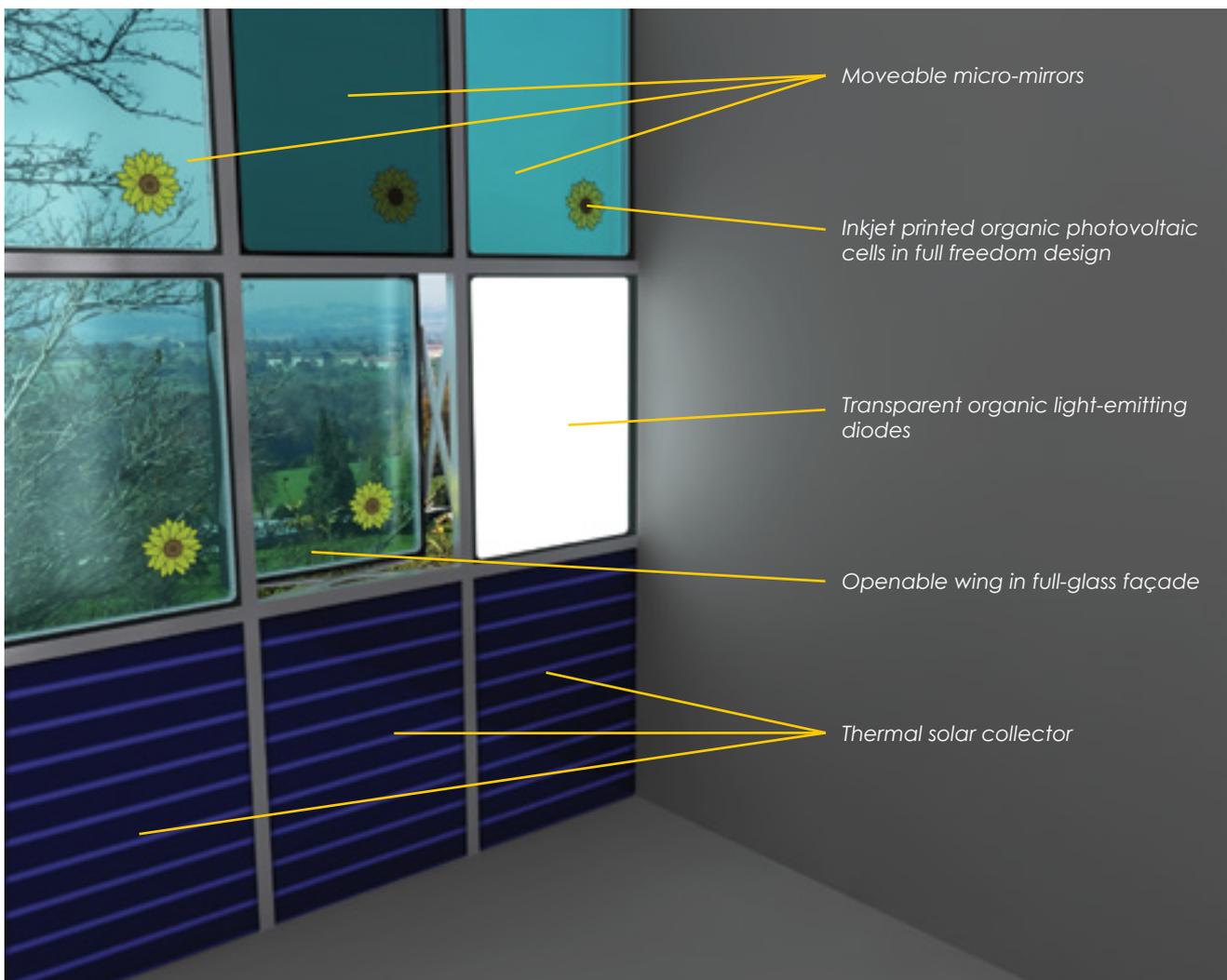
**B**uildings are responsible for around 40 per cent of Europe's energy consumption. Façades and windows play a decisive role in improving energy efficiency. In the future, windows will even supply energy and take on other intelligent functions that are crucial for the comfort of the building users: shading, light control, lighting, noise reduction. The 'window of the future', which will include all

of the above functions, will be developed as part of the EU-funded project 'MEM4WIN'. The Austrian industrial company LiSEC - global leader in glass processing machines and a pioneer in the production of insulating glass - is coordinating the international research project.

## AMBITIOUS GOALS

The sights have been set very high for the window of the future: An innovative four-pane

insulating glass means that heat transfer will be reduced by up to 50 per cent ( $0.3 \text{ W/m}^2\text{K}$ ) of the U values that were previously achieved. The weight of the window will be reduced by 50 per cent through the use of tempered thin glass, and the windows are designed to supply energy. Even though the glass units are significantly thinner than those in similar windows, the noise insulation is improved by around 20 per cent thanks to the four-pane structure.



### ECONOMIC EFFICIENCY

The main goals of the 'MEM4WIN' project are to achieve value for money and to make the windows feasible in an industrial environment. The manufacturing costs will be 20 per cent lower than for other windows with a similar range of functions.

### MULTI-FACETED RESEARCH TASKS

LiSEC is focusing on the following development areas within the research project:

- Tempered ultra-thin glass membranes (thickness of ~0.9 mm)
- Anti-reflective coating (plus 3 per cent transmission)
- Innovative frame assembly for a four-pane structure ( $U_g$  value:  $0.3 \text{ W/m}^2\text{K}$ ), which also allows for a frameless, openable wing in full-glass façades
- Sealing for the integration of PV and OLED, which takes care of diffusion proofing - for many decades into the future

The Austrian research company PROFACTOR, five universities and six additional industry partners are all closely connected to the project. These are just some of the tasks that they are focusing on:

- Movable micro-mirrors sized approximately  $0.06 \text{ mm}^2$  are to be built into the insulating glass using nano-imprint lithography. Taking the level of daylight into account, these mirrors ensure that there are ideal lighting conditions or intelligent shading on the

inside of the building.

- Organic photovoltaic cells in full freedom design are to be directly applied to the glass surface using inkjet printing. Transparent, organic light-emitting diodes and thermal solar collectors are also to be integrated into the window. During hours of darkness, the light-emitting diodes take over the interior lighting while the photovoltaic cells and solar collectors supply energy.
- Graphene is to be used as transparent conductor for the photovoltaic system and the micro-mirrors. This transparent and conductive material will be employed for both the manufacturing of contactive layers and the printable ink for the conductor paths. This makes it possible to replace expensive raw materials such as silver and indium tin oxide that up until now have been essential in the manufacturing of transparent conductive layers. ●

The project, which began on 1 October 2012 and has a run time of 42 months (project close: March 2016), is funded by the European Commission within the Seventh Framework Programme (project number: NMP3-SL-2012-314578). The following partners are involved in the project, in alphabetical order:

- Aixtron SE and Aixtron Ltd.
- Belectric OPV GmbH
- Consiglio Nazionale delle Ricerche / IMIP
- Durst Phototechnik AG
- Energy Glas GmbH
- Johannes Kepler University Linz / ZONA
- Korea University / NMDL
- LiSEC Austria GmbH
- PROFACTOR GmbH
- Tiger Coatings GmbH and Co. KG
- The Chancellor, Masters and Scholars of the University of Cambridge / DENG / NMS
- University of Kassel / INA and CESR

### Current achievements:

- 18 June 2013: Working together with LINDE, LiSEC launched S-COAT®, the new AR coating technology for solar applications, at the Intersolar exhibition in Munich / Germany. LiSEC will further optimise the AR coating technology for use in energy-efficient windows as part of the MEM4WIN project.
- 16 September 2013: Energy Glas presented the new tempering furnace from LiSEC which has been specially designed for the production of thin glass at Wolfhagen / Germany. As the first manufacturer of IG units, Energy Glas launched NEUTRALUX triple-light, a triple isolated glass unit containing 2 mm tempered thin glass. Energy Glas will reduce the thickness to 0.9 mm during the MEM4WIN project.
- 1 October 2013: BELECTRIC OPV presented the next generation of PV products named SOLARTE at 28th EU PVSEC 2013 in Paris. In MEM4WIN BELECTRIC is OPV involved in system integration of OPV e.g. for smart windows.

More information: [www.mem4win.org](http://www.mem4win.org)

# Green materials technologies: A significant role in the reduction of the energy demand in construction? A practitioner's eye

By Jean Garcin, *KARBON architecture & urbanisme*

**T**he construction sector has a considerable weight in the global energy consumption and CO<sub>2</sub> emissions, and since the Rio Summit in 1992 this sector has changed and diversified. The goal of lowering the energy consumption of the building stock in Europe (Objective Zero Energy 2020) has brought a series of new regulations and tools, to raise the performances of buildings. Standards and Labels such as Passive House, BREEAM, have been developed nationally in EU countries, responding to Europe's 2002 directive.

Since 1992, numerous buildings have been erected nearly reaching the zero energy goal, showing the potential of this type of high performance buildings. But this model shows some limits and a new type of innovative materials and products manufactured by local and dynamic firms announce another shift in the sector.

As practitioners in the small to mid scale construction sector, we develop projects with a close look at their global impact, from concept to execution. Our goal is not necessarily to reach the passive house standard, but more to minimize the energy requirement without compromising comfort\*\*. A

global approach that goes from the localization to the choice of materials and the clear organization of plans and the construction lead our designs.

In terms of materials and technology, we try to take into account not only the energy demand for the use of our

building, but we put a particular focus on the weight of the embedded energy. It is a complex calculation, and data is difficult to combine, but research such as IECB/ARENE report\* highlights that for instance, on a new building in 2005 under French BBC standard, the amount of grey energy is equivalent to



Photograph of Matthieu Delatte's House (architect Matthieu Delatte / KARBON): Built with timber, hempcrete and prefabricated straw panels

*Prefabrication of straw / earth / timber walls and roofs by PAILLETECH*



30 to 50 years of consumption, a very high amount. Renovations reveal often a smaller ratio of grey energy. Having a closer look at the origin and the production of materials and technologies can greatly influence the global energy balance of a building.

In terms of material efficiency, and technology, the use of natural material is interesting, but their embedded qualities are also complex to analyze. The software and tools developed by and for the certifications (PHPP for Passive House, BREEAM, HQE...) are very comprehensive on some parameters such as insulation efficiency, but a lot of them are still difficult to calculate. One of the most crucial is the regulation of humidity. A good regulation can greatly contribute to the reduction of heating or cooling demand, thus reducing the ventilation / heating system. Important shares of natural materials embed interesting regulation potential, but are unfortunately often set aside because they don't fit into the canvases to obtain certifications.

Today, there is a growing number of initiatives of small to mid-scale entrepreneurs that develop innovative natural materials based on low transformation

technologies. Most of them transform locally extracted or harvested materials: earth, straw, hemp, with the goal to develop products adapted to the actual construction market. Their motto is to use the natural technologies and qualities embedded in the materials with a minimal transformation, to reduce the transportation, to shorten the construction chain between the production and the construction. These manufacturers and small industries also participate dynamically in the economic development of rural areas, and to the diversification of agriculture by using its sub products (straw balls). This makes a new palette of interesting materials for the architects and developers, and show real advantages in terms of technology and consumption reduction.

**VALIDATION OF NATURAL AND ADAPTED TECHNOLOGIES TO SAVE ENERGY**

If these products are sometimes less efficient than traditional insulation materials in terms of pure performance (lambda), they present other qualities such as thermal mass and humidity regulation, two qualities essentials to reach a great internal comfort. They also help to reduce the technologies

usually necessary to dry the air and minimize the condensation in a building. Also, the natural water transformation the Earth does, by stocking vapor when the air is too humid or liberating it when too dry is an important amount of energy that is saved from heating or cooling systems. Placing ARGIO<sup>1</sup> crude earth blocks as partition walls has great advantages, with a very low embedded energy (no baking) and a similar price to traditional construction. ISOHEMP<sup>2</sup> Blocks and Hempcrete from Evia Partners<sup>3</sup>, composed of hemp and lime, present a good insulation performance (lambda 0.07) and provide thermal mass and humidity regulation that stabilize the interior climate without the help of other mechanical systems.

**REDUCING THE ENERGY FOOTPRINT**

Using locally produced material not only reduces the transport part of the consumption, but the low transformation technologies used and the simplicity of these materials minimize drastically the required energy for their production. ARGIO blocks use locally extracted earth, mechanical press and low temperature drying oven. ISOHEMP blocks are made from locally harvested hemp and lime, mixed and pressed together and then air-



dried. Very simple technology for very efficient materials.

#### **REDUCING THE CO<sub>2</sub> BALANCE**

These materials store CO<sub>2</sub>. A prefabricated straw wall from the firm PAILLETECH<sup>4</sup>, with 4cm earth inside coating, 37cm of straw + timber structure and outside coating captures about 340kg of

CO<sub>2</sub> per square meter, so around 100 tons of CO<sub>2</sub> for a single family house. The Hempcrete blocks from ISOHEMP have also a positive CO<sub>2</sub> balance.

This new family of materials has a great potential for designers, architects, developers and builders to minimize the global impact of European's constructions, without compromising on comfort, quality

or durability. There are of course numerous other factors that are necessary to develop comfortable, sustainable zero energy buildings, such as the space composition, light, colours, heating systems, but natural materials with low tech transformation show a real potential to improve building quality comfort and durability. If distributors putting on the market these products ? , there are still some barriers that are difficult to cross, such as the lack of confidence of the clients, architects and developers with natural materials. To reach the goal of Zero Energy buildings, Europe should encourage practices, developers, architects and builders to use locally produced material in the construction sector. ●

**www.karbon.be**

\* [www.arenidf.org/fr/Guide-Bio-tech-Lenergie-grise-des-materiaux-et-des-ouvrages-1050.html](http://www.arenidf.org/fr/Guide-Bio-tech-Lenergie-grise-des-materiaux-et-des-ouvrages-1050.html)

\*\* [www.karbon.be/fr/projets/habitat/037-VDN/](http://www.karbon.be/fr/projets/habitat/037-VDN/)

\*\*\* [www.karbon.be/fr/projets/](http://www.karbon.be/fr/projets/)

1 [www.argio.com/](http://www.argio.com/)

2 [www.iso hemp.be/](http://www.iso hemp.be/)

3 [www.eviapartner.com/](http://www.eviapartner.com/)

4 [www.pailletech.be/](http://www.pailletech.be/)



# How can Europe save 4 billion barrels of oil per year?

**W**hen 40% of EU primary energy demand comes from buildings, isn't it time to consider how Europe can stop wasting energy, virtually burning money and putting public finances in jeopardy? There is an answer.

80% of energy demand could be saved by deep renovation of existing building stock, reducing EU total energy use by 30%. The equivalent of 4 billion barrels of imported oil a year.

## ENERGY EFFICIENCY COMES FIRST

It begins with improving the energy mix and making it as sustainable as possible. However, energy efficiency must be treated as a priority, especially when it comes to buildings, in line with the well-established three-step concept of 'Trias Energetica':

1. Promote energy efficiency
2. Use renewable energy
3. Meet remaining needs with fossil fuels only if sustainable sources of energy are unavailable but do it as little and as cleanly as possible.

## THERMAL AND ACOUSTIC INSULATION - OFFERING THE WAY FORWARD

When it comes to energy efficiency in buildings, insulation is key. Andriy Kotsyumbas, product manager of URSA explains why: 'Over their life cycle, insulation products can save up to 600 times the energy needed for their production, saving money while improving thermal and acoustic comfort.'



He continues, 'Evidence, and research, shows that energy efficiency in buildings has a positive impact on public health. Thermal insulation reduces the water condensation, dampness and mould growth which can affect asthma and other respiratory disease. Increased thermal and acoustic comfort improves productivity and learning. People enjoy better indoor air as well as less polluted outdoor air.'

In fact, effective thermal and acoustic insulation in buildings could have other far-reaching effects. It has been proven that ambitious renovation investments have significant benefits for public finances and could act as an important economic stimulus,

creating up to 2 million green jobs by 2020.

Insulation also prevents energy waste and CO<sub>2</sub> emissions, protecting the environment. Over its lifetime, insulating one house in France can save as much CO<sub>2</sub> as planting a park of 212 trees.

Who knows, saving 4 billion barrels of oil a year might be just the start. ●

### Contact details

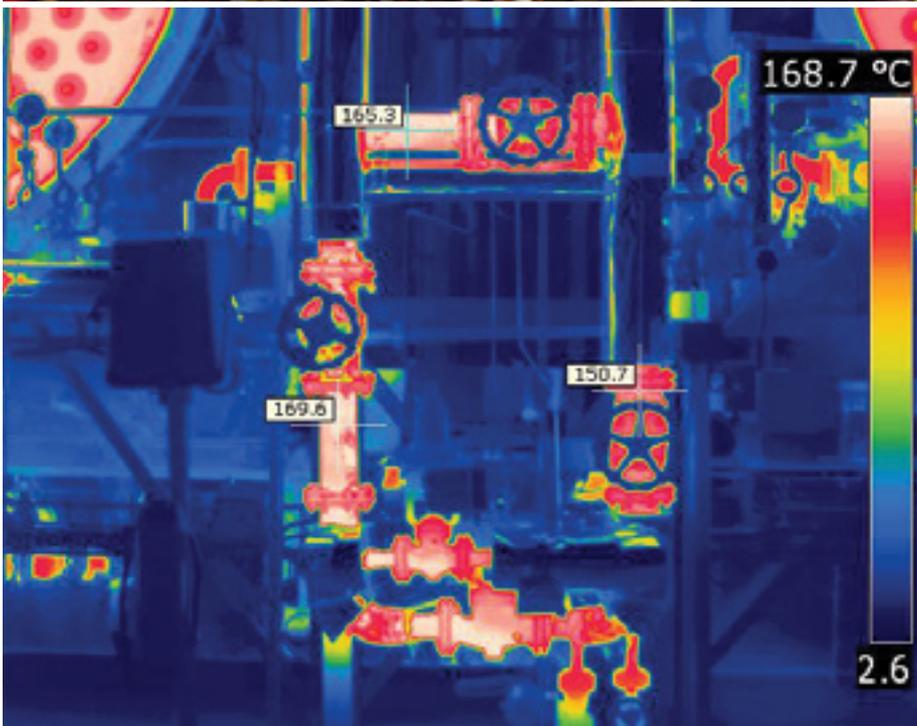
URSA Insulation, S.A. - URALITA  
Pº de Recoletos, 3 4ª planta  
28004 Madrid, Spain  
Tel: +34 91 594 90 00  
[www.ursa-insulation.com](http://www.ursa-insulation.com)  
[www.uralita.com](http://www.uralita.com)

### About URSA

URSA is one of the major insulation players in Europe, focused on glass mineral wool and extruded polystyrene as solutions for insulating residential and non-residential buildings, both new and being renovated. With 14 production sites in 9 countries and a commercial presence in around 40 markets in Europe, Middle East and Northern Africa URSA employs around 2.000 people in countries such as Germany, France, Russia, Poland, Slovenia, Austria, Czech Republic, Italy, Spain and other.

# The large potential of industrial insulation

European industry is losing energy and money every day, emitting tonnes of avoidable CO<sub>2</sub> emissions.



Infrared images show the high energy losses in the non-insulated parts.

**G**eneva/Gland, October 2013 - The EU proposed earlier this year to agree on new ambitious climate targets till the end of 2013. Now, facing the end of the year, the discussions are going high in Brussels. Can carbon emissions be reduced by 40% till 2030? Shall there be binding targets like foreseen in the famous 20-20-20 targets to also reduce energy consumption and increase the share of renewables in the energy mix? Yet, what is most astonishing about the current discussions regarding 2030 is that the latest estimates of the European Commission show already a wide gap between the formerly agreed 20-20-20 targets and the projected reality for 2020. Although the EU seems to be on track cutting CO<sub>2</sub> levels and increasing renewable energy sources by 20%, there will be a large gap between the target to reduce energy consumption by 20% and the projected energy savings achieved till 2020. In addition, the latest World Energy Outlook from the International Energy Agency concludes that two-thirds of the economic potential to improve energy efficiency will remain untapped between now and 2035. Why?

One major reason is the broad lack of awareness about the benefits of existing energy efficiency technologies such as industrial insulation. According to an Ecofys report (Climate protection with rapid payback, 2012), the thermal insulation is

one of the most often overlooked cost-effective energy efficiency measure that can significantly contribute to the reduction of the EU's energy consumption and CO<sub>2</sub> emissions.

In fact, industrial insulation is a Best Available Technique that can help European industry to reduce its annual fuel consumption by 620 PJ (roughly equivalent to the energy consumption of 10 million households). Furthermore, industrial insulation would contribute to reduce the annual emissions by 49 million tonnes of CO<sub>2</sub> (the equivalent to the CO<sub>2</sub> emissions of 18 million cars). More importantly, the report analyses that this savings potential exists across all regions, sectors, equipment and operating temperatures.

"With just better maintenance and consistent insulation of industrial applications, about two thirds of the energy and emission savings potential could be tapped," says Kornelis Blok, Director of Science at Ecofys. "And since insulation investments will usually be paid back in less than one year, this is also a great business opportunity."

Unfortunately, this potential is currently untapped despite being cost-effective to implement. But why is this large potential still untapped? On the one hand, as said before, the main decision makers simply do not know

of this large savings potential. On the other hand, the level of insulation is based on minimum investment decisions such as safety requirements regarding the maximum surface temperatures and minimum process needs. According to the study, 10% or more of all equipment in running industrial plants is not insulated or is covered with damaged insulation. Furthermore, split responsibilities and budgets and often outdated maximum heat loss rates in industrial environments could also be responsible for this failure.

It is against this background that the European Industrial Insulation Foundation (Eiif) launched its TIPCHECK Programme. A TIPCHECK (Technical Insulation Performance Check) is a thermal energy audit that evaluates industrial insulation systems of existing facilities, planned projects or retrofits with the aim to improve the energy efficiency of industrial processes. It quantifies the amount of energy and actual euros a facility is losing in its current configuration and it demonstrates how more efficient insulation could save energy, save money and contribute to a cleaner environment through reduced CO<sub>2</sub> emissions.

These energy audits are carried out by insulation experts trained and certified by the Eiif. Within the framework of its TIPCHECK Programme, the Foundation

organizes training courses to teach engineers how to perform high quality thermal audits based on national and international insulation standards such as VDI 2055 and ISO 12241. Moreover, TIPCHECK engineers are provided with the TIPCHECK calculator software that helps engineers to identify savings potentials in tailor-made audits for their clients. Very often they find cost-effective insulation solutions with payback times of just one year or even less. ●

The European Industrial Insulation Foundation (Eiif) is a non-profit foundation established in 2009 and headquartered in Switzerland, which promotes insulation as a top-of-mind method of enhancing sustainability and profitability. Its programme raises awareness of the growing, much needed benefits of insulation and is open for new members.

For more information about the Eiif, visit [www.eiif.org](http://www.eiif.org)



# StorePET: PCM-enhanced fiber insulation for lightweight building solutions

By Jorge Corker (Instituto Pedro Nunes, Portugal) and Pablo Gamallo (Tecnologías Avanzadas Inspiralia SL, Spain)

Under the currently growing role for near-zero energy buildings designs, innovative lightweight structures has been one of the most interesting building technologies arising. While it represents an economical alternative to traditional heavyweight constructions, the main drawback of highly insulated lightweight envelopes is still their lack of thermal mass, which are unable to curb and dampen rapid and marked daily swings of temperature and maintain internal comfort conditions, especially during the summer in hot regions. This quick thermal response is especially significant during the warmer seasons and responsible for indoor overheating trends,

forcing the costly peak period of energy consumption to be spent upon cooling rooms during the day.

The project concept is based upon the fact that potential cost savings can be achieved by smart building envelope structures having a novel fiber insulation that possesses active heat storage capacities provided by phase change materials (PCM), capable of reducing the total cooling loads and shifting the peak loads to off-peak periods. The StorePET product under development will be a ready-to-use and easy to install insulation blanket, made with recycled polyester fibers and enhanced with a PCM content. The embedded PCM will provide thermal inertia by means of its latent heat while keeping relatively unchanged the high thermal resistance of the original nonwoven material.

Different manufacturing technologies have been lab-researched in the project, either by developing bi-component PCM-fibres systems, using electrospinning and coaxial melt-spinning extrusion/injection techniques (the latter being most promising for up-scale production), and by means of spray deposition

of microencapsulated PCM in the nonwovens, which is currently being used in an industrial level for making trial blankets that will be field-tested in different demo-house locations to evaluate StorePET energy savings potentials.

A remarkable characteristic of the StorePET technology is the flexibility to produce tailor made products for different climate conditions. As part of the research a simulation tool has been developed to aid in the selection of the type and amount of PCM required for different climate conditions. For instance, it is estimated that, by using a StorePET products with a PCM, around 25% savings in air conditioning consumption can be achieved in a typical summer day in a lightweight building in Madrid compared to using a standard insulation.

The installation of two demo-houses is underway, to compare, in real conditions, the thermal performance of the StorePET product versus standard insulating materials. The test results will be reported in a near future issue.

Entitled "Development of PCM-based innovative insulating solutions for the lightweight building sector", StorePET is a research for SME associations project funded by the European Commission's Seventh Framework Program, Theme FP7-SME-2011-2, under the Grant Agreement 286730 and will run until the end of October 2014. ●

This communication reflects only the authors' views and the EC is not liable for any use that may be made of the information contained therein.

## Contact details

### Project Coordinator

Vladimir Gumilar  
(SGG - Construction Cluster of Slovenia)  
vladimir.gumilar@sgg.si

### Authors

Jorge Corker (Instituto Pedro Nunes)  
jcorker@ipn.pt

Pablo Gamallo  
(Tecnologías Avanzadas Inspiralia SL)  
pablo.gamallo@inspiralia.com

Project Website <http://www.storepet-fp7.eu/>

## Project Partners

### SME Associations



### SMEs



### RTDs



# Bright future for district heating and cooling in Finland

By Jari Kostama, Director, District Heating & CHP, Finnish Energy Industries

**F**inland's cold climate has provided a strong incentive for the development of efficient heating solutions, and district heating first emerged in Finland in the 1950s. Since that the development of district heating has gone hand in hand with the development of combined heat and power (CHP), and together they form a very efficient backbone to Finland's overall energy system. District cooling was introduced to Finland in the 1990s. Growth has been strong in recent years leading to position number five when we are looking at district cooling sales among the European Union countries.

In Finland, unlike in many other European Union countries, heating market is unregulated and highly competitive. By all appearances, district heating has fared well in the competition, with about half of residential and service buildings connected to district heating. In the largest cities, the proportion is still significantly higher, for example 93 per cent in Helsinki. Last year about half of the country's population (2.7 million people) lived in district heated apartments.

There are many reasons for the success of district heating in Finland. District heating means living comfort and well-being. It's safe, its operational reliability is very high, it's easy to use and its price is still competitive

compared to other forms of heating. District heating is also part of the infrastructure. It significantly reduces local emissions, improves substantially the air quality and thus increases the comfort of the living environment.

In Finland, three-quarters of district heating is based on CHP production (cogeneration). Because of the efficiency of cogeneration the fuel use and emissions at the same time are about 30 percent less in comparison with separate heat and power production. Due to district heating and cogeneration carbon dioxide emissions of Finland are more than 8 million tons lower than without these technologies. In fact, the district heating system is the largest contribution of Finland to participate in the world's climate change prevention effort.

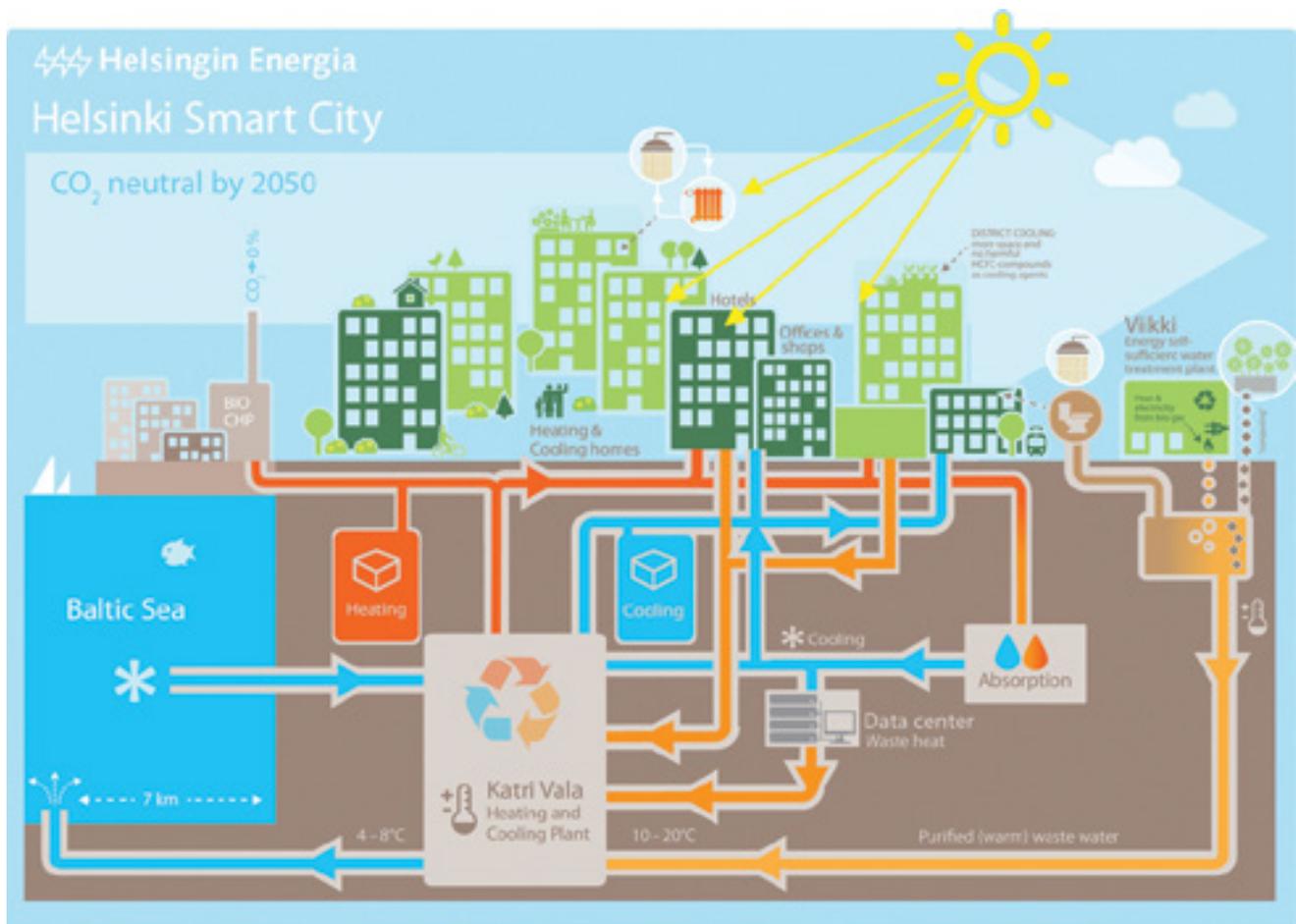
Well, what about the future? It's evident that the heat energy demand in Finland will stop and slowly decline as early as the 2020s. However, it doesn't mean the same for capacity needs or for amount of customers. They both still grow for a longer time. Besides, new ways to use heat energy will be taken in the use, for example district heat driven washing machines, tumble driers and dishwashers and many kind of smelting solutions.

Finnish Energy Industries announced recently a new strategy for the district heating



sector. The aim of it is to describe what kind of heating market in Finland is in the coming years and what district heating's role in this market is. The strategy also describes the strategic choices that district heating companies have to face in coming years. The vision of the strategy is "Versatile energy solutions and services based on district heating and cooling are the most desired by customers. They enable a common path towards a carbon-neutral future."

The strategy aims to increase the



Helsinki Smart City as an example of an intelligent energy system using many kinds of energy sources and delivering right products to right customers at the right time. Source: Helsingin Energia.

flexibility of the sector, as well as integration with customers. Customers will be included in business development and the aim is to find more flexible approaches and solutions on a win-win basis. District heating systems are also being developed in such a way that the use of surplus heat of any

kind of customer is possible on a commercial basis. This means that the period of one-way-street is soon over.

The sector's goal is also to better understand its customers' business and technical systems, values, and even emotions. The aim is satisfied customers and maintenance of competitive and unregulated heating market.

While energy efficiency in buildings is improving the need for space cooling is also growing tremendously. This means that it is absolutely necessary that district energy companies are able to provide customers with cooling solutions as an integral part of their product range.

One of the cornerstones of the strategy is sectors commitment to a carbon-neutral future. The target is far away; 2050, but the pace of concretization must be speeded up through an increasing number of investments and other measures. Sure, the sector has already done a lot. For example, during the first decade of this century the sector built 37 CHP plants and about 300 heat-only-boilers mainly using biomass or natural gas. The sector actively participates in developing technological solutions and especially those enabling carbon-neutral production. For example, the first district energy companies' investments in centralized solar thermal solutions are close to reality. ●

#### Contact details:

Finnish Energy Industries  
Fredrikinkatu 51-53 B, P.O.Box 100, FI-00101  
Helsinki, Finland  
Tel.: +358 (0) 9 530 520  
GSM: +358 (0) 50 3011 870  
Fax: +358 (0) 9 5305 2900  
E-mail: jari.kostama@energia.fi  
**www.energia.fi**



# The Marche region and its energy efficient communities



**S**VIM - Sviluppo Marche SpA is the development agency of the Marche Region in Italy. Since 2003, the agency has been engaged to promote the shift to a low carbon energy model throughout the territory, through the setting up of Sustainable Energy Communities (SEC) composed of Municipalities active in this field. The strategy has been implemented mainly through innovative European co-funded projects in the energy and environment sectors. In particular, significant results have been achieved through the implementation of the CITY\_SEC project that allowed 12 regional municipalities (out of a total of 50 in the 6 EU countries involved) to draft and approve their Sustainable Energy Action Plans (SEAPs). The difficulties and constraints identified by the Municipalities in the realization of energy investments are now addressed through the **EFFECT project**, aimed to provide tools and methodologies for the introduction of **innovative**

**public procurement procedures** based on the integration of **energy efficient criteria** in the purchasing of product and services. Specifically, the EFFECT project supports public authorities in the drafting of real tenders for the retrofitting of public buildings adopting the Energy Efficient Public Procurement guidelines developed as project output. Innovative public procurement is a key tool for regional public authorities to effectively address energy efficiency plans, implement the SEAPs, foster the production and consumption of EE products and services and also act as a leverage to improve the **EE innovation level in the regional private sector**. Moreover, the energy requalification of public buildings represents a very good potential for CO<sub>2</sub> saving: for example, the action foreseen in the sector "Administration" of the 12 regional SEAPs already approved will contribute to a reduction of nearly **83.000 tCO<sub>2</sub>**, which represents **11,20% of CO<sub>2</sub> reduction until 2020**.

Regional SMEs active in Energy field will also benefit from the project through the implementation of **Operative Plans** aimed to re-orient productive processes towards energy efficient products and services.

The EFFECT project is co-financed through the **South East Cooperation Programme** and foresees the cooperation of 14 partners from Italy, Hungary, Slovenia, Bulgaria, Greece, Austria, Romania and Serbia. All partners supporting both local public Institution and private sector representatives in their own countries, following a defined and shared common path to facilitate the harmonization of energy efficient public procurement at European level, through the signature of a Memorandum of Understanding for the adoption of the EEPP national guidelines for the next programming period. ●

## Contact details

lcatalani@svimspa.it  
vconigli@svimspa.it  
cdauria@svimspa.it



# The contribution of carbon capture and storage technologies (CCS) to the decarbonisation of European energy systems towards 2050

By Beatrice Coda, Policy Officer, Low Carbon Technologies Unit, Directorate General for Climate Action, European Commission

**T**he EU is committed to reducing its greenhouse gas emissions by 80-95% below 1990 levels by 2050 as a part of the efforts needed by developed countries to reduce their emissions by a similar degree.

The Roadmap for moving to a Low Carbon Economy in 2050 and the 2050 Energy Roadmap, both published by the European Commission in 2011, indicate that there are several cost-effective pathways

to achieve decarbonisation according to the targets agreed, including energy efficiency, increased use of renewable energies. However, forecasts of global energy demand growth indicate that the reliance from fossil fuels will continue for many decades to come. In the context of increasing demand for energy and in order to reconcile the rising demand for fossil fuels, widespread introduction of carbon capture and storage technologies (CCS) in the power generation and industrial sector is likely to be a necessary mitigation options in the transition to a low-carbon economy.

The role of CCS in cost efficient climate mitigation has been confirmed by the two above mentioned Roadmaps, in which all scenarios imply the use of CCS in the power generation sector by 2050. The Roadmap for moving to a low Carbon Economy by 2050 shows also that a delay in the deployment of CCS would result in a significant increase of the amount of investment needed to reach the required emission reductions, in line with the conclusion of

similar assessments conducted at global level. Furthermore, according to the assessments of the two Roadmaps, CCS starts to contribute on a broader scale to reducing CO<sub>2</sub> emissions from industrial processes in the EU after 2030. The application of CCS in certain industries, particularly in cement, steel, refining sector, could therefore represent an interesting option for the early deployment of the technology in view of the expected lower costs in comparison to power generation sector. The deployment of CCS in industrial processes may also help to increase public understanding and acceptance of the technology given the very visible link between jobs in local communities and continued industrial production.

In close co-operation with industries and Member States, the EU supports the demonstration and development of CCS, both financially and with regulatory steps. Following the European Council's decision back in 2007 to support up to 12 large-scale demonstration projects by 2015, the European Commission took a number of steps to



Beatrice Coda

establish a common regulatory and demonstration support framework: the CCS Directive was adopted to provide a legal framework for CO<sub>2</sub> capture, transport and storage.

Moreover two funding instruments were set up with the aim to channel substantial funding to commercial-scale demonstration projects: the European Energy Programme for Recovery (EEPR) and the NER300 programme, which is funded by the sale of 300 million ETS allowances.

Despite considerable efforts to take the lead on CCS developments in Europe, of the 12 CCS large-scale projects currently operating in the world, none of them are situated in Europe and even the most promising EU demonstration projects are stopped or are facing delays. Bringing costs down and securing a business case in Europe remains still a challenge. The Consultative Communication on the future of Carbon Capture and Storage in Europe, published by the European Commission in March 2013, provides a summary of where we are today taking into account the global context and discusses the available options to encourage CCS demonstration and deployment, in order to

support its long term business case as an integral part of the EU's strategy for low carbon transition.

The Communication indicates that the development of CCS in Europe has been affected by lack of business case in view of the low carbon prices over the last few years. The ETS carbon price is currently the main support instrument for CCS at European level, as the CO<sub>2</sub> emissions captured, transported and stored are considered as not emitted pursuant to the ETS Directive. In the first competition round the NER300 funding programme, no CCS projects were selected as Member States were unable to confirm projects, the reasons being among others, funding gaps in the national and/or private contribution, and delays in the permitting procedures. A number of projects also faced public opposition, especially in Poland and Germany. In general a recent Eurobarometer survey shows that the European population is unaware of CCS and its potential contribution to mitigating climate change. While sufficient storage capacity probably exists in Europe, some Member States decided to ban or restrict CO<sub>2</sub> storage from their national territories, while only few Member States in Europe are currently leading efforts on CCS development.

The success of the CCS demonstration projects is seen as critical first step to ensure timely deployment of this technology and to establish a positive perception of CCS as a cost-effective, climate- friendly technology among investors and the general community. For CCS demonstration to happen within the shortest possible delays action needs to be taken on several fronts, in particular on the policy support and for the improvement of the business case for CCS large scale projects; this requires coordination of efforts among private and public sector.

The consultative Communication has spurred a debate about the possible determining factors and policy measures, at EU level as well as at national level, for the successful demonstration and subsequent deployment of CCS by 2020 in the power generation and industrial sectors. Following the consultation, the European Commission will consider the need to prepare proposals, if appropriate, in the context of its work to on the integrated policy framework for climate and energy in the period up to 2030.

The time for CCS in Europe is running out. "No action" is not an option. ●

1 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0112:EN:NOT>

2 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0885:EN:NOT>

3 IEA Energy Technology Perspectives 2012

4 DIRECTIVE 2009/31/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0114:0135:EN:PDF>

5 [http://ec.europa.eu/energy/eepr/index\\_en.htm](http://ec.europa.eu/energy/eepr/index_en.htm)

6 [http://ec.europa.eu/clima/funding/ner300/docs/c\\_2010\\_7499\\_en.pdf](http://ec.europa.eu/clima/funding/ner300/docs/c_2010_7499_en.pdf)

7 GCCSI, The Global Status of CCS: 2013, Global Carbon Capture and Storage Institute, <http://www.globalccsinstitute.com/publications/global-status-ccs-2013>

8 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0180:FIN:EN:PDF>

Disclaimer: The views expressed are purely those of the writer and may not in any circumstances be regarded as stating an official position of the European Commission.

# CIUDEN: Reality in the full CCS chain

**T**he European Union is committed to fulfill the 20-20-20 goals that became law in 2009 by 2020. About 30% of the European power generation capacity is coal-fired and this percentage is much higher in certain EU countries. Therefore, it can be predicted that in the long-term, coal will remain an essential fuel in power generation in Europe. The EU members must promote energy savings and increase the share of renewables as the most viable options to achieve decarbonisation. However, decarbonisation of certain industrial sectors is impossible without the application of CO<sub>2</sub> capture, transport and storage (CCS).

CCS is a complementary and realistic technology that can contribute to combat climate change and achieve goals of Europe 2020. Therefore the EU planned in 2007 to set up a network of CCS demonstration plants by 2015 to test their viability, with the aim of commercial update of CCS technologies by around 2020.

Nevertheless, nowadays there is not any commercial full scale CCS project in operation in Europe. The leadership role abandoned by Europe is now being filled by China, Canada and the US.

After the great effort made by the EC and some European countries, what has been left as actual facilities is not much and it is worth to use the available industrial size technological development facilities, as CIUDEN are to continue CCS development.

CIUDEN, an institution supported by the Spanish Government, promotes one of the most relevant European initiatives, whose facilities permit the complete CCUS process: CO<sub>2</sub> Capture, Transport, Use and Storage. CIUDEN was part of The Compostilla OXYCFB300 Project, co-financed by the European Union's Energy Programme for Recovery, with ENDESA and Foster Wheeler Energia Oy (FWEOy). CIUDEN has settled unique facilities, dedicated to public and private CCUS development, with highly qualified personnel and specialized equipment.

At the moment, the lack of commercial drivers for CCS causes the absence of business cases, what makes necessary the continuous and adequate public funding for flagship projects at adequate scale as a way to ensure the dissemination of the knowledge generated with public support. In this sense, the continuous operation and optimization of processes in CIUDEN facilities would allow technological development and joint efforts in collaboration without been under the limitations of a real production facility. Technology development and demonstration experiences carried out will contribute to diminishing investment and operating costs by accelerating the learning curve which in turn will entail technical and economical risks reduction.

Given that nowadays the three-stage process of CCS has yet to be demonstrated on large scale power stations, CIUDEN is proposing to convert its industrial size technological development installations into a Demo Plant of the CCUS complete chain.





This unique installation would be “the first of this kind” in Europe covering the three steps: Capture, Transport and Storage. The Demo Plant project is intended with the aim of “keeping the pilot flame alight” as a transitional measure for this period in which CCS deployment of commercial demonstration plants seems to be delayed.

CIUDEN, through this full CCUS chain project can contribute to the development of Carbon Capture, Transport and Geological Storage working on technical development, regulatory and financial issues and public perception.

The EU parliament should give CCS the momentum it requires for moving forward and becoming a commercially viable technology by reducing its current techno-economical feasibility risks. Ensuring the link between private and public initiatives, CIUDEN CCS demo project would provide an exceptional support to the acceptance and implementation of CCS technologies by a public non-profit organization, which will contribute to knowledge sharing and to giving advice to Policy and Regulatory makers by providing them with the necessary scientific and technological basis

Developments achieved will build the necessary knowledge base and the public confidence in CCS technologies, by scientific and technological research and addressing public awareness and investors’ interests.

CIUDEN es.CO<sub>2</sub> centre is divided in two main facilities: Technology Development Centre for CO<sub>2</sub>

Capture and Transport, and the Technology Development Plant for CO<sub>2</sub> Geological Storage:

- CIUDEN Technology Development Centre for CO<sub>2</sub> Capture and Transport, located in Cubillos del Sil (NW Spain), is a industrial scale facility with advanced equipment for the development of oxy-combustion based on two main combustion technologies: pulverized coal (PC) and circulating fluidized bed (CFB). Furthermore CO<sub>2</sub> transport issues can be addressed in the 3,000 m long Transport Experimental Pilot Plant, and three different quality CO<sub>2</sub> streams can be employed for high added value uses.
- CIUDEN Technology Development Plant for CO<sub>2</sub> Geological Storage, situated in Hontomin (N Spain), allows carrying out experiments in real scale in saline formations to develop CO<sub>2</sub> storage knowledge. It aims to acquire new knowledge regarding CO<sub>2</sub> injection and monitoring techniques which will lead to an increase in technical feasibility and safety issues.

CIUDEN facilities are conceived not only for the development of CCUS technologies, but also for the improvement of technologies related with co-combustion of coal and biomass that can result in negative CO<sub>2</sub> emissions. Furthermore, the facilities promoted by CIUDEN allow a wide range of experimental campaigns, and constitutes an exceptional place for specialized education and training for technical personnel

in real operating conditions. These facilities have the necessary characteristics to move forward in the development of the oxy-combustion and others “near-to-the-market” technologies at a reasonable cost.

CIUDEN is the only project in the world which has completed the process from fuel preparation to CO<sub>2</sub> capture using a circulating fluidized bed boiler (30 MWt) in oxy-combustion. CIUDEN facilities are open to international development in partnership as demonstrated by its participation in 11 international projects and forums (IEAGHG, ISO, ZEP, etc) in cooperation with industry, universities and research centres from all Europe, investigating aspects which go from oxy-combustion processes and materials development to networking for CCS and biomass gasification and the important public perception issues.

CIUDEN Demo CCUS Project, as a world installation of excellence in Europe, will help to strength the European energy politics with a balanced energy mix and reducing the actual intensive carbon economy. It will contribute to keeping Europe relevant presence in these technologies and .generating “own knowledge and “ thousands of highly qualified jobs across the continent. ●

**Centro de Desarrollo de Tecnologías de Captura de CO<sub>2</sub>**

Avda. del Presidente Rodríguez Zapatero, s/n  
 24492 - Cubillos del Sil (León) España  
 Mapa/maps: <http://mapesco2.ciuden.es>  
**Tel:** +34 987 457 454 / +34 618289104  
**Fax:** +34 987 419 570  
**www.ciuden.es**



## First phase of Foster Wheeler's oxy-CFB combustion tests at Ciuden's es.CO<sub>2</sub> center completed

**T**he research of CCS, Carbon Capture & Storage, is proceeding at Foster Wheeler with the development of Flexi-Burn® CFB boiler. This technology allows switching smoothly from

air combustion to oxycombustion to capture carbon dioxide, which then can be transported to end storage.

The first phase of large pilot scale (30 MWth) oxycombustion tests in the CIUDEN es. CO<sub>2</sub>-center located nearby the Spanish Compostilla power plant have now been completed. Foster Wheeler's R&D has analyzed the results in co-operation with partners such as VTT Technical Research Center of Finland, Lappeenranta University of Technology and University of Oulu. The results have been used in designing the commercial scale (300 MWe) oxy combustion demonstration plant, OXY-CFB-300 Compostilla.

center, **Mr Pedro Otero** has been happy with Foster Wheeler, even though there have been many challenges in testing this new type of technology. "Because this is a large scale pilot facility where we use new type of equipment to test brand new technology, it is clear that we have faced many challenges. The plant erection phase went well, and also the challenges in commissioning phase were solved eventually. Especially the air ingress issues brought up a remarkable challenge. The pilot plant we have designed is very flexible and suitable for the tests. We can switch from air combustion to oxygen combustion in about 30-40 minutes."

"The technical co-operation between Foster Wheeler and Ciuden's professionals has been good", Pedro Otero continues. "Based on the tests we have conducted there are no major challenges from technical side in building the Compostilla 300 MWe demonstration plant."

At the moment Ciuden es.CO<sub>2</sub>-center is focusing on commissioning of the PC boiler in the test facilities, and further oxy-CFB testing for higher oxygen contents. "FW's R&D department participates in the CFB boiler tests and continues the optimization of the oxy-firing boiler based on those results. The target is to decrease the investment costs and operating costs of oxygen combustion", says FWEQY's R&D Director, **Mr Arto Hotta**. ●

The design for the commercial scale plant is now almost completed and the 300 MWe Flexi-Burn® CFB demonstration unit could technically be built. However, the concept itself does not, at the moment, appear commercially viable due to lack of regulation and the low price of carbon dioxide in the EU's emission trading system. Therefore it could be challenging to find sufficient funding for this project. Furthermore, in future research the optimization of the oxy combustion concept continues for example by increasing the share of oxygen in the combustion gas from 24% to 40% in order to reduce boiler size and to reduce investment and operation costs.

Director of Ciuden's es.CO<sub>2</sub>



*Ciuden's director, Mr Pedro Otero has been happy with the test facility and also for Foster Wheeler's performance. In the background lies the Compostilla power plant owned by Endesa. The OXY CFB 300 is planned to be located in this site.*



*Mr Otero emphasizes that Ciuden is a large scale pilot facility (30 MWth) that is equivalent to industrial scale. The results gained in this project have been used in designing a commercial demonstration plant.*

# CCS: Picking up the pieces

*By Liberal Democrat MEP Chris Davies, European Parliament's rapporteur on CCS*

Carbon capture and storage technology offers the potential to allow Europe's CO<sub>2</sub> reduction goals to be achieved at lowest cost. Efficiencies will be improved and financial savings made as large scale operating experience is gained, but the capability of CCS is already proven; it just needs putting into greater practice.

Yet CCS prospects are often met with scepticism and even hostility. Electricity generators see risk, long term liabilities, and no prospect of financial rewards that could justify their involvement. Many Green groups object to the idea that CCS could sustain the use of fossil fuels for power generation. Some critics stand accused of promoting public fears about the sequestration of CO<sub>2</sub>, an inert gas, even while they pay no regard to the underground storage of methane, which is explosive.

The European Union's strategy for CCS promotion has all but collapsed. The 2007 pledge by heads of government to have up to 12 CCS projects in operation by 2015 lies broken. The baton of leadership has been handed to China, Canada and the USA. These countries may not usually be considered prominent in the fight against global warming but they are the places where CCS projects are being developed and they will gain the rewards of experience. The lessons learnt from building Canada's Boundary Dam post-combustion coal project, for example, should enable its successor to be built 30% cheaper.

Europe's failure stems from the absence of a business model that can promote CCS investment. While promoters of renewable energy have received cash subsidies the presumption was that carbon allowances would be priced so high that investors would invest in CCS development to avoid emitting CO<sub>2</sub>. With the collapse of the carbon price went the technology's financial rationale.

It remains the case that the best way to stimulate investment in CCS is to put a price on CO<sub>2</sub> emissions. Investors must also be confident that the EU's will confirm its intention to introduce more ambitious CO<sub>2</sub> reduction requirements.

Brussels needs to give priority to ensuring that at least some full chain CCS projects are taken forward to operation. Setting a modest target could help facilitate the release of funds from different lines within the EU budget. Specific support could be given for pipeline construction and evaluation of CO<sub>2</sub> storage sites.

Additional EU funding could help promote investment by Member States. An innovation fund could be created from the sale of carbon allowances. Longer term financial support might come from creation of a certificates scheme similar to that used by Sweden to promote renewable energy, with fossil fuel producers required to invest in CCS development or purchase certificates to an equivalent value.

Even so, the initiative for CCS

development rests primarily with Member State governments. No investor is going to proceed without their enthusiastic support and very few have provided that.

Too many give the impression that they have dismissed CCS as an option without giving it real consideration. This may be because most have not explained how they will achieve the 2050 CO<sub>2</sub> reduction goals without it. EU legislation requiring every Member State to publish a long term CO<sub>2</sub>-reduction strategy would promote fresh thinking.

Governments that choose to endorse CCS will have to play a more active role than formerly conceived: providing financial support mechanisms, assisting in the building of a pipeline network, and helping to prepare storage sites. It will be their task to win public opinion, and they will have to accept a share of the financial liability in case problems occur at a storage site that they have themselves approved.

Immediate hopes for progress rest very largely with the UK. The government there remains firmly committed to CCS development and the technology commands cross-party support. A billion pounds of support for capital expenditure remains on offer and efforts are being made to determine how operating support could be provided through the UK's Contracts-for-Difference arrangements. Progress is slow, but the sums involved are not small and the means of providing them innovative and complicated. They may yet provide a model and benchmark for Europe. ●



# Geological storage of CO<sub>2</sub> and the role of CO<sub>2</sub>GeoNet



CO<sub>2</sub>GeoNet Association partners: Founding institutes (located in countries shown in blue) and new member institutes (countries shown in yellow).

## CO<sub>2</sub>GeoNet is the European Network of Excellence on the Geological Storage of CO<sub>2</sub>

Carbon dioxide Capture and Storage (CCS) involves the capture of carbon dioxide (CO<sub>2</sub>), compression of this CO<sub>2</sub> into a dense liquid form, and its injection deep underground into reservoir pore space (i.e. between the rock grains) usually in saline formations or depleted hydrocarbon fields. From the 1990s onwards, CCS has been seriously considered and studied as an essential method of reducing emissions to the atmosphere, by which carbon extracted from underground in the form of gas, oil and coal is returned to the deep subsurface in the form of CO<sub>2</sub>. CCS is currently the only technology that can greatly reduce CO<sub>2</sub> emissions from fossil-fuel-based power stations and other industrial processes such

as oil refining and steel and cement manufacture.

Key projects throughout the world show CCS is achievable with current technologies but the number of storage projects needs to increase greatly in order to significantly reduce anthropogenic emissions. There are seven large-scale installations currently operating world-wide that individually store more than 0.7 million tonnes (Mt) CO<sub>2</sub> per annum (p.a.); 1.7 Mt p.a. are stored by two large-scale Norwegian industrial projects specifically designed for CCS (Sleipner and Snohvit) and the remaining 20.4 Mt p.a. are stored through five Enhanced Oil Recovery (EOR) schemes that utilise anthropogenic CO<sub>2</sub> injection (source: Global CCS Institute).

Large-scale implementation of CO<sub>2</sub> storage is particularly appropriate in Europe because of the combination of a large number of industrial and power plants producing CO<sub>2</sub> emissions and favourable geology for storage. Although opportunities for storage are not evenly distributed, regional-scale estimates indicate huge storage potential in Europe. Moving forward, detailed assessments are required for individual storage sites.

Both small-scale pilot projects and demonstrations at commercial scale will be needed to drive CCS forward in Europe and globally. Small-scale pilot projects will allow testing of a range of geological storage types and novel concepts with regards to injection strategies and monitoring technologies at lower costs. Demonstrations aim to prove safe and secure storage at scale.

It is clear that support for demonstration projects which are now close to a final investment

decision (FID) is extremely important to the future of CCS in Europe. There are currently five demonstration-scale projects in Europe which are approaching FID: In the UK, the Department of Environmental and Climate Change (DECC) will support up to two projects (White Rose and Peterhead projects are the preferred bidders) and the commercially-supported Yorkshire and Humber Cluster Project is undertaking public consultation on their proposed CO<sub>2</sub> pipeline route. In the Netherlands, the ROAD project is well developed and has already obtained a storage permit. In Spain, CIUDEN (a CO<sub>2</sub>GeoNet partner), is currently undertaking a pilot-scale injection project at Hontomín and if financial investment is obtained, larger, demonstration-scale storage will take place.

CCS research requires strong international cooperation and knowledge sharing, particularly in the field of geological storage. Each storage site is unique and its capacity to trap CO<sub>2</sub> permanently must be demonstrated on a site-by-site basis. The knowledge gained from each pilot or demonstration project is valuable and builds understanding and confidence. CO<sub>2</sub>GeoNet aims to be pivotal in sharing knowledge on geological storage, providing arenas for the exchange of ideas, information and knowledge such as the annual CO<sub>2</sub>GeoNet Open Forum, and encouraging collaborative working and pooling of expertise across the whole of Europe. The CO<sub>2</sub>GeoNet Network of Excellence has recently expanded as partners from the recently-completed CGS Europe project joined. CO<sub>2</sub>GeoNet now comprises 24 partners from 16 European countries and involves more than 300 researchers with expertise on every facet of CO<sub>2</sub> geological storage. ●

### Contact details

CO<sub>2</sub>GeoNet Secretariat: [info@co2geonet.com](mailto:info@co2geonet.com)  
[www.co2geonet.com](http://www.co2geonet.com)

# Why rapid industrialisation of CCS is vital to prevent the carbon bubble bursting

By Frank Ellingsen, Managing Director, TCM

**R**ecent months have seen the debate surrounding the future use of fossil fuels reach new heights, driven by the release of the sobering “Unburnable Carbon” report. Produced by The Carbon Tracker, supported by Lord Stern’s Grantham Institute for Climate Change, the research shows that up to 80% of the existing coal, oil and gas reserves on global stock

exchanges cannot be burned, if we are to prevent the global average temperature rising above two degrees Celsius limit.

Despite the absence of policy certainty on climate, at current rates, it is estimated that \$674 billion – around one per cent of global GDP – is invested each year in excavating additional fossil fuel sources. When up to 80% of

the fossil fuels we already have may be unburnable, the stock market valuations of fossil fuel assets now has serious questions hanging over it.

Further to this, revaluations are also resulting from other drivers, such as falling clean technology costs (with technologies like solar PV approaching ‘grid parity’), the rise of cheap natural gas (with the





fracking industry in full swing), water scarcity, and rising litigation. For any investor looking at fossil fuels, these are all additional risks pushing fossil fuel towards the status of a 'stranded' asset. With these odds stacked against it, the fossil fuel industry is starting to evolve, but that will not happen overnight. Global energy demand is rising by over one third up to 2035<sup>1</sup>; market forces dictate that a very large amount of fossil fuels will be called upon to meet that demand.

To bridge the gap to lower carbon energy, whilst meeting energy demand, requires the rapid industrialisation of Carbon Capture & Storage (CCS), to prolong and decarbonise the use of fossil fuels. CCS is capable of reducing CO<sub>2</sub> emissions from fossil fuel power stations by as much as 90%. This would render fossil fuels still burnable - which would ensure that the carbon bubble can be deflated, leaving fossil fuel investment intact.

There is an argument that the high costs of CCS will mean it may be slow to make an impact. However, it can also be argued

that a large part of the \$674 billion a year being spent on developing new fossil fuel assets, which could become stranded, would be better invested in safeguarding the industry by investing on bringing the costs of CCS down.

Demonstration projects - like the CO<sub>2</sub> Technology Centre Mongstad (TCM) - are vital in making that cost tipping point occur; where the price per kilowatt hour of CCS is investible, based on the payback of reducing the financial and social costs of carbon emissions. For example, typical efficiency of a modern gas power plant is 59%. Currently, efficiency drops to around 50% when fitted with carbon capture. If we can limit the reduction of efficiency to around 54%, then CCS will become an attractive investment prospect.

Technology testing is the vital route for verifying and demonstrating capture technology, which in turn can reduce costs, plus technical, environmental and financial risks, thereby creating the preconditions for CCS success.

Here at TCM, there have been proven results from our first year of testing, which contribute to preparing the ground for widespread CCS deployment to combat climate change and show achievements that are crucial to de-risking CCS investments.

Progressive oil and gas firms have recognised the risks of the carbon bubble and are innovating to deflate it. For example, Shell's VP of Exploration Technology, Dirk Smit, recently spoke at the EmTech conference describing how oil companies will be at the forefront of the emissions-reducing business through developing technologies like CCS. Smit describes a future in which fossil fuels provide a smaller fraction of the world's energy needs—not because the world will run out of them but because a range of factors, including improved technology and concerns about climate change, make alternatives to fossil fuels more competitive.

The IEA has urged governments and industry to ensure that the incentive and regulatory frameworks are in place to deliver upwards of 30 operating CCS projects by 2020 across a range of processes and industrial sectors. Oil companies' expertise in geophysics and in managing extremely large-scale operations is key to the rapid commercialisation of carbon capture, and it is up to them and other technologists to demonstrate the commercial reality of CCS. ●

<sup>1</sup> The International Energy Agency (IEA) World Energy Outlook 2012: [www.iea.org/publications/freepublications/publication/English.pdf](http://www.iea.org/publications/freepublications/publication/English.pdf)

# Opportunity, urgency, responsibility: Key words for European Energy Policy, key words for CCS

*By Theo Mitchell, Policy Manager, Carbon Capture and Storage Association (pictured)*

**W**hen it comes to CCS, Europe is at a crossroads. While the rest of the world is ramping-up efforts to install CCS, Europe's vision is somewhat less clear. The Global CCS Institute (GCCSI) currently lists 20 'active' commercial-scale CCS projects across the world - needless to say, none of these are in the EU.

The International Energy Agency (IEA) estimates that CCS will need to make a 17% contribution to emissions reductions in 2050 if we are to achieve our 2 degree climate ambitions. Despite this, some in Europe still see CCS as an unnecessary evil that does nothing but hinder the deployment of renewables. This is simply not the case. Like the European Commission, the CCSA believes that CCS should be seen as complementary to renewables and energy efficiency, not in competition with them.

In Europe, the reality is that CCS will always divide opinion. That, however, should not stop us from making progress on CCS.

At the October meeting of the Ministerial Green Growth Group, energy and climate Ministers from across Europe identified three key words central to shaping the post-2020 framework for energy and climate policies: responsibility, urgency and opportunity.



Incidentally, these three words are also central to the arguments for a proactive approach to CCS.

### **OPPORTUNITY**

There are numerous opportunities for Europe if it develops CCS. Primarily, including CCS as part of the energy mix - alongside energy efficiency, renewables and other low-carbon technologies - offers the opportunity to decarbonise at least cost; reducing consumer energy bills and improving European competitiveness. IEA analysis suggests that decarbonisation without CCS could be 40% more expensive.

Despite the obvious economic benefits, the CCS opportunity isn't just about green growth, it also encompasses energy security, technology leadership, and of course, the fight against climate change. The European Council recognised the potential of CCS back in 2007 when it set an ambition to have 12 large scale demonstration projects up-and-running by 2015. Europe was to be the leader on CCS and there were even plans to export our expertise to the rest of the world.

For a number of reasons, this didn't happen.

Some blame the low carbon price and ineffectiveness of the ETS to drive investment; some blame the distraction of renewables targets; some blame the lack of coherent policy and a clear long-term vision for CCS. Whatever the main reason, we now have

the opportunity to address these failures and reestablish Europe as a world leader on CCS in the run up to a new global agreement on climate change in 2015.

### **URGENCY**

A Green Paper on the 2030 framework for EU energy and climate policies is expected in January 2014. CCS needs to feature prominently and there should be clear recognition of its value to European energy, climate and industrial policies.

The CCSA has long been calling for a clear and substantive role for CCS in the 2030 framework package but, so far, there appears to be little consensus on the role that CCS will play.

There are factions within European Parliament that call for CCS to be rolled out across the board, wherever applicable. There are others that think CCS should only be applied in instances where there are absolutely no other decarbonisation options available, in the case of steel or cement industries for example.

This is where the final key word comes in.

### **RESPONSIBILITY**

The CCSA is calling on the European Commission, Members of European Parliament and the Council of the European Union to ensure that the 2030 framework package ensures that CCS is not unreasonably rejected or disadvantaged. As a European community, we have a responsibility to ensure that we tackle climate change in the most sustainable, cost-efficient manner available. To achieve this, we need to ensure that our policy framework does not unduly disadvantage any sustainable, low-carbon technologies. This includes CCS.

Europe may have lost the lead on CCS but we now have a timely opportunity to ensure it remains a key component of our future approach to tackling climate change. In order to move CCS forward we need to learn from the failures of the 2020 framework and ensure that we don't make the same mistakes again. ●

#### **Theo Mitchell**

Policy Manager  
The Carbon Capture & Storage Association

[www.ccsassociation.org](http://www.ccsassociation.org)

**Follow us on Twitter:** @The\_CCESA

The Carbon Capture & Storage Association,  
6th Floor, 10 Dean Farrer Street, London, SW1H 0DX

**T:** +44 (0)20 3031 8751

**M:** +44 (0)7756 336 807

**E:** [theo.mitchell@ccsassociation.org](mailto:theo.mitchell@ccsassociation.org)

# RAG: Paving the way into the energy future



## **GAS - THE ENERGY SOURCE OF THE FUTURE**

Gas is a true all-rounder in the energy world. Being environmentally friendly and efficient it is an indispensable part of the energy mix. Huge proven gas reserves exist around the world. It can be easily transported and stored out of sight, underground throughout Europe using safe infrastructure that is already in place. Gas is the balancing fuel for intermitted wind and solar energy production.

Gas offers a high potential for innovative technology. Constantly available wind and solar energy regardless of weather conditions? Gas can turn this dream into reality:

Cutting edge "power to gas" technology is capable of converting unused wind and solar energy into gas via methanation (SNG - Synthetic Natural Gas). Large quantities of SNG produced in this way could be fed into the European gas system and held available in large scale gas storage facilities. This means gas storage facilities are transforming into energy storehouses.

Thus RAG's strategy is based on the conviction that gas is the energy of choice for the future in Europe. Today RAG supports research and development projects paving the way for implementing the new gas technology "power to gas".

## **RAG STORAGE FACILITIES STRENGTHENING EUROPE'S ENERGY SUPPLY SECURITY**

RAG has already triggered investments of more than

1 billion Euro over the last decade in gas infrastructure - mostly big scale underground gas storage facilities.

Storage facilities are central to affordable and secure natural gas supplies for Europe. RAG is one of Europe's leading gas storage operators, and now operates around 5 billion cu m of storage capacity and a maximum withdrawal capacity of 2.3 mn cu m/hour from its Haidach, 7Fields and Puchkirchen storage facilities. The company developed the Haidach gas storage facility - the second-largest in Central Europe - and the 7Fields facility in cooperation with Wingas, Gazprom and E.ON. These storage assets play a key role for security of supply in Central Europe and have proven their performance during long and cold winters and also supply disruptions.

## **COMPANY PROFILE:**

RAG is Austria's oldest exploration and production company. Since its formation over 75 years ago, RAG has produced over 15 million tonnes (mn t) of crude oil and 24 billion cubic metres (cu m) of natural gas. Its core lines of business are oil and gas exploration and production and gas storage. Today, the company's 400-strong workforce is trading some 600 mn cu m of natural gas and produces 140,000 t of crude oil per year. RAG's main exploration and production assets are situated in Austria and Germany. ●

## **Contact details:**

RAG Rohöl-Aufsuchungs Aktiengesellschaft  
 Schwarzenbergplatz 16, A-1015 Wien  
 Tel: +43 (0) 50724 5448  
 Mobil: +43 (664) 614 8010  
 www.rag-austria.at  
 eMail: elisabeth.kolm@rag-austria.at



# Gas markets in Europe: the new dynamic

*Philip Lowe, Director General for Energy, European Commission, DG ENER (pictured)*



**T**he European Union is committed to creating a low carbon energy economy, which provides businesses and households with competitive and affordable energy. Our energy policy makes it clear that this energy should be safe, secure and environmentally sustainable. The future role of natural gas depends on how it contributes to achieving these targets.

Europe's gas markets have proliferated since the discoveries of large gas fields in Groningen and the North Sea in the late '50s and '60s. In the following years, the gas price was fixed according to its replacement value, leading to gas prices being indexed to those of oil. As EU prices were in line with those in competing economies, producer rents were effectively guaranteed while the economies of Europe grew.

Clearly, the situation has changed. While oil indexation persists in long-term contracts, gas-to-gas competition is putting pressure on the old pricing system. In addition, gas prices in the EU's competitors are often lower than those in the EU, and Europe has a diminishing industrial base. Gas today also plays an important role in power generation, but here a low carbon price means that the gas industry is facing stiff competition from coal-fired power. The gas sector, therefore, has little choice but to prioritise innovation and to seek to establish new markets.

A particular challenge is to ensure liquidity through competition.

Gas-to-gas competition is one way to improve the price competitiveness of gas on the European market. Indeed, buyers seek hub-based pricing in their contracts, as hub liquidity is increasing around Europe. This pushes long-term indexed prices down in current market conditions, compared to traditional long-term oil-indexed contracts.

However, this liquidity has been generated by the resale of unwanted gas in some regional markets and not by the entry of new players into the wholesale market. Under these circumstances, exchanges are subject to the loss-mitigation strategies of those who operate under long-term oil-indexed contracts.

To support liquidity, and to foster genuine competition, the European gas market needs more suppliers. This involves a shift in emphasis away from simply new routes and supplier countries, to a diversity of counterparties – notably new companies upstream.

Concerted efforts to open new routes will be undercut by the declining value of gas rents – lower profits mean fewer funds for new pipelines. Moreover, in the context of Europe’s 2050 decarbonisation commitments, the time-horizon for the pay-back

on investments is declining.

As a fossil fuel with lower carbon emissions than coal, and with a good geographical distribution, the gas industry has clear advantages. However, the sector has so far failed to maintain its advantage in ramp-up rates, and some coal stations are now as flexible as gas stations. Several CCGT plants are now being shut down, as they are seen as uneconomical.

To address this problem, the gas industry needs to work with other sectors, and redefine its role for the future. Gas to power and power to gas, for example, are excellent back-up solutions for renewables. An energy system where renewable resources are fully utilised will benefit from the fast ramp-up and ramp-down capabilities of the gas sector.

In the transport and heating sectors, gas has the potential to limit dependency on imported refined oil products, to reduce pollution and emissions and contribute to the decarbonisation objectives.

The electricity market design will also have a significant impact on the role of gas in the power sector. We should seek to eliminate the silo thinking that isolates gas and electricity market designs and move away from separate markets for electricity and gas to a more integrated fuel market. We should understand how the two are intimately linked,

and regulate accordingly.

In spite of the many challenges facing the sector today, there is a clear role for the gas industry in Europe’s future energy markets and in policies to achieve competitiveness, climate goals and energy efficiency. However, to secure this future, the gas industry itself needs to become more flexible, diversified, and competitive. ●

# Security of supply needs

## investment security

**Natural gas storages can continue to play a central role in supplying energy to Europe - provided that legislators set the right framework conditions.**

*By Andreas Renner, Managing Director of astora GmbH & Co. KG*



*The natural gas storage at Rehden in Northern Germany is one of the largest natural gas storage facilities in Europe.*

**T**he German “Energiewende” was the most ambitious project of the old German federal government - and is probably now one of the biggest challenges of the new federal government. With the “Energiewende”, Germany has positioned itself as Europe’s frontrunner as we move forward to a new “energy era”. However, the frontrunner has so often let go of the reins during the last few years and now threatens to gallop off on the wrong course. Too many players have been enticed by the tempting vision of living from the wind and sun without any negative effects on their own wallets and the security of supply in Germany. The reality has to be addressed. The EU quite rightly criticises Germany’s lack of coordination with other European countries and weaknesses in implementation. Even in the third year of the “Energiewende”, coherent strategies are still not evident.

We urgently need a convincing concept in order to secure our energy supply in an ecologically and economically sensible manner

- at a German and European level. The fact is, we need to work more closely together in the EU, particularly in the energy sector, whereby even in the era of the “Energiewende” we will still remain dependent on fossil fuels for decades. In this regard, natural gas in particular can lead the way in creating a fundamentally changed energy system as we proceed towards “a green future”. Faced with a lack of raw materials and declining production volumes in Europe, the EU countries are, however, increasingly dependent on cooperation with neighbours rich in raw materials such as Russia or Norway. Therefore, in order to further secure the energy supply, Europe should also rely on developing secure storage capacities.

However, the construction and operation of natural gas storages must also be worthwhile for the private sector in future, in particular when high investments have to be secured. This can only succeed when appropriate prices are achieved in this highly volatile market environment. This is where politicians need to act. Market-based instruments must be given fundamental priority over further regulatory interventions. The existing market environment already offers instruments in this regard, which in particular cover the logistical grid-based tasks provided by storages (e.g. load flow commitments, local balancing

energy). Nevertheless one question remains unanswered: Who is responsible for ensuring a secure energy supply in Europe? Legislators have unbundled the formerly jointly operated storage, transport and trade segments, without, however, providing the players in this newly structured market with concrete and long-term framework conditions. This is a serious omission, since without planning security there is no investment security. And without investment security there is no security of supply.

Given this context, Europe’s energy supply can only be secured for the long term under three prerequisites: firstly, with an integrated concept for the future energy supply in which natural gas storages constitute an elementary component; secondly, with improved cooperation within the EU in regards to energy policy and, thirdly, with a targeted expansion of our international energy partnerships. The political decision-makers should address these tasks as soon as possible, since the success of industrial societies will also be decided in future by the capability of the energy infrastructure. ●

*Andreas Renner is Managing Director of astora GmbH & Co. KG. The company, which is headquartered in Kassel, Germany, is currently one of the largest natural gas storage operators in Europe.*

# The 2030 policy framework and natural gas as a transitional fuel to a low carbon future

*By Niki Tzavela, Member of the European Parliament*

**E**nergy and climate issues are at the heart of the European Parliament's (EP) agenda as discussions on a new "2030 Framework for Climate and Energy Policies" evolve. Policymakers find themselves at a political crossroads as they attempt to adopt targets ambitious enough to protect the environment, while at the same time, retaining the necessary realism and flexibility to ensure that the European economy is competitive. On the one hand, some policymakers argue that a single CO<sub>2</sub> emission target should be adopted, i.e. one overarching target that would ensure a level playing field. On the other hand, policymakers indicate that, for the sake of the climate, a multi-dimensional target should be adopted - also arguing, that the current set up of the Emissions Trading Scheme (ETS) does not take into account the most emitting sectors: such as transport and buildings. Within the context of these discussions, the EU's gas policy needs to be clarified. This necessity is, further reinforced by the impact that the United States 'shale gas revolution' is having on global energy markets and pricing trends.

Regarding the medium-long term perspectives of our energy policy, there is broad agreement that we should gradually increase the share of Renewable Energy Sources (RES) in our energy mix and devote more R+D funding towards renewables that are not yet competitive on the market. Policy makers also need to be wary about the effects of overly-subsidized RES which may further endanger a level playing field in the energy sector and create market distortions. Renewables are intermittent in nature and they need to have a flexible back-up generation. The most common fossil based fuels used in Europe are natural gas and coal. Since natural gas-fired electricity generation releases about half the carbon emissions of coal, a greater focus should be placed on natural gas in terms of structuring an efficient, competitive and environmentally friendly energy mix. Yet what we witness in Europe is exactly the opposite. The "shale gas revolution" has led to cheaper gas prices in the US. This, in turn, has made US coal almost obsolete and a cheap source of energy for Europe; combined with the low ETS price, our EU greenhouse gas (GHG) emissions are on the

rise while the US CO<sub>2</sub> emissions have declined 12% between 2005 and 2013 and are at their lowest levels since 1994, according to the US Energy Information Administration - this is all down to the simple switch from using coal to natural gas.

Admittedly, Europe has already started initiatives to provide the security of energy supply by supporting projects to bring more gas to its member states. The Trans-Adriatic Pipeline (TAP) is a perfect example of that. TAP will bring 10 billion cubic metres of natural gas from the Caspian Basin to Europe by 2018. Furthermore, new discoveries in the eastern Mediterranean have a potential to be considered as new sources of energy by the EU, but we need to wait for the resource potential to translate to proven resources. Indeed, it is important to note that the reserves in the east Mediterranean would also constitute EU indigenous resources as Cyprus attempts to become a gas producing country. Meanwhile, Greece is also looking to join the club of EU gas producers, having announced the opening of calls to tender for exploration in the Ionian Sea

and possibly South of Crete in the near future. With regards to unconventional gas exploration, this has been a contentious issue in Europe since its arrival onto the political scene. Various member states have already started shale gas exploration. Most recently, Lane Energy Poland<sup>1</sup>, was extracting some 8000 cubic metres of shale gas per day at a test well in northern Poland, an amount unseen in Europe to the date. The daily amount of gas being produced there still does not qualify for commercial production, but was the largest obtained in any shale gas well in Europe to date.<sup>2</sup> It is also worth considering that in the United Kingdom, the British government has welcomed a package of community benefits that has been brought forward by the energy industry. These will include £100,000 for communities situated near each exploratory well and %1 of revenues from every production site which may translate into millions of pounds being spent for the welfare of communities.<sup>3</sup> Thus far, the UK has been the only Member State that has attempted to tackle the

issue of gaining a 'social license to operate'.

In conclusion, the EU needs to clarify its natural gas policy and urgently provide a clear, predictable and realistic framework for energy and climate policies. Moreover, the EU needs to incentivise natural gas in order to curb the use of coal within the Union. Coal may be cheap and competitive but it is not doing any favours to the EU's credibility vis-à-vis its climate aspirations and the role that the EU wants to play in international negotiations. Finally, it must be stressed that in order for the EU to break free from anachronistic crude oil indexation policies and reliance on imports from third countries, the EU needs to diversify its sources further, including by exploring its own indigenous resources and by supporting a balanced energy mix that is non-discriminatory and technology-neutral. In addition to this, the key goal of EU energy policy remains the completion of the internal energy market for gas and electricity by 2014 and the eradication of energy islands by 2015. ●

1 An oil and gas exploration company controlled by ConocoPhillips

2 <http://www.reuters.com/article/2013/08/28/poland-shale-idUSL6N0GT00I20130828>

3 <https://www.gov.uk/government/news/estimates-of-shale-gas-resource-in-north-of-england-published-alongside-a-package-of-community-benefits>

# Gas Technologies and the future low carbon Energy System

## INTRODUCTION

Europe has set challenging targets for the decarbonisation of its energy systems. Meeting these targets is highly dependent on generating a substantial proportion of electricity from renewable sources. A larger proportion of final energy in Europe is used to provide heating and mobility. In order to meet carbon reduction targets, these will also need to be decarbonized. If this is also done through the end use of electricity from increasingly renewable resources, this will place a huge burden on electricity infrastructure. There are also challenges to renewable integration due to its variability and intermittency. Indeed in order to provide renewable capacity to meet peak demand across Europe, even with interconnected smarter grids, there will be periods where large amount of renewable energy will need to be stored for hours or even days. The alternative will be to switch off the renewable generators,

with penalties to transporters and resulting wastage. This is already happening in Europe.

Gas technologies can play a vital and innovative role in the future of Europe's energy system, partnering the increased use of renewables in the power and heating sectors, and importantly opening up options for system transformation which would otherwise be lost.

## THE NATURAL GAS NETWORK IN TRANSFORMATION - SYNERGIES WITH RENEWABLES

### Storage and Power to Gas

The capacity of the existing power transmission network is already constrained where wind and other energy production peaks. This situation will only worsen as more intermittent wind power comes online. The gas grid provides a highly flexible medium for storage of energy. Developments in Power-to-Gas

are exploiting the potential of the gas network to provide storage of energy through conversion of excess electricity to hydrogen or synthetic natural gas. Efficiencies of over 70% in conversion mean that the load factor of renewables can be increased avoiding costs of grid reinforcement or further storage. In combination with the injection of bio-derived gases, the gas network has the potential to become increasingly decarbonized.

## SMARTER POWER GENERATION

The converse situation occurs where peak power is required and renewable intermittency requires rapid load following. The most efficient power generation technologies (CCGT) are typically best at provision of base-load. However, smaller-scale highly flexible CCGT systems are beginning to appear which maintain efficiency at high turn-down. Of course, a larger proportion of base-load power

Fig 1a – volatility of renewables–wind power variability and grid capacity.

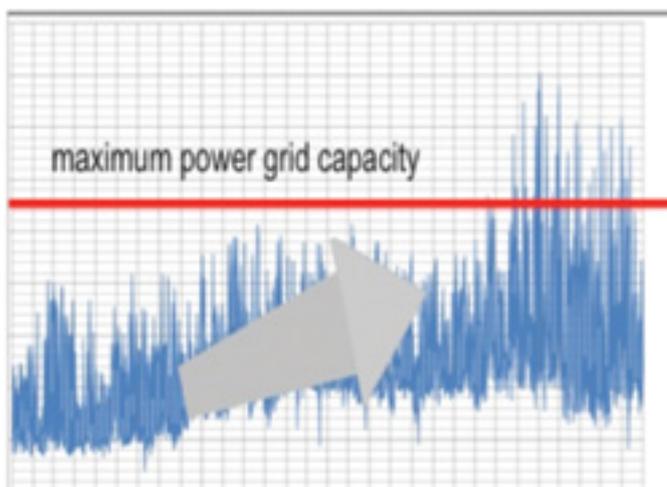
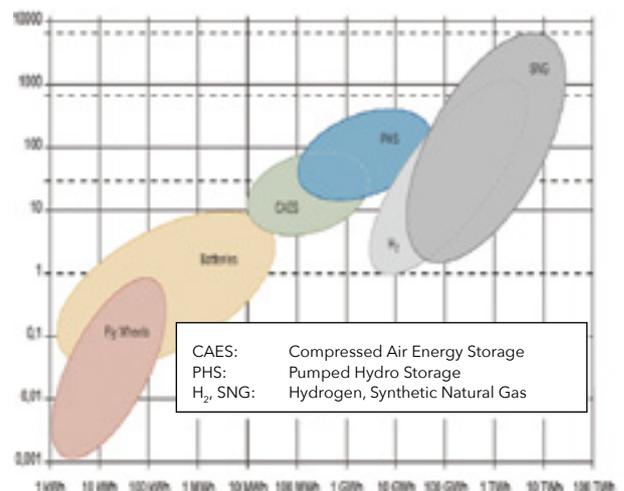
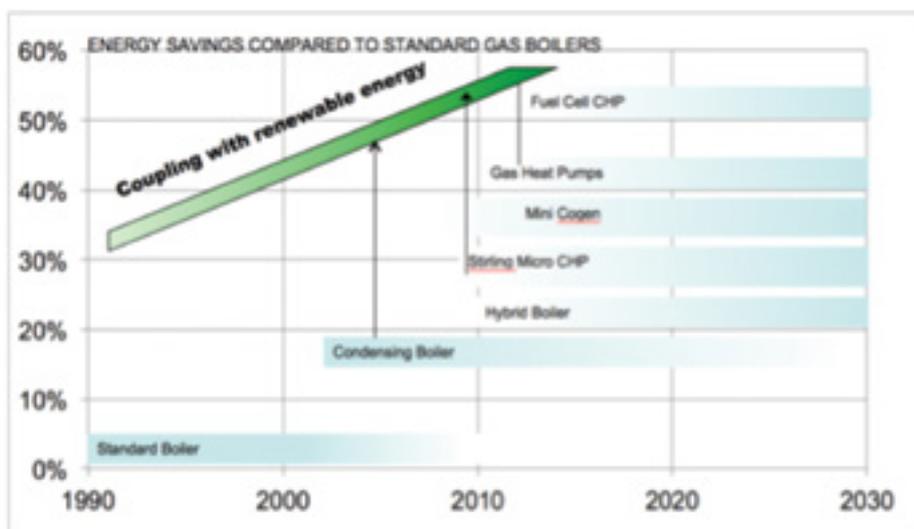


Fig 1b – Storage potential of various media  
Source: ZSW





provision from CCGTs will also lower the proportion of turndown and efficiency loss required to load follow. The future smart energy grid could combine power-to-gas storage and flexible load following generation along with decentralized power and CHP.

#### THE IMPORTANCE OF GAS IN END USE APPLICATIONS

In many parts of Northern

Europe, the largest final use of energy (excluding transport) is for heating. This load is highly seasonal, and mostly provided by natural gas. Condensing boilers are already over 90% efficient. A new generation of equipment in development includes small-scale gas heat pumps and hybrid systems (gas-solar, gas-electric). These will not only provide efficiency gains but also the potential to support renewable-based technologies while enabling energy system decarbonisation and the road to a long-term hydrogen based future. If the gas distribution grid is lost these options are lost. Emerging electric heat pumps are superficially more efficient (ignoring transmission losses), but less able to deal with peaks. Switching end-use to a fully electric system may also require at least a doubling of electricity transmission and distribution grid capacity.

As the gas network becomes

increasingly decarbonized through power to gas and increasing biomethane injection, the long-term prospect of a low carbon infrastructure can be realized. Recent modeling work in the UK has supported this analysis, and consideration of a Europe wide smart energy model should be given.

#### CONCLUSIONS

New gas technologies integrated with renewables can their increase flexibility and total capacity:

- The existing gas grid provides a flexible storage medium for energy and avoids costs of electricity grid reinforcement and under-utilization of renewable capacity.
- Smaller-scale flexible gas powered generation is developing which can load follow to support the intermittency of renewables.
- The gas network can become increasingly decarbonized through a mixture of power to gas and biomethane injection.
- The integration of a new generation of gas end use appliances will provide a lower-cost and flexible alternative to a dependence on increases in electricity transmission capacity.

In summary, natural gas technology will be vital in enabling the smart supply and demand managed, low-carbon integrated energy network of the future. ●

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#### Contact details:

Robert Judd  
Secretary General  
European Gas Research Group (GERG)  
Tel: +32 475 80 29 22 / +44 7796 610189  
robertjudd@gerg.eu

Av. Palmerston 4  
B-1000 Brussels  
[www.gerg.eu](http://www.gerg.eu)

# Cogeneration in Europe: An engine for growth

*By Fionna Riddoch, COGEN Europe*

**C**ogeneration is the process of producing heat and electricity at the same time. It is also known as “Combined Heat and Power” (CHP). Usually fuelled by natural gas, renewable energies or waste, cogeneration installations can vary in size from small units in residential buildings to large facilities that service industrial sites or district heating networks. Today, cogeneration is already providing 11% of

Europe’s electricity and 15% of its heat, and employing 100,000 European citizens.

Europe boasts a large indigenous cogeneration supply and manufacturing base and some of the most developed cogeneration economies in the world. This is partly driven by Europe’s historical strength in engine and turbine design, and partly by certain EU member states’ strong interest in making

energy-efficiency improvements – as a result of various energy shocks and crises. Historically, different member states have taken different approaches, but the result was good overall growth in the market in the last quarter of the 20th Century, which established a strong engineering and project development base.

Indeed, the design, development and implementation of CHP are core skill sets of many



*Fionna Riddoch*

major EU engine and turbine manufacturers.

Just like all successful industries, the cogeneration sector has innovated to follow the market. Applying CHP to an industrial process demands a bespoke approach, but well-designed systems deliver productivity gains to the host industry and CHP is now the best available technology in several industrial sectors. Engines and turbines have sought increasing electrical generation efficiency while maintaining overall high performance, continually pushing for higher efficiency and better environmental credentials.

The design of cogeneration plants has adapted to external market signals from the electricity and wider energy sector. They can now be fired by a range of renewable fuels. They reuse heat in an innovative manner. They can be combined with hot water storage, and other generation and storage devices, particularly in the district heating sector. The last five years has seen the introduction of micro-CHP units with capacities of as little as 1kW<sub>e</sub>, capable of fitting into individual homes. Units under 1MW are becoming increasingly popular, as interest in the self-generation of electricity and heat grows in response to changes in electricity pricing.

The last five years have also seen significant developments in fuel cell rather than combustion-based CHP. The European Commission's research and innovation directorate has continuously supported the development

of fuel cell technology, and a significant number of companies now have fuel cell offerings either on or close to being put on the market. The ene.field project – co-funded by the European Commission's Fuel Cells and Hydrogen Joint Undertaking (FCH-JU) – is Europe's largest demonstration of micro-CHP, the smart energy solution for private homes. Thanks to ene.field, up to 1,000 households across Europe will experience the benefits of this new energy solution.

As an approach to energy efficiency, cogeneration offers a wide range of opportunities for innovative engineering in order to get the most out of one unit of energy. Cogeneration is suited to a wide range of applications – indeed, while cogeneration is already recognised worldwide as the best available technology for refineries, paper mills, chemical plants and ceramic plants, it can offer energy advantages in many other sectors too. The list is long, varied and evolves along with the energy market.

Examples of cogeneration applications:

- Romanian wood processing company Sortilemn's biomass CHP plant uses modern, efficient biomass technology. An upgrade to trigeneration is planned.
- German beer giant Warsteiner uses CHP in its Warstein brewery, harnessing existing water tanks in order to store heat. Such maximisation of efficiency and heat utilisation is very attractive to the food industry.

- A trigeneration CHP in a Greek high-tech agricultural greenhouse generates electricity and provides heating and cooling as required.
- The CHP plant in Hotel Mons in Slovenian capital Ljubljana is an efficient solution placing a special emphasis on noise reduction.
- Slovenian metal supplier Riedl, which uses CHP for full heat supply with heat storage.
- The Ospedale Policlinico, a hospital in Milan, has a trigeneration plant, with a 1 MW absorption chiller and a black-out emergency function to guarantee continuous electrical supply.

COGEN Europe's annual technology and innovation award recognises projects or technological developments that break new ground for cogeneration. Past winners include Stadtwerke Rosenheim (2013) for its pioneering role in decentralised power generation, Honda's micro-CHP project team (2012), and Knook Energy Solutions (2009), for developing an alternative and effective way of reducing NO<sub>x</sub> and hydrocarbon emissions from gas engines.

COGEN Europe looks forward to recognising and celebrating innovation in the sector again at next year's conference and awards ceremony. Visit the association's website for the latest updates regarding nominations for 2014. ●

# Energy Efficiency: How Flanders is working towards an energy efficient future

By Ivo Belet, MEP

In the Belgian federal system energy policies are, at least partly, a regional matter. This means that Flanders, Wallonia and Brussels have the power to formulate their own energy policies.

With regard to the Europe 2020 targets, Flanders established an ambitious energy strategy. One of the important objectives of the Flemish government is to encourage low-energy construction and conversion of houses, being the most effective way of saving energy. The "Energy Renovation Programme 2020" stipulates that by 2020 all houses in Flanders must be low on energy use: Owners of existing houses are encouraged to make their buildings more energy-efficient; new buildings must comply with strict criteria with regard to energy efficiency.

The strategy regarding housing renovation in Flanders is based on 3 pillars: encouraging owners to install extra insulation (particularly in roofs); replacing single glazing with insulating glass and replacing outdated heating boilers with installations that are more energy efficient. The potential for improvement in Flanders is enormous. Nearly one in three rented houses currently has no roof insulation and more than half of them do not have any external wall insulation.

In order to encourage owners to invest in energy-efficiency measures, energy suppliers and

public authorities have made available grants and subsidies, with a tax rebate of 30% of the investment cost. By doing this, the Flemish government hopes to reduce families' fuel consumption by 30% by 2020 compared to 2004.

Further, the Flemish government has introduced a number of insulation and energy consumption requirements for new houses. The energy efficiency standard of houses is expressed by means of an E-rating: The lower the E-rating, the more energy-efficient the house. New houses built since 2012 cannot exceed an E rating of E70. From 2014 the maximum E-rating will go down to E60, followed by a further reduction to E50 in 2016, E40 in 2018 and E35 in 2020. As from 2021, new homes can only be built with a maximum E-rating of E30, making the building virtually energy-neutral.

Anyone who fails to comply with those standards faces a fine which can go up to several thousand of euros. Over the years, the number of fines has been increasing. In 2012, 7% of new houses failed to achieve the required E rating, a doubling compared to 2011. In the years ahead, the requirements will become even more stringent, resulting in more and more houses that will fail to meet the required standards.

Despite concerns that meeting the E rating standards will be difficult for some people, one should take into account that energy efficiency

measures give important benefits too. Effectively insulating your house can save vast amounts on your energy bills. In most cases, installing roof insulation makes it possible to recoup the cost within two years. Other measures, such as installing double glazing or a high-efficiency boiler, pay off within 5 to 10 years. Research done by the Belgian consumers' organisation 'Test Aankoop' has revealed that people's prime motive for investing in energy efficiency measures are not so much the environmental concerns but the desire to reduce their energy costs.

It is essential that we should continue to carry out campaigns to raise awareness of the cost effects of energy-efficiency investments. The cheapest energy, after all, is that which is not consumed. ●



Ivo Belet

# Brussels successfully takes up the energy challenge!

Over the past ten years, the Brussels-Capital Region has changed dramatically. Fast and for the better.

Brussels has achieved impressive results in most environmental fields, especially in terms of energy, thanks to a number of policy initiatives aimed at the whole population.

By Evelyne Huytebroeck, Brussels Minister for the Environment, Energy and Urban Renewal

**T**he Brussels Region is a city presenting challenges of every kind: economic, social and demographic. This context is decisive. So it was vital to address the existing situation, but also to look forward to the future. These efforts have met with success. Between 2004 and 2011, CO<sub>2</sub> emissions have fallen by 20% and per capita energy consumption by 21%, despite a 10% rise in the population. This excellent result is largely due to the introduction of an effective energy policy since my first term of office in 2004. This article will give several examples.

The **sustainable building**

policy has made a significant contribution to these results. It consists of financial incentives, the most ambitious energy performance legislation in Europe, a support mechanism for renewable energy, a programme of replicable exemplary buildings and aware-raising among the public, focusing in particular at those on low incomes. The results have been rapid and tangible.

For example, since the scheme was introduced in 2004, **more than 150,000 energy grants** have been paid out in the Brussels Region, amounting to some **€100 million**. Thanks to these grants, more than **€650 million** of energy-saving investments have been generated.

The **Brussels green loans scheme**, PVB ("*prêt vert bruxellois*"), was created in 2008 and primarily targets low-income households who have difficulty acquiring the finance needed to carry out works. The PVB offers zero-interest rate loans for a whole range of energy-saving investments (high-performance double glazing, roof insulation, fitting control thermostats and thermostatic valves, etc.).

At the same time, since 2007 the Brussels-Capital Region has organised five calls for projects

as part of its **Exemplary Buildings** scheme to provide technical and financial encouragement for eco-design approaches to both construction and renovation. Candidates must meet four criteria: the best energy performance, the lowest environmental impact, cost-efficiency and replicability, and architectural quality and sound urban integration. Winners receive a subsidy of €100/m<sup>2</sup>, together with technical support and they can improve their visibility. Thanks to these five calls for projects, Brussels now has **193 Exemplary Buildings, representing 520,000m<sup>2</sup> subsidised** to the tune of **€29 million**. They include housing, offices, schools and crèches, a funeral parlour, a swimming pool, etc.

These calls for projects have also celebrated the arrival of the **passive standard**, with hundreds of housing units (new and renovated), several schools and office buildings, totalling **500,000m<sup>2</sup> of passive buildings** consuming one-tenth as much energy as traditional buildings. Brussels is now a European leader in the field of buildings with very high environmental performance. In 2015, the Region will be the first in the world to adopt the passive standard for all new public and private buildings.

Photo: Victor Levy, Sofam



Evelyne Huytebroeck

Brussels has thus taken the first step towards introducing the zero energy standard (= passive standard + renewables) in 2020.

This energy policy would not have been possible without the support of the building industry. The sustainable building strand of the **Employment-Environment Alliance** was launched in 2010 with the construction sector. The aim? To provide support in achieving the ambitious standards adopted by Brussels and to ensure that the transition generates economic activities in Brussels and new jobs for its residents.

Finally, this year Brussels has launched the **"Maison de l'Energie" or Energy House**, an information and advice centre offering free services to all Brussels residents. It answers all their questions about energy in the home. Technical, financial and administrative information and advice is available, relating both to the rational use of energy and to carrying out works.

All these results have been welcomed by the European Commission and by independent international experts. The Brussels Region was chosen among the finalists and came second in the European Green Capital award. It was also one of the leading cities in the Economist's Green City Index. We also won a European Energy award in 2012 for our energy policies as a whole.

Brussels is now clearly one of the leading cities in Europe in terms of environmental and energy policy, and day by day it is becoming a more and more sustainable city. ●



*L'Espoir, an Exemplary Building in Molenbeek*



*The future headquarters of Brussels Environment, the environmental administration in Brussels (the administration of Evelyne Huytebroeck). The largest passive building in Brussels (in construction).*

# Brussels Nearly Zero Energy Building Policy and Brussels Local Action Plans for Energy Management (PLAGE) distinguished by Europe!



Commissioner Oettinger and (former) Minister-President of the Brussels-Capital Region, Charles Picqué, EUSEW Award 2012

The Brussels-Capital Region is an urban area whose population exceeds one million inhabitants and is continuing to grow. The housing stock in Brussels is very compact but old. In terms of energy policy, the energy, geographic and socioeconomic characteristics of Brussels have led to priority being given to the energy performance of buildings (buildings consume 72% of energy consumed in the Brussels area) and the development of an energy culture among all players.

In this context, the Brussels-Capital Region (through *Bruxelles Environnement*, its administration for environment and energy) has organised since 2007 five calls for projects for Exemplary Buildings to provide technical and financial encouragement for eco-design approaches to both construction and renovation (see interview of Minister Huytebroeck on page 76).

Thanks to these five calls for projects, Brussels now has **193 Exemplary Buildings**,

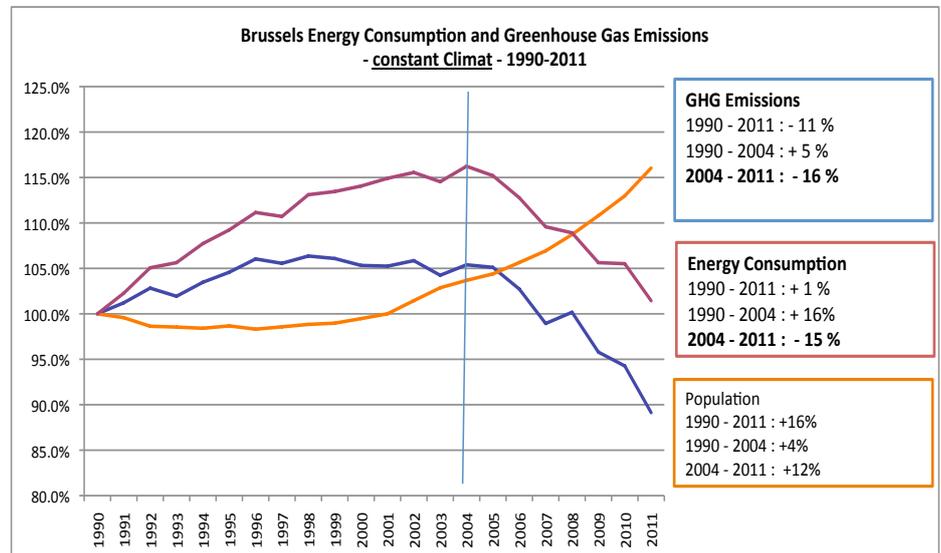


representing **520,000 m<sup>2</sup> subsidised**. Also, thanks to this programme, the building sector has been encouraged towards high energy performance and, since 2007, **more than 500,000 square metres of passive buildings** have been built from scratch in Brussels. On the basis of this successful experience, the Brussels-Capital Region decided to make the passive standards the legal reference for all new buildings from the first of January 2015. For its Nearly Zero Energy Building Policy, the Brussels-Capital Region has won the EUSEW 2012 Award (Living Category)<sup>1,2,3</sup>.

**The Local Action Plan for Energy Management, known by its acronym PLAGE**, is aimed at organisations managing large building stocks in both the private and public sector. Since it was introduced in 2005, PLAGE has led to an average 16% cut in heating costs and an annual reduction of 10 000 tonnes of carbon dioxide emissions.

In addition to cutting the heating costs of participating organisations, the PLAGE project has also led to a stabilisation of electricity consumption (rather than a projected 2% annual increase) and the saving of €4.25 million a year.

PLAGE has so far been implemented in 15 (of 19) Brussels communes, including five hospitals, two collective housing organisations, six social housing organisations and 70 schools, totalling around 1380 buildings and 4.5 million m<sup>2</sup> of floor space. The project provided funding for participating organisations



Evolution in energy consumption and greenhouse gas emissions – at a constant climate – 1990-2012. Source: Bruxelles-Environnement 2012

to appoint an energy manager for a four-year period. Each participating organisation is required to compile an inventory of all its buildings and to identify priority buildings whose energy consumption is closely monitored over a four-year period.

According to Grégoire Clerfayt, Head of the Energy Directorate at Bruxelles Environnement, “the main idea behind the adoption of a PLAGE action plan is to bring about a new energy culture in the management of buildings and infrastructure. This methodology is relatively simple and not expensive to implement and the energy-saving measures usually pay for themselves within less than five years.”

As a result of PLAGE’s success, the Brussels Regional Parliament stated that, from 2015, all private building owners with estates over 100 000 m<sup>2</sup> and public building owners with estates over 50 000 m<sup>2</sup> must adopt a PLAGE action plan. This will extend the reach of the scheme to between 12 million and 15 million m<sup>2</sup> of public and privately-owned property, helping the Brussels Region reach EU 2020 targets.

With its PLAGE project, the Brussels-Capital Region, through Bruxelles Environnement, has been nominated for the EUSEW 2013 Awards (Consuming category) and for the Managenergy Local Energy Action Award<sup>4,5</sup>. ●

1 [www.eusew.eu/awards-competition/awards-2012](http://www.eusew.eu/awards-competition/awards-2012)  
 2 [www.racine.be/fr/exemplary-buildings-success-stories-brussels](http://www.racine.be/fr/exemplary-buildings-success-stories-brussels)  
 3 [www.bruxellesenvironnement.be/batimentsexemplaires](http://www.bruxellesenvironnement.be/batimentsexemplaires)  
 4 [www.eusew.eu/awards-competition/awards-2013](http://www.eusew.eu/awards-competition/awards-2013)  
 5 [www.bruxellesenvironnement.be/PLAGE](http://www.bruxellesenvironnement.be/PLAGE)

# 100% renewable energy in Belgium

## An opportunity to seize!

**Since 1991, the Association for the Promotion of Renewable Energies (APERe) has pleaded for the inclusion of more renewables in the energy mix. The claim that seemed totally unreasonable then is now part of concrete plans that will shape our future... If we go for it now.**

*By Michel HUART, Secretary General of APERe and Senior Lecturer at Université Libre de Bruxelles*

**T**here is no mystery, no secret, no magic. We have needs, and available energy resources to fulfil them. A balance must be found between what we demand and what is on offer. To do so, we have to reduce the energy consumption (working on behaviour and equipment) and to produce what we still need

thanks to renewable energy.

So far, Belgium has managed to reach 5% share of renewable energy in the final consumption of energy (including 9% of the electricity, figures for 2011). The EU 20-20-20 directive fixed our 2020 objective to 13%. Our National Renewable Action Plan aims to get there with 20.9% of

electricity, 11.9% of heating and 10.1% of transport. This works theoretically, but the Regions which hold most of the energy competences still have to turn these objectives into regional binding targets, then into reality.

This will only be a stepstone towards a goal that needs to be much more ambitious.





With the support of European interconnections, Belgium can achieve 100% of renewables, but it will only happen if we put the right drive into it. As Laurence Renier points out<sup>1</sup>, energy is very often considered as a technical challenge only. Renewables are seen as a simple substitute to fossil fuels, which they have to replace in the current social and technical framework. Their capacity to reach this objective is – often rightly – questioned. Renewable energies demand technical, political, economic and social systems that are radically different from the ones in which fossil and nuclear energies have grown. They only make sense in a new institutional framework implying the re-appropriation of the energy issue by the citizens, and their decentralised exploitation. This is their main challenge for our society. By offering a new relationship with the world and nature, they open horizons way beyond the technological innovation.

Belgium is facing real challenges regarding the support given to renewable energies. The energy transition is heatedly debated, political and administrative bodies struggle to adapt regulations to the market pace, a simple system must be found that will allow all technologies to be attractive enough for their target. We are at a crossroad, and social acceptance is crucial to make the right turn.

Local initiatives prove that mentalities are evolving. Sixty-eight Belgian towns have signed



**You don't believe it's possible?  
 Trust the sky!**



Coordinated by APERe, the EU-funded project EnergizAIR adds renewable indicators to the weather forecast. Day by day, you can know how much energy was offered by the weather through solar PV, solar thermal and wind energy.

The data are available for ten countries (Belgium, France, Germany, Hungary, Italy, Portugal, Slovenia, Spain, Sweden and the UK) and are broadcasted regularly in national media.

Check them out on [www.energizair.eu](http://www.energizair.eu)

the Covenant of Mayors and committed to more ambitious objectives than the European and national ones. In Wallonia, no new wind farm can be built without the question of local participation being openly discussed. Energy group purchases are flourishing in all parts of the country. People need to be involved in the change of paradigm that will lead to sustainable energy for all. The technologies are mature, the resources available. Social sciences might be the missing link to actually embrace the energetic transition that definitely is within reach. ●

*“The analysis leads to the undeniable observation that drastic changes in a multitude of areas throughout society are required to obtain the desired level [100%] of renewable energy penetration in 2050, but also that such a transition can be realised through various sectoral, technology and inter-temporal choices.”*

Towards 100% renewable energy in Belgium by 2050 – study by **VITO, ICEDD and Federal Planning Bureau**

<sup>1</sup> RENIER Laurence; Dossier « Adaptation aux changements climatiques! » - Vers une transition énergétique ? - Natures Sciences Sociétés 19, 133-143 (2011)



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