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Shipping

Waste-to-Energy

Energy Efficiency in Buildings and Industry

Country profile
IRELAND

Spring 2015

Includes editorial contributions from:

Alex White
Ireland's Minister for Communications, Energy and Natural Resources

Jos Delbeke
Director-General of DG Climate Action, European Commission

Gerben-Jan Gerbrandy
Environment spokesman o the Alliance of Liberals and Democrats for Europe

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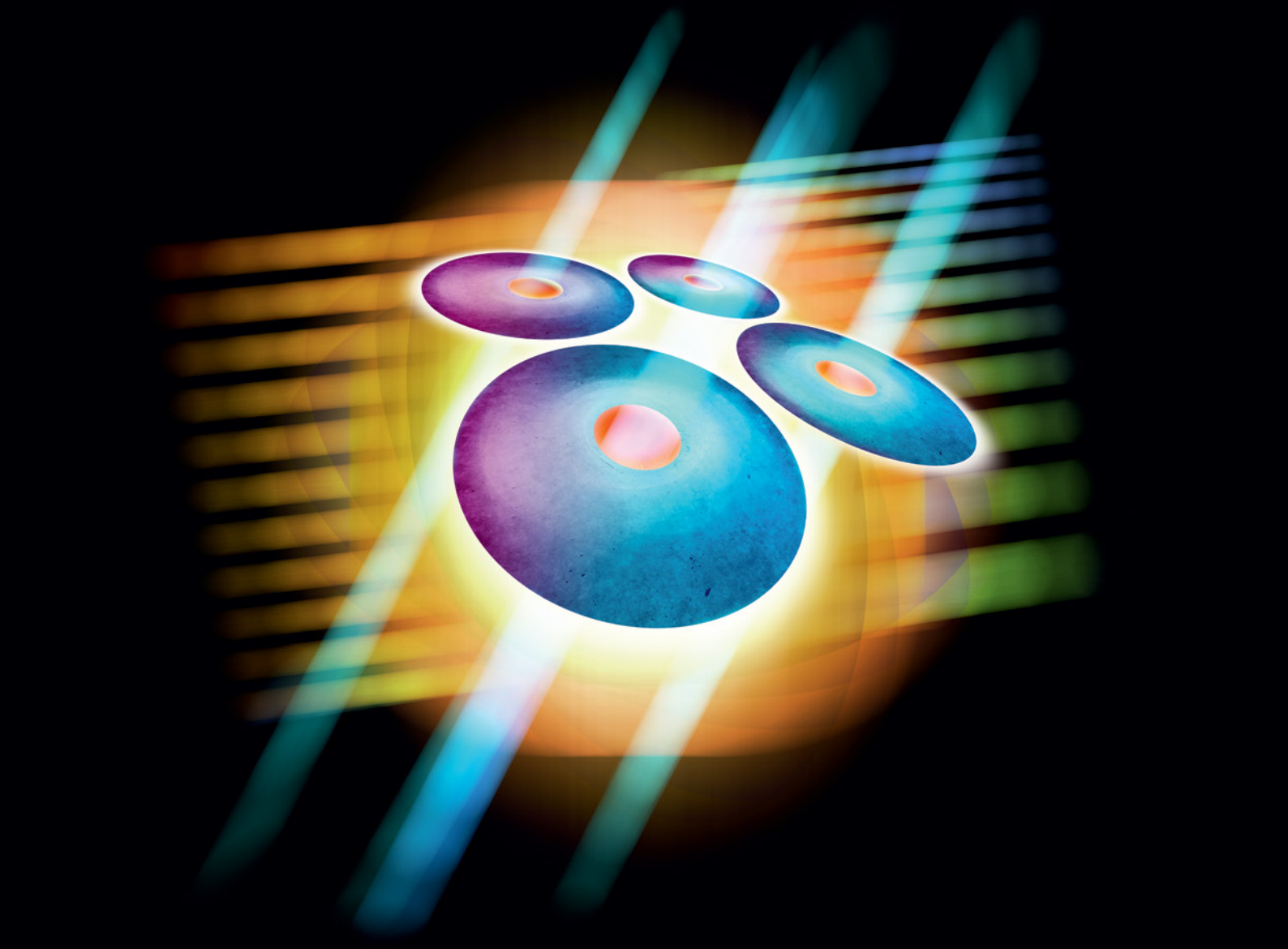

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Contents


6


8


16


42

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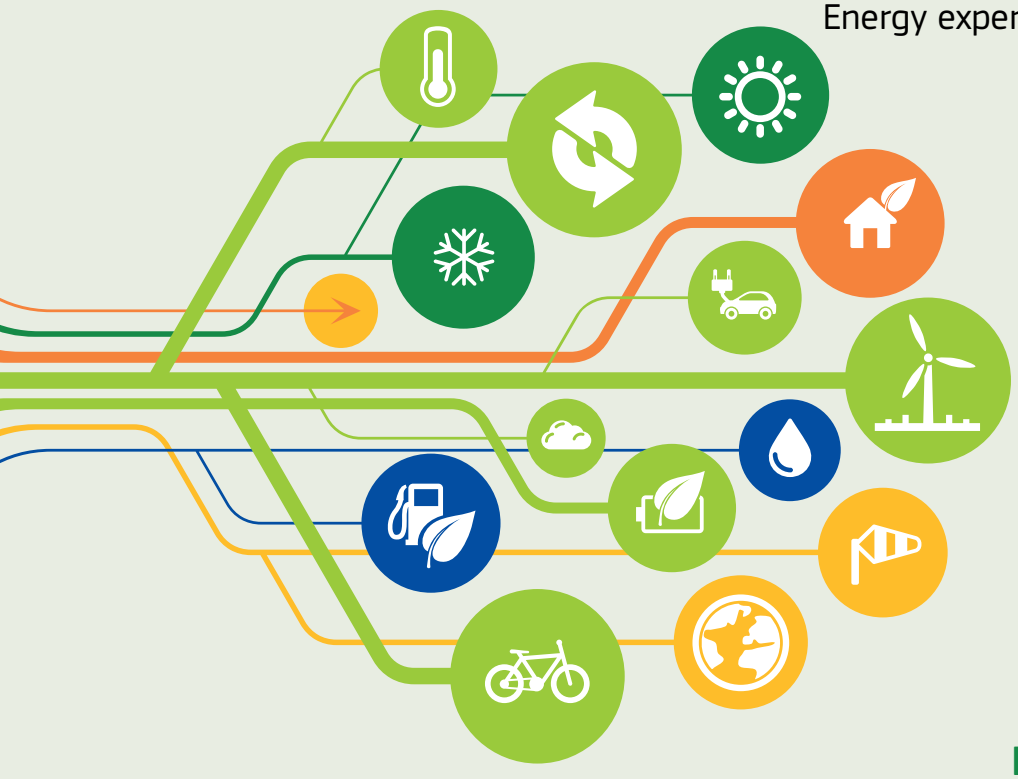

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Foreword

2015 seems to have begun much as 2014 ended - austerity hovers over Greece while insecurity looms over our energy supply; tensions in the Balkans, terror in the Levant. There are however one or two themes in this issue that offer a more sanguine outlook.

Dr Edmund Fleck reviews the role of waste-to-energy (WtE). Around 85% of the energy contained in waste can be recovered by burning it, producing the lowest emissions of all European combustion industries. But he argues that this is to overlook the benefits of recycling, pointing out that energy and the circular economy are intertwined. Echoing these arguments, Marta Gurin and Lorenzo Ceccherini explore the role of WtE in waste management and energy systems. In 2012, 456 plants across Europe produced 32 billion kWh of electricity and 79 billion kWh heat, while preventing about 78 million tonnes of waste from being landfilled.

Minister Alex White discusses Ireland's forthcoming energy policy covering the period to 2030 and beyond, advocating a well informed and robust debate on sustainability, affordability and security of supply as integral to developing a definitive energy policy statement to 2030 and beyond. With COP21 this December, he contends that 2015 will be a decisive year in climate policy.

Beatrice Coda reviews the potential of Carbon Capture and Storage (CCS) to reduce the impact of CO_2 produced by the largest emitters, fossil fuel power plants and heavy industry. Citing EU acknowledgement of the importance of CCS for power and energy-intensive industrial sectors, she sets out the challenges of containing costs and securing a business case. She foresees infrastructure connecting CO_2 sources to sinks - reflected in the TEN-E Guidelines.

Jesper Aagesen gives an insight into the focus at Lloyd's Register on Energy Efficiency for Ships. Referring to recent developments in emissions legislation, he proposes a four stage approach to energy efficiency and goes on to discuss how this may further be improved by optimising both trim and "design point". Nevertheless, he maintains, transportation by sea remains the most environmental friendly means of transporting goods. Continuing the maritime theme, Gesine Meissner MEP explains the importance of Blue Energy. Oceans and seas provide us with fish, she explains, connect our industries and supply oil and gas; and now offshore wind, and potentially wave and tidal energy.

In a fascinating article, intriguingly titled: Investing in Negawatts, the world's 'first fuel', Kathleen Van Brempt MEP investigates the potential economic significance of energy efficiency. Energy efficiency projects, she says, create 3 to 5 times more jobs than fossil investments, while the International Energy Agency (IEA) has called energy efficiency 'an invisible powerhouse' worth at least 276 billon euros per year and growing.

Room for optimism? Indeed! And there is more for you to read inside.

Michael Edmund
Editor

Why Europe need a strong Energy Union

By Gerben-Jan Gerbrandy the environment spokesman of the Alliance of Liberals and Democrats for Europe (ALDE)

The European Commission recently presented a proposal for one of its most important flagship projects: the creation of a European Energy Union. If done right, it could lead to the delivery of a genuine single European energy market with increased competition and lower energy costs. It could increase energy efficiency, create millions of new jobs, make Europe the leader again in the fight against climate change and make Europe a more attractive place for companies to invest in. Moreover, European energy independence would be a blow to Russia's geopolitical significance and make Europe more independent from third country energy suppliers.

But it will only work if Europe dares to propose an Energy Union with teeth. We need to invest substantially in energy efficiency, renewables and infrastructure the coming years. If we make the right choices now Europe will have cheap, clean and secure energy in abundance. This requires concrete actions in five areas.

Europe urgently needs a much more ambitious energy efficiency strategy. The potential benefits of becoming more efficient are enormous! The International Energy Agency even calls energy efficiency the world's "first fuel" by virtue of its lowest cost, availability and sustainability. If Europe modernises its houses and offices, updates its transport means and allows smart technologies and ICT innovations, we could save incredible amounts of currently wasted energy. A clear focus on energy efficiency will boost investment and potentially create millions of jobs, for instance in the building sector, but also in Europe's troubled manufacturing industries. It is a crucial condition, if we are to achieve the EU's goal to reduce emissions up to 95% in 2050.

Secondly, we must establish a competitive and integrated energy market within the EU. Liberalisation measures, such as the Third Energy Package, are underway, but EU Member States have been too reluctant to implement these laws. They have made little effort to invest in interconnections with other energy grids and they too often act only to protect their own semi-state owned energy companies. While in fact, a more integrated single market in energy could result in efficiency gains of some 50 billion euros a year. We need to overcome the current fragmentation of energy policy into 28 different systems and reaping the full benefits of a common European.

In order to secure a functioning Energy Union, strong European governance is essential. Modelled on the economic governance framework, the EU should set up an "Energy Pack" that will keep all 28 Member States on track. The Commission must monitor and strictly enforce the rules regarding the Energy Union, but also the implementation of the targets that will be set in the EU 2030 climate and energy framework – those include a drastic reduction of CO2 emissions, and an increasing use of renewable energy.

Fourthly, Europe's advanced position in clean technologies needs to be maintained by boosting research and innovation. We must enhance cooperation between researchers by better targeting existing European funds. Particular attention should go to bridging the gap between the pre-commercial demonstration stage and the actual marketing of new technologies, bringing economies of scale.

Finally, special attention needs to be given to the business side of the Energy Union. The single biggest barrier to investment is regulatory uncertainty, with national and Union policy frameworks changing constantly. Investors will only put their money in the many projects of the Energy Union if the associated regulatory framework is put in place, environmental legislation is predictable and competition policy is sound. This also applies

for citizens – today's micro-investors – who increasingly want to produce their own energy.

The stakes are high. If Europe can deliver an ambitious and effective Energy Union, we will achieve our crucial goal: having cheap, clean, and secure energy in abundance. Europe will once again lead the development of green technologies and make a fast transition to a sustainable economy. Putin and many of the other energy exporters outside the EU, who have grown wealthy on our addiction to fossil fuels, will be willing us to fail; but this is a fight we cannot afford to lose.

Waste-to-Energy: Essential for Future Energy Systems Essential for the Circular Economy

By Dr Edmund Fleck, President, ESWET (pictured)

Energy systems of the future and the Circular Economy are being developed separately. If Europe acts smartly, Waste-to-Energy can connect the two

What to do with our waste?

The best solution would be to not generate waste in the first place. Thus a zero-waste-society would be the ultimate aim to achieve. But as mankind is not perfect, human beings are not perfect, reality is not perfect, a zero-waste-society will not materialise anytime soon.

The next best option is to apply the EU Waste Hierarchy: Reduce, Reuse, Recycle, Recover and, as a last resort, Dispose. Once waste is generated, sorting it to encourage reuse and recycling should be the preferred choices. Nevertheless, not everything can be recycled. Residual municipal waste, the waste stream focussed on in this article, contains a mix of many materials that can only be recycled by creating a low-grade recyclate, e.g. paper which ended up being soaked by liquid or greasy substances.

A solution is needed to recover the energy and materials from residual municipal waste. This can be done with different

Two types of renewable energy, side by side, wind and waste

technologies, but the best overall environmental benefits are yielded by a plant that can co-process all types of residual municipal waste and re-insert its energy and materials back into the circular economy; Waste-to-Energy (WtE) plants.

This technology has enabled many European countries to have among the highest recycling rates in the world and at the same time to minimise the amount of waste ending up in landfills.

Which technology is the most suited for residual municipal waste?

There are several candidate technologies to handle residual municipal waste. On the one hand, Waste-to-Energy (grate incineration with energy recovery and flue gas cleaning), the technology supplied by ESWET Members, has been used for decades worldwide.

Waste-to-Energy plants have the lowest emissions of all European combustion industries.

On the other hand, many emerging processes, which promise superior performance and results, fail to break ground on the market due to yet unresolved core technical issues.

Residual municipal waste is a complex resource, challenging any treatment because of its heterogeneity. This same characteristic makes energy recovery processes such as gasification and pyrolysis, which thrive on "pure" fuels or waste streams, struggle to process mixed waste, whose nature is constantly fluctuating, on an industrial scale.

The most energy-efficient treatment of residual waste must minimise the amount of energy needed to make the waste usable as a fuel, and valorise all combustible fractions. Any avoidance of sorting or pre-treatment of the residual waste is saved energy. Additionally, fractions of residual waste that do not undergo thermal treatment will likely head for landfill, "burying" that energy.

WtE plants combine a maximum energy production from waste, while minimising pre-treatment energy losses. On top of that, the process can be arranged locally, reducing fossil-fuelled transportation.

Increasing the energy efficiency

Around 85% of the energy contained in waste can be recovered by Waste-to-Energy plants' boilers. About half of this energy is considered renewable as it comes from the biogenic part of waste. If it is converted into electricity, waste will act as a dispatchable source which can feed the European grids with much-needed reliable and balancing electricity.

However, grid access is becoming increasingly challenging, but waste incineration is better performed in a steady and continuous manner. Hence, electricity production should be complemented by heat supply wherever possible, also in order

An example of recovered metals (in particular the metal sole of a safety boot)

to increase the overall energy efficiency of the process.

This is where District Energy from Waste kicks in. Waste-to-Energy plants operating as CHP (cogeneration of combined heat and power) maximise the energy output from waste and help powering the circular economy we all crave for. Supplying a city's heating and/or cooling networks with indigenous energy – its own waste – helps securing Europe's energy supplies. It also contributes to reducing Greenhouse Gas Emissions (avoided landfilling and its associated methane emissions) and increases the reliance on renewable energy. ESWET, along with partner associations, advocates for the continued development of District Energy from Waste[1].

Closing the loop of the circular economy

Along with the energy-producing benefits that Waste-to-Energy entails, those plants also sort material and make them available for various uses in the circular economy.

Valuable materials that would have swelled landfill volumes if they had not been treated in Waste-to-Energy plants – metals and minerals – are routinely recovered from Waste-to-Energy plants' residues. For instance, 116,176 tonnes of ferrous metals were recycled from Dutch Waste-to-Energy plants in 2013[2].

Similarly, in European countries that have minimised landfilling it is estimated that 40% of the aluminium recycled from Municipal Waste comes from Waste-to-Energy plants. And in some fore-running plants, it has been possible to recover a few kilos of gold per year from waste[3] thanks to advanced sorting.

Integrating the circular economy for materials in a sustainable energy system

At the moment, Europe is pondering its energy future while simultaneously – but separately - yearning for a circular economy.

A clear example of this compartmentalised thinking is the current approach to Waste-to-Energy. On the one hand, it is not seen as a significant energy source, despite already fulfilling 1.3% of total European energy needs, equivalent to 19% of the EU gas imports from Russia[4], and heating entire city blocks. On the other hand, it is shunned from the circular economy, despite producing valuable energy and materials from polluted or unwanted resources that would otherwise have been landfilled.

Realising that energy and circular economy are intertwined should guide decision-makers to increase synergies and coordinate support while making Europe more competitive and sustainable. Such goals cannot be fully accomplished without policies that minimise landfilling while developing the necessary Waste-to-Energy infrastructure in each EU Member State. ESWET is ready to answer that call.

1 http://www.eswet.eu/tl_files/eswet/1.%20Welcome/Warmth%20from%20Waste2014.pdf
2 http://www.verenigingafvalbedrijven.nl/fileadmin/user_upload/Documenten/PDF2014/Reststoffen_2013_augustus_2014.pdf
3 http://zar-ch.ch/zar/publikationen/medien/
4 http://www.ciwm-journal.co.uk/archives/11811

Environmental compliance and economic performance can shake hands

The EU's circular economy, greater energy self-sufficiency and promoting energy and climate goals are placing greater demands on today's society. New power generation technology makes it possible to balance environmental compliance with economic performance.

Using fossil fuels in energy production is becoming more challenging due to their effect on climate change. Another major challenge is the ever-increasing amount of waste and how to handle waste streams sustainably.

Waste used to be a problem but is now a valuable fuel. One ton of combustible waste contains the energy equivalent of approximately 300 liters of crude oil. Air pollution and the issue of hazardous emissions connected to combustion have basically been eliminated by modern environmental technology.

MORE EFFICIENCY AND ADDED VALUE FROM WASTE THROUGHOUT THE WASTE STREAM

Innovative waste-fueled energy generation can be found, for example, in Lahti, Finland. In 2012, Lahti Energy Ltd. started up the world's first gasification power plant running purely on solid recovered fuel (SRF) to produce 50 MW of electricity and 90 MW of district heat. By replacing coal with SRF, the company has been able to significantly cut its CO_2 emissions. According to Lahti Energy, gasification is the most energy-efficient way to utilize waste.

In the present waste hierarchy, gasification stands at the same stage as traditional waste incineration, regardless of the fact that it features unrivaled benefits. Gasification almost doubles the efficiency in power generation, lowers emissions and generates a refined product (product gas). In addition, the fuel used is sorted waste, thus promoting a higher rate of recycling.

Now that the EU is making decisions about the circular economy and revising the waste framework directive, it should be promoting new and more efficient technologies to enter the market instead of hindering progress.

In addition to high energy efficiency, gasification provides other benefits, too. In Lahti, a new supply chain has been born around waste. Fuel payments have created a new market for fuel preparation, and the quality of SRF has improved. Tighter quality control benefits other SRF users as well, for example, material recycling. Operations have created approximately 100 new jobs in the supply chain.

ROLE OF BIOMASS INCREASING

In addition to waste, local renewable fuels, such as various biomasses, are an economically viable way to reduce greenhouse emissions. They generate both heat and electricity, are locally available and benefit the local economy.

With today's technology, biomass can replace coal in coal-fired plants. For example, Vaskiluodon Voima started up the world's largest biomass gasification plant in Vaasa, Finland, in 2013. The company has been able to cut CO_2 emissions by around 230,000 tons per year with the 140 MW plant.

USE OF WASTE AND BIOFUELS TO REDUCE EMISSIONS

These two cases feature Valmet's technology. During the past ten years, Valmet has delivered more than 13 GWth of boiler capacity that utilizes renewable fuels and reduces emissions associated with fossil-fuel-fired boilers.

This CO_2 neutral energy production has helped avoid 40 million tons of greenhouse gas emissions annually, corresponding to emissions from over 24 million cars.

Read more about Valmet's technology solutions on **valmet.com**.

Photo: Lahti Energia

Energy Efficiency in practice – contribution from Waste-to-Energy plants

By Marta Gurin and Lorenzo Ceccherini, CEWEP

Waste-to-Energy (WtE), waste incineration with energy recovery, plays an important two fold role in waste management and energy systems. Its primary purpose is to safely treat the residual waste that cannot be recycled while producing sustainable, low-carbon and local energy from it. In the last years, the WtE sector focused a lot on energy efficiency, providing substantial results. This short article will focus on the contribution of WtE plants to Energy Efficiency: use of heat for District Heating (DH) and steam for industrial application.

OVERVIEW ON WTE IN EUROPE

WtE helps to divert waste from landfills, thus reducing possible impacts on land, air and groundwater quality. At the same time WtE is ensuring a high quality recycling by treating all residual waste that is not suitable for recycling and recovers energy from it.

In 2012, 456 plants across Europe (EU28 + Norway and Switzerland) produced 32 billion kWh of electricity and 79 billion kWh heat, while preventing about 78 million tonnes of waste from being landfilled. This amount of energy is enough to supply about 28 million inhabitants with electricity and heat.

Energy produced in WtE plants helps to achieve the EU's policy for renewable energy sources to cover 20% of the whole energy consumption by 2020. This is due to the fact that a significant part of the waste treated in WtE plants (about 50% in average) is biogenic – biomass – which means that about half of the energy produced by WtE plants is renewable.

ENERGY EFFICIENCY IN PRACTICE – WTE PLANTS AS SUPPLIERS OF HEAT AND STEAM

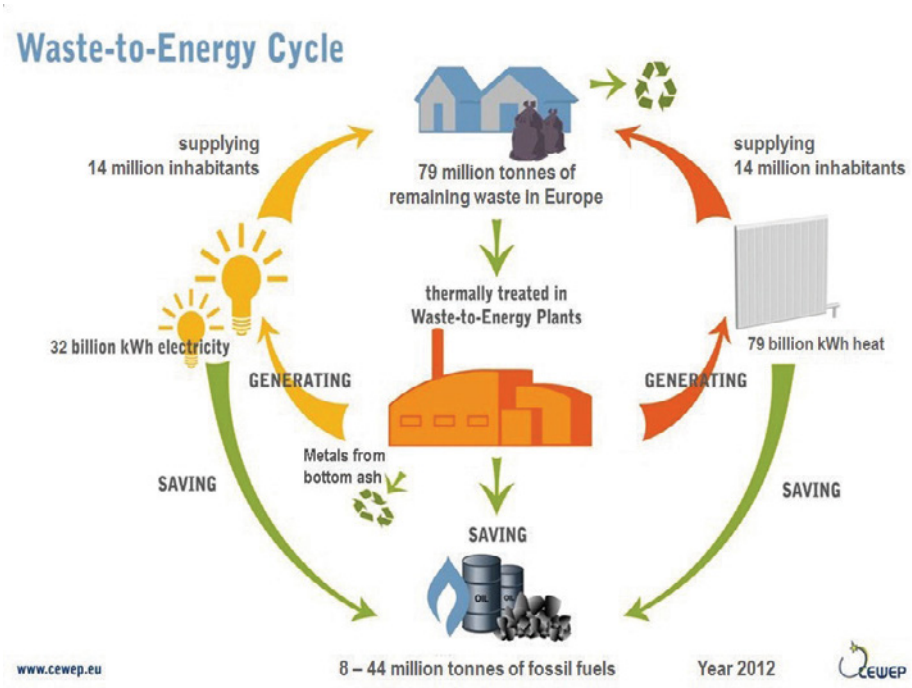
Residual waste represents a local, cost effective, secure and sustainable energy source which is already used in some District Heating and Cooling (DHC) systems across Europe, allowing them to deliver affordable energy and reducing primary energy consumption.

About 60% of the WtE plants across Europe are Combined Heat and Power (CHP), providing electricity through a steam turbine and then recovering heat with high efficiency for both district heating and steam supply to neighboring industries. Recovered energy from waste for DH systems represents 50 TWh per year, i.e. around 10% of the total heat delivered through DH systems.

The following two examples are coming from the Netherlands, where in 2013 almost 12% of all sustainable energy produced in the country was generated by WtE plants.

The supply of heat and steam by Twence Hengelo WtE plant to local industry and local district heating systems won a 2013 Global District Energy Award in the category "Modernisation of existing networks". The WtE plant of Twence, supplies steam to AkzoNobel's salt-production plant via 1.5 km steam pipeline. Thanks to this pipeline, which delivers around 800,000 tonnes of steam per year AkzoNobel managed to reduce their consumption of natural gas by 80 million cubic meters per year. Another pipeline connects the WtE plant to the local DH system of the city of Enschede and supplies around 180 GWh of heat which equals the heat consumption of 13,000 households. This allows the saving of natural gas of about 22.5 million cubic meters per year.

The AVR Rozenburg WtE plant supplies steam to industry located in the area of Rotterdam harbour and heat to the DH of Rotterdam. The WtE plant supplied in 2013, 416 GWh of process steam to several industrial plants via an above-ground steam pipeline. The current DH system – South Branch, length of 26 km, supplied in 2013, 416 GWh of heat for 50,000 households in Rotterdam. In 2015 a new DH pipeline – North Branch, length of 16 km, will supply on a yearly basis around 972 GWh of heat to the city of Rotterdam, providing sustainable heat for 95,000 households.



The last example of the efficient use of resources in this short article comes from the north of Italy.

The A2A Brescia WtE plant delivers both electricity and heat through DH system, satisfying the energy needs of one third of the inhabitants of the city of Brescia. In 2013, the WtE plant supplied 561 GWh of electricity and 805 GWh of heat for district heating. This represents fossil fuel savings of about 150,000 toe (tonnes of oil equivalent) and avoids 400,000 tonnes of CO2-emissions. It is worth noting that in the city of Brescia the WtE plant delivers 68 % of the local district heating demand.

The examples presented above demonstrate well the general trend in the WtE sector – strong focus on achieving high energy efficiency and providing substantial results for the local industries and communities.

However even more can be done by better shaping the energy and environmental policy on European and local level. Better infrastructure (for district heating and cooling and steam delivery for industry) and diverting more waste from landfill to quality recycling and energy recovery are necessary in order to develop Waste-to-Energy's full potential for providing high energy efficiency solutions.

CEWEP (Confederation of European Waste-to-Energy Plants) is the umbrella association of the owners and operators of Waste-to-Energy plants (waste incineration with energy recovery) across Europe. CEWEP's members are committed to ensuring high environmental standards, achieving low emissions and maintaining state of the art energy production from remaining waste that cannot be recycled in a sustainable way.

Waste-to-energy Agency (EGE), City of Oslo

The Waste-to-Energy Agency (EGE) has 200 employees, and develops and operates industrial waste-to-energy plants. The agency receives and recycles waste from Oslo households and businesses. Source-sorted household waste from Oslo's population is received at the EGE optical sorting plant, where green bags containing food waste and blue bags containing plastic waste are separated from residual waste with the aid of optical scanners. The plastic from the blue bags are recycled into new plastic products, while food waste from the green bags is used to produce biogas and biofertilizer. Burnable residual waste becomes eco-friendly district heating and electricity. Flue gas from the incinerators undergoes an extensive cleaning process in several stages, in order to ensure that all pollutants are safely separated and that the level of emissions remains as low as possible.

For more information about our waste-to-energy services, contact our sales representative Kjell Henrik Olsen (pictured).
Tel: +47 904 77 115
Email: kjell.henrik.olsen@ege.oslo.kommune.no

Oslo has ambitious goals for its environmental policies, and is keen on becoming one of the leading international environmental cities. The city's environmental vision is "We will hand the city to the next generation in a better environmental condition than when we received it."

WASTE FROM EUROPEAN ACTORS

EGE has the capacity to recover energy from 410,000 tons of waste annually, and produces 900 GWh of district heat and 160 GWh of electricity. The agency sells some of its energy recovery capacity to European actors, and in 2014 it received approx. 80,000 tons of sorted waste from England. With focus on efficient logistics and a quality value chain, sorted waste (RDF /Refuse Derived Fuels) is transported in containers and below deck in cargo holds, and its quality is optimal for energy production at our plants. Waste from England is used for winter fuel at EGE plants in Oslo, which increases the supply of eco-friendly heat to district heating systems during the cold winter months.

RDF from England is a mix of unsorted household waste and commercial waste with good heating value, and is well-suited for intermediate storage. The current capacity for eco-friendly waste processing in Europe is quite limited, and large amounts of household waste (about 150 million tons per year) end up in landfills. Research has shown when waste is transported to Oslo and treated here, (waste which would otherwise have ended up in landfills), CO_2 emissions are reduced by 600 kg per ton of waste.

HEATING OSLO

Waste management in the city of Oslo is based on the philosophy that waste should be processed through a "life cycle waste system". This means that all household waste that cannot be recycled is recovered as energy. Heat energy from residual waste is used for district heating for residential and office buildings, as well as public buildings. EGE's district heating production currently constitutes about 50% of the energy needs for Oslo's district heating system. One major alternative to district heating is oil heating, and four tons of waste can replace one ton of oil for heating purposes.

District heating can reduce the amount of oil heating by as much as 50 million litres per year, and thanks to district heating, Oslo has now been named the most eco-friendly city in Norway.

During 2015, EGE will carry out a significant upgrade of its cleaning technology, and will implement measures aimed at increasing production. The goal for 2016 is to recover energy from 460,000 tons of waste, including 150,000 tons of residual waste from Europe, which would otherwise have ended up in landfills. This upgrade will provide an energy production equivalent to approx. 1.3 TWh energy annually, and would satisfy the energy needs for about 95,000 households in the city of Oslo.

Increased profit and competiveness and decreased carbon footprint in industry through better understanding of powder processing operations

Combining powder technology, process analytical technology and multivariate statistics presents novel opportunities for improving energy efficiency and reducing production costs by optimization of process design and first time-right production.

Powder/particulate materials processing technologies are required across all sectors of the process industry and are characteristically high in energy demand. Processing operations such as mixing, filtering, agglomeration, surface coating, dosing, milling, wear protection, classification, corrosion, scaling and erosion, transport and storage, all have potential for improved energy efficiency, increased profit and reduced carbon footprint. Such processing operations are critical with respect to quality of products as well as erosion of equipment.

Intensification of powder processing technologies are therefore one of the most important challenges in industry, with a high potential for improved performance and reduced carbon footprint. The challenges are often very complex and should be approached with a multivariate way of thinking combined with knowledge in process analytical technology and soft sensors (Smart Manufacturing). This is essential in order to really understand and control the most important product quality and process parameters resulting in robust operational excellence.

Tel-Tek is a Norwegian industrial research institute with focus on energy efficient processes and low emissions. We conduct projects for and in collaboration with industry and public enterprises.

In addition to highly skilled and experienced researchers within powder technology and smart manufacturing, our powder technology research facilities include a wide variety of analytical instrumentation and pilot equipment of various scales.

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Investing in Negawatts, the world's 'first fuel'

By Kathleen Van Brempt (pictured), MEP and S&D's vice-president responsible for sustainability

The European Energy Union has been on the political agenda since 2010, but only recently a first ambitious framework for such a Union was presented by the Commissions Vice-President Maros Sefcovic. Just as the early sprouts of the European Union, notably the European Coal and Steel Community, emerged from industry and energy questions, the new European Solar and Wind Community will have to solve the energy problems we are facing now and will face in the future.

In 1951 European leaders acknowledged that coöperation would boost the European economy. Integrating the patchwork of 28 national energy grids, which symbolize an energy policy of the past, would create a similar boost to the European economy. With a growing share of renewables in our energy mix, we will need to transport energy over vast distances in Europe, from our off shore windfarms in the North Sea, the hydroelectric plants in Scandinavia, solar farms in the south of Europe and the thousands of decentralized micro-power plants in other parts of the Union. In times of distress member states will have to rely on each other, using each others reserves or sur plus capacities.

Much can be said about the Energy Union framework

presented in February, but I will focus only on the emerging Negawatt - not Megawatt - industry: energy efficiency (EE).

During the last years political leaders have paid massive lip service to energy efficiency, but forgot to put their investment money where their mouth is. Energy efficiency has long been treated as the Cinderella of investments, even though EE investments offer immens benefits which go far beyond energy savings. They can be an important contributor to economic growth and social development. Energy efficiency investments can create short term benefits, helping the economy grow in times of recession by promoting employment. Renewable energy projects are creating ten times more jobs than similar-sized fossil fuel projects. Energy efficiency projects also create 3 to 5 times more jobs than fossil investments. The macroeconomic outcomes from EE could be huge.

An Energy Union consistent with the EU's strategic objectives, such as tackling climate change or job creation, should therefore prioritise energy efficiency measures. The S&D group in the European parliament pushed energy efficiency towards the top of the Energy Union agenda. The first drafts of the framework performed poorly on energy efficiency, but the final text stated: 'Energy efficiency first'. The Commissions Vice-president Maros Sefcovic acknowledges that energy efficiency is "an energy source in its own right", which will make it possible to compete on equal terms with generation capacity. The International Energy Agency (IEA) called energy efficiency 'an invisible powerhouse' worth at least 276 billon euros per year and growing. This confirms EE's position as the world's 'first fuel'.

The EU's devastating austerity policy prevented us from taking the necessary actions to reach our most important objectives. For the first time in years the Juncker Investment plan EFSI changes Europe's small minded stance on the economic crisis by better balancing budget control with investments. Finally, underfunded European priorities like energy efficiency could be back on the agenda. But are they? Looking at the member states projects for the EFSI, only 5% of them include energy efficiency measures, smart technology or demand side measures although, according to the IEA, 40 % of emission reductions can come from energy efficiency. When taking decisions on where to invest, we will have to prioritise EE's share in the investment portfolio. In doing that, Europe can take a big leap forwards and reclaim it's world leadership in sustainable development.

FMECA / RAM / ENERGY Analysis in Data Centers

Energy requirements and availability are currently the driving forces in the area of data centers. The innovative **FMECA** (Failure Mode, Effects and Criticality Analysis) / **RAM** (Reliability, Availability, Maintainability) / **ENERGY** analyses of Bilfinger HSG Facility Management, takes a close look at the interaction among these influencing factors and serves as a sound basis for decision-making. The objective is to determine energy saving potential and to quantify its influence on availability and reliability.

FMECA / ENERGY SESSIONS

In order to gain an overview and to allow an objective evaluation, all systems are included in FMECA / ENERGY Sessions on site at the beginning and broken down according to their components. At the same time, the system technology is analyzed from an energy perspective.

The recording of the data is essential since empirical values, system interdependencies and functionality must be collected so that afterwards an image can be modeled that is close to reality.

In order to ensure a uniform procedure, standardized lists are used and the exchange of information with those responsible for the location is managed by an experienced employee.

FAILURE MODE AND EFFECTS ANALYSIS (FMECA)

The FMECA method is based on the risk analysis and the risk evaluation. In the product introduced, this is complemented by the criticality factor for FMECA. The recording of all components / failure possibilities follows their evaluation with regard to

- Severity of the failure S
- Probability of occurrence O
- Probability of discovery D

This is conducted by means of a risk matrix that is coordinated with the relevant customer.

The multiplication of the three factors (SxOxD) results in the so-called risk priority number and is an indicator for components which require closer consideration.

The methodology is used to verify a design:

- What can fail?
- What are the causes and effects of failure?
- What are the mitigating measures?

RAM ANALYSIS

For the RAM analysis, the software for the electrical and mechanical systems is illustrated in a reliability block diagram (RBD).

The relationships between the individual components in the system network are presented and allocated to the component failure models and maintenance activities in order to define the availability, reliability of the analyzed system.

The FMECA Session(s) form the data foundation for the modeling.

ENERGY ANALYSIS

In the data center area, the energy analysis is conducted from the inside to the outside. To this end, the data center is divided into the following areas

- **In the building – within the server room**
- Cooling distribution
- Hot spots
- Air flow management
- Parameters for air conditioning systems and air handling units
- Cold aisle or hot aisle housing & temperature adjustment

- **In the building – outside the server room**
- Air conditioning systems
- Parameters for Building Management System (BMS)
- Auxiliary drives and energy distribution
- Lighting

- **Outside the building**
- Refrigeration – refrigerating machines, cooling towers
- Heat generation - heating systems, CHCP
- Electricity supply – low voltage distribution systems, transformers, UPS

The areas listed are analyzed for their optimization potential. At the request of the customer, corresponding business cases can be prepared. The possibilities for improvement developed as a result are reviewed in further RAM analyses for their impact in relation to the availability of the data center.

VALUE ADDED FROM THE COMBINED ANALYSIS

Through the combination of the analyses presented, the following value added for the customer can be achieved

- Provision of a reliable basis for decision making
- Avoidance of unnecessary investments
- Displaying optimization potential
- Showing Single Points of Failure (SPOF)
- Reviewing existing documentation
- Exchange of experience and reflection on the current situation
- Increasing awareness of employees involved
- Risk mitigation
- Optimization of maintenance management

The result of the combined analysis is an evaluation of the current situation with regard to energy efficiency, availability and reliability as well as a summary of energy saving measures including their impact on the parameters mentioned above.

The customer thus receives a well-founded basis for decision-making in order to be able to implement action plans that are derived from the analysis.

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Energy efficiency gains in a connected world

By John Higgins (pictured), Director General of DIGITALEUROPE

Technologies such as broadband connectivity, wireless mobility, cloud computing, social media, sensors and the Internet of Things are transforming our society and many aspects of our daily life. Many appliances that previously operated in isolation can now be controlled remotely and are able to interact with other devices.

The effective use of these connected devices and IT infrastructure represents a real opportunity to improve energy efficiency and environmental sustainability for all industries and economies particularly within the framework of future Smart Grids and Smart Cities.

The SMARTer2020 report calculated savings of $1.9 trillion in gross energy and fuel consumption, and a reduction of 9.1 Giga tonnes of carbon dioxide equivalent (GtCO2e) of greenhouse gases through ICT-enabled solutions across the six sectors: power, transportation, manufacturing, consumer and service, agriculture, and buildings.

But these savings come at a cost. Data traffic might be tripled from today's levels by 2017. Also network connectivity requires some energy consumption as appliances use 'network standby' power just to remain connected to the network. As shown in the joint IEA/4E publication, "More Data, Less Energy", the current annual standby power consumption of networked devices is over 600 billion kilowatt-hours, which is greater than Canada's and Germany's 2011 annual electricity consumption. With up to 50 billion devices forecast to be connected to networks by 2020, global standby power consumption is projected to nearly double by 2025.

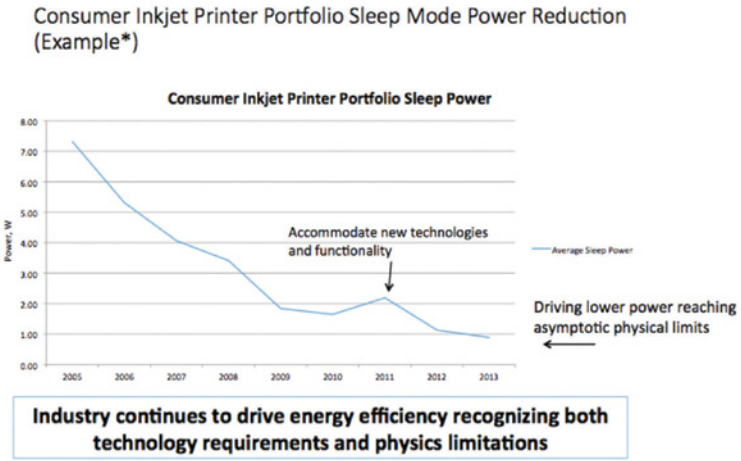
The challenge for industry is to reap the opportunities while continuing to deliver on the energy efficiencies of IT and consumer electronics devices and infrastructure. It will be key to enable connected devices to power down to low power modes as soon and as long as possible without compromising the functions or services.

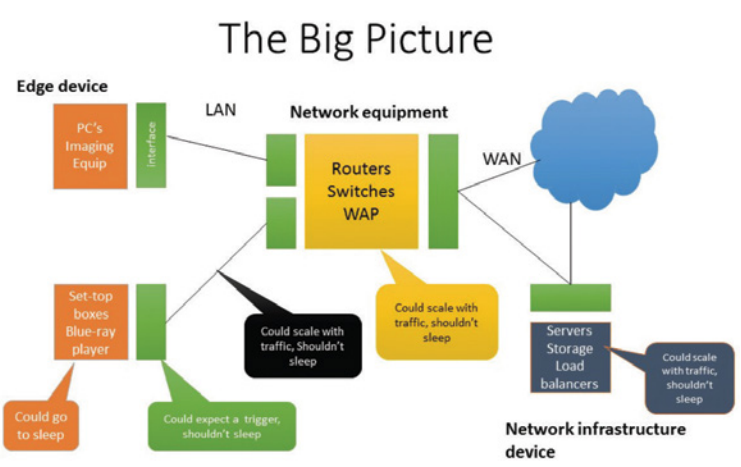
WHERE ARE THE LOW HANGING FRUITS?

Figure 1 differentiates between edge devices (computers, monitors, printers etc.), networking devices (equipment that connects edge devices to the network) and networked infrastructure devices (load management systems and other network infrastructure). These categories allow for different ways to achieve energy efficiency.

The most obvious and easiest way to harvest energy savings is with edge devices since they can easily power down their main functions when not needed. Power management has been implemented for many edge device product categories such as imaging equipment, PCs, displays, or TVs. These products are appropriately covered by the European regulation 1275/2008 on network standby or any of their product specific regulations. The graph below shows the trend of sleep mode power reduction at the example of a consumer inkjet printer. Studies have also shown decreasing energy consumption for white goods and consumer electronics in a residential setting in the US, despite an increase in the number of these products in the market.

In addition, many devices that connect to a network are battery powered, e.g. mobile phones, but also smoke alarms or connected wearables. These battery-powered products have an intrinsic motivation to use as





little energy as possible so that they function as long as possible without recharging or replacing the battery. Much of the desired energy savings will therefore happen without the need for regulatory intervention.

Networked infrastructure devices such as servers and data storage facilities manage the data within the network and service application requests from edge devices. Networking devices connect edge devices to the network. Thus an autonomous power management which puts those devices in a sleep mode would cause bottlenecks in the entire system, leading to unavailable services, data loss and increased energy consumption across the network due to data being re-routed, resent, and devices being re-booted.

This infrastructure requires a holistic approach. Only by taking a system-wide view of the data networks will it be possible to improve the efficiency in collecting, handling, synthesizing and storing the data. It requires a coordinated effort. No independent unit drives the efficiency. In fact energy reduction across the network requires coordination around specific opportunities to scale the energy consumption of various components.

Networked infrastructure devices and networking equipment can't be switched off or put to sleep, so the best way to reduce their energy consumption is to improve their ability to adapt to changing levels of traffic intensity. The existing European codes of conduct for Data Centres and Broadband networks are excellent tools to drive the efficiency of such systems. For example active energy efficiency management of Data Centres can help to reduce up to 30% of energy consumption by implementing permanent changes through measurement, monitoring, and control of energy usage.

There's no silver bullet for energy efficiency in the tech sector. One single approach to improving energy efficiency does not work across the different systems and devices. While networks and networking equipment can scale power, they should never go to sleep. On the other hand, edge devices can sleep and wake up when needed, assuming they comply with widely accepted interoperability standards.

As a way forward we promote a world where edge devices and networking equipment are optimized for energy management while delivering increased value, productivity and services. This requires a global approach and the IEA G20 Energy Efficiency Action Plan for Networked Devices is an excellent framework to achieve this.

Reducing the "Big data" ogre's energy appetite

New applications in the Internet of Things (IoT), which promises to change our lives, will require storing and computing ever-increasing amounts of data. By 2020, it is expected that IoT will generate around 4.4 zettabyte of data worldwide (source: IDC 2014). To transfer, sort and analyze those "Big Data", it will cost, per year and only in the US and only for the infrastructure (network and data centers), 14 billion kilowatt hours, which accounts for $1.3 billion and 15 million tons of CO_2.

Addressing this issue implies a drastic reduction of the amount of data that has to flow through the network, which translates into the ability to perform distributed data storage and processing at the individual node/connected device. As such, each node now acts as an intelligent buffer between the sensing device and the network, in turn enabling the use of medium/low-throughput network such as the one recently proposed by SigFox.

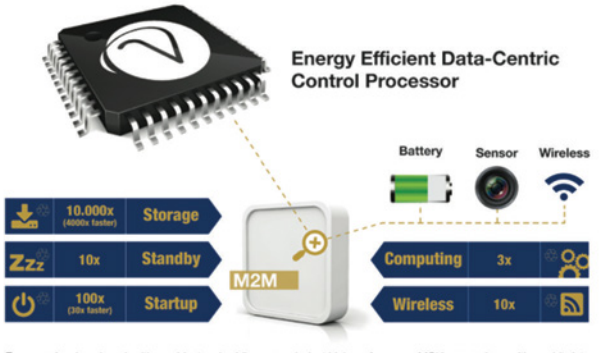
As node-level individual devices are often distributed in remote and/or difficult to access area, power is seldom available and batteries life is crucial. Moreover, these systems are mostly idle (90 to 99.9% of the time), hence efficient on-chip storage implies the use of non-volatile memories (e.g. memories which retain data when power is turned off). However a proper balance has to be found between computing/storage intelligence and battery life, as the more on-chip data, the higher the power consumption and in return the lower the overall battery life.

The solution proposed by young start-up eVaderis, spin-off of SPINTEC-lab, consists in integrating emerging non-volatile memory technologies such as STT-MRAM into microcontrollers/microprocessors used in wireless, battery-operated devices. STT-MRAM, by its sheer magnetic nature, is intrinsically non volatile, which existing Static-RAM (SRAM) memory is not, with a much lower active power than FLASH, today's best-in-class non-volatile memory. It is this unique combination which allows to embed large amounts of (non-volatile) memory at minimal power cost. eVaderis will go beyond the simple SRAM/FLASH memory blocks replacement and will promote a "global system approach" whereupon STT-MRAM technology is also embedded within the logic blocks themselves. Together with specific firmware libraries, this will result in a massive decrease of the overall chip power consumption both in active (operating) and stand-by modes.

Thanks to this new approach, eVaderis products will combine high performances and intelligence levels, together with long lifetime operation, whilst also offering a highly flexible platform to software developers through, for instance, quasi instant-on capabilities, transparent data/code partitioning and over-the-air ultra-low power hardware programmability. A smartmeter embedding such a technology would, for example, exhibit high-processing and storage capabilities with 10 times less standby power consumption and 10.000 times less storage energy, over the air firmware update and enhanced security.

All this of course has a price: Beyond the processing add-cost, it requires a total rebuilt of the circuit and system level architectures. The pain is severe but the reward is there with a massive reduction of the IoT ecosystem overall data path and energy footprint, from the devices to the network (transmission channels and server farms). The future is here !

Enable low power standby-high performance connected objects



Energy gains: benchmark with an object embedding an equivalent high-performance MCU processing multimegabit data

Being at the forefront of innovative solutions

The future of energy retrofitting in Europe

By Cosmina Marian, Buildings Performance Institute Europe (BPIE)

Energy retrofitting is perhaps the most challenging aspect to consider when upgrading the building stock so that it achieves the ambitious European goals set to cut CO_2 emissions. Making the case of the worthiness to refurbish buildings so that they consume less energy can prove to be quite easy. But actually implementing these strategies can end up being difficult. Facts and figures showing we can become less dependent on imported energy or achieve important CO_2 reductions if we choose the path to ambitious retrofitting are hard to deny. At the same time, Europe is faced with a considerable implementation gap between existing policies and what is being done in practice on the ground.

Around half of Europe's buildings were built before 1975, in an era when energy efficiency, CO_2 emissions and energy consumption were not a priority. Now a strong need arises to transform the most energy demanding buildings into energy efficient ones. There are multiple challenges such as:

- striking the right balance between benefits and costs - most energy retrofits need a large up-front investment that requires a number of years to pay for itself;
- choosing the best solution to finance such renovation works – either government incentives, tax breaks, public-private financing or through an "integrated approach" that plays on policy and financing incentives with technological advances;
- aesthetic challenges related to façade modifications;
- and finally the human factor – namely convincing tenants and owners of such investments ' worthiness.

Thus, the implementation gap can be reduced by making retrofitting an attractive investment, highlighting the economic, social and environmental benefits; diminishing the disturbance level caused by the works; improving the speed of delivery and guaranteeing the quality of the results.

There is a niche market to develop innovative technologies that can in time address all the challenges associated with renovation. For instance, researchers have developed new insulation materials to transform buildings constructed before 1975 into energy efficient units, materials applicable to façades, wall cavities and interiors. Novel solutions for these insulation products have been developed within the EU-funded project EASEE[1] which adopts a holistic and innovative approach to retrofitting. The insulation materials bring together a novel design and assessment strategies, with scaffolding-free installation approaches to minimise the impact on occupants while reducing energy demand and enhancing the façade's original appearance. The EASEE results for external wall insulation are distinguishable from anything else currently on the market due to the simplified dry-construction processes and the high level of customisation.

These kinds of endeavours have to have a lasting effect and leave their mark on the market and the whole value chain. The overall aim is to have products and approaches that can incentivise the application of sustainable


Aerogel wallpaper installation
©EASEE


Aerogel laminated boards prototypes installation


Panels casted by Magnetti for the test facade

and energy efficient solutions in the construction sector. EASEE delivers this goal as it derives benefits for every level considered:

- at the macro-level, there is the obvious gain in terms of energy savings and reduced carbon dioxide emissions, as well as the benefits for SMEs operating in the field of construction resulting in a job surge;
- there are clear, more immediate gains for owners which also avoid the many burdens typically associated with this kind of works;
- new products mean that professionals will need new skills which in turn will increase the level of competitiveness and will lead to different business opportunities.

The EASEE technologies are innovative not only due to their adaptability and modularity which implies fast and targeted interventions, but also because they give owners a realistic estimation of the benefits through the *Retrofitting Planner & Design Tool*. This tool quantifies economic savings by assessing the building's envelope with a 3D laser-scanning technique, then simulates and analyses the information using Virtual Environment (VE) software in order to provide a ranking of options available. In the end the Design Tool module provides manufacturers with design specifications for the off-site production of the prefabricated components[2]. An innovative approach to retrofitting can be sophisticated and complex in its design, but should be simple in its applicability.

Francesca Marchi from D'Appolonia – lead partner- points out that: "such a project wouldn't be as pertinent if the solutions and materials it proposes weren't tested first on dedicated test façades and subsequently on demo buildings. Works have progressed at the test façade with some of the products already installed[3]. Monitoring sensors revealed a retrofit improvement (in terms of U value measured before and after the retrofitting intervention) up to 40% due to the installation of prototypes for interior retrofitting based on high performing insulating materials (perlite and aerogel)."

Thus, during the last phase of the project, the EASEE products will be installed in three demo buildings (in Milan - Italy, in Gdansk - Poland and in Madrid - Spain) and monitored in order to evaluate their performance. Monitoring activities of thermal performance were also kick started both at the test façade and at the demo buildings. The pertinence of the monitoring results will gain in credibility as the demo buildings are covering more than one climate zone. Just to mention one, the injection of perlite within the cavity of the Spanish demo building provided an increase of the indoor temperature of around 4-5 degrees.

Supporting this kind of projects and their market uptake is key to bridging the implementation gap and fully benefiting from the untapped potential of energy renovations. Going beyond just recognising through legislation the multitude of benefits that renovation can entail and putting to the test these policies has to become the main priority. Projects such as EASEE are important at this stage because they focus on developing innovative solutions for retrofitting purposes and on strengthening technical capacities in the buildings value chain. Showcasing good practices through successful implementation at demo sites sends a strong message that there are solutions out there and the market has to and is able to change in order to stay competitive.

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1 EASEE stands for Envelope Approach to improve Sustainability and Energy Efficiency in existing multi-storey multi-owner residential buildings. The EASEE project has received funding from the European Union Seventh Framework Programme FP7 2007-2013 under Grant Agreement n. EeB.NMP.2011-3-285540. www.easee-project.eu

2 For more technical information on the materials developed within the EASEE project – i.e. prefabricated panels for exterior retrofitting; adjustable moulding tool; hydrophobation process to reduce hygroscopicity of natural and synthetic perlite; production process for highly insulating perlite to be used as loose filler for cavity walls; perlite boards; aerogel wallpaper; aerogel boards; methodology for energetic assessment and for the geometrical reproduction of the façade; monitoring platform – visit the website at www.easee-project.eu

3 For a more in-depth look at the works performed in Italy view the short documentary made by EuroNews at http://www.euronews.com/2014/09/08/new-skins-for-leaky-buildings/

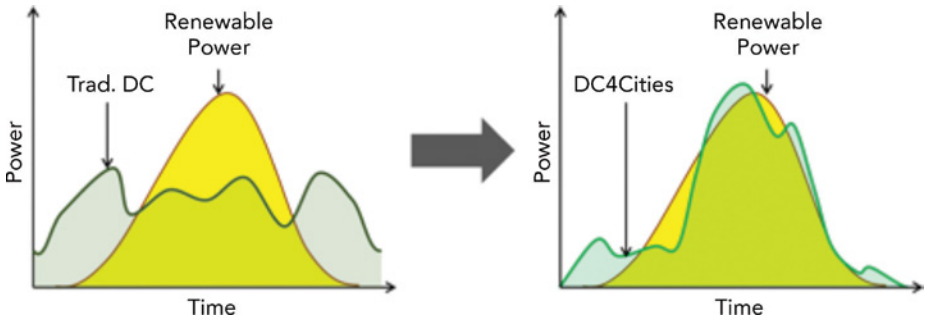
DC4Cities

By María Pérez Ortega, Giuliani Giovanni and Hermann de Meer

DC4Cities is an EU funded research project that aims at better integrating data centers (DCs) into future smart cities. Data centers are needed in smart cities to provide a high quality of IT-services to citizens while at the same time they should run in an eco-friendly manner. To this end, the flexibility in data center power demand is used to shift non time-critical jobs in such a way that a maximum of renewable energy can be used for the process. To enhance this potential for adaptability, a unified management of computational workload and characterization of available energy is employed. Adaptiveness of data centers is used in two ways:

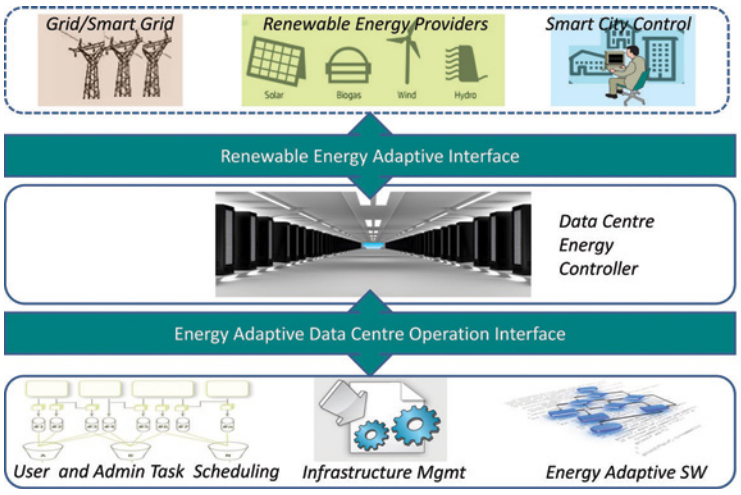
- **Act:** Adapting power consumption to the availability of renewable energy
- **React:** Adapting to requests received from Smart City Energy Management Authority

To achieve these goals, intelligent usage of electrical power is essential in order to maintain the quality of IT-Services in smart cities. New metrics are used to quantify the required and obtained energy efficiency of DCs to develop accurate measurement concepts and evaluation processes. Furthermore, metrics are used to better capture the relation of the amount of services delivered by the data center with respect to consumed energy. Data center optimization policies are focused on a) efficient usage of IT equipment, ensuring that workload is concentrated on the minimal amount of hardware, b) scheduling policies which manage workload activities so that IT equipment load is adapted to the energy constraints (based on given power plans) and c) software applications which have the chance to directly become power adaptive, and internally reorganize their behavior to also match energy constraints. Additionally, the architecture has three types of actors: Energy providers/controllers, the DC4Cities data centers and the data center energy aware subsystem.



The *DC4Cities* architecture can be applied to any data center type and, since it is focused on data center software and operations, **no logistic modification in the data center is required**.

Three trials have been built up in Barcelona (Spain), Milan (Italy) and Trento (Italy), with energy suppliers using different renewable energy sources (e.g. wind, solar and water renewable power supply) and the data center supporting different kinds of application workloads. The trial sites employ the developed energy optimizing/aware/adaptive workload management techniques in specific real life scenarios. The preliminary results show a significant improvement compared to the baseline measurements when using an optimized power plan and the concept of workload shifting. The first trial results confirm the expectations regarding values of increase in renewable energy share, the provision and adherence to policies by smart city stakeholders and improved quantification processes via the developed metrics.



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Efficient insulation in industry ready to deliver the missing 1% to EU targets

Energy efficient insulation solutions are ready to contribute to tap the existing energy and cost savings potential in the European industry delivering almost the entire missing 1% to the energy efficiency target for 2020 (620 PJ = insulation potential / 772 PJ = EU 1% target). However, if these economic insulation potentials remain untapped and Member States don't increase their energy efficiency ambitions in general, DG Energy predicts that the European Union (EU) will end up by 2020 with an energy consumption reduction of only 18-19% compared to 1990 levels and therefore fail to reach its self-set target of 20%.

Although it is true that the EU is nowadays committed to secure the supply of energy and ensure that energy prices remain stable, much more still needs to be done, especially in the EU industrial sectors. European industrial facilities are wasting energy, losing money and emitting tonnes of avoidable CO2 emissions every minute of operation due to the fact that, for example, thermal insulation in industry is poorly maintained and that special parts like valves and flanges very often remain completely uninsulated leading to excessive heat losses. Likewise, the level of insulation applied is typically based on minimum requirements regarding the maximum surface temperature that equipment is allowed to reach to avoid personal injuries or based on generic and very often outdated maximum heat loss rates allowed. Cost-effective and energy-efficient insulation solutions are still – and regrettably too often – not taken into consideration in the planning and building process of an industrial plant.

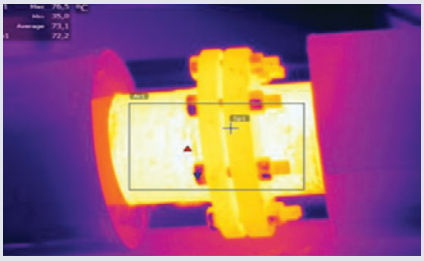
Unfortunately, if focused exclusively on energy, this will probably never change, but what has potential to become a driver is the aspect of the cost-effectiveness of the investments in insulation offering rapid payback times to the investors. At the relevant political levels, this benefit seems to be already well known as the Commissioner for Climate Action and Energy, Miguel Arias Cañete, has recently pointed out in his speech at the Energy Union Conference in Riga on 6 February 2015 that "investments in insulation are amongst the most profitable for citizens and industry today".

Besides the economic and the energy efficiency aspects, there is another important reason why insulation energy savings potentials should be immediately tapped. The EU is highly dependent on energy from abroad, importing 53% of all the energy it consumes at a cost of more than one billion euros per day. The majority of the energy imports into the EU come from Arab or former Soviet countries, many of which are not considered to be democracies but authoritarian regimes. This and the figures as such mean that Europe can be vulnerable to external energy shocks. As a matter of fact, the EU has further strengthened its commitment after the crisis in Ukraine and its – let us call it – difficult relationship with Russia to push energy efficiency as the "first fuel", and it is currently developing the Energy Union concept to coordinate energy imports into the EU, making Europe the biggest and most powerful energy client in the world.

Already last year and in this context, the European Commission hosted a high-level conference on Energy Security in Brussels on 21 May 2014, in which representatives from Member States, non-EU governments and other stakeholders discussed ways to cut down the EU's dependence on energy. Their aim was to exchange knowledge on how to set up a competitive and secure energy system that ensures affordable energy for all consumers, increases the security of the EU's energy supplies, reduces our dependence on energy imports and creates new opportunities for growth and jobs.

At this conference, the European Industrial Insulation Foundation (EiiF) presented that industrial insulation could reduce Europe's dependency for example on Russian gas imports by 9-12.5% (100% = 4932 PJ/1370 TWh). This was taken into account in the Communication from the Commission to the European Parliament and the Council on 28

TIPCHECK case study 1:
Chemical plant (NL) - Piping
- Insulation investment: **66,700 EUR**
- Insulation savings: **112,000 EUR/a**
- Payback period: **0.6 (a)**



TIPCHECK case study 2:
Refinery (IT) - Rooftop storage tank
- Insulation investment: **430,000 EUR**
- Insulation savings: **344,000 EUR/a**
- Payback period: **1.25 (a)**

Two examples of the 85 TIPCHECKs evaluated so far.

May 2014 about the European Energy Security Strategy, which includes that Member States should "speed up measures to achieve the 2020 energy efficiency target, focusing on heating and insulation in particular in buildings and industry".

Furthermore, the European Commission adopted the Energy Efficiency Directive (EED) in 2012. The EED sets up a common framework of measures for the promotion of energy efficiency within the EU-28 in order to ensure the achievement of the Union's targets to reduce energy consumption. In particular, article 7 and article 8 of the EED compel each EU country to establish an energy efficiency obligation scheme and to promote energy audits and energy management systems, respectively. In this regard, the TIPCHECK Programme of the EiiF offers an energy efficiency solution: a standardized, high quality thermal energy audit tool quantifying the amount of energy and money an industrial facility is losing with its current insulation system (including uninsulated parts).

The TIPCHECK Programme provides industries – and especially energy-intensive industries – with sustainable insulation solutions contributing to tap the energy and cost savings potential in industrial plants. Even though potentials vary between regions and sectors, due to differences in energy use, temperature profiles and fuel mix, energy savings potentials were found to exist across all regions and industrial sectors.

A first evaluation of 85 TIPCHECKs carried out until 2014 has identified energy savings of **200,000 – 400,000 MWh** per year reducing now every year the energy bills of TIPCHECK clients by up to **7 million euros**.

The TIPCHECKs were carried out in Europe and abroad across several energy intensive industrial sectors (i.e. chemical plants, refineries, processing plants, food and beverage, etc.). The usual **payback periods** for the investments in insulation were in most cases **1 to 2 years** only.

The European Industrial Insulation Foundation (EiiF) is a neutral and non-profit institution promoting insulation as a top-of-mind method for enhancing sustainability and profitability. For more information, visit www.eiif.org

PVGUM
Towards sun power made for roofing

Started in November 2010, PV-GUM is a 4.5 year demonstration project involving eight European partners, 6.4 M€ funded by the European Commission under the 7th Framework Programme. The main scope of the PV-GUM project is to fully integrate flexible thin film PV modules in the roofing membrane from manufacturing stage.

Building Integrated Photovoltaic (BIPV) potential is estimated to 23 million m² of suitable existing roofs and facades with proper sunshine exposure. In particular, flat roofs which are usually part of commercial and industrial buildings, offer important surfaces which can be exploited for PV electricity production. Nevertheless, BIPV remains significantly more expensive than standard construction materials, with non-proven robustness, which hinders the adoption of BIPV solutions by builders and building owners. To overcome these issues and support BIPV mass deployment, the **PV-GUM project aims at developing a BIPV product where the thin film PV modules are fully integrated during manufacturing in bitumen-based or polymer-based roofing membranes**, which are waterproofing solutions widely used for flat roofs. Indeed, to be adopted by the building industry, the new BIPV product should be **low-cost**, close to 'classical' high performance roofing membranes in terms of size and installation, with **proven waterproofing properties, enhanced production of PV electricity, robust, easy-to-install, sustainable** and **recyclable**. To tackle these challenges, the PV-GUM consortium implements an end-to-end approach: **the work carried out includes developments from manufacturing to installation and recycling of the total product.**

The 4.5 year project is aiming at reaching a production capacity of **10 MW** of the new 'PV-GUM' roofing membrane in Europe, with expectations of expansion in the future. It also should have a real impact in the European BIPV industry, as manufacturing and cost competitiveness will be significantly improved due to less labor and installation cost needed.

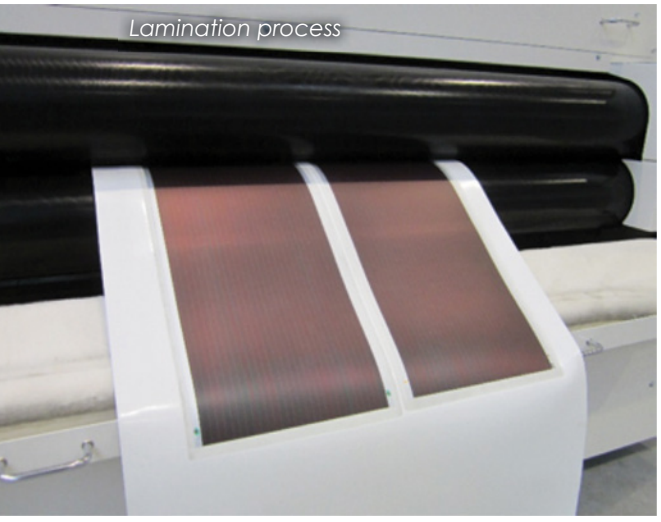
In fact, the PV-GUM laminates will be the result of a unique roll-to-roll lamination process, with a dedicated operational production line set up at the end of the project. The performance of the PV-GUM products will then be assessed in real conditions thanks to 100 kWp demonstration installations.

Based on current technology development, PV-GUM consortium decides to focus on the application on synthetic waterproofing membranes.

Effectively DERBIGUM has a plant in Germany (Hassfurt) producing synthetic membrane based on a specific formula of EVA/PVC polymers.

So the objectives for the PV-GUM project will be to :

- Reach **11% efficiency** for PV modules
- Produce **6m long membrane** with 2 PV modules industrially produced and laminated
- Reach competitiveness for final PV system installed (around **1.5 €/Wp** – including waterproofing) by doing a considerable cost decrease thanks to optimization of R2R process
- Draw a **Full Life-Cycle Analysis** of Photovoltaic membranes
- Design an automatic flame-less application tool


Lamination process


Quality control of 2 modules of 6 meter length laminated onto synthetic roofing membrane.

- Prove the **100% recyclability** of the PV-GUM membrane
- Be compliant to the building and electricity standards, tests of sustainability and robustness of the product.

The main RTD developments in the PV-GUM project are focused around 3 areas:

1. Selection of materials for waterproofing, lamination and encapsulation. This in order to comply with all production demands such as throughput and production costs, and on the other hand the lifetime and safety aspects of the modules.

2. Increasing product performance by improving the module efficiency to 11%. This is achieved by optimizing the individual layers in the solar cell stack and taking into account all the different interactions. The main achievement is the development of individual layers and processes that are now being combined to reach the efficiency target.

3. The last area is the process and equipment development to increase production costs while reducing material costs and keeping the amount of labor to an acceptable level. The main achievement there is the increase of production capacity at HyET Solar that is compatible with the materials selected for the PV-GUM product.

PV GUM FIRST TEST ROOFS

2 test-roofs were installed in October 2014 and January 2015

These test-roof are a major step in the project, demonstrating that the technology of production of PV modules and roll-to-roll process is working.

This process of production needs optimization to lower the cost but it's already able to produce some functional modules.

These test-roof have a full power of 7 kWp and were installed in Belgium on the roof of DERBIGUM's production plant.

HyET Solar is a high-tech SME and has a proprietary roll-to-roll production technology developed for thin film silicon based flexible PV modules, making use of abundantly available raw materials. The flexible PV modules are integrated into for example building integrated PV (BIPV) products. HyET Solar has a state-of-the-art fully functional manufacturing plant which is operated on foil widths of 35 cm wide. Roll-to-roll production scale machines of the key processes for foils in excess of 1.2 meter width have been designed and are in the stage of ramping up. Highly flexible and light weight PV products with efficiencies ranging from 7 up to 11% are produced. The highly flexible and light weight product has been successfully tested at TüV and thus passes the lifetime and safety tests that are required for the high quality PV modules in the market.

The Belgian enterprise Derbigum specializes in energy-saving and sustainable roof covering materials. The company, which started in 1932 as a family SME specializing in waterproofing for roofs and flat surfaces, is now making very substantial investments in innovating products in sustainable construction and energy management. The Group has four production units – two in Belgium (Lot & Perwez), one in Germany (Haßfurt) and one in the United States (Kansas City) and employs 400 throughout the world. More than two thirds of the production is intended for export. The consolidated turnover of the Derbigum Group is now 120.4 million Euros. The logo and the baseline 'Making Buildings Smart' clearly illustrate the Derbigum mission: pioneering and sustainable solutions tailored to the needs of the client so as to obtain energy-savings, to generate renewable energy, to increase durability and, thus, to soften the ecological impact of the building.

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PV-GUM Consortium

DERBIGUM – Belgium
Roofing membranes manufacturer, Project coordinator

HYET SOLAR – Netherlands
Roll-to-roll produced flexible, lightweight thin film silicone-based solar modules

DNV GL – Netherlands
Large energy consulting and testing & certification company

MEYER – Germany
Lamination equipment manufacturer

NOLAX – Switzerland
Adhesives designer and provider

GUILBERT EXPRESS – France
Welding hand tools designer and manufacturer

ECN – Netherlands
Energy research Centre of the Netherlands

B-ENERGY – France
Conception and realization of PV generators, development and distribution of solar solutions for roofing applications

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The BRIDLE project

Direct diode laser systems as energy-efficient, reliable and flexible manufacturing tools in laser material processing

By Thomas Brand, Coordinator of the BRIDLE project, Dilas Diodenlaser GmbH, Germany

The BRIDLE project is funded by the EU within the FP7 program since 2012. It seeks to develop the basic technologies to establish high power diode laser systems as one of the most efficient laser tools in high-brightness applications.

In many industrial branches, as environmental costs increase, the demand for more energy efficient, flexible and reliable tools grows, and this is also the case for laser material processing. Power consumption and disposal of waste heat to the ambience attracted more attention in production during the last years because of the more stringent legal restrictions and an increasing public awareness.

Nowadays, laser material processing is a multi-billion euro market, continuously growing. A large part includes metal treatment like cutting and welding, with the automotive industry as a primary driver. Here, for a long time, the CO_2 lasers were the dominant work-horses in the multi-kW power range because of their robustness and relatively easy to handle wavelength at 10µm, despite a low wall plug efficiency (WPE) of only 15-20%. Lamp pumped solid-state lasers with the advantage of possible fiber delivery of the laser power to the work-piece, are even less efficient around 3-4%.

In the last years these tools have been increasingly replaced (slowly but steadily) by diode-pumped lasers and more recently by fiber lasers. Today, fiber lasers in the multi-kilowatt power range for material processing reach 40% WPE.

Direct diode lasers, scaled to the kilowatt region, have been used in the past mostly for low brightness applications like heat treatment, soldering and welding. Such systems have the ability to reach a WPE of more than 60%, as long as there is no need for best beam quality as provided by CO_2 or fiber lasers. Fiber coupled diode laser systems as pump sources for fiber lasers thereby help to keep their high efficiency.

Since each high power diode laser system is composed of a multitude of single emitters, combined and shaped to one single beam by means of complex micro-optical arrangements, it's obvious that more of this is needed to scale it up to a higher brightness. Inevitably, this also increases the costs and reduces the systems' overall efficiency. Thus, a natural limit must exist for the deployment of more and more complex direct laser diode systems, and it would make more sense to use lower brightness pumps and an active resonator (e.g. from a fiber laser) as a "brightness converter" .

A lot of work is being done at the moment to shift these limits for direct diode lasers to a higher brightness, while retaining the benefits of the diode lasers' inherent high electro-optical efficiency. Finding the best useful commercial system level solution is the ultimate goal, with available fiber laser systems as the benchmark in terms of complexity, efficiency and at the end "cost per laser power and beam quality".

The BRIDLE project within FP7, as one part of these research activities, combines several novel approaches, tested and compared in parallel, beginning with a newly developed chip design, fundamental research in coherent coupling, and methods of dense wavelength multiplexing to scale overall output power. As one outcome, an industrial type, high brightness direct diode laser in the kilowatt range will be presented this year.
More results can be seen on www.bridle.eu.

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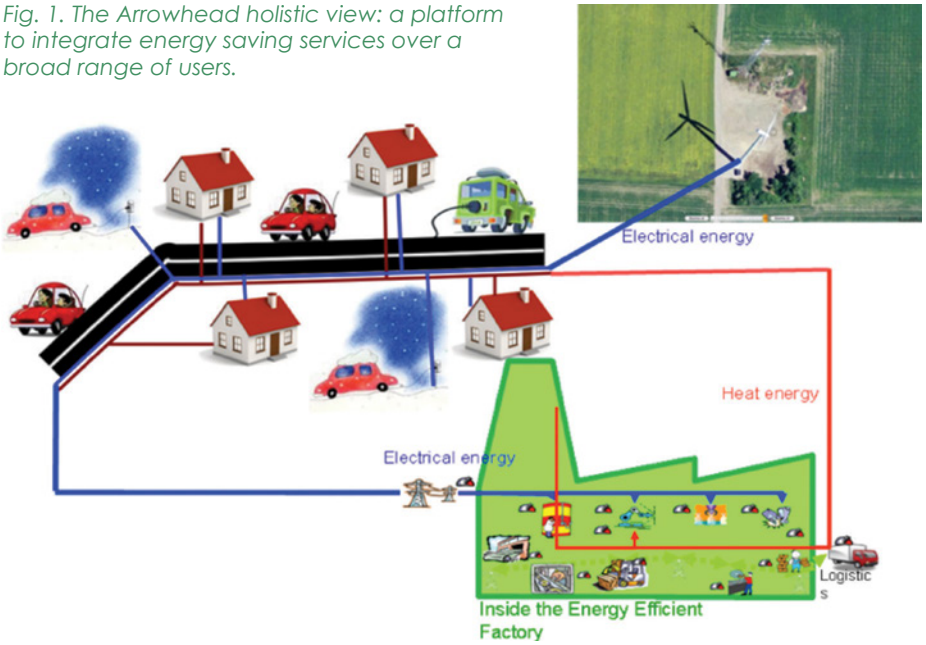
ARTEMIS and Smart Energy

Between 2008 and 2014, the ARTEMIS Joint Undertaking launched 56 Research, Development and Innovation projects that study and implement "embedded systems". Financed by a three-way funding model (roughly half from the industrial and academic partners in the projects, the other half from both EU and National funding sources) and using a Public-Private Partnership collaboration model, the programme has proven to be well tuned to getting scientific ideas – in this case concerning the development of software that is "hidden" inside the plethora of devices that surround us in our daily lives – into real practical use and ready to generate significant added value, both financial and through other benefits to the user. Instruments that provide public funding for industrial research are not new; ARTEMIS and its sister organisation ENIAC brought a new dimension of scale and "European footprint" by promoting a "think big" attitude in terms of project impact. Also, recognising that "taxpayer value for money" is important, these projects need to show awareness of their contribution and positive impact for (EU) society in general. Which they do. One such domain where the fruits of embedded systems research can lead to solutions for society's concerns is in the rational use of energy.

Of course, developing some hardware and writing some software that can more precisely control the temperature of a room or even optimise part of a production flow may not exactly be rocket science, things get infinitely more complicated when such control systems need to be scaled up. Not only does the technology itself get more complicated, other tertiary considerations quickly come into play, including any "emergent phenomena" ("bugs" to most people), or issues around the interoperability of equipment from different suppliers in different parts of the chain. To address these, new and more extensive approaches to the science, to the development and to the deployment are needed, and it is here that larger-scale ARTEMIS projects show their true worth: creating the architectures, the tools and the business environment in which such solutions can be deployed in economically and socially responsible ways. One such example is the ARTEMIS "Arrowhead" project (www.arrowhead.eu).

Fig. 1. The Arrowhead holistic view: a platform to integrate energy saving services over a broad range of users.



Arrowhead address efficient and sensible energy use in four application domains, production, electro-mobility, smart buildings, energy distribution, illustrated in figure 1.

These application areas today use a diverse mix of technologies to solve local optimisation of energy use. This currently hinders larger scale and cross application, cross technology optimisation due to the complex and costly engineering efforts necessary to achieve this with today's technology.

The much highlighted Internet of Things ("IoT") provides an

opportunity in this respect. Unfortunately, IoT technology on its own does not currently support global interoperability or fast and simple engineering of applications, such as minimisation of energy consumption (our focus in "Arrowhead").

To address this, "Arrowhead" provides a technology Framework (often called a "platform") that minimises the interoperability problems while substantially reducing the engineering effort needed to create and deploy innovative energy-saving solutions on a large scale.

In short, the Arrowhead Framework provides all necessary "glue" to enable structured use of services provided by IoT devices, while at the same time supporting the provision of security.

These capabilities are exploited by Arrowhead partners in more than 20 applications. Some examples:

Using intelligent lifts, energy savings of up to 65% can be achieved through optimisation services (software) on a per-day basis for the lift (depending on the day conditions) by making use of data services from lift controller, battery, and energy recuperation devices. This is a nice contribution to the "Near zero-energy buildings" of the EU directive (2010/31/EU: new buildings to be NZEB by 2020).

Another example is the pumping of water in large water distribution networks. Through an Arrowhead-enabled set of sensors and actuators together with an Arrowhead optimisation service, a large water network in the south France expect energy saving of about 15%.

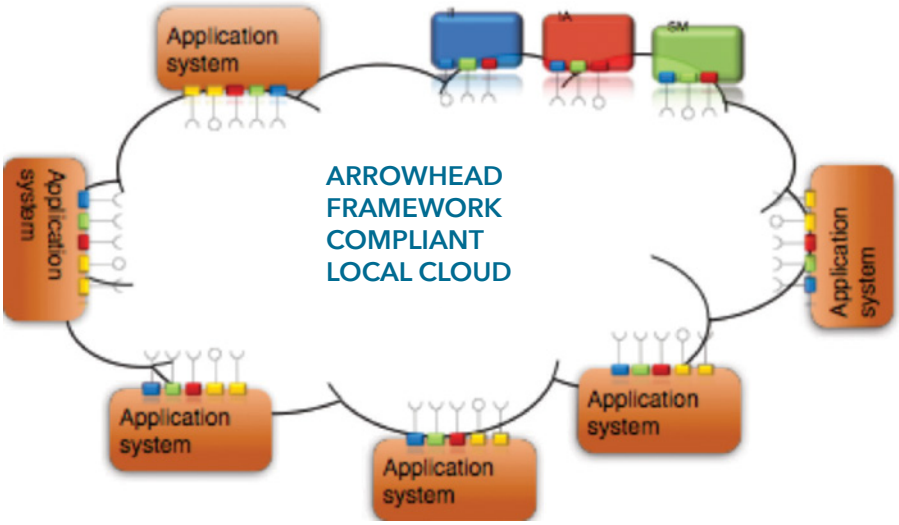


Fig. 2. An Arrowhead Framework cloud enabling local automation system to be integrated with suitable security using IoT application devices.

In Spain, a micro energy grid around larger buildings in Barcelona is being explored. The complete system comprises a photovoltaic generator, a storage system, and peak load and emergency diesel generators. By integrating these systems with necessary sensors complying with the Arrowhead Framework and using an Arrowhead optimisation service, energy savings of 25% are expected. Also in Spain, SPLAU - a larger shopping centre – will use the Arrowhead framework to integrate various sensors and actuators to monitor and control the HVAC system. Energy savings estimated are 15%.

In Jyväskylä, northern Finland, energy saving of 62% is expected for a smart street-lighting system that uses an optimisation service together with wireless sensors integrated through the Arrowhead Framework.

A big Swedish housing company, Stena, with the support of Arrowhead partners has deployed space heating optimisation with adaptive heating curves using the Arrowhead Framework. Stena claims 5% savings in energy usage from an initial optimisation being deployed at one of Stena's larger housing projects.

All of these examples have energy costs mounting up to millions of Euro per annum. The savings therefore can be substantial, provided the implementation is not too expensive. Initial comparisons indicate implementation costs of less than 25% when using Arrowhead Framework compared to the current state-of-the-art technology.

Innovative HVAC system solutions towards nearly zero energy buildings

Highly efficient systems for heating, cooling, ventilation and air-conditioning (HVAC) play a key role in the design of nearly zero energy buildings (nZEB). Technology developments of the last decade resulted in a new generation of HVAC products, integrated solutions complying with EU regulations and standards. However the challenge is not only technical. nZEB-s require a holistic approach at each level: integrated building design, interactive systems for smart districts, tackling societal and economical challenges. In the following interview REHVA Board Members give their opinion on the nZEB market in the context of the EU 2020 targets.

KAREL KABELE, CZECH REPUBLIC
REHVA President

What is the biggest challenge to reach the EU 2020 energy and climate targets?

In most EU countries legislation in improving building energy performance is in force. Still it's a question how the market, especially investors and users, whose behaviour largely affects energy use, will respond to this pressure. Implementing energy efficiency measures in buildings raise new problems, especially regarding indoor environmental quality and its potential consequences, e.g. CO poisoning in sealed homes with gas appliances, formation of harmful mould, overheating of buildings. Such issues burden energy retrofit of buildings. REHVA's mission is to promote holistic solutions for energy efficient, healthy and smart buildings. I am confident that the obstacles will be overcome, thanks also to the 100.000 experts in our membership.

What are the most important actions taken in your country of origin towards nearly Zero Energy Buildings?

The definition of nearly zero energy in the Directive (2010/31 EC, EPBD) gives large freedom of interpretation at Member State level. The Czech Republic has settled its nZEB definition in the Implementing Regulations to the Act on energy management, defining numerical requirements for thermal insulation of the envelope and for non-renewable primary energy. The regulation is currently being tested to verify whether it entails the expected reduction in energy consumption.

Which are the most promising HVAC system technologies to boost buildings energy efficiency?

I am expecting a boost period in the market of HVAC systems used in buildings. Recent heating and energy systems must be dynamic, with minimal or zero power consumption in stand-by condition, to be supported by the building envelope. At the same time the policy requirements on exploitation of renewable energy sources are pushing the market from the problem of conversion towards innovative energy storage technologies.

JAREK KURNISTKI, ESTONIA
REHVA Vice-President

What is the biggest challenge to reach the EU 2020 energy and climate targets?

The energy efficiency goal is a challenge. The EU does not seem to have enough capacity to renovate as many buildings as needed to achieve this target. However, many Member States have implemented schemes boosting renovation volumes and deep integrated renovations, which are the only way to tackle indoor climate and energy performance improvements at the same time.

What is the most important action taken in your country towards nearly Zero Energy Buildings?

The national nZEB application in Estonia is well done. However the regulatory framework in many EU countries needs to be improved to enable the implementation of nZEB. Energy calculation methods and tools are a challenge. National authorities have to understand that nZEB legislation is not just setting a couple of new numeric requirements, but a major upgrade of the whole energy calculation and regulatory system. The guidance of the EC is crucial here, like the upcoming

2nd generation EPBD standards. Supporting national EPBD implementation is a key priority of REHVA; we've published a guidebook on nZEB calculation and participate in many initiatives for capacity development of professionals.

Which are the most promising HVAC system technologies to boost buildings energy efficiency?

As author of many technical guidebooks on nZEB calculation, I don't see any problem with HVAC or other building technologies needed for nZEB-s. I am convinced that all the technologies we need are already available and, if properly applied, for an affordable price. The latter one is the issue we should work on. REHVA's mission is to provide professionals with guidance and support with its technical guidebooks and other training and capacity building activities across Europe.

STEFANO PAOLO CORGNATI, ITALY

REHVA Vice-President

What is the biggest challenge to reach the EU 2020 energy and climate targets?

The challenge is the integration of the targets. In the future, strategies recently running on parallel tracks should become integrated. To reach the 2020 goals the challenge in the building sector is to loop the objectives of "reducing energy demand-rising energy efficiency-using renewable energy-lower CO2 emissions" from the very beginning of the design process of new or retrofitted buildings. Strategies have to be jointly developed by all the involved actors.

What is the most important action taken in your country towards nearly Zero Energy Buildings?

In Italy, the major issue concerning nZEB is the energy retrofit of the existing building stock. Currently significant incentives are given for building retrofit with two main support measures: tax cuts for building refurbishments and tax incentives for implementing energy efficiency measures (from thermal insulation improvement to innovative technologies for energy production). I think there is a clear need for government subsidies to make nZEBs economically competitive and sell this "product" in today's buildings market.

Which are the most promising HVAC system technologies to boost buildings energy efficiency?

In the Mediterranean countries the most promising technologies in the HVAC market sector are the mechanical ventilation systems with heat recovery and dehumidification, which are poorly deployed currently. A significant increase in these installations can be foreseen for summer and winter heat recovery systems and for heat pumps. The general trend is rapidly moving towards all-electric buildings with electricity produced on site. Concerning cooling the challenge is to find the tradeoff between natural and mechanical cooling.


Karel Kabele


Jarek Kurnistki


Stefano Paolo Corgnati

A new pathway to recycle NORM in building materials – a COST Action initiative

By Wouter Schroeyers, chair of the European COST network 'NORM4Building' (TU1301), professor at the University of Hasselt (Belgium) dealing with the radiological aspects of material flows in the non-nuclear industry.

Since the birth of the Earth, very long-lived natural occurring radionuclides and their decay products have been present in the planet's crust. These radionuclides occur in the mineral ores that we mine to produce the materials that we need. Upon extracting metals from ores or burning resources for the production of electricity and heat, the naturally occurring radionuclides are concentrated in (waste) residues that are produced in very large quantities. Typical examples of residues that, depending on the origin of the ores and the used industrial process, can contain enhanced concentrations of naturally occurring radioactive materials (NORM) are:

- fly ash produced in large quantities from coal burning;
- phosphorous slag from thermal phosphorus production;
- unprocessed slag from primary iron production;
- lead, copper and tin slags from primary and secondary production;
- phosphogypsum of the phosphate industry;
- red mud of the aluminum processing industry.

Wouter Schroeyers measuring NORM residues. A small detection portal for radiological material in the background

The depletion of energy resources and raw materials demands the introduction of sustainability in the construction sector and construction material production. In the development of new synthetic building materials, the reuse of (waste) residue streams, especially residues that are produced in large quantities, becomes a necessity. This is even more the case if the reuse can increase the energy efficiency of the production process or can contribute to a reduction in CO2 emissions. The listed NORM containing residues have excellent technical properties for reuse in cement, concrete or ceramics and can bring this kind of added value.

Estimations suggest that cement production is responsible for 5% to 7% of the worldwide CO2 emission. Adding alternative raw materials with low embodied CO2 as well as supplementary cementitious materials reduces the cement CO2/mass. Several of the listed NORM containing residues can be used as alternative raw materials or as supplementary cementitious materials. In the case of residues with a high calorific value, they can be introduced as an alternative fuel where the remaining ash is typically incorporated in the cement clinker.

In Europe, a substantial amount of residues is currently used and included in use cases for several concrete applications and civil engineering works. This not only offers improved material performances and engineering properties, but also great environmental gains by saving the natural resources and lowering the CO2 footprint per tonne of concrete produced. Nevertheless, this brings also along some major health concerns which have only been considered on the basis of their potential environmental impacts (hazardous elements and their leaching behaviour), but not on the basis of their natural radionuclide contents.

Using NORM residues in the production of new types of synthetic building materials raises concerns among authorities, public and scientists on the potential gamma exposure to building materials among

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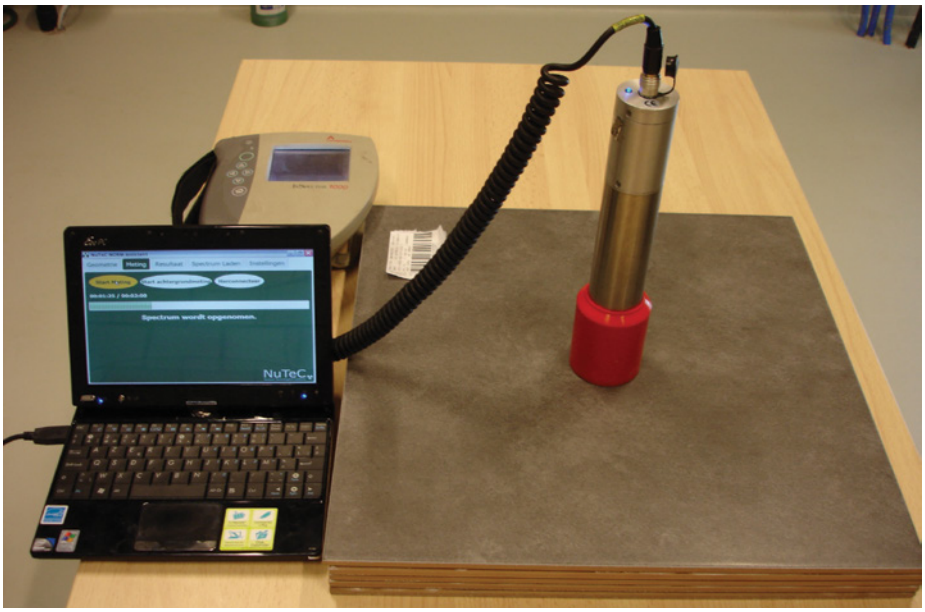

occupants and on indoor air quality. Several exposure pathways must be investigated to assess the impact of natural radionuclides in buildings on residents. In addition to direct gamma radiation, an important pathway of radiation exposure comes from radon, originating from building materials or the soil.

WHO (World Health Organisation) and ICRP (International Commission on Radiological Protection) studies have shown that public is exposed to a non-negligible amount of radiation caused by radon.

Introducing the new Euratom-Basic Safety Standards (EU-BSS, December 2013) resulted into new legislative requirements that developers of new building materials have to meet. There are many comments and questions from industry on the EU-BSS and on the options of recycling of NORM residues in building materials. More precisely, there is a need for more practical and technical support and reliable research data on this topic.

To deal with the lack of knowledge on the radiological aspects of the building materials, the COST Action '**NORM4Building**' was launched in January 2014. The main objective of this research network is the exchange of multidisciplinary knowledge and experiences (radiological, technical, chemical, economical, legislative, ecological) to stimulate the reuse of NORM containing residues in new, tailor-made sustainable building materials while considering exposure to external gamma radiation, the resulting indoor air quality and the lifetime of the building materials. Currently, more than 95 researchers from 25 different European countries are participating in the COST Action and there is a strong involvement from industry representatives and national and European legislators that are involved via discussion via roundtable discussions. IAEA (International Atomic Energy Agency), US and Japan representatives are keen on joining the Action as international participants. A first key publication (Nuccetelli, C. et al.), that deals with improved radiological impact models for building materials has been accepted and will be published in May 2015, in the *Journal of Environmental Radioactivity*[1].

In three years' time we hope to have had a big impact on the way that the new EU-BSS will be implemented in the Member States. COST Action members are involved in the technical working groups that are preparing the technical documents linked to the implementation of the new EU-BSS. We hope to provide support for researchers, legislators and companies to the safe reuse of NORM in building materials. A lot of the information can be found on the website of this COST Action: www.NORM4Building.org. Results of the '**NORM4Building**' COST Action will be combined in a database of good practices for the reuse of NORM residues in building materials and in a book that will compile the most outstanding findings of this Action network.

COST (European Cooperation in Science and Technology) is a pan-European intergovernmental organisation allowing scientists, engineers and scholars to jointly develop their ideas and initiatives across all scientific disciplines. It does so by funding science and technology networks called COST Actions, which give impetus to research, careers and innovation.
www.cost.eu

1 The paper is already accessible online: http://www.sciencedirect.com/science/article/pii/S0265931X15000387

european energyinnovation

Energy Efficiency in SHIPPING

Ship energy efficiency – why regulatory action is needed to save energy and fight climate change

By Jos Delbeke (pictured), Director-General of DG Climate Action, European Commission

Shipping is already the most energy efficient mode for most transport needs. The size of today's ships creates economies of scale that help provide the same level of service with less energy and emissions than before. Nevertheless, shipping is responsible for 2.5% of global greenhouse gas emissions today, and these emissions are growing.

The good news is that there is significant potential to reduce emissions from maritime transport. Energy efficiency measures and practices can bring important fuel cost savings at low or even negative costs.

These 'low-hanging fruits' make a compelling case for action. According to the second greenhouse gas study of the International Maritime Organisation (IMO), the UN body in charge of maritime transport, existing technologies represent an emissions reduction potential of up to 75%, with associated fuel cost savings estimated at €60 billion per year by 2020.

MARKET BARRIERS PREVENT COST-EFFECTIVE ENERGY EFFICIENCY MEASURES

Why is this reduction potential largely untapped today? Mainly because of market barriers that hamper the uptake of cost-effective measures.

- Firstly, split incentives. The party paying for the investment in an efficiency measure (the ship owner) is not the beneficiary of the associated fuel cost savings (the charterer of the ship). This does not create the conditions and incentives for highly cost-effective investments to occur.

- Secondly, lack of access to finance. In today's difficult economic context, ship owners do not necessarily have sufficient cash to invest into energy efficiency.

- And finally, the sheer lack of reliable information. Charterers, or potential buyers of ships, do not have access to reliable and comparable data on ships' fuel consumption and efficiency, and thus cannot consider this important aspect when taking business decisions. In addition, ship owners cannot increase the market value of their ships by investing in efficiency, as this is not reflected by market prices. Economists call such non-transparent markets a 'lemon market' where low quality products can easily compete with high quality products.

NEED FOR REGULATORY ACTION

To overcome these market barriers, regulatory action is needed. With this in mind, the European Commission proposed in 2013 a staged approach to reduce greenhouse gas emissions from shipping. It consists of the following steps:

1. Measuring ship emissions by introducing a system for monitoring, reporting and verification (MRV)

2. Defining a mid-term emission reduction target for the sector

3. Introducing further regulatory measures to incentivise emissions reductions at least possible cost

A robust system for MRV is a prerequisite for any regulatory measure to reduce emissions. It should also by itself contribute to removing market barriers. This is why, as a first step, the Commission put forward a legislative proposal for an EU-wide legal framework for MRV. The EU institutions reached a political agreement on the proposal in November 2014, and final approval by the European Parliament and the Council is expected in May 2015.

Under the new Regulation, from 1 January 2018 onwards all large ships using EU ports would be required to annually report their CO_2 emissions. The approach is lean and pragmatic as it relies on using existing documents and equipment. The data will need to be independently verified and then annually reported. The Commission will make aggregated data publicly available on a "per ship" basis. The Regulation also includes a revision clause to align the EU system to a global system once adopted by the IMO.

GLOBAL ACTION IS PRESSING

At global level, the IMO started its work on greenhouse gas emissions already in the 1990s. The first outcome of this work was the Energy Efficiency Design Index (EEDI) adopted in 2011. This measure sets minimum energy efficiency requirements for new ships built after 2013. This is an important step forward, as the EEDI is expected to reduce the sector's greenhouse gas emissions by 20% by 2030 compared to a 'do-nothing scenario'.

But this measure alone does not deliver sufficient emissions reductions. IMO partners have recently put much effort and hope on ideas to establish further efficiency standards that would also cover the existing fleet, as well as operational measures to test efficiency indicators. These would be based on a step-wise approach starting with an initial data collection phase, equivalent to the EU's MRV Regulation.

Developing and adopting such measures by 2016 should be the top priority for IMO members. The EU will continue to push for effective action at international level. Industry support will also be essential to make this happen. 2015 will see the intensification of global talks for a new climate agreement due to be sealed in Paris at the end of the year. All sectors, including international shipping, are expected to bring their fair contribution. It is therefore important that the IMO, at its 68th session of the Marine Environment Protection Committee, sends a strong signal about its commitment to contribute to these global efforts.

The EU, however, is not waiting to act. By going ahead with its new legislation, it can build up data and experience to help inform and influence international discussions towards a more climate-friendly global shipping sector.

LET'S ALL GO SUPERGREEN

Shipping is the most environmentally friendly mode of transportation per ton/mile and about 90% of the world's trade is seaborne. But good can always get better and thanks to the size of the industry, small improvements can have a dramatic effect. Many practical, sustainable and economic factors point towards methanol as an attractive marine fuel for the future. The RoPax-ferry Stena Germanica will in early 2015 become the world's first large merchant vessel converted to run on methanol with a total project cost around € 22 million.

In 2015, new sulphur emission regulations came into force in North European waters. By 2020 or latest by 2025, the rest of the world will also introduce similar emission regulations. Although costly for the shipping industry these new regulations will make a big contribution towards a cleaner world around us. There are however alternatives that go even further than the planned regulations, potentially making the shipping industry go from green - to supergreen.

In order to achieve lower emissions, the most common solution today is switching to low-sulphur marine gas oil (MGO) bunker fuel. A second alternative is installing exhaust cleaning equipment called "scrubbers". Another option to meet - and surpass - the emission regulations is to use natural gas (LNG) as fuel. All the way from the processing plant to the vessel´s engine room, the LNG must however be kept at -163 ° C in specially designed cryogenic tanks in order to become liquid. This means that the logistical chain, shore facilities and on-board technical solutions are costly.

Stena's pilot project is instead using methanol as fuel. It is equally clean to LNG but more cost effective as it is a liquid and can be handled more easily. The use of methanol, when compared to international bunker fuel, is expected to reduce vessel emissions as follows; Sulphur (SOx) by about 99%, Nitrogen (NOx) by 60%, particles (PM) by 95% and Carbon Dioxide (CO_2) by 25%. Most methanol today is produced from natural gas but methanol can also be produced from organic feedstock, further lowering the net greenhouse gas emissions. Stena and the project partners Wärtsilä, Methanex, Port of Kiel and Port of Gothenburg are now first in exploring the potential of methanol in a full scale test. M/S Stena Germanica, a 240 meter RoPax vessel operating between Gothenburg and Kiel is the first one out. Every year she carries about 50 000 cars, 45 000 trucks and 220 000 passengers – soon with very little environmental footprints. In addition to retrofitting the ship, the project will also create the appropriate port infrastructure and supply chain of methanol. This project has recently received the support from EU's TEN-T and Motorways of the Sea.

Ship-owners are concerned with handling the new, stricter, emission limits. Stena Line and its partners in this project believe methanol provides a fuel alternative which will help to overcome several challenges in the future. We remain committed to the vision which upholds shipping as the cleanest mode of transport, to limit the emissions of SOx, NOx and CO_2 – and to be able to do so safely, practically, and with a realistic economic cost and benefit. Methanol, as a fuel source, also satisfies the need to diversify the energy supply in order to ensure European competitiveness – it ticks all the boxes.

The future is green – supergreen.

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Lloyd's Register: Focus on Energy Efficiency for Ships

By Jesper Aagesen, Area Consultancy Manager, Scandinavia, Baltic & Western Europe, Lloyd's Register EMEA

The shipping industry faces many challenges today and in the future. One of the challenges is related to how ships burn their fuel most efficiently. Even though that the fuel oil prices have dropped dramatically over the past months, there is still considerable savings to be obtained when working with energy efficiency for ships.

Part of the reason is the ECA (Emission Control Areas) rules that apply to all ships operating in the Baltic Sea, the North Sea and the North American Coast. The rules came into force 1st January this year. These rules state that the content of sulphur in ships' fuel should not exceed 0.1%. So either the ships need to burn fuel with a low content of sulphur, install a scrubber or use an alternative fuel such as LNG, which does not contain any sulphur at all.

In addition IMO (International Maritime Organization) has adopted requirements in regard to energy efficiency by implementing the so called EEDI rules i.e. the Energy Efficiency Design Index. A ship's EEDI is an expression for the ship's CO_2-emissions in relation to transportation work, i.e. ton deadweight per nautical mile. The EEDI requirements will gradually be tightened during the coming years and it will mean that newbuilds in 2025 should emit less than 30% CO_2 than newbuilds do today.

Due to the above mentioned reasons it is only natural that many shipowners are looking at how they can make their ships more energy efficient. This is something that we in the Classification Society Lloyd's Register have experience with and we have assisted in energy optimisation of a number of ships.

The illustration shows the four phases that comprises of Lloyd's Register's approach to energy efficiency.

LLOYD'S REGISTER'S ENERGY EFFICIENCY APPROACH

Energy Efficiency is at the heart of our clients' requirements. Whether they are seeking strategic partnerships in order to produce innovative energy efficiency solutions or are driven by regulatory and commercial requirements to improve energy efficiency, our energy efficiency offer provides leading support for managing energy efficiency throughout all stages of a vessel's life. The value this provides to the clients is seen through the potential to reduce costs, manage regulatory change and understand the increased complexity and choice they are now presented with. Within the energy efficiency offer:

- The "Requirements" stage provides a strategic look at the needs of a client in relation to their current and future fleet requirements. The service makes use of market models and databases in order to determine how they

might impact on this strategy. In addition, the impact of regulation is considered. The service aims to deliver a specific set of criteria against which a design can be based.

- "Concept Design" design stage services are aimed at clients who are looking to evaluate options for optimising future newbuilds. Factors for consideration include regulatory drivers such as optimising for EEDI, ensuring compliance against NOx engine limits and SOx ECA limits.

- "EEDO" services support the client throughout the advanced design and build stages. LR provides independent verification of efficiency aspects of the design options through use of CFD (Computational Fluid Dynamics) and model test/trials witnessing.

- "EEOO" services apply to ships in-service and focus on the operational aspects of efficiency. LR has developed a series of scalable services designed to support 'beyond compliance' aspects of Ship Energy Efficiency Management Plans (SEEMP) through identification of energy efficiency measures, measurement of efficiency and training covering the human element part of energy management. In addition, Lloyd's Register offers assessment of various retrofit options for 'bolt-on' technologies selected by the client.

However let us look a bit closer at the different and more practical approaches to promote energy efficiency.

The more straightforward way to reduce the energy consumption is to reduce the speed. Since the necessary propulsion power for a ship depends on the speed to the power of three (and in some cases even more) there will be more to save when sailing with the "right" speed. Of course there is also a lower limit to how slow a vessel is able to operate both in terms of machinery and manoeuvring and it would also be necessary to fit it into the ship's schedule. In order to obtain the same capacity it could be necessary to increase the fleet, so all in all it is a balance between speed, transport time, and number of ships.

However there are other means of increasing efficiency. One way is to optimise the ships' trims. Many shipowners have worked closely with trim optimisation because there is no need for any investments in the ship, since this is a purely operational "exercise". Most optimal trim is depending partly on speed and partly on draft. Lloyd's Register assists shipowners with this using advanced computer models where the hull of a ship is defined and a number of calculations are made in various combinations of speed, draft and trim to find the most optimal situation. The calculations are done by using CFD (Computational Fluid Dynamics), which Lloyd's Register has more than 20 years of experience in.

The result of these calculations are summarised in an easy to read overview which can be put on the bridge so the crew can always refer to it for the most optimal trim in any given situation.

Nowadays the shipyards are also more willing to listen to the demands and requirements of the shipowners and this gives a better basis for a more energy efficient ship. The technique behind CFD can also be used to optimise the shape of the hull. It is possible to work with a number of alternative designs which can relatively easy be adjusted and changed.

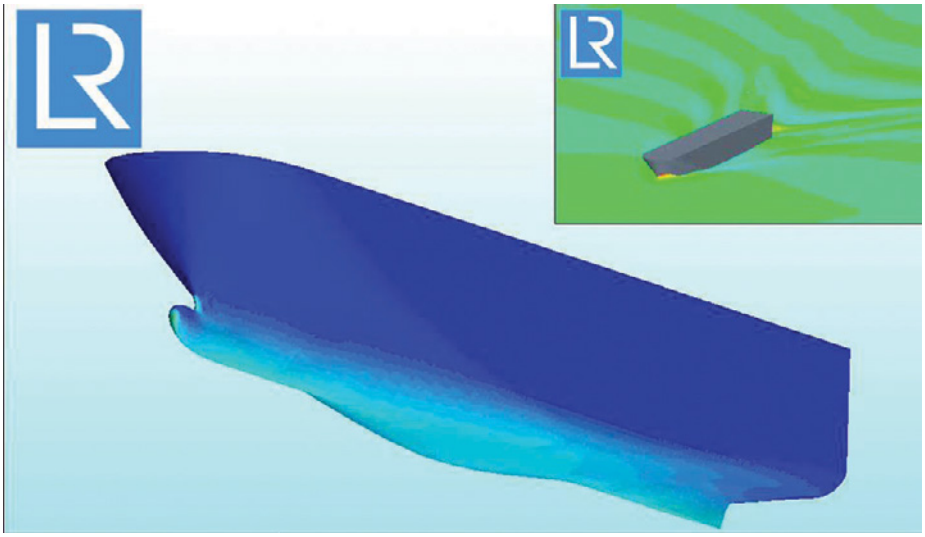
Another important factor is that earlier on the industry used to optimise the ship in one single design point i.e. at a given draft and speed often called the "design point". In recent years it has become more common to look at optimising in a wider perspective and today the entire operations profile of the ship is considered. Hereby you can cut down on efficiency in one point, but on the other hand get a better energy efficiency, also at lower speeds and for instance with partial cargo, so that the shipowner gets a better return of investment.

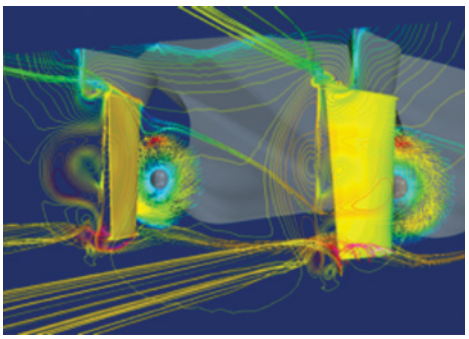
Below is an example of a trim optimisation overview where the green fields indicate the most favourable combinations of trim and draft in the given speed interval.

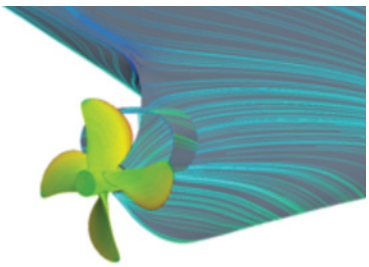
Speed		14 – 15.9 knots					
Trim (metres)		-2 – -1.51	-1.5 – -1.01	-1 – -0.51	-0.5 – -0.01	0.01 – 0.5	0.51 – 1
Draught (metres)	7.9 – 8.5	Avoid 6.4%	Fair 2.5%	Good 1.6%	Optimal 0.0%	Fair 2.2%	Avoid 8.5%
	7.2 – 7.85	Fair 2.0%	Good 0.6%	Optimal 0.0%	Good 0.3%	Good 0.9%	Fair 2.8%
	6.5 – 7.15	Good 0.6%	Good 0.2%	Optimal 0.0%	Good 0.6%	Fair 2.0%	Avoid 3.0%

An example from Lloyd's Register's trim optimisation software, ***LR TrimOS****.*

Optimisation of a ship by using CFD.







Read more here: http://www.lr.org/en/marine/consulting/ship-efficiency

However CFD is not only applicable to newbuildings and trim optimisation. It can for instance also be applied for modification of the ship's bulbous bow, so that this suits the actual operations profiles better (which is often lower speed than the ship was originally designed for) or it could be design of stern, propellers, rudder and so forth.

Measurement of a ship's performance is an important parameter and since the measurement of a ship's performance is rather complex, then it is necessary to have a good performance monitoring system in order to identify smaller savings. Many parameters influence the performance of a ship and a ship never has two identical journeys. Variances in draft, trim, speed, current, wind and weather etc. thus it is important to compare apples with apples in a consistent way in order to draw useful conclusions of such measurements.

Many shipowners are working intensely in either implementing or improving existing performance monitoring systems and Lloyd's Register is assisting with this. It is also very interesting to measure a ship's performance over time, because it makes it possible to identify how slow or fast performance drops.

Two things are certain – that the focus on energy efficiency has become an integrated part of the maritime business and that transportation by sea remains the number one most environmental friendly means of transporting goods.

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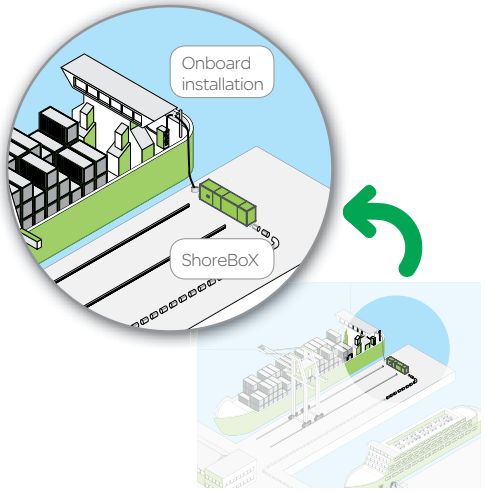

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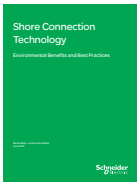

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An EIB perspective on the European Commission Directive "Clean Power for Transport" and its Implications for Shipping

By Mark Clintworth, Head of Shipping, European Investment Bank

1. INTRODUCTION

In line with EU transport policy the European Investment Bank (EIB) provides financial support to the EU Maritime sector including for the purposes of this article, EU commercial shipping. The Bank gives particular attention to projects that better assist the sector in dealing with environmental challenges and encourage, in line with EU legislation, the development of clean technology and increased fuel efficiency[1]. EU Institutional financial support not only benefits EU ship owners and shipbuilders but also supports the multitude of SME's and midcap equipment suppliers involved in the EU's maritime knowledge economy. In 2012[2], the EU shipping industry is estimated to have directly contributed €56 billion to EU GDP, employed 590,000 people, and generated tax revenues of €6 billion.

2. CLEAN POWER FOR TRANSPORT

The European Commission's (EC) "Clean Power for Transport" Directive aims to establish an infrastructure of alternative fuel stations for electricity, hydrogen and natural gas with common standards of design and use across Europe. This Directive is a package of the "Commission´s Transport 2050 Strategy" which aims to break EU transport´s dependence on oil and sets a target of 60% greenhouse gas (GHG) emission reductions by 2050. This strategy includes all modes of transport.

The Clean Power for Transport Directive provides a comprehensive EU framework on LNG for shipping. The Action Plan for the development of Liquefied Natural Gas (LNG) in shipping aims to ensure publicly accessible LNG refuelling points according to the technical specifications set out (applicable for LNG stations from 2015) for maritime and inland waterway transport in all maritime ports of the Trans-European Transport (TEN-T) Core Network by 31 December 2020. The same is suggested for inland waterway transport for all inland ports in this area by 31 December 2025. The 83 maritime ports within the TEN-T Core Network are the prime locations for use of LNG in shipping. In addition, inland waterways and road

transport corridors shall also be equipped with sufficient LNG and CNG (for vehicles) stations. A vital part of the proposal is the adoption and implementation of safety regulations with respect to storage, transport and the refuelling process of LNG, as well as the technical specifications for interoperability between ships and boats and refuelling points for the LNG in maritime and inland waterway transport.

3. IMPLICATIONS OF THE DIRECTIVE OF LNG IN SHIPPING

The European shipbuilding industry is still a global leader in innovative technologies but is suffering from lack of demand, as ship owners are waiting for clear indications as to the development of a future network for cleaner fuels. Shipbuilders on the other hand, lack resources for research, development and innovation (RDI) especially in the LNG technology. Many initiatives, as for example, Horizon 2020, the North European LNG Infrastructure Project, the Clean North Sea Shipping (CNSS) project and the marine engine project HELIOS, aim to prioritise research, demonstration or market-oriented projects for alternative fuels.

It is expected that the focus and development of LNG technology will create opportunities for European shipyards and the equipment manufacturers, considering that approximately 10,000 ships are currently mainly used for European Short Sea Shipping and 5000 of these vessels spend 50% of their time in SECA´s, (Sulphur Emission Controlled Areas) thus having to use mainly low sulphur marine gasoil (1% until 2015, 0.1% from 2015 – Directive 2012/33/EU of the European Parliament and of the Council of 21 November 2012). LNG is the most promising shipping fuel alternative for vessels to meet these requirements. In addition, the amendments to MARPOL Annex VI – Regulations for the prevention of air pollution from ships, which came into force 1 January 2013, add a new chapter 4 to Annex VI on Regulations on energy efficiency for ships (CO_2 emission reductions) making the Energy Efficiency Design Index (EEDI) mandatory for new ships and the Ship Energy Efficiency Management Plan (SEEMP) mandatory for all ships in operation.

4. OPPORTUNITIES

4.1 Environment

LNG is the most promising alternative shipping fuel short to medium term for Short Sea Shipping but also for maritime activities outside transport. The experience gained in over a decade of a small number of LNG ships has proven reliable technology.

- LNG reduces sulphur contents to nearly 0% thus fulfilling existing and future sulphur emission limits in sulphur emission controlled areas (SECA´s) in the EU.

- LNG fuelled ships emit nearly no particulate matters, 90% less NOx and 20-25% less CO_2 than formal fuel bunker.

- In the long run, the CO_2 emission needs to be complemented with more energy efficient engines and vessels, in order to comply with the EEDI.

- Japan´s transport ministry stated the adoption of LNG fuel in maritime sector in November 2011. And € 6.2 million budget plan for 2012 aims to promote the development of safety measures for marine renewable energy. European RDI needs to maintain its global leadership.

- The enforcement of the ECAS (Emission Controlled Areas for ships) zones in several European will additionally "push" LNG as an alternative fuel. Furthermore, there are concrete plans to introduce SECA´s are emerging from China, Japan, South Korea, Singapore and the US. The impact of the worldwide fuel sulphur reduction to 0.5% in 2020 (or 2025) may have a significantly bigger impact on the shipbuilding sector than the NOx regulations, as all ships sailing worldwide will need to significantly reduce their SOx emissions.

- Both specific LNG and dual fuel engines reduce NOx emissions. A pure LNG four stroke engine can reduce NOx emissions up to 80%. (Futureship 2011).

1 The EIB Transport Lending Policy states that lending for inland waterway, port, logistics and maritime projects are also prioritized in support of sustainable transport solutions.
2 Oxford Economics Report, 2014, commissioned by the European Community Ship Owners Association.

4.2 Economic

Apart from the environmental benefits that a switch from heavy fuel oil will introduce there are a number of strong economic benefits to be realised, amongst which are:

- Despite current bunker prices being below 400 USD per tonne, they can easily rebound above 600 USD per tonne. Ships are long-term investments compared to oil.
- The LNG market will mature further and prices are expected to decrease once Australia and US are in full production.
- Wider spread use of LNG would help decouple shipping costs in those areas where oil prices are rising and could be expected to reduce operational costs -> increasing perspectives for long-term sustainability of EU shipping operations.
- RDI in the LNG technology will also influence the price.
- The North European LNG infrastructure project; final report May 2012 concludes that LNG modifications (retrofits) and new builds have a payback time of 2 – 4 years.
- Norway, supported by the state-driven introduction of a national LNG bunkering network, has set a positive example for the success of LNG. Total market potential following from the US NOx ECA is estimated at € 7-9 billion for the period until 2030. If a European NOx ECA were to be in place in the Baltic, North Sea and Mediterranean, an estimated market potential of € 9-12 billion would be created. This potential only applies to new ships, not to retrofit.

4.3 Shipbuilding Industry & Marine Equipment Suppliers

- The adoption of LNG fuelled vessels in Europe will adapt according to the IMO & EU policy measures taken. If the policy measures taken are appropriate, 20-30 new LNG fuelled vessels could be expected per year.
- Today, more than ever, Europe's shipbuilding industry prospects rely on its ability to maintain its competitive advantage and to further move into new high value – high complexity activities.
- Europe has a 77% market share in building passenger vessels (including both cruise ships as well as ferries) and a 17% share in the construction of non-cargo vessels. These segments make up a relatively small share of the world order book (in CGT). However, in value they represent a much higher share due to their relatively sophisticated characteristics.

Several marine equipment suppliers are active in ship technologies and in land technologies such as the road and/or rail industry which allows for a transfer of knowledge and technology to the shipbuilding domain from another economic sector, or vice versa.

- European engine makers are leading in the LNG market in terms of their share. MAN and Wärtsila main engine manufacturers in Europe.
- However especially Korean companies have started entering the LNG market with Hyundai and Daewoo being the biggest competitors.
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LNG could also be used for compliance, as it contains hardly any sulphur, and as prices tend to be relatively lower than low sulphur diesel oil.

- LNG as a fuel is a specific possibility because of its low sulphur content and its attractive price relative to other low sulphur fuels.
- For both LNG and

scrubber technologies, EU manufacturers have developed the required systems and they are considered 'best in class' worldwide in these fields. There are however a number of suppliers elsewhere as well.

4.4 Research Development and Innovation

- RDI in the area of shipping fuels (bio-LNG, methanol, hybrid propulsion and hydrogen) is being supported amongst others by the HORIZON 2020 Programme (2014 – 2020) which funds are dedicated to boost research, innovation and competitiveness in Europe with a budget of € 80 billion -> LNG ship tanks are twice the size of equivalent oil tanks.

- The European shipbuilding and maritime industry need investments and incentives in order to maintain their global leadership.

- Already many European maritime equipment companies have subsidiaries close to Asian shipyards with the aim of keeping up to date and promoting their knowledge worldwide

5. EIB-EC FINANCING OF LNG TECHNOLOGY IN SHIPPING

The EIB is already active in the Maritime industry (EIB Shipping Projects: http://www.eib.org/infocentre/publications/all/shipping.htm) and financing of shipping is part of the core business of the Bank's overall long term transport lending. As mentioned above, particular attention is given to projects that better assist the sector to cope with the environmental challenges and encourage, in line with EU legislation, the development of clean technology. This includes project relating to retrofitting abatement technology such as scrubbers or LNG duel fuelled engines or new build projects incorporating alternative clean power sources. The two most recent recent projects the Bank has been involved with include the construction of two LNG powered ferries for Fjord Lines and a fleet retrofitting project for the retrofitting of scrubber technology for DFDS.

A number of financial instruments are also available to support the introduction of LNG bunkering Infrastructure, such as the Work Programme for the development of Motorways of the Sea (MoS) within the Trans-European Transport Network (TEN-T) which will continue to finance projects addressing environmental issues and promoting the development of related green infrastructure and facilities. There are also other EU funds promoting R&D programmes as there is financing of LNG Bunkering stations according to the Guidelines on National Regional Aid for 2007-2014

The Horizon 2020 Programme (€ 80 billion) is a package of measures proposed by the Commission in November 2011 to boost research, innovation and competitiveness in Europe. It will run between 2014 and 2020 with focus on three key objectives. It will support the EU's position as a world leader in science with a dedicated budget of € 24.6 billion, including an increase in funding of 77% for the very successful European Research Council (ERC). It will help secure industrial leadership in innovation with a budget of € 17.9 billion. This includes a major investment of € 13.7 billion in key technologies, as well as greater access to capital and support for SMEs. Finally, € 31.7 billion will go towards addressing major concerns shared by all Europeans, across six key themes: Health, demographic change and well-being; Food security, sustainable agriculture, marine and maritime research and the bio-economy; Secure, clean and efficient energy; Smart, green and integrated transport; Climate action, resource efficiency and raw materials; and Inclusive, innovative and secure societies.

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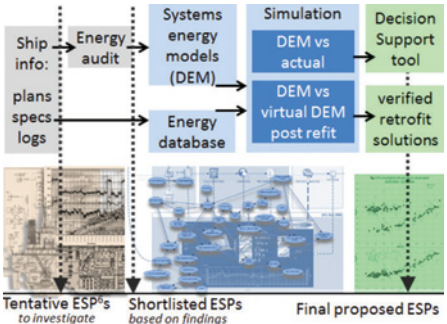
REFRESH
Green Retrofitting of Existing Ships

Green retrofitting of existing ships

The underlying idea of the REFRESH[1] was to identify retrofitting solutions considering mutual interaction of integrated shipboard systems and functions or services. The concept of integration of multiple solutions constituted the central concept and the driving force of the project. Obviously, the idea of assessing impact of local changes (i.e. retrofitting) on overall performance had not been new but REFRESH aimed at bringing the concept into a new level. The goal was to move beyond simple integration of physical components into energy models.

The work carried out within the first half of the project resulted in developing a versatile computational platform. The software brings together the rapid modelling techniques (implemented earlier within the EU-funded project TARGETS) with a powerful sensitivity framework. This allows a thermo-hydraulic network (fully integrated with an electrical grid, a control layer and top-level functions, such as propulsion) to virtually reproduce any level of complexity to be assessed for energy performance as well as for system integrity. The framework identifies important interactions between components and physical parameters (e.g. heat-exchange or flow characteristics) playing dominant role in the systems' performance, hence providing a benchmark for future tasks, such as optimisation.




Decision Support Tool on-board RoPax *Olympic Champion*

In REFRESH, the optimisation of energy performance was carried out for a number of systems (such as cooling system for a VLCC[2] or HVAC[3] system of a passenger ferry), but the most complete studies were undertaken for a cargo handling system of an oil tanker. These studies involved the optimisation of the system's topology as well as its sizing and operational efficiency.

One of the major difficulties in assessing energy performance of ship systems is the amount of data required for running simulations and validating results. Accuracy of numerical predictions is highly dependent on both the quality of the data and the resolution of the models. Furthermore, high-resolution models often produce large amount of data that is used as final results or just for quality control. Operational data is also necessary for validation and verification of the predictions, and all this results in a need for efficient technologies for data storage and information management. This complex task was addressed within the project by a dedicated team aiming to develop a database solution, universal enough to meet the needs of various partners and different applications. An additional requirement imposed to the development of the database was to make it compatible with advanced data-mining techniques and probabilistic modelling (Bayesian Network). For this, in REFRESH the suitability of data-intensive models in retrofitting problems was investigated in parallel to parametric modelling.

All the tools and methodologies developed or refined in the project were brought together, unveiling the required strategy for handling the whole energy modelling application process, which allows the installation on-board of a DST[4] for efficient operation based on DEM[5].

The tool installed on-board a RoPax ship aims to use parametric models of the ship propulsion and auxiliary plant as well as live feeds from the navigational system and ship's automation data to identify operational deficiencies in. Once the efficiency issues are properly evaluated the tool produces a list of actions and recommendations for improving energy efficiency in operation. Furthermore, the system stores the data for use in finding retrofitting solutions for the efficiency failings originating in suboptimal performance of the systems' components.

The above description would not be complete without mentioning major difficulties encountered during the project's execution. Most of these stemmed from the project's inherent over-reliance on operational data, which proved to be far too scarce and too unreliable to provide the basis for accurate assessment and generalisation of the results. Other information-related challenges were encountered while calibrating numerical models as well as during the installation of the DST (backward compatibility of data exchange interfaces within onboard automation systems). The latter issue may require paying particular attention for the regulatory framework on monitoring, reporting and verification. On the other hand, the troublesome reliance highlights the importance of numerical prediction (combined with targeted audits) and use of sensitivity analysis for (educated) decision making in retrofitting, both applied during the course of the project.

1 7 FP EU funded project
2 Very Large Crude Carrier
3 Heating, Ventilation and Air Conditioning
4 Decision Support Tool
5 Dynamic Energy Models
6 Energy Saving Potentials

Blue Energy: Why an energy transition has to start offshore

By Gesine Meissner, Member of the European Parliament

The German Energy Transition or Energiewende is a gigantic project to shift from nuclear energy towards renewable energies. In fact, so far it is mostly a shift towards one of the least sustainable forms of energy: coal.

In addition it is happening at a time when Europe is discussing about reducing its dependence of gas-imports from Russia due to the latest political developments. So, if we consider the German Energiewende as a gigantic project a European shift towards renewable energies will be a by far bigger one. How can it be done?

One step is to reduce our energy consumption. The EU aims at energy savings of 20% by 2020 and 30% by 2030. A lot of attention is paid to reduce the consumption per household, in particular by improving the insulation of our homes and by promoting energy efficient products. But will that be sufficient? It is very unlikely.

But what are our other options? Many people believe in wind energy after the crisis of the solar industry and the shortage of rare earths. However, one of the

GESINE MEISSNER

Member of the European Parliament

In 2009, Gesine Meissner became a member of the European Parliament. She is currently the coordinator of the ALDE Group on the Committee on Transport and Tourism and a substitute member in the Environment, Public Health and Food Safety Committee. Mrs Meissner is also a member of the EU-Mexico and Euro-Latin America Delegations. Since January 2015 Gesine Meissner is President of the European Parliament Intergroup Seas, Rivers, Islands and Coastal Areas.

She is a member of the council of the ALDE party and the federal executive board of the German Free Democratic party (FDP). In November 2013, she was elected as Vice President of the ALDE Party Gender Equality Network.

Before joining the European Parliament, Gesine Meissner was a member of the regional Parliament of Lower Saxony where she was chairing the Committee on Health and Social Affairs from 2003 to 2009.

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biggest problems we are facing in Germany, but many other countries too, is where to build those wind turbines.

Countries like Denmark, Germany and the United Kingdom are shifting more and more to build them offshore. Thanks to the strong winds in the North Sea those wind farms have the potential to play a very important role. However, also offshore those farms need a lot of space and it is becoming more and more obvious that the challenge of the next years will be to organise the different demands for space in our seas and oceans. In the first multination approach in the world the European Union decided to encourage all Member States to come up with maritime spatial plans. The directive on maritime spatial planning was adopted last year and is currently implemented in the Member States. It will be a key tool to organize exclusive economic zones of the Member States more efficiently. It is obvious that the energy transition is asking for a general shift in our procedures of policy planning and space will play a crucial role.

It is true that this is a challenge but I also see it as a big chance not to make the same mistakes at sea which we made so often on land. So far our oceans and seas are already providing us with the fish we eat and are connecting our industries with the rest of the world. But they bear a greater potential. We are already exploiting oil and gas fields, in particular in the North Sea. But there is more. Offshore wind farms will grow and I am convinced that wave and tidal energy has the chance to play a bigger role in the future. We are at the beginning of the process of discovering the great potential of our seas and oceans but we have to be careful. We don't know as much about the seas as we do about the land. An energy transition offshore can only work in a sustainable way. Therefore, we need tools like maritime spatial planning to divide the space between the various actors and to take the sensitivity and vulnerability of the marine ecosystems properly into account.

But this can only be one tool within a greater integrated maritime policy for a blue growth. The EU is a forerunner in the field of maritime policy and I would like to encourage the new Commission strongly to continue its work of the last years. Together with my colleagues of the European Parliament Intergroup Seas, Rivers, Islands and Coastal Areas I will push in the next years for an ambitious maritime agenda, from maritime transport or marine protection to offshore energy.

To reduce Europe's dependency of energy imports we need to improve our internal market and to build up proper transnational grids. One of the first challenges will be to connect the offshore wind farms and to establish a North Seas Offshore grid in one of the busiest seas in the world. However, now is the moment to do it and to overcome national resistance in order to improve transnational co-operation. Neither fish nor water knows boarders and it is up the EU and its Member States to make it the same for energy. For an European energy transition as well as for the German Energiewende the success will depend on whether we succeed in establishing a strong blue energy sector or not.

Reducing CO_2 emissions from shipping

By Dimitrios Banas, Manager, Communication and Information, European Community Shipowners' Association

In the last few years, the reduction of CO_2 emissions from shipping has become increasingly prominent on the EU and international political agenda.

But let's start with the facts. Shipping emits far less per tonne/km than any other mode of transport: it contributes only a fraction of the total volume of atmospheric emissions compared to road vehicles, trains and air transport, as well as other emission sources such as power plants. Shipping transports 90% of the world's goods and emits less than 2.2% of the world's CO_2. In other words, in terms of CO_2 emissions per tonne of cargo transported over one mile, shipping is recognised as the most efficient form of commercial transport. This is due to the ever increasing size of many types of vessels, which in turn is brought about by the need to reduce not only costs, through economies of scale, but also the industry's carbon footprint.

In that respect, shipping is also the first industrial sector with a global binding regime that aims at reducing CO_2 emissions, an impressive feat by any standard. This includes the application of the IMO Energy Efficiency Design Index (EEDI) to new vessels, and the use of the Ship Energy Efficiency Management Plan (SEEMP) that is now a carriage requirement for all ships.

The EEDI provides a method for establishing the minimum efficiency of new ships depending on the type of ship and size. It offers a fair basis for comparison and should stimulate the development of more efficient ship design. The EEDI will enter into force incrementally and in a number of phases that increase the restriction on CO_2 emissions. With increasing global competition, the key to survival will be designing, building and operating ships efficiently within this environmental framework. Under the current phase, naval architects and operators have introduced slight modifications to existing technologies. However as subsequent phases introduce tougher restrictions, more structural changes in ships design will be needed to ensure vessel compliance. In other words the EEDI will become an increasingly important factor in the reduction of CO_2 emissions and the improvement of energy efficiency in shipping.

The Ship Energy Efficiency Management Plan (SEEMP) is intended to be a practical tool for helping ship-owners manage their environmental performance and improve operational efficiency and has been mandatory since January 2013.

Things have however also been moving on the European front: In March 2011, the European Commission published its White Paper on the Future of Transport. In it, the Commission suggested that CO_2 emissions from shipping in the European Union should be reduced by 40% (if possible 50%) of 2005 levels by 2050.

In June 2013, the European Commission published a communication, accompanying the proposal for an Monitoring, reporting and verification of CO_2 emissions (MRV) Regulation, which sets out a strategy for progressively integrating maritime emissions into the EU's policy for reducing its domestic greenhouse gas emissions.

The Commission's strategy is intended to be an integral component for a global MRV system. It consists of three consecutive steps: Monitoring, reporting and verification of CO_2 emissions from large ships using EU ports, CO_2 reduction targets for the maritime transport sector and finally further measures, including Market Based Measures (MBMs), in the medium to long term.

In November 2014 EU co-legislators reached an informal agreement on the Commission proposal, which paves the way for a European MRV system that will become operational as of 2018, applying to ships above 5000 GT arriving and departing from EU ports, regardless of their flag and ownership. The Regulation is meant to be a stepping stone towards a global MRV instrument, which is currently being discussed at the International Maritime Organisation (IMO). Apart from data on fuel consumption and distance sailed, the negotiators agreed that the Regulation will also require ships to report cargo-related information.

European shipowners, mindful of the need for a global solution which ensures a global level playing field, support the European Commission's efforts to align its MRV system with a global system.

Regardless of the legislative developments at international level, it is important to also remember that the EU is presented with a unique opportunity to make its transport system more sustainable and achieve its CO_2 goals through multimodality. In Europe, shipping only accounts for 40% of intra-EU trade. By shifting more cargo and passengers to the sea, the EU can exploit the superior energy efficiency of shipping to reduce its global CO_2 emissions.

Shipowners of course do not rest on their laurels and are actively pursuing the reduction of the industry's carbon footprint. The industry can become even greener without losing its competitive edge, provided that EU environmental standards are aligned with those at global level and that transition periods are foreseen to allow for structural changes when they are needed.

Development of European CO_2 infrastructure networks

By Beatrice Coda, Policy Officer, Unit B1, Internal Market I: Networks and Regional Initiatives, Directorate-General for Energy, European Commission

In the transition to a low-carbon economy, the Carbon Capture and Storage (CCS) technology has the potential to become in the mid-term an economically cost-effective way to reconcile the rising demand for fossil fuels, with the need to reduce greenhouse gas emissions. The CCS technology has a very large potential of reducing by up to 90% the CO_2 produced by the world's largest emitters: fossil fuel power plants (both gas and coal/lignite) and heavy industry (such as steel and iron, cement, refining, chemicals).

The role of CCS in cost efficient climate mitigation and in the low-carbon transition of the European economy, while contributing to diversification and security of supplies, was reiterated by the European Commission proposal for a 2030 climate and energy framework[1], adopted in January 2014, and the European Energy Security Strategy[2], adopted by the European Commission in May 2014.

Both documents acknowledge the importance of CCS for power and energy-intensive industrial sectors, and urge continued support, at European and Member State level, for R&D, demonstration, and the development of an adequate transport and storage infrastructure, in order to pave the

way for commercial deployment post-2020 of carbon capture and storage plants.

Bringing costs down in the CCS chain (CO_2 capture - CO_2 transport - CO_2 storage) and securing a business case in Europe, which is based on the carbon price, remains still a challenge. Even while carbon price is not at a sufficient level, there is still a need to demonstrate and further develop CCS technology, including CCS infrastructure, as well as develop skills and knowledge through the deployment of a limited number of CCS projects to test whether the subsequent deployment and construction of CO_2 infrastructure across Europe is feasible.

Development of CO_2 infrastructure network for the purpose of transporting CO_2 from the point of the capture to a storage site, is crucial for the development of CCS projects.

While sufficient storage capacity exists in Europe not all capacity is accessible or located close to CO_2 emitters. It can be expected that initially CCS projects will most often explore CO_2 storage sinks in the vicinity of capture points, hence infrastructure will first have to be developed at national level. Such national infrastructure needs will have to be properly addressed by Member States, in order to then advance to cross-border networks. In view of the long lead times to plan and develop infrastructures, a proper coordination between Member States is paramount to kick off the European wide infrastructures as long as CCS is not commercially demonstrated. A cross border transport infrastructure is hence necessary to efficiently connect CO_2 sources to sinks. This is reflected in the inclusion of the CO_2 transport infrastructure in the Regulation 347/2013 "Guidelines for trans-European energy infrastructure" (TEN-E Guidelines)[3]. Under the TEN-E Guidelines, cross border carbon dioxide networks (by means of transport infrastructure between Member States and with neighbouring third countries in view of the deployment of CCS) are a priority thematic area.

The new framework established with the TEN-E framework (with measures for improving infrastructure planning, accelerating permit granting, regulatory incentives, and EU financial assistance) is envisaged to radically improve the investment framework for trans-European energy infrastructure and therefore contribute to meeting the challenges related to the 2030 and 2050 energy and climate policy goals. Under the TEN-E Guidelines, CO_2 transport infrastructure projects can qualify to become projects of common interest (PCIs) and, under certain conditions, may be eligible for funding under the Connecting Europe Facility[4].

The first PCI list adopted in December 2013 did not include any cross-border carbon dioxide infrastructure projects; it is expected that the development of common carbon dioxide infrastructure projects will be addressed in the upcoming years until 2020 and beyond. In this respect, it is of paramount importance to address both the technical and economic challenges linked to the feasibility of (cross border) CO_2 transport infrastructure as well as the associated legal, regulatory and policy implications at EU level.

The European Commission is expected to facilitate the development of the CO_2 cross-border infrastructure network of trans-European relevance, by means of the legal framework estabilished under the TEN-E Guidelines. There is also the need to address the legal and regulatory sides linked to the transport of captured CO_2 which is likely to occurr from fossil fuel dependent Member States to areas with high storage potential (such as the North Sea). Support of Member States to this initiative will be crucial to move the process forward.

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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.

1 A policy framework for climate and energy in the period from 2020 to 2030 (COM/2014/015 final)
2 European Energy Security Strategy (COM/2014/330 final)
3 Regulation on guidelines for trans-European energy infrastructures, Regulation (EU) No 347/2013
4 Regulation establishing the Connecting Europe Facility, Regulation (EU) No 1316/2013

Innovation is key to addressing our energy goals

Seán Kelly, MEP

Technological innovation is essential in meeting our climate and energy targets, and in delivering a reliable and affordable energy supply to consumers. Across Europe, scientists and engineers work every day to achieve the improvements in efficiency and reliability across the Energy system that will contribute to lowering the bills of European consumers and move towards a cleaner energy mix.

Ireland, along with the rest of Europe, is far too dependent on external sources to meet its energy needs. 90% of our gas is imported and although the new Corrib project will soon begin to alleviate this somewhat in the short term, the need to diversify our supply is clear. We find ourselves at the very end of the gas supply line and so are in a position that is quite vulnerable to gas crises. That Europe is so reliant on Russian gas is worrying, and given what we have seen over the past year especially, Mr. Putin has proven to be a less than trustworthy gas supplier. The need for change in our energy strategy is clear.

Last week's announcement of the Energy Union package by the European Commission sends a clear signal that Europe is ready to focus on increasing the competitiveness of the EU, improving its energy security, putting in place a functioning internal energy market with greater energy efficiency, and moving towards a low carbon system. While there will be much work and discussion on the proposal in the coming weeks and months, the initiative is good news for Ireland. When it comes to energy security, in a strategic sense, Ireland is perfectly placed to receive LNG which would bring clear possibilities to diversify our gas supply. This is why I am and have been a strong supporter of the LNG terminal project at Shannon in the west of the country and hope that the right actions are taken to ensure its completion.

Research and innovation are vital components of the Energy Union proposal and have a key role to play in fulfilling the outlined objectives. As we move to a low carbon energy system, increasing the share of renewables in the Energy mix is a priority. Ireland currently has significant potential for increased renewable energy production, particularly wind and ocean energy, given our geographical position. Significant support for R&D activities will be crucial in getting promising renewable energy technologies ready for market, and indeed improving the performance, efficiency and reliability of existing ones. Europe enjoys world leadership in many renewable technologies, such as renewable heating and cooling, and we need to ensure that this leadership is preserved and built upon. I am certain that Irish R&D activities will contribute greatly in this regard.

As well as for renewables, R&D activities should be undertaken to explore the viability of all possible solutions that may contribute to achieving our energy goals. Europe's current position of over-dependence means that all possibilities to diversify supply should be given due consideration as no one solution will solve the problems we face.

Central to all this is the consumer, and it is important to not lose sight of this. We must work to ensure that European energy consumers have access to a secure and affordable energy supply. Any prospect of supply shortages is unacceptable, and energy poverty in Europe is a real problem that needs to be eliminated.

I look forward to the coming months as we seek to address all of these challenges.

Delivering Ireland's energy potential

By Alex White, Ireland's Minister for Communications, Energy and Natural Resources

Energy is the lifeblood of all our economies and societies. Electricity and gas demand for business and for households must be met safely and securely on a continuous basis 365 days a year. Secure, reliable, affordable and safe supplies of electricity, gas and oil are critical to Ireland's ability to attract inward investment, support domestic investment, and retain and create jobs. The three pillars on which European energy policy is developed – security of supply, competitiveness and sustainability – will continue to be the heart of Ireland's energy policy.

Ireland is in the process of developing a definitive energy policy statement to 2030 and beyond. To this end, a Green Paper on Energy Policy in Ireland was published in 2014. The Paper considered the long-term policy, regulatory and societal interventions necessary for Ireland to make the transition to a low-carbon future, and to ensure that we have a secure supply of affordable energy. The Green Paper acknowledged the significant interrelated challenges we face and the inevitable tensions between these complex policy objectives. Resolving them will require Government, regulators, industry, system operators, consumers and citizens to make informed and evidence-based choices in shaping our future energy policy. It is planned to publish the final Energy Policy Paper in September this year.

We are all aware of the effects of climate change and responding to this challenge is a key element of Irish energy policy. Ireland

supports the EU level ambition for climate and energy to 2030, and welcomes the conclusions of the October European Council, including in relation to agriculture. Ireland will make a cost effective, achievable and fair contribution to the realisation of the overall EU ambition, which will need to take full account of our specific economic circumstances. We are actively engaging with the Commission and Council on this basis, supported by expert advice and rigorous economic modelling.

2015 will be a decisive year in climate policy. We are all aware of the importance of securing a global legally-binding agreement on climate change at COP21 in Paris this December if we are to set the world on a more sustainable low-carbon pathway consistent with the goal of keeping average global temperature rise to below 2 degrees Celsius. As part of the EU, we are committed to playing our part in reaching that historic agreement; the EU INDC, based on the October European Council Conclusions, will be a key contribution to global aggregate ambition. In Ireland, we are currently further developing our national structures to facilitate transition to a low-carbon economy as part of that broader effort.

Lima COP20 delivered on some key aspects that the EU had prioritised including a requirement for quantifiable up-front information and a synthesis report that will provide us with information on aggregate ambition. In the course of those negotiations, I saw for myself the complexity and seriousness of the issues facing us this year. In addition to detailed technical negotiations, a concerted effort at political level will be needed in order to deliver. The recent Geneva meeting (8-13 February) has ensured that the June session (1-12 June) will get straight to work on what is now a fully Party-owned text but there is still much to do. A legally binding agreement in Paris can be achieved but it will require a sustained effort by all Parties if the necessary progress is to be made. The Paris outcome, which Ireland believes should be a Protocol to ensure the legal certainty necessary, will need to deliver a clear signal that the world's Governments are serious about addressing this issue, and that the international rules-base will be strengthened to ensure we can accurately measure progress towards our shared goal, as well as recognising and encouraging the contribution of non-state actors.

Ireland also recognises the benefits of increasing energy efficiency and the share of renewable energy in our fuel mix, both from an economic and environmental perspective. We welcome the recognition that energy efficiency and renewable energy have an important contribution to make to the overall 2030 EU goals. These sectors are of key importance for how emissions targets are met in the context of Climate and Energy Policy. Ireland's first National Energy Efficiency Fund was launched in March 2014. The Fund will make finance available to support energy efficiency measures in both the public and commercial sectors.

Bioenergy can also play an important role in reducing emissions across the electricity, transport and heat sectors. Ireland is in the process of developing a Bioenergy Plan. The draft plan recommends the introduction of a renewable heat incentive (RHI) for larger heat users to change to heating solutions that produce heat from renewable sources.

Ireland's Offshore Renewable Energy Development Plan provides a framework for the sustainable development of Ireland's offshore renewable energy resources and sets out a vision of how these resources can contribute to our economic development and sustainable growth.

All energy stakeholders, including the general public, have an important role to play in the safe and sustainable development of our energy sector. A well-informed and robust debate on energy matters can result in a shared vision of sustainability, affordability and security of supply, with broad support for an energy policy that meets the needs of this and the next generation.

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