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WINTER 2016

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Foreword

Welcome to the Winter edition of the magazine: the time of year when it is traditional to look back at what has happened over the past twelve months; and to try and foretell what the next twelve will bring. June's Brexit vote and subsequent events in Italy, France, Germany and Holland (to name but a few) promise uncertainty. So, too does the developing migrant situation in Turkey, with its attendant misery and its political grandstanding. Mix in a little economic uncertainty, Russian ambivalence; and the gathering humanitarian crisis in Syria. Add the not inconsiderable threat posed by AGW to the Polar Ice Caps and perhaps November's launch of the Commission's long-awaited Winter Package represents one bright spot in all the gloom. You are, of course, reading another one!

How many times have we heard the phrase "the wind doesn't always blow and the sun doesn't always shine"? Perhaps the biggest issue faced by RE is this unpredictability. In that light, an excellent (and positive) article from Francesco Battiglio reviews the Winter Package from an electricity storage perspective, concluding that it is taking the right steps to create the right market conditions for advanced batteries. He notes that incorporation of energy storage can halve the reliance of a household upon grid-supplied electricity. Echoing this theme, Arnulf Jäger-Waldau explores the principal means by which self-consumption of electricity can be increased: using smart systems to operate higher demand items (such as tumble driers) when the sun is shining; and storing excess electricity to smooth out the peaks and troughs in supply and demand. Going on to examine the economics of residential PV systems in more detail, he concludes that battery storage will grow strongly; and that within five years, PV electricity will be the lowest cost electricity option for more than half of Europeans. Hans ten Berge goes further, exploring the potential offered by smart metering. Noting the obvious benefits for consumers of the availability of more information with which to manage their electricity demand, he suggests that rollout across Europe has been somewhat patchy, principally because of interoperability issues and concerns over data privacy; this, he concludes, is a crucial issue.

Paloma López Bermejo MEP writes thoughtfully about the role of the market in Energy Savings, noting how much European dependence on energy imports impedes the ability to deliver on the 2020 strategy. She makes the important point that trading systems must be engineered to reward energy efficiency, perhaps as part of larger cultural change, but that doing so is inherently contradictory.

Another important element of Europe's RE strategy to receive attention in this issue is Bioenergy. Silvia Vivarelli, Emilio Font de Mora, and Pat Howes examine how almost €50 million has been spent on supporting its market uptake; money that, by June had realised 1.65 Mtoe of bioenergy and saved 5.7 Mt of carbon dioxide emissions, according to EASME. Perhaps crucially, in the context of the Winter Package and its market-oriented measures, the money had generated a €0.9 billion return on the investment. Saving money and saving the planet: bright hopes, indeed.

And, as always, there is much more for you to read inside…

Michael Edmund
Editor

Energy savings and the market economy

By Paloma López Bermejo (pictured), Member of the European Parliament

There is little doubt that one of the major obstacles in creating a sovereign, sustainable and democratic energy system for Europe lies in the colossal import dependency of the continent, which consumes as much as twice the energy it produces. While the EU has engaged in aggressive trade and neighbourhood policies to guarantee its future imports, thus perpetuating geopolitical tensions and economic dependency for the coming decades, energy savings (along with the development of renewables and traditional resources such as European coal) seem an alternative and ultimately more promising avenue to adjust the energy needs of the European economy to its production capacity and climate commitments.

There is, however, legitimate concern on the ability of the EU to deliver on its promises. The 20% target for primary energy savings for 2020 is unlikely to be met, and whatever progress has been made seems more a result of prolonged of economic stagnation and deindustrialization than of meaningful public action.

The relevant directives (the Energy Efficiency Directive and the Buildings Directive) are still far from fully implemented by the Member States and legal loopholes and overall uncertainty over the post-2020 framework have further inhibited investment. These delays are not without consequences for employment: conservative estimates put at at least 2.4 million the number of jobs that could have been created in building renovation alone if the 20% target was achieved. But they also create a growing gap between the energy and climate policy of the EU and its ability to create a credible roadmap for energy savings -which, as the European Parliament has repeatedly emphasized, should be not lower than 40% in the 2030 horizon.

While we insist on the necessity of binding action in this sense, it is not only goals -but instruments, that we must focus on. Up to now, the EU has concentrated in creating "markets" for energy efficiency, hoping that prices will lead the way towards meaningful reduction in energy consumption. In doing so, it has once more led neoliberal theory trumps reality -for indeed, many households are constrained in their ability to change individual consumption, while industry often finds it more convenient to relocate production than to reduce its environmental impact when energy prices rise. It is by now widely accepted that markets create (and reward) inequality: it is no different for environmental market solutions, which, as implemented, have been doing more to generate energy poverty and erode our industrial base than to prepare a meaningful energy transition.

On the one hand, it is clear that a reduction in energy consumption at household level requires public investment and subsidies to lead the way. With an emphasis on energy-poor consumers, public administrations have to intervene to design better urban infraestructure and renew current buildings, planifying for a significant reduction in energy demand. Better isolation, improved heating and cooling systems and a shift away from private transport to better integrated production and residential urban systems require a fundamental shift in the market-led developments that have so far dictated developments in this area -and not unsurprisingly, led to the boom-and-bust cycles in real estate and infrastructure development that we are still suffering from.

Equally, it is clear that we must adjust our trade systems to reward energy-efficient production and short value-chains. Currently, environmental dumping threatens European plants in sectors, such as steel or ceramics, where the EU is the most efficient amongst global producers. This situation is unlikely to be solved through free ETS permits, since these only shift the burden of adjusment from some industrial sectors to others. Border-adjustment mechanisms, rewarding energy-efficient production, should be part of any meaningful reform of anti-dumping measures: we certainly hope that the EU considers these before opening up any further to trade overseas.

Ultimately, however, achieving durable energy savings will also require a cultural change, from the individual to society as a whole. We must not forget that consumerism is, after all, the material culture of neoliberalism -both creating the needs that alienate workers and enforce distinction in an increasingly unequal economic system.

So, while the enjoyment of particular goods can always be made more efficient, the societal drive towards higher consumption levels jeopardizes any particular achievement. A global paradox emerges: while production improves, waste becomes ever-more prevalent.

Understanding this later, civilizational obstacle places market environmentalists in a difficult position. It is hard to imagine a world that rewards frugality without being austeritarian -unless, of course, one that does not threat consumption as a competitive reward, but as a socially-defined good. Environmental challenges represent, in this way, a powerful justification for a radically different life: one, ultimately, that is only possible with a fundamental re-shifting of social relations.

There is, by now, a fundamental consensus that improving energy efficiency can be a boon for quality jobs when those are dear and a potential niche for European production at a time of ever-increasing global competition. Only vested interests and an increasingly irrational fear of public intervention hold back Member States towards more decisive action: we will continue our fight to ensure such obstacles are removed.

But we are not blind to the contradictions that a market response to environmental problems is creating -a contradiction unlikely to be overcome within the current economic system.

The Core-Network Energy-Efficiency Challenge

By Dr. Klaus Grobe, Director Global Sustainability, ADVA Optical Networking SE, Germany

INTRODUCTION

Bit rates in the Internet are growing exponentially. So is the negative environmental impact of the global ICT sector, albeit somewhat slower. This is primarily driven by the Internet energy consumption and the associated greenhouse gases (GHG). It holds as long as electricity is not fully based on renewable energy.

ICT energy consumption splits into core and access networks, data centers, and end-user equipment. There is a significant difference between core-networks and data centers on the one hand, and end-user equipment on the other. In the recent years, the energy consumption of end-user equipment decreased globally, which was primarily driven by improvements in flat-panel displays and (laptop) computers. On the other hand, core-network and data-center energy consumption is commonly predicted to grow significantly. Broadband access networks are also predicted to grow, but growth rate depends on technology. With Passive Optical Networks, growth can be kept to a minimum.

Relevant core-network components are IP/MPLS core routers and high-capacity transport. The latter is based on Wavelength-Division Multiplexing (WDM). In WDM, multiple wavelengths are used in optical fibers, each carrying digital information.

This started approximately 20 years ago with per-wavelength bit rates of 2.5 Gb/s, the latest generation is carrying up to 200 Gb/s per wavelength. Although the WDM contribution to global ICT electricity consumption is comparatively low, WDM is one of the areas where growth is predicted. This is shown in Figure 1, where WDM contributes to Networks.

ICT AND THE CORE-NETWORK CONTRIBUTION

The main environmental impact from core-network equipment results from its use-phase energy consumption. This is confirmed in so-called Life-Cycle Analysis (LCA), where various impact aspects like GHG production, Ozone depletion and others are calculated over the entire equipment life, from extracting raw materials via production, transport, use-phase up to end-of-life (recycling, landfill). A simplified WDM LCA example is given in Figure 2, which shows the dominance of the use-phase.

The energy efficiency of core-network equipment, in particular core routers and WDM, has been substantially increased in the last two decades. Unfortunately, the bit-rate increase – throughput in core routers and WDM transport capacity – has grown even faster. For both equipment categories, one can approximately derive duplicated energy consumption for 10-fold bit-rate increase. This is shown in Figure 3 for typical routers and WDM gear. It is relevant to note that the latest numbers in both equipment categories are only achieved by combining the most energy-efficient measures in all equipment aspects. This includes latest chip sets, optimized voltage supply, deactivation of unused parts, etc. In other words – even if the best technologies are combined today, the resulting efficiency increase is slightly lower than the bit-rate increase. This behavior is different as compared to other equipment, e.g., computers, TV sets etc.

Figure 1. Internet energy consumption in Germany [Hintemann et al., EGG 2016+, Berlin, September 2016

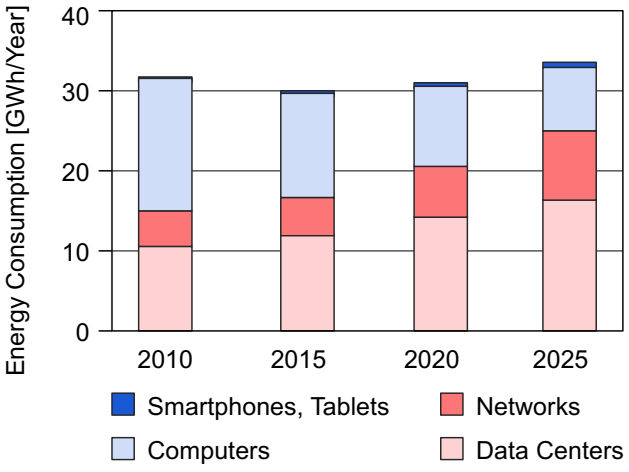


Figure 2. Simple WDM LCA example.

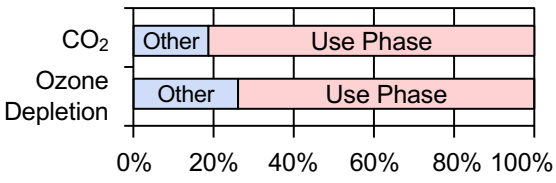
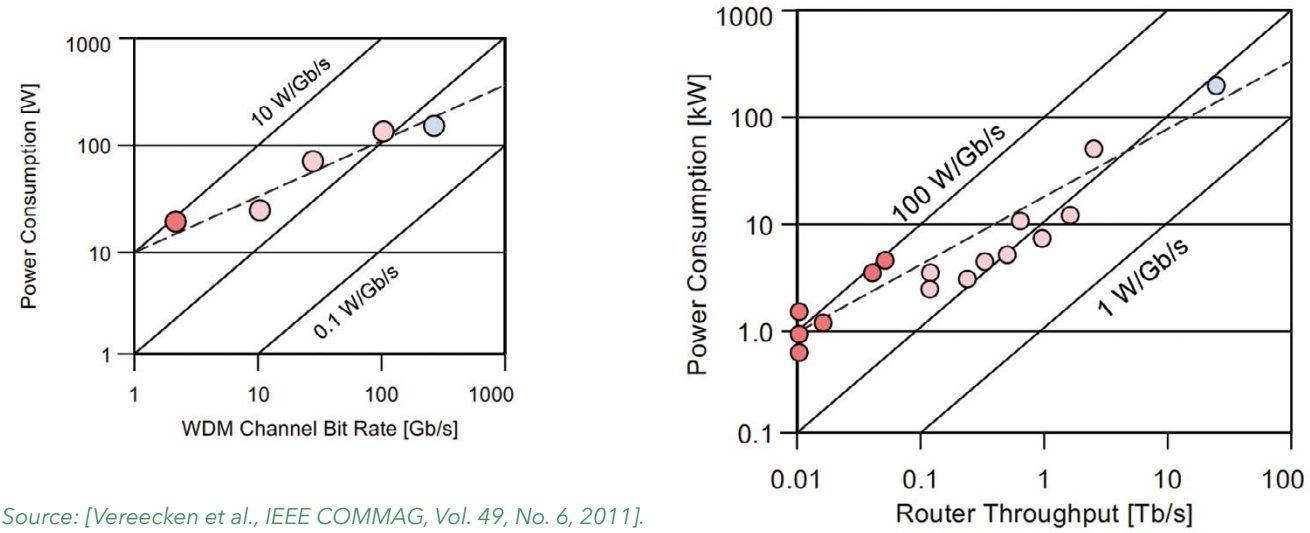


Figure 3. Energy efficiency of core-network equipment



Source: [Vereecken et al., IEEE COMMAG, Vol. 49, No. 6, 2011].

ENERGY-EFFICIENCY INCREASE IN THE CORE – THE CHALLENGE

The fast Internet bit-rate increase puts an additional challenge on the respective equipment vendors. On the one hand, they must seek for new technologies for further efficiency increase, even though many areas have already been optimized. As in example, with latest power-supply units, there is little space left for further improvements. On the other hand, they may even be penalized for not decreasing the energy consumption of their equipment. The latter meanwhile happens in an increasing number of environmental-performance assessments. Here, the goal often is to demonstrate year-over-year decrease of relevant impact factors, namely, energy consumption and/or GHG production. Most assessments today use metrics (for energy consumption or efficiency) which do not consider the exponential bit-rate increase with whom today's core-network equipment efficiency cannot keep up. This also disregards the fact that proper use of the Internet is one of very few known ways to decrease global energy consumption elsewhere, an effect known as Green-by-ICT that can substantially over-compensate energy consumption growth in parts of the Internet. This aspect must be considered in particular for core-networks since all Internet traffic has to pass this part of the network. The non-consideration of the strong Internet bit-rate growth with regard to core-network equipment energy consumption is common practice in assessments today.

One possible solution to this problem consists of applying an analogue to using intensity energy-consumption or GHG-production metrics when assessing companies with regard to these impact factors. Here, the respective numbers are normalized to, e.g., company growth or number of goods sold, in order not to penalize growth. This is done, for example, in assessments done by the Carbon Disclose Project (CDP).

The analogue to intensity metrics can be some sort of Internet-growth metrics. Here, the approximate average efficiency increase as per Figure 3, duplication in energy consumption per 10-fold bit-rate increase, can be considered.

Falling behind this trend may then be penalized, whereas staying ahead can be rewarded. Such a metric can – and should – be applied until disruptive new technologies appear which may drastically increase energy efficiency.

It is relevant to note that this proposal does not intend to reduce the respective vendors' efforts to developing better equipment energy efficiency. The intention is to achieve somewhat better assessment fairness for a certain group of equipment.

We will discuss this approach in relevant sustainability fora, including CDP and the QuEST Forum Sustainability Initiative.

CONCLUSION

Core-network equipment in the Internet is getting more energy-efficient quickly, but this trend today cannot compensate even faster bit-rate growth. We therefore propose to apply Internet-growth metrics in energy-efficiency or GHG-production assessments. This approach will be discussed in relevant sustainability fora. ●

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How Intelligent Energy – Europe II supported policy making and implementation for the market uptake of bioenergy in Europe

By Silvia Vivarelli, Executive Agency for Small and Medium-sized Enterprises, European Commission, Emilio Font de Mora, Innovation and Networks Executive Agency, European Commission, and Pat Howes, Ricardo Energy & Environment

SYNOPSIS

The EU Intelligent Energy – Europe II (IEE II) programme supported the market uptake of bioenergy in Europe with EUR 48.3 million of funds from 2007 to 2013. A new report prepared by Ricardo Energy & Environment for the Executive Agency for Small and Medium-sized Enterprises (EASME) of the European Commission reveals that, by June 2016, the programme triggered over 1.65 Mtoe of bioenergy and saved 5.7 Mt of carbon dioxide emissions, predominantly from heat production, and stimulated over EUR 0.9 billion investment in bioenergy. Those are conservative figures, and if potential data is taken into account then the achieved impact of the IEE II programme could be much higher.

A PROGRAMME FOR BIOENERGY UPTAKE

Bioenergy is playing an important role in the achievement of Europe's 2020 renewable energy targets. However, despite significant advances in technological development and innovation, a number of non-technological market barriers present challenges to the uptake of bioenergy as a whole. These include:

- A lack of knowledge, skills and confidence in biomass feedstocks and available technologies
- Insufficient mobilisation of biomass and underdevelopment of effective biomass supply chains
- Unfavourable policy frameworks at local, regional and national levels

All of these barriers are interlinked.

Since 2003 the Intelligent Energy Europe (IEE) programme has funded specific actions to address non-technological barriers in bioenergy to improve energy sustainability, support policy development and implementation across the EU, prepare the ground for investments and improve the capacity and skills of European market actors.

Over the course of the second phase of the programme (IEE II, running from 2007 to 2013), more than 2.8 million stakeholders were informed on bioenergy, more than 200,000 attended IEE II events and 14,600 were engaged in development meetings and site visits.

The programme contributed to the development of 443 business plans and 1,536 feasibility studies, resulting in the concrete implementation of 236 biomass supply chains. IEE II bioenergy projects have been linked directly with the development of over 400 plants across the EU representing over 165 MW, most of them as heat or Combined Heat and Power plants.

The leverage effect of the IEE II programme has been EUR 18.9 million investment and 0.035 Mtoe of bioenergy generated per EUR million of EU funding.

This article specifically focuses on how creating a favourable policy framework is enabling bioenergy uptake at the local and regional level.

INFLUENCING BIOENERGY POLICY IN EUROPE

A common challenge of IEE bioenergy projects has come from facing an unfavourable policy framework. Policy makers at European, national, regional and local levels need to recognise the benefits of using biomass for energy production.

Bioenergy has a number of unique attributes that make it an important component in Europe's short and long term renewable energy ambitions. Bioenergy can be produced in a decentralised manner, makes use of local resources and contributes to local development. Biomass can also be stored and used when convenient and the energy produced fed directly into the gas and electricity grids. Significantly, bioenergy also requires low capital investment to convert from traditional fuel sources. This makes it an attractive option to deliver local energy needs while potentially offering a rapid return on investment.

Policy makers have been involved in IEE II projects in different ways, such as attending project events, participating directly in project activities such as training, round tables, meetings and study tours or being members of project teams or part of project steering committees or working groups.

In IEE II bioenergy projects, direct contacts occurred with 560 policy makers, with many more attending conferences or other events. Recommendations to address specific barriers were provided and methodologies, decision-making and policy supporting tools were developed, such as modelling of biomass and bioenergy potentials – and Geographic Information Systems showing those potentials – and greenhouse gas (GHG) emission calculators.

Many of these tools have been recognised at European level and in a number of EU Member States. Some of these tools have contributed to harmonisation between some Member States, such as the standardised method of calculating bioenergy GHG emissions developed in the BioGrace (for liquid and gaseous biofuels for transport) and BioGrace II (for solid and gaseous biofuels for heat and electricity) projects. The BioGrace GHG calculation tool has been recognised as a voluntary scheme by the European Commission and has been endorsed by some EU Member States. The tool developed by BioGrace-II is mentioned as a reference tool to facilitate the calculation of GHG emissions in the European Commission's Communication (SWD(2014)259) on the state of play of the sustainability of solid and gaseous biomass used for electricity generation, heating and cooling in the EU.

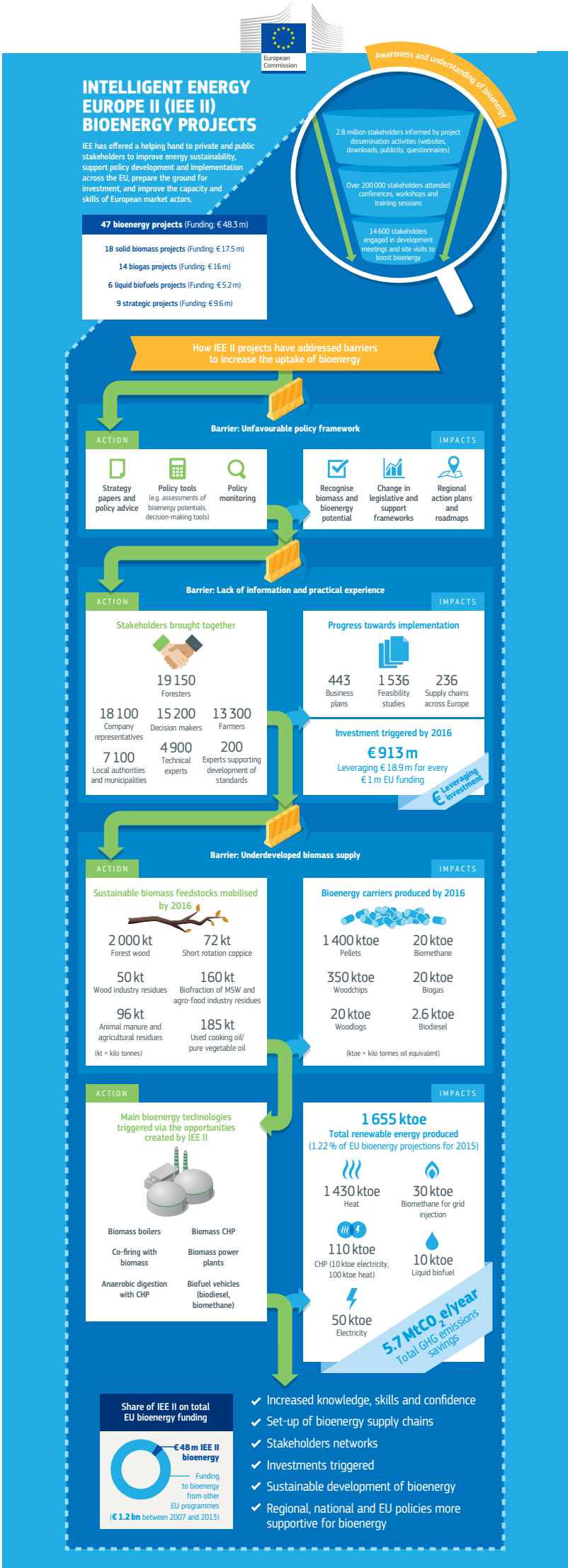
Outcomes from IEE II bioenergy projects have informed studies prepared for the European Commission to inform the Commission's policy making. This includes results from Biomass Futures, which provides quantitative information at EU level on biomass potential to meet the European renewable 2020 targets and BiomassPolicies, which is aimed at supporting the development of integrated policies for the mobilisation of resource efficient indigenous bioenergy chains. Likewise, BioTrade2020plus is supporting the development of an EU bioenergy trade strategy ensuring that imported bio-resources are sustainably sourced and used in an efficient way, limiting distortion of other markets.

At a local level, 76 biomass action plans, roadmaps or implementation plans were developed. Of these, 59 were aimed at specific regions, five provided plans for relevance at EU level and 12 were aimed at national level. These resulted in 39 action plans or project recommendations being implemented at the regional level and 17 at the national level.

The following case studies show concrete examples of how IEE II projects have supported policy-making and implementation at different levels.

Success story: supporting bioenergy uptake in rural regions in Europe

A particularly successful project at local level is the BioRegions project.



Rural areas in Europe are ideally placed to benefit from bioenergy generation. In these regions, local economies are often dominated by agriculture and forestry, offering an immediate supply of biomass for energy generation. However, key stakeholders in local government often have limited experience in implementing local bioenergy exploitation, and low visibility of the financial and environmental benefits it can bring.

The IEE II BioRegions project aimed to support five rural areas in Europe to supply at least a third of their heating and electricity needs from local and sustainable biomass sources. During the project a range of workshops and events were carried out, involving business owners, local government decision makers and other local stakeholders to formulate a shared vision for bioenergy production in the targeted regions. Study tours to best practice regions in Sweden and Germany were organised to demonstrate how similar areas have successfully supported bioenergy uptake. Policy makers were supported to develop regional action plans, which resulted in the implementation of more than 20 bioenergy projects, with a total installed capacity of 14 MW and another 18 energy efficiency projects that contribute to the bioenergy target by reducing the energy demand. The project also inspired other regions: over 130 additional regions expressed interest in developing similar activities.

Success story: facilitating the international trade of biomethane in Europe

At European and national level, the GreenGasGrids project aimed to increase the production and use of biomethane (from animal waste, other waste materials and sustainable biomass), for grid injection and as transport fuel, by removing non-technical barriers and paving the way towards a European biomethane market.

The project achieved an agreement on a harmonised methodology to allow the cross border market of biomethane and to establish 'guarantees of origin' and agreement to exchange information on biomethane transactions in six countries: Austria, Denmark, France, Germany, Switzerland and the UK.

In addition, 10 national biomethane roadmaps and one pan-EU roadmap were produced. The European Biomethane Roadmap drew attention to the potential of bio-methane at EU level with a vision to reach 18-20 billion m^3 of biomethane production by 2030. This figure is estimated to represent about 3% of the European natural gas consumption and a minimum of 10% of the total gaseous vehicle fuel consumption by 2030. The EU roadmap received positive feedback from several policy makers and European relevant organisations.

LONG LASTING IMPACT

IEE II bioenergy projects have played an important role in the development of bioenergy in Europe and continue to influence the sector at present and into the foreseeable future.

To find out more about the impacts and achievements of IEE II bioenergy projects, download the full report "Review of bioenergy projects implemented under IEE II" and the summary report "Impacts and achievements of bioenergy projects supported under the EU programme IEE II" at the EASME website: https://ec.europa.eu/easme/en/

Since 2014, Horizon 2020, the common EU programme for Research and Innovation, supports actions for renewable energy market uptake, including bioenergy. Several Horizon 2020 projects are building up and wide-spreading the successful results obtained in IEE II. For information on the bioenergy projects supported under the Competitive Low-Carbon Energy calls visit the INEA website: http://ec.europa.eu/inea/en/horizon-2020/projects/funded-projects.

The information provided is resulting from a review performed by Ricardo Energy & Environment. It does not necessarily reflect the opinion of the European Union. The European Commission cannot be held responsible for any use which may be made of the information contained therein.

The INCREASE simulation platform

NEW CHALLENGES IN THE DISTRIBUTION NETWORK

Over the past decades, research has been focused on developing software tools to analyze, plan, optimize and simulate electrical networks. The advent of distributed generation (DG) has gradually changed power flow in the power distribution network from downstream unidirectional to a bidirectional scheme, introducing challenging technical issues, such as unacceptable overvoltages, voltage unbalances, line congestions, and protection issues. Although novel control schemes have been proposed for interfacing DGs to the grid and mitigating these issues, such controlled inverters need to be also efficiently incorporated in the simulation software packages. A major drawback of current software platforms is that they usually have a closed form architecture, not allowing the easy and efficient integration of user developed models, especially regarding control systems.

THE INCREASE APPROACH

To overcome these issues, **a new simulation platform has been developed in the framework of the INCREASE project**, allowing the efficient integration of several distributed renewable energy sources (DRES) control strategies. The new simulation tool has the following basic characteristics:

- Employs **phasor-domain** solutions, resulting in short execution times even in cases of extended distribution networks.
- Offers a **graphical user interface** (GUI) for the convenient input and configuration of the system under study.
- Can allow the efficient incorporation of any DG control scheme.
- Can be **interlinked** with other software platforms and tools to form a generic co-simulation platform, capable to simulate modern power system networks from both power, control and communication point of view.

FEATURES

The INCREASE simulation platform provides the user with a **co-simulation tool** that can be used to investigate the influence of DRESs on their distribution system. In general, the simulation platform offers the following major features:

- **Detailed analysis** of MV/LV electrical power grids, including all potential DRESs, DGs, loads and control systems and high-end control schemes in DRESs. Due to the required analysis, a **quasi-dynamic** solution is adopted.
- Incorporation of an adaptive **Multi-Agent System** (MAS) taking into account multi-objective control algorithms as well as the communication among the individual agents.
- Implementation of a **multi-layer** control strategy for the secure and optimal operation of active distribution grids. The distinct control strategies are coordinated by employing a user defined **timeslot concept**.
- Ability to simulate **balanced** as well as **unbalanced** distribution networks with **high accuracy**.
- Offers the ability to perform time-series simulation with **reduced** execution times.
- Allows the **integration** of load and generation forecasting algorithms for short- and medium-term provision of reserve, focusing on the power loss reduction, maximizing active power injection and the **optimal** performance of DRES.
- Employs a discrete **LAN simulator** of communication networks to evaluate the communication performance and the vulnerability of a communication-based control system.
- **Simple** GUI for the power system design with **user-friendly** post-processing tools for reporting and plotting results.
- **Built-in** import and export features for most common data and calculation formats.
- **Flexible** platform based on **open-source** software with **modular** architecture structure to readily integrate future packages, features and functions.

The above features and advantages, make the INCREASE simulation platform a **competitive** simulation program among other commercial and open-source software packages.

KEY STAKEHOLDERS

The key stakeholders that can make use of the INCREASE simulation platform include:

- **Distribution system operators** (DSOs). They can perform **long-term analysis** of the distribution grids to assess different control techniques of DRESs and their impacts.
- **Transmission system operators** (TSOs). The INCREASE simulation platform can be a valuable tool for developing and/or evaluating the provision of **ancillary services** for the TSOs.
- **Aggregators**. It can be used as a **powerful tool** for the aggregators to ensure the safe and reliable network operation, following certain interventions.
- **Power retailers**. The developed platform can be used to investigate **different pricing policies** for the prosumers, taking also into consideration the network operation from a power systems point of view.
- **Other regulatory authorities**. They can exploit the INCREASE simulation platform to develop new and/or assess existing **regulatory frameworks**.
- **Energy companies**. It can be used to investigate the **long-term performance** of the network from the grid side as well as from the economic point of view.
- **Universities or research institutes**. They can perform simulation studies to evaluate existing control techniques and/or to develop new control strategies.

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How much longer can we dream of a White Christmas?

By Michael Edmund

Good King Wenceslas looked out
On the feast of Stephen
When the snow lay round about
Deep and crisp and even
Brightly shone the moon that night
Though the frost was cruel
When a poor man came in sight
Gath'ring winter fuel

–John Mason Neale

One year ago, COP21 Paris was being lauded for its commitment to limiting the rise in global temperatures; COP 22 Marrakech has now concluded and it too has been hailed for shifting the focus to one of implementation: indeed, ratification of the Paris Agreement has proceeded remarkably swiftly. And as part of that process, and to much fanfare, the Commission unveiled its long-awaited Winter Package on November 30th. This date surely represents only one of many landmarks in the protracted struggle to decarbonise energy and mitigate the impact of anthropogenic global warming; and the initiative should be put in some sort of context.

As the COP 21 delegates were no doubt congratulating themselves on a successful meeting and boarding their homeward flights, news was reaching us of a heatwave across the Arctic: in the depth of the Arctic Winter, temperatures above minus 2° C were being recorded. Freezing point was reached (or even exceeded) around the turn of the year, while the region has already experienced 0° C this winter, at a time when the mercury might be expected to register minus 30° C. The news from the other pole has been no less alarming: it emerged in August that a crack in the Larsen C ice shelf had grown 20% longer, threatening to calve a huge area of ice with unpredictable effects on the stability of the shelf itself. Of course, this occurred during the Antarctic Winter and it is important because of what has already happened to the Larsen B ice shelf. Clearly, short-term temperature variations, such as those caused by El Niño, are implicated in these extraordinary events, but longer-term data from the NSIDC in Boulder, Colorado data present a clear warning: the extent of polar sea ice in December this year is smaller than the 1982-2010 average; smaller by an area the size of India. A suggestion is being made that as much as a third of the world's polar bear population might disappear by 2060 because of melting Arctic sea ice. The point is that we have yet to understand the full impact upon Arctic fish stocks of the loss of the ecosystem's apex predator – this quite apart from the unknown consequences for the climate of the difference between relatively dark-coloured seawater and relatively light-coloured ice in their absorption and reflection of solar irradiation.

Almost everything about the Commission's latest undertaking is big: even its name grew from "The Winter Package" to "New Rules for consumer centred clean energy transition". The document itself extends to over 1,000 pages and, as Vice-President Šefčovič observed at its launch, its proposals "touch upon all clean energy related sectors: research and innovation, skills, buildings, industry, transport, digital, finance to name but a few. These measures will equip all European citizens and businesses with the means to make the most of the clean energy transition." At the same time, Commissioner Arias Cañete singled out the binding 30% energy efficiency

target, suggesting perhaps this might be a primary test of the new package. For, as he observed, achieving it will reduce our dependence on energy imports as well as our emissions.

The sheer size and scope of the Winter Package make it impractical to attempt an in-depth review in a single article. Several analyses, examining different perspectives, have already been forthcoming elsewhere; but it is worthwhile to attempt to identify its key themes; and perhaps discern a central message. The package of new and updated legislation includes a Regulation concerning the governance of the Energy Union; updates to three Directives (Renewable Energy (RE); Energy Efficiency (EE); and Energy Performance of Buildings, the EPBD); and a Market Design Initiative, consisting of a Directive on Common Rules for the Internal Market in Electricity and three Regulations governing Electricity Market Regulation, ACER, and Risk Preparedness.

Amongst other things, the initiative on Energy Union governance introduces a requirement for National Energy and Climate Plans, while the EE and RE Directives include new 2030 targets and a new bioenergy sustainability policy. This has been the subject of criticism for the balance struck between support for new RE versus existing fossil fuel power generation. ACER, perhaps predictably, has welcomed the increase in its scope. Elsewhere, while noting the urgency of global warming, Professor Karl-Friedrich Lenz evaluates the new 27% RE Target. The steep fall in PV pricing, he observes, should assist efforts to accelerate the growth of RE before he concludes that the new EU-wide target, which replaces targets for individual Member States, requires a little more good faith in everyone making the maximum effort. Other commentators have been somewhat less charitable, criticising the target as lacking ambition.

And here, perhaps, lies the crux of the matter. The Winter Package circumscribes an enormously complex energy sector. Almost inevitably, there is disagreement over the best way forward. The risk is that the ensuing debate - however healthy, however well-intentioned - will blunt the thrust of the initiative. Time is clearly running short: if potential salvation of the global climate lies in Energy Efficiency, then we need action. Not discussion, not even legislation.

The words to the John Mason Neale Christmas Carol reflect an act of altruism by a King who was subsequently martyred. His Saint's Day, September 28th, is an official public holiday across many European countries: our attempts to use renewable biofuels might find an extension of this modern European metaphor in the image of a poor man gathering winter fuel. But "deep and crisp and even"? We must work harder if our children are to have a chance of seeing a traditional White Christmas. And much harder still if our Grandchildren are to see one. ●

With Targets to be reached, Energy Efficiency is Key

By Seán Kelly MEP (pictured)

To most people, increasing Energy Efficiency represents an obvious policy choice both for economic and environmental reasons. Reducing our energy use means lower energy costs for consumers, it means less dependence on external energy suppliers, and it means a reduced carbon footprint by cutting our Greenhouse Gas (GHG) emissions.

Add to this the boost to employment levels that Energy Efficiency can bring to the construction sector by increasing the demand for building renovations and it becomes evident that benefits of striving for a more Energy Efficient system are multiple.

However, for a number of reasons, investment in energy efficiency is not at the level it should be. The relative longer payback time of an Energy Efficiency investment, along with difficulties in accessing finance, and indeed the general lack of awareness, has hindered progress on this issue.

As we move into a crucial period here in Brussels in which we will work on the reviews of the Energy Efficiency Directive, the Electricity Market Design, the Renewable Energy Directive, the Energy Performance of Buildings Directive, while at the same time working on the legislation to ensure emissions reductions are achieved in the ETS and non-ETS sectors up to 2030, I feel it is crucial that we get the balance right to ensure the complementarity of all parts of this legislation, and that includes helping

to stimulate cost-effective investments in energy efficiency.

In the coming months, I will be focusing much of my own efforts in Parliament on the proposal for a new Effort Sharing Regulation for the period 2021 - 2030, which deals with emissions in the non-ETS sector. This is a crucial piece of legislation in terms of meeting our 40% GHG reduction target by 2030 which we pledged in Paris last year at COP21.

There is no getting around this - the 40% target is one that we cannot afford to miss. In the non-ETS sector we are looking for a 30% reduction by 2030 compared to 2005 levels, but current policies would see a reduction of just 24%. For this reason is absolutely crucial that we set the required high level of ambition, and energy efficiency has a key role to play in this.

Big improvements are needed in Europe's buildings, 75% of which are currently considered to be inefficient. Buildings account for 40% of final energy consumption in Europe and an enormous amount of this is wasted due to buildings not performing efficiently. Our legislative work in the coming months needs to ensure that we set the right framework to make investment into Energy Efficiency projects happen, and I look forward to the challenge ahead.

Part of the challenge is finance. We have a problem in Europe in that investments that should be economical are not being made. Despite the various EU funding instruments, there remains a lack of attractive options for energy efficiency financing. There is simply a lack of availability of finance for such investments, and this can be attributed mainly to the longer payback period and a higher perceived risk associated with energy efficiency investments. This essentially makes such undertakings seem not worthwhile to your typical homeowner.

Something that can really help this issue, and we are seeing examples of it pop up around Europe now, is the idea of an on-bill repayment scheme. In this system, a customer would be able to have the energy efficiency work undertaken on their home, often without an upfront cost, while the payment is made over time through the utility bill.

These are schemes that I think need to be made more available and we need to better promote them. In Ireland, for example, a recent study showed that almost half of Irish consumers would consider taking out a loan to pay for energy efficiency improvements. This pay-as-you-save idea could be a game changer for stimulating investment in energy efficiency projects and I think we need to support and enable it as much as possible.

In terms of mobilising finance, since it was announced in November 2014, I've been extremely interested in how the European Fund for Strategic Investments (EFSI) could be used for energy efficiency investments, particularly in buildings. For this reason I am excited by the new EFSI-backed EIB funding for an Energy Efficiency project in France. Under this project, €400 million will be made available to trigger the needed investment for energy efficiency renovations for private homes in France on a large scale.

Regions in France will set up specialised companies to provide assistance and packaged solutions to homeowners for the retrofitting of their homes, and it is reported that up to 40,000 flats and houses will be able to benefit. I truly hope this initiative is a resounding success as I think it could provide the blueprint for similar projects across Europe.

This is a great example of what EFSI has the potential to do if we use it effectively. I think this model, the grouping together of smaller schemes for funding under EFSI, has the potential to really drive the renovation of buildings in the EU which will greatly assist us both in terms of reducing emissions, and lowering energy costs for end-users. I hope to see something similar in Ireland in the not too distant future.

I think it is clear that Energy Efficiency has a vital role to play reducing energy demand in Europe and hence help us to meet our targets. As I prepare, at the time of writing, to depart for Marrakesh where I will represent the European Parliament at COP22, there is no better time than now to highlight this crucial topic and the important role it has in the fight against Climate Change.

Innovative solutions for the energy efficiency in industries

Resource efficiency, and especially energy efficiency, is a key driver to a smart and sustainable growth, while promoting a more efficient and competitive economy based on knowledge and innovation

In this context the Research Centre for Energy Resources and Consumption, CIRCE (Spain) is leading several initiatives within EU projects addressing the improvement of resource efficiency in industry.

TOP-REF: RESOURCE EFFICIENCY IN INDUSTRY BY MONITORING

TOP-REF is an initiative coordinated by CIRCE in the framework of the industrial association SPIRE. The project consortium consists of industrial partners including Dow Chemical, Ibérica (DCI), Petrogal and Fertinagro (Tervalis Group)

TOP-REF will develop and demonstrate a resource-efficiency and cross-sectorial methodology, which will be validated by the development and testing of non-invasive control tools.

By means of this methodology, the project has shown the most inefficient spots (45% of the economic losses and 55% of the energetic losses), in the ethylene cracker of DCI in Tarragona, leading to estimated savings of 3M€ per year.

The application of TOP-REF at the Fertinagro plant (4.000 t of product /year) during the drying and transport process of the granulated fertilizer would imply a reduction of gas (2-5%) and power consumption (2-3%). This could represent estimated savings of up to 200.000-250.000 € per year. Furthermore, the savings at this plant are equivalent to the CO2 emissions of 50 cars per year, or 90 houses. This provides an enormous potential, since the production of fertilizers in Europe, using the same process as Fertinagro's plant, is 40 Mt/year.

Furthermore, the project is a pioneer in the application of exergy as a Key Resource Indicator (KRI). Exergy enables us

to compare the resource efficiency between different process scenarios, identifying inefficiencies, supporting decision-making, and detecting poor process performance.

NIWE: WIRELESS POWERING FOR INDUSTRIAL FURNACES

CIRCE is a worldwide leader in the development and application of inductive charge for electric vehicles. This technology has been used in the NIWE project, coordinated by Tecnalia, to improve the flexibility and efficiency in the foundry sector.

CIRCE, has designed and constructed a 100 kW industrial prototype for melting and maintaining aluminum, within the project, in order to be tested in real conditions. The WPT (Wireless Power Transfer) will transfer the power from the grid to a 500 Kg furnace with no wires, allowing the mobility of the furnace /ladle, and improving production flexibility.

The quick power transmission system allows the use of smaller and more flexible furnaces, improving efficiency and productivity in the plant. For example, in the aluminum sector, the energy waste, produced as a result of overheating the aluminum to maintain the temperature, is avoided. Finally, the more accurate temperature control improves the aluminum quality.

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1. COM (2012) 2020 final. A strategy for smart, sustainable and inclusive growth
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3. This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 296024

Boosting the energy efficiency of buildings

By Steen Schelle Jensen, Head of Product Management, Kamstrup

Almost half of Europe's energy consumption goes to buildings, many of which are supplied by inefficient individual oil or gas boilers. As a result, they represent an unparalleled potential for energy savings. Improving the energy efficiency of buildings is a multi-phased process that begins with connecting more buildings to a district heating system based on waste heat and renewables.

Today, buildings are responsible for 40% of energy consumption in the EU – not to mention more than a third of CO_2 emissions. As a first step, connecting more buildings to a district heating system would mean getting rid of inefficient individual boilers and allow utilities to supply the buildings with more clean and sustainable energy sources.

OPTIMISING EXISTING BUILDING STOCK

The energy performance of individual buildings varies significantly not least due to their age. About 35% of EU buildings are over 50 years old and were built with little or no attention to energy efficiency. With frequent data from smart meters, utilities gain detailed insight into how different buildings perform, which allows them to target their efforts.

The next step is, therefore, to look closer at the buildings that consume the most energy and uncover their potential within three main areas: substation efficiency, building envelope performance and end-user behaviour.

MONITORING SUBSTATIONS

An energy efficient heat supply is dependent on well-functioning buildings and low return temperatures in the district heating network. However, Swedish research has shown that 75% of all substations are misadjusted. Hourly values from smart meters allow utilities to monitor the performance of substations and quickly identify errors or opportunities for improvement.

PERFORMANCE OPTIMISATION

Data-based knowledge about how individual buildings perform under different wind and weather conditions enables utilities to continuously make informed decisions about their energy production and distribution. It also allows them to evaluate the building characteristics to determine when and how to push for renovating buildings in the most efficient way.

INVOLVING END USERS

Energy consumption and peak demands are still closely connected to end-user behaviour and so, when comparing identical buildings, energy consumption will differ significantly. Smart metering coupled with advanced data analytics enable utilities to provide targeted energy advice to individual consumers. Also, visualisation tools already available today allow end users to follow their consumption by the hour and to benchmark how they compare to other end users with similar profiles.

ENERGY STORAGE IN BUILDINGS

Today and in the future, buildings are a key factor in the energy efficiency equation – and technological advances continue to present new opportunities. For example, as the energy efficiency of buildings increases so does their potential as energy storage. Storage-in-buildings (SIB) – both deep storage in the structural core e.g. in walls, and shallow storage in gypsum etc. improves heat load shifting without reducing thermal comfort or requiring new constructions. The result is a higher quality of the energy mix enhancing the integration of renewables in the district heating system, which is the very prerequisite for the energy efficient heat supply.

Learn more at **kamstrup.com**

Safeguarding energy security in South-East Europe with investment in demand-side infrastructure

By Cosmina Marian, Buildings Performance Institute Europe (BPIE)

A recent analysis of the building stock's vulnerability to gas-supply disruptions concludes that Central and South East European (SEE) countries are confronted with a strategic choice. Indeed, in the case of disruption, Slovakia and Hungary face a severe risk, Bulgaria a substantial one, to be unable to heat their national building stocks.

A newly developed Building stock Vulnerability Indicator (BVI) assesses the susceptibility of the building sector to gas-supply interruptions. The BVI takes into account the importance of gas use in the building sector, along with the dependence on imported gas and its routes. Based on this assessment, seven countries in the SEE region are facing significant risk.

An "efficiency first" approach presents itself as a good solution to counter the heavy focus put on gas infrastructure. A dedicated renovation programme could, within 20 years, address all gas-using buildings in the region and reduce the building stock gas consumption by as much as 8.2 bcm/a, or 70% of the current consumption.

This solution can prove to be very effective as the building stock in SEE countries consumes 38% of the gas imports.

Unlike supply-side solutions (like investing in gas infrastructure), which make the region more dependent on imported gas in the long term, demand-side solutions (such as the electrification of the district heating network with heat pumps, or the energy efficiency in buildings achieved through deep renovations) also bring a raft of other benefits – creating employment, boosting economic growth, cutting fuel poverty and improving the region's often very poor air quality.

While the current Security of Gas Supply Regulation aims to ensure deliveries of gas to protected customers (i.e. residential buildings), its rate of success in a real crisis is yet to be determined. Doubts were cast on

BVI results and corresponding map: Considering this vulnerability, SEE States need to mitigate the pressure by considering viable alternatives.

Building Stock Vulnerability

	BVI	Vulnerability level
Albania	0	Not Applicable
Bosnia & Herzegovina	5	Moderate
Bulgaria	12	Substantial
Croatia	4	Low
FYROM	5	Moderate
Greece	3	Low
Hungary	34	Severe
Kosovo	0	Not Applicable
Montenegro	0	Not Applicable
Romania	1	Low
Serbia	7	Moderate
Slovakia	39	Severe
Slovenia	6	Moderate

Scale:	N/A	Low	Moderate	Substantial	Severe	Critical
	BVI = 0	0 < BVI < 5	5 < BVI < 10	10 < BVI < 20	20 < BVI < 40	BVI > 40

its effectiveness when the gas supplies from Russia to Ukraine were cut off in 2015. Some consumers – such as business and public-sector buildings – are not covered by the regulation and thus at risk not to be able to fulfil their energy needs in case of a disruption.

Thus, a sound renovation programme should not be a 'safety net' but a Plan A.

MAKING THE ECONOMIC CASE

The potential impacts can be presumed by modelling four scenarios that examine the evolution of a dedicated renovation programme focused on gas-consuming buildings.

One of the most ambitious scenarios taken into account in BPIE's analysis - 'energy security' - proved to dramatically reduce the vulnerability to gas-supply interruptions. All buildings currently using gas could be renovated within 20 years, cutting gas consumption by 70%, or over 8 bcm/a[1]. Even in the event of a

complete and prolonged gas-supply disruption from Russia, the region would be able to meet its demand with reverse-flow pipelines from Western Europe and LNG terminals.

The upfront investment is relatively high in all scenarios, but is more than offset by the avoided energy costs. The maximum investment needed under the 'energy security' scenario is €81bn, which delivers energy-cost savings of €106bn (present value costs and savings, derived over the measures' lifetime). To sum up, the savings far outweigh the initial commitment.

While a considerable share of investment will come from private sources, public funding can fast-track and support the process, by using funding from the European Fund for Strategic Investment and the European Structural and Investment Funds.

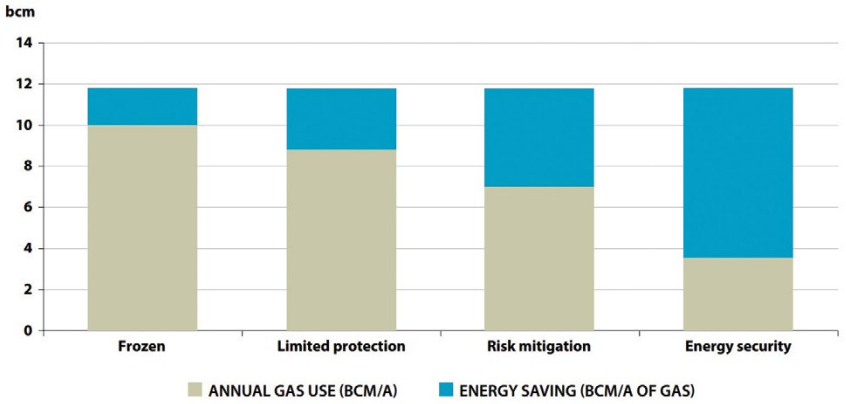
RECOMMENDATIONS ON THREE LEVELS

In BPIE's view, several steps can be taken order to decrease the risks South-East Europe is facing:

Preventive measures have to be considered

- The European institutions and countries in the region are strongly encouraged to set energy efficiency as an infrastructure priority.
- In drawing up their Preventive Action Plans under the Security of Gas Supply Regulation, participating countries need to look into demand-side measures on an equal footing with supply-side measures.
- Countries in the region are encouraged to take the Building Vulnerability Indicator (BVI) into account when preparing their risk assessments under the Security of Gas Supply Regulation.

Gas demand in buildings reduced through energy efficiency measures



EU level policies and definitions need refinement

- Funds from the Connecting Europe Facility, the Multiannual Financial Framework, the European Fund for Strategic Investments and the Structural and Investment Funds should be better directed for investments in deep renovations of the building stock.
- Energy efficiency and demand-side response need to be taken into account in The Projects of Common Interest list for 2018.
- To ensure that local employment opportunities are maximised and that economic benefits are retained within the region, a strategic multi-country approach that sees the development of manufacturing capacity alongside the expected increase in the installation of renovation measures is required.
- The significant renewable energy potential in the region needs to be maximised, including within the building stock.

Heating and cooling infrastructure to be planned strategically

- A strategic roadmap should be developed to shift away from traditional heating and cooling methods based on fossil fuels and local biomass, towards modern approaches built on best available low-carbon technologies. Energy efficiency of the whole energy system, including district heating, should be addressed in order to mitigate the demand for gas as well as for other energy carriers.
- Subsidies for fossil fuels need to be phased out and redirected to clean energy developments that support the combination of renewable energy technologies and energy efficiency improvements in the building sector.

Some food-for-thought, as governments should consider other alternatives to decrease energy supply risks and encourage investments to upgrade their national building stock. This would generate domestic growth, modernise the national building infrastructure and improve inhabitants' living conditions.

1. bcm = billion cubic metres

For an in-depth analysis, see BPIE's report at
http://bpie.eu/publication/safeguarding-energy-security-in-south-east-europe-with-investment-in-demand-side-infrastructure/

eeBIM LAB – Towards A Coherent Green Building Design Process

By Romy Guruz, Peter Katranuschkov & Raimar Scherer (Technische Universität Dresden, Institute of construction informatics)

eEmbedded is an European FP7 industry-driven project established under Call "Optimised design methodologies for energy-efficient buildings integrated in the neighbourhood energy systems". The project runs from 01.10.2013-30.09.2017, the consortium features 15 partners from 9 European countries. It develops an open BIM-based holistic collaborative design and simulation platform, a related holistic design methodology, an energy system information model and an integrated information management framework for designing energy-efficient buildings and their optimal energetic embedding in the neighbourhood of surrounding buildings and energy systems. A new design control and monitoring system will support the complex design collaboration process. Knowledge-based detailing templates will allow energy simulations as soon as in the early design phase and BIM-enabled interoperability will provide for a seamless design process with distributed experts. The main developed results after three years project running are:

KEY POINT DRIVEN MULTI-DISCIPLINARY DESIGN METHOD

Key Points guide the design process by providing building requirements and design criteria in form of target values, checked after all major design steps. They are categorized in Decision Values (DV), representing the preferences of decision makers related to the project goals, Key Performance Indicators (KPI), providing numeric metrics of the building energy performance, and Key Design Parameters (KDP) representing mandatory building properties in terms of allowed value ranges as explained in the results of the first period.

DECISION LEVEL SUPPORT

The developed method supports decision-making in four clearly structured decision levels corresponding to respective process and data views. The Setup view addresses the translation of requirements to Key Points and their use to setup individual design tasks. The Designer View comprises the tasks related to the evolution and evaluation of the design based on the set KDPs. The Analyst View regards the energy and cost analysis and evaluation of proposed design alternatives based on the computed KPIs and the Decision Maker View regards the evaluation of the design alternatives based on the weighted Decision Values.

INTEROPERABLE SERVICE ORIENTED ICT PLATFORM

The developed conceptual approach is technically enabled by a layered service-oriented platform. It comprises a User Layer including the actual value-add expert applications of the end users, a Virtual Lab Layer covering the functionalities on user side developed generically and configured specifically for each domain view, a Communication Layer providing a BCF-based Service Bus inter-connecting all the distributed component services and tools, a Service Layer providing services for all needed model, variant and simulation management functions, and a Repository Layer representing the common project-wide information storage.

MULTI-MODEL FRAMEWORK

The developed platform tools and services are supported by a coherent multi-model framework based on standard BIM/IFC4, a set of interoperable data access APIs and a novel Link Model approach enabling the flexible integration of distributed heterogeneous (non-BIM) information resources such as climate data etc. The relevant domain models encompass the Architectural Model and a new Energy System Information Model (ESIM), which provide the backbone of the framework , as well as BACS, HVAC, Energy Simulation, LCC, and LCA models. Data consistency is ensured by an overarching lean ontology, which provides for a uniform representation of the important multi-model inter-relationships also enabling data exchange requirements, KDP and KPI checks thereby ensuring high model and data quality.

VIRTUAL EEBIM LAB TOOLS

The Virtual Lab comprises two tools common for all actors - the developed Multi-Model Navigator (MMNav) and the Key Point Analysis (KPA) tool. MMNav enables visualizing the 3D BIM model, linking its components with external data, and can also show the results of the analysis/simulation tools and the performed model checks. The KPA tool provides a decision maker perspective by summarizing and configuring KPI results from all analysed variants into easy to understand and decide upon diagrams. Each Lab is also configured to include local or cloud-enabled design, analysis and simulation tools as appropriate for the respective actor profile.

COLLABORATION AND RESOURCE MANAGEMENT SERVICES

The developed Scenario Manager coordinates a structured project setup (based on IDM), supports each design step and manages data validation and data sharing. Additional services like Job Matrix, Model Combiner etc. are developed as resource management services and support the idea of intelligent BIM processes.

Contact details:
More results and a download section containing all public materials issued so far can be found on the project's Web Site: http://eeEmbedded.eu

Increasing the energy performance of buildings – The enabling role of Research & Innovation in Advanced Materials

By Fabrice Stassin

Energy is a priority for Europe and President Juncker wants an Energy Union delivering secure, affordable and sustainable energy.

While it is expected by International Energy Agency (IEA) that power, industry and transport sectors contribute the most to CO2 reductions, buildings have a role to play through energy performance. Improving energy performance of buildings in Europe is crucial since they account for 40% of final energy demand and are key to reaching EU energy efficiency target of 20% by 2020 and 27% by 2030.

The adoption and deployment of energy performance technologies for buildings require that costs keep decreasing. The cost of these technologies depending namely on the advanced materials (non-ferrous metals, steel, alloys, glass, ceramics, plastics, composites), innovation is needed to increase performance, reduce cost and extend lifetime of advanced materials used in building components.

Low carbon energy (LCE) technologies (energy performance in buildings, energy capture & storage, decarbonization) are developing fast and represent an important opportunity for Europe-based industry of advanced materials. EMIRI (the Energy Materials Industrial Research Initiative) estimates our Europe-based industry today at 30 billion euro yearly revenues, over 500.000 direct & indirect jobs and close to 3 billion euro of yearly investment in R&D and capital expenditures. Every additional billion euro of revenues generates about 4.000 direct jobs.

Global trends are however impacting the Europe-based industry of advanced materials for LCE technologies:

- Developing countries invest more than developed countries in the deployment of LCE technologies and appear as the key markets (China is global leader investing 2.5 times more than Europe in renewable energy with an installed capacity at 26% of world total)
- Manufacturing of devices and components used in LCE technologies is moving to growing markets leading to new industrial champions and European dependency on imported technologies (1st wind turbine & photovoltaic cell suppliers are Chinese)
- Europe is losing leadership in R&D investment and innovation eco-systems develop outside Europe (China and Europe spend each $2.8 billion but spending in Europe fell 8% compared to 2014 (government spending down 18%) while it rose 4% in China)

These trends strongly impact job creation in Europe in LCE technologies. Losing ground, Europe becomes a LCE technology importer, and represents less than 15% of jobs in the sector (1.17 million jobs in Europe according to International Renewable Energy Association (IRENA)) while China accounts for 44% of total.

EMIRI estimates though that up to 50% of jobs preserved in Europe in LCE technologies are related to advanced materials. Our industry is strongly anchored in Europe and serving global markets but to maintain leadership, develop manufacturing presence and innovation power in Europe, we recommend that EU and Member States:

- Stimulate, in frame of Energy Union, a stronger growth of European market for LCE technologies … Otherwise the Europe-based sector of advanced materials will not develop local manufacturing presence if growing markets are outside Europe

- Focus innovation support on fewer priorities in line with business realities so that industry can develop competitive innovation-driven products … Otherwise manufacturing could still happen in Europe but based on innovation from elsewhere

- Create a business-friendly environment so that manufacturing in Europe comes at a benefit … Otherwise the European markets could become steadily served from outside

Regarding innovation EMIRI calls for an Innovation Pillar based on collaboration between public and private, aligned with 10 actions of Integrated SET (Strategic Energy Technologies) Plan and industry orientations. Covering advanced materials for energy performance in buildings, for competitive renewable energy, for energy system integration and for decarbonization, the pillar will bridge the gap between laboratory and market, reduce innovation risks and accelerate innovation to reach better and faster the market for LCE technologies.

Over 2015, EMIRI worked in close collaboration with European Commission Directorate General Research & Innovation to create the EMERIT Industry-Driven Initiative (EMERIT stands for "Energy Materials for Europe – Research & Industry innovating Together") which lays the foundations & priorities of the

Innovation Pillar. Among the 10 actions listed in the Integrated SET Plan Communication to accelerate energy system transformation, Action 5 "Develop new materials and technologies for energy efficiency solutions for buildings" is well covered in EMERIT by focusing on Advanced Materials used over 5 technologies.

- Transparent conductive coatings

- Smart windows and switchable glazing

- Building-integrated photovoltaics

- Electrochemical (batteries) and thermal energy storage

- Energy efficient highly glazed high rise facade systems

If EU implements policies driving innovation, manufacturing and market development of LCE technologies, the Europe-based industry of advanced materials can develop strong business positions. European society will benefit from presence of a competitive industry safeguarding investments, generating growth and employment, and creating strong innovation ecosystems. By 2025, annual revenues of the sector could reach past 40 billion euro, generating an additional 300.000 jobs (65.000 direct jobs including 3.000 in R&D) and leading to an additional cumulated investment of 15 billion euro.

EMIRI represents more than 60 organizations (industry, research, associations) active in Advanced Materials for low carbon energy technologies. The association contributes to industrial leadership of developers and producers of Advanced Materials by shaping an appropriate innovation, manufacturing and energy policy framework at European level. In frame of Horizon 2020, EMIRI collaborates with European Commission to develop the Innovation Pillar on Advanced Materials for low carbon energy proposed in the EMERIT Industry-Driven Initiative. More information at www.emiri.eu

COST Action TU0905 Structural Glass – Novel design methods and next generation products – A success story

By Jan Belis, Ghent University, Chair of COST Action TU0905

INTRODUCTION

Structural glass is a young and challenging domain, which is gaining importance in building practice at fast pace. The use of glass in the built environment is evolving rapidly from traditional small windows to large area structural glass and novel solar energy products. These novel applications impose new and increasingly onerous performance requirements on glass, which are far beyond excellent building physical performance only. Indeed, load-bearing building components such as beams, columns, passable floors and shear walls require resistance, component and system safety, robustness, and durability.

However, in spite of Europe's pole position in research and new developments in this field, the scientific research in this domain was rather fragmented and research projects were often running independently mainly in national or regional research programs. Furthermore, Structural Glass is usually not yet incorporated in academic engineering and architectural engineering education although knowledge transfer is required on both an educational level and a professional level. Moreover, the structural use of glass is currently not incorporated in European design codes, which makes its application even more challenging.

COST ACTION TU0905 "STRUCTURAL GLASS – NOVEL DESIGN METHODS AND NEXT GENERATION PRODUCTS"

The European "Cooperation in Science and Technology" programme (COST) offers a competitive, bottom-up funding opportunity for promising research networks in all fields of science and technology. Its projects are known as "COST Actions". The main objectives of this COST Action were to provide a strong contribution to the

on-going development of innovative high performance structural glass products mainly in architectural and solar applications, and to European standards in this field.

The Action identified and shared the outcomes of existing fragmented activities within the European research community. Additionally, the Action established a diverse multi-disciplinary network that encourages new research and collaborations across academics, practitioners, and industry. Finally, the Action strengthened the current and future generations of European glass designers by developing a structural glass Education Pack for university curricula across Europe.

RESULTS

Since its start in April 2010, more than 110 participants from 25 countries joined the Action, which established a strong academic and professional network. The participants have worked in 4 working groups to detect links between existing research projects and to identify demands for new research. In addition, 13 smaller specialized Task Groups were created to efficiently work on defined tasks and to develop an Education Pack to help educating students and researchers in this field.

A major tool in the development of the Education Pack was the organization of two Early Stage Researcher Training Schools on Structural Glass (Ghent University, 2012 and TU Darmstadt, 2013). During 5 days, early stage researchers (ESR) were educated by means of presentations, workshops and company visits under the guidance of about 15 renowned experts from all over Europe. With an extraordinary high participant-number of about 150 early stage researchers from 20 different countries and a high appreciation from the participants, the training schools were considered a great success.

Furthermore, the Action has facilitated an amazing number of over 40 successful short term scientific missions (STSM), allowing unique on-demand mobility and cooperation for a great number of young researchers. STSM's proved to be one of the most powerful tools of the Action, in particular for ESR, and a great stimulus for common international research applications and publications.

The Action successfully organized two international conferences (Porec, 2013 and Lausanne, 2014) to further disseminate the Action results. Accordingly, high-quality proceedings were published with an established scientific publisher. In addition, the Action triggered the launch of a brand new scientific journal 'Glass Structures & Engineering' (Springer Nature), which aims to be the leading reference in the field and which therefor is of vital importance for the scientific community.

Finally, the creation of a new Eurocode on Structural Glass in CEN TC250 WG3 (currently replace by CEN TC250 SC11) was heavily supported by COST Action TU0905.

"COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation."

Major publications

Belis J., Louter C., Mocibob D. (eds.). COST Action TU0905 Mid-term Conference on Structural Glass. Leiden:CRC Press/Balkema, 584 p. ISBN 978-1-138-00044-5

Louter C., Bos F., Belis J., Lebet J.P. (eds.). Challenging Glass 4 & COST TU0905 Final Conference. Leiden:CRC Press/Balkema, 852 p. ISBN 978-1-138-00164-0

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M. Feldmann et al., Guidance for European Structural Design of Glass Components, JRC Scientific and policy reports, S. Dimove et al. (eds.), Ispra, 2014.

ASCENT will provide a robust proof-of-concept of three related high temperature processes for CO_2 separation

ASCENT (ww.ascentproject.eu) will provide a robust proof-of-concept of three related high temperature processes for the separation of CO_2 from gaseous streams; each will lead to a step-change in efficiency of carbon removal in three types of pre-combustion capture, producing the hydrogen needed for highly efficient low-carbon power production. The project brings together small and medium enterprises preparing to launch these concepts with the support of leading research institutes, universities and industrial partners.

The essential feature linking the three technologies is the use of a high temperature solid sorbent for the simultaneous separation of CO_2 during conversion of other carbon containing gases (CO and CH_4) into H_2. Each technology has the ability to provide a step-change in efficiency because they all separate the CO_2 at elevated temperatures (>300°C) providing for more efficient heat integration options not available in technologies where the separation occurs at lower temperatures. Each process matches both endothermic and exothermic heat requirements of associated reactions and sorbent regeneration in an integrated in situ approach.

The synergies between the three technologies are strong, allowing both multiple interactions between the different work packages and allowing a consistent framework for cross-cutting activities across all the technologies. Each technology will be proven under industrially relevant conditions of pressure and temperature, at a scale that allows the use of industrially relevant materials that can be manufactured at a scale needed for real implementation. This represents a necessary step to be taken for each of the technologies before setting out on the route to future demonstration level activities.

ASCENT, Advanced Solid Cycles with Efficient Novel Technologies, addresses the need for original ideas to reduce the energy penalty associated with capturing carbon dioxide during power generation, and create a sustainable market for low carbon emission power with low associated energy penalties.

The unifying concept of the ASCENT project is the high temperature CO_2 capture during production of hydrogen fuel by means of the steam-methane reforming and associated water-gas shift reaction. The conditions under which the hydrogen fuel is produced is inherently optimized for highly efficient electricity generation (both gas turbines and fuel cells).

Improved heat integration options become available than for comparable low temperature capture processes, where the possibility for simultaneous reactions will be limited

Together, these three major advantages can be usefully implemented by several competing technologies with yet another unifying concept in that reactive solid materials are needed in all cases. These materials must be able to be carbonated (or reduced) and regenerated (or oxidised) in a cyclic fashion. Lab scale experimentation under highly idealised conditions, not highly representative of industrial scale applications have shown the feasibility and advantages of all three of these technologies. ASCENT aims to provide a robust proof-of-concept of these technologies using industrially relevant materials under industrially relevant conditions.

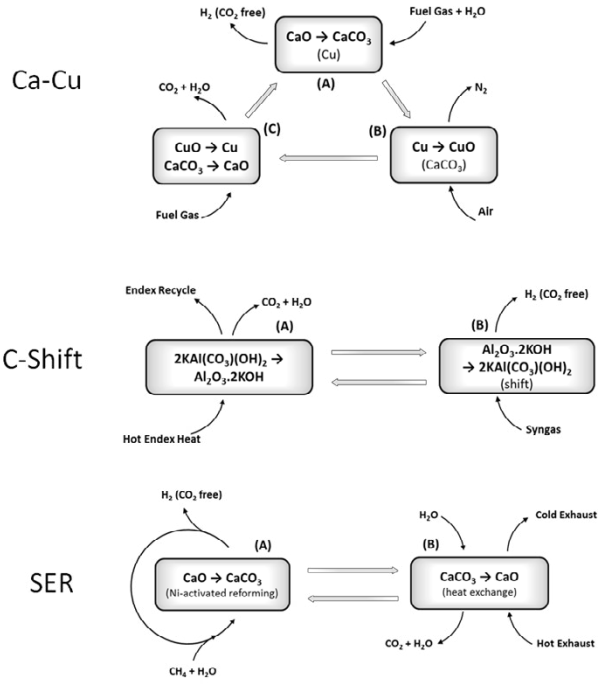

Figure 1 Conceptual cycles for the ASCENT technologies: Ca-Cu, CSHIFT and SER reaction systems respectively.

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Costs and Economics of Electricity from Residential PV Systems in Europe

By Arnulf Jäger-Waldau (pictured), European Commission, Joint Research Centre, Renewables and Energy Efficiency Unit

Over the last decade, prices for residential grid-connected PV systems have decreased significantly, as shown in Fig. 1. The increase in PV system prices in Japan, between 2007 and 2010 as well as the increase from 2015 to 2016, are due to changes in exchange rates; in the local currency the prices fell further.

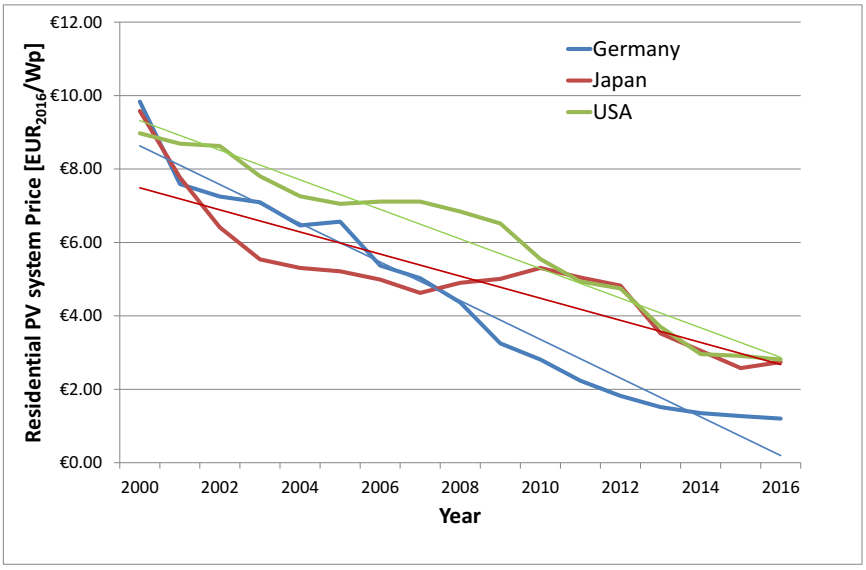
In September 2016, the worldwide average price of a residential system without tax was given as USD 1.67/Wp (EUR 1.49/Wp) about 25 % higher than in Europe with EUR 1.21/Wp or Australia[1]. T aking the European price and adding a surcharge of EUR 0.14/Wp for fees, permits, insurance, etc., an installed PV system costs EUR 1 350/kWp without financing[2] and VAT. The influence of the European VAT rates on investment costs and LCOE are shown in the European Cost Maps[3].

As shown in a growing number of countries, electricity production from residential PV solar systems can be cheaper than the variable part of residential electricity prices, depending on the actual electricity price and the local solar radiation level. Therefore, using self-generated electricity provides a means to lower the electricity bill on one hand, and to avoid excessive penetration of PV generated electricity in the grid network. In the case of a PV system size that generates as much electricity as the customer uses over a year, the actual consumption during the time of generation is in general about 25%-30% on residences, in commercial buildings it can be more[4,5].

There are in principle two methods, to increase the direct consumption ("Self-Consumption") of solar electricity. One is to use intelligent control systems, which switch major loads (washing/dryer machines, heat pumps, refrigerators, air-conditioners) on when the sun is shining. The second one requires a means to store the energy, either as electricity which requires accumulators, or as "product", (heatstorage, cold-storage or pumped water), for use at night or rainy days. Storing electricity has the additional advantage of making energy offers to the network operator at times the operators chooses as being profitable.

Nevertheless, some fraction of the electricity generated has to be sold to the grid. The question is what kind of pricing should be used – contract, wholesale or day-ahead prices. The fact that the costs of PV-generated

Fig. 1: Residential PV system price development over the last decade (data sources: IEA PVPS, BSW, DoE SunShot Initiative, Eurostat, OECD key economic data)



electricity can be equal to or lower than residential electricity costs is not yet sufficient to support a self-sustained and unsupported market.

For the benchmark calculation of residential systems operation, maintenance and repair (O&M) costs of 2% was used, which is higher than in other analyses. This reflects the fact that labour costs related to O&M activities have not decreased like the hardware components. Depending on the actual radiation level, the 2% O&M costs are the second or third largest cost factor. The O&M costs cover the foreseeable repairs and exchange costs of components like the inverter, as well as the annual degradation of the solar modules as specified by the manufacturers.

Depending on the actual radiation level, the 2% O&M costs are a main cost factor besides financing costs. The O&M costs cover the foreseeable repairs and exchange costs of components like the inverter, as well as the annual degradation of the solar modules as specified by the manufacturers. Adding a conservative safety margin of 0.8 EUR cent/kWh on top of the 2.7 EUR cent /kWh results in an electricity price of 2.9 to 3.5 EUR cent/kWh after the 20-year financial payback period, depending on the actual solar radiation.

The average European residential electricity price given by Eurostat[6] for the second semester of 2015 was EUR 0.211/kWh, including fixed charges. Fixed charges vary widely between EUR 20 and 170 per year, depending on the respective Member State and electricity provider. The same holds true for the variable part of the electricity price, which can vary between EUR 0.075 and 0.26 per kWh. Nevertheless, PV-generated electricity for the lower ROI financing options, which are more realistic for private consumers, is already cheaper for a large number of European Union citizens. Cyprus, Denmark and Germany had the highest prices with EUR 0.294/kWh, EUR 0.292/kWh and EUR 0.248/kWh, respectively.

Table 1: LCOE of PV-generated electricity for residential systems with a system price of EUR 1350/kWp (excluding VAT, because the differences in the various countries are too large), 2% O&M cost, an annual generation of 1 000 kWh/kWp/year and financial lifetimes of 20 years

	Price [EUR/ kWp]	**LCOE Product [EURct/ kWh]**	**LCOE Capital [EURct/kWh]**			**LCOE O&M 2 % [EURct/ kWh]**	**LCOE Total [EURct/kWh]**		
Return on investment		0%	3%	5%	10%		3%	5%	10%
Hardware	910	4.55	1.39	2.40	5.17	1.82	7.76	8.77	11.54
Eng. & and installation	300	1.50	0.46	0.79	1.70	0.60	2.56	2.89	3.80
Other (fees, permits, insurances...)	140	0.70	0.21	0.37	0.79	0.28	1.19	1.35	1.77
Total	**1350**	**6.75**	**2.06**	**3.56**	**7.66**	**2.70**	**11.51**	**13.02**	**17.12**

Table 2: LCOE of PV-generated electricity for residential systems with a system price of EUR 1 350 kWp (excluding VAT, because the differences in the various countries are too large), 2 % O&M costs, an annual generation of 1 300 kWh/kWp/year and a financial lifetime of 20 years

	Price [EUR/ kWp]	**LCOE Product [EURct/ kWh]**	**LCOE Capital [EURct/kWh]**			**LCOE O&M 2 % [EURct/ kWh]**	**LCOE Total [EURct/kWh]**		
Return on investment		0%	3%	5%	10%		3%	5%	10%
Hardware	910	3.50	1.07	1.85	3.97	1.40	5.97	6.75	8.87
Eng. & and installation	300	1.15	0.36	0.61	1.31	0.47	1.97	2.23	2.93
Other (fees, permits, insurances...)	140	0.54	0.16	0.28	0.61	0.22	0.92	1.04	1.37
Total	**1350**	**5.19**	**1.59**	**2.75**	**5.90**	**2.08**	**8.85**	**10.01**	**13.17**

The profitability of an unsubsidised solar PV system depends primarily on the owner's self-consumption, as less energy has to be purchased from the utility. In the case of a PV system size that generates as much electricity as the customer uses over a year, the actual consumption during the time of generation is in general only around 30% if no demand shifting or local storage is applied. Therefore, 70 % of the generated electricity has to be sold to the grid. The question is what kind of pricing should be used – contract, wholesale or day-ahead prices.

The first option for improving profitability is to increase selfconsumption by demand shifting and using electrical appliances like the washing machine, dishwasher, electric hot water haters or heat pumps during the day when the sun shines. Another option is to use the difference between the PV electricity generation costs and the household retail price to invest in local storage options, be they residential or community-owned. The current investment costs for a residential battery storage system are roughly equally divided between the batteries and the electronic control components. In the future, it is very likely that the solar inverter will include large parts of the necessary electronics, thereby lowering the costs significantly.

As an indication of storage costs, according to BNEF prices for battery packs for electric vehicles have declined from about USD 1000/kWh in 2010 to USD 350/kWh in H2 2015 and could reach USD 200/kWh by 2020[7]. Lithium-ion batteries have an average of 5000 cycles, and with the above cost estimates, this would corresponds to net kWh costs component for the full used battery pack of USD 0.07/ kWh (EUR 0.063/kWh) and should fall to USD 0.04/kWh (EUR 0.036/kWh) by 2020. However, these costs do not yet include the investment for the power and control electronics needed to combine it with a PV system.

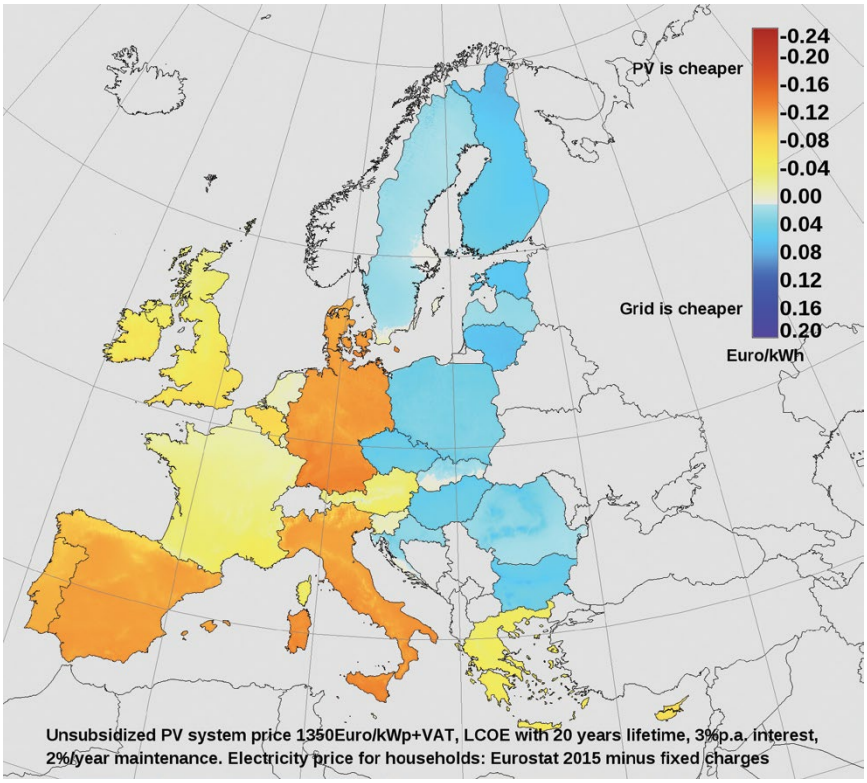


Fig. 2: Comparison of European residential electricity prices with electricity generated by a PV solar system.

However, LCOE of residential battery storage systems do not only depend on the CAPEX (battery pack, power and control electronics and installation) and total storage cycles, but are strongly influenced by the sizing of the PV and battery systems and the actual use of the battery system, i.e. depth of discharge, overall battery system efficiency, usable annual storage cycles and actual kWh stored and used[8]. Therefore, there is a wide range of prices of electricity from storage at EUR 0.18 to 0.36/kWh, which has to be added to the PV LCOE.

Some electricity providers in Europe are already offering PV systems and local storage to their customers, often including maintenance services. The packages also include apps to monitor the performance of the system, use of electricity and often functionality to control the match between demand and supply. The motivation for this model is described by those companies as follows: "This gives customers a complete and compatible package consisting of a PV system, storage device, app, and green electricity tariff."

Battery producers and storage system developers have started to offer their customers the organisation of their decentralised electricity generation and storage facilities as virtual power plants and acting as electricity providers and traders. Examples are Sonnen Gmbh or E3/DC.

In Germany KfW is offering loans with a non-repayable component for PV systems including storage with a maximum system power of 30 kWp [KfW 2016]. The loan is only available if the maximum injected power is 50% or less of the nominal power rating of the PV system. The maximum eligible amount is 25% of EUR 2.000 per kWp if the PV system and the battery storage are installed at the same time and EUR 2.200 per kWp of the PV system if the

system was installed after 31 December 2012 and more than 6 months have passed before the battery storage is added. However, the maximum eligible amount is reduced by 3% each 6 months starting 1 July 2016. The available funds for 2016 were already allocated at the beginning of October 2016 and new applications are now only accepted from 1 January 2017 on. The programme will be terminated at the end of 2018.

Another concept is "virtual storage" for electricity generated by PV systems either for a monthly fee or a down payment for a number of years. To take advantage of this offer, the PV system owner has to be a customer of the respective service provider. The advantage of the virtual storage is that the customer has no installation and maintenance costs for the storage system and virtually infinite lifetime.

In addition there are a number of companies, which offer the management of swarm or cluster storage facilities in cooperation with DNO's. However, detailed business information are very limited at the moment.

According to various consultancy reports, the electricity battery storage market is expected to grow 10-fold over the next five years and exceed EUR 6 billion by 2022. This market development, together with a further retail price increase and a PV system price reduction, could lower the LCOE of a PV system, including storage, below average European electricity retail prices and make PV electricity the lowest cost option for more than half of the Europeans within the next five years.

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Biography:

Dr. Arnulf Jäger–Waldau is a Scientific Officer and Senior Scientist at the Renewables and Energy Efficiency Unit, Institute for Energy and Transport of the European Commission's Joint Research Centre since 2001. He works on the assessment of renewable energy technologies, the effectiveness of their implementation, their integration into energy infrastructures and the role of renewable energy for climate change mitigation.

Since 1987 he works in the field of material research for solar cells and holds patents on semiconductor material deposition for thin film solar cells and solar module design.

He has more than 200 publications in peer reviewed journals and conference proceedings ranging from materials research for PV and solar cell development to market studies and policy evaluations for Renewable Energies. He is the author of the European Commission's annual "Photovoltaic Status Report", which is published annually since 2002.

From 2011 to 2014 he was the Technical Chairman of the European Photovoltaic Solar Energy Conference (EUPVSEC) and served as European Co-Chair of the 6th World Conference on Photovoltaic Power Conversion in Kyoto, November 2014 as well as Conference Chairperson of the E-MRS Spring Meeting in 2009 and 2013.

Dr. Jäger-Waldau was a Lead Author for Solar Energy of the Special Report of the IPCC on Renewable Energy and Climate Change Mitigation. He served as a reviewer of the Global Energy Assessment Report (GEA) published in 2012 and as a reviewer of the 5th Assessment Report (AR5) of IPCC published 2014.

He serves as a member of the Academic Advisory Board of the Chinese Trina State Key Laboratory for Photovoltaics, Academic Committee Vice Chairman member of the Asian Photovoltaic Industry Association (APVIA), member of the International Advisory Board of the Warsaw University Photovoltaic Centre and member of the Scientific Advisory Board of the Solar Research Centre of the Bulgarian Academy of Science. From 2005 to 2013 he was a member of the Executive Committee of the European Materials Research society (E-MRS).

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ZEROCO2
Towards zero emissions buildings

The European Directive on energy efficiency (Directive 2012/27/EU) and on energy performance of buildings (Directive 2010/31/EU) create a breakthrough in European (sustainability or climate) policies. The objectives as well as tools of intervention and verification oblige member states to immediately adopt a clear strategy for the improvement of performance of the buildings. The EU Directive stipulates that after 2020 all new buildings must be zero energy buildings and those buildings will also be near zero CO_2 emission buildings (NZCO2EB) due to energy use. Although there has been much recent focus on measures to reduce the emissions from new buildings, the existing building stock remains largely untouched and many refurbishment projects miss opportunities to reduce emissions to deliver low CO_2 buildings. The newly approved Interreg Europe project - ZEROCO2- comprises partners from eight member states. ZEROCO2 is led by Local Energy Agency Spodnje Podravje, Slovenia, and is joined by partners from Greece, Italy, Lithuania, Malta, Germany, Finland and France. The project partners will define near zero CO_2 emission buildings due to energy use (NZCO2EB) and present the various benefits resulting from this innovation. The main subjects addressed in the ZEROCO2 project are regional policies concerning environment and energy that will support the EU targets.

This project was initiated in April 2016 with the commencement of each partner's regional policy report in respect of NZCO2EB and the execution of a cost benefit analysis based on applied examples in each of the partner's regions. In executing the cost benefit analysis, exchange activities will create the process of presenting different options of energy sources and different technologies that can be used locally, regionally and nationally that will contribute to decrease of CO_2 emissions, while supporting regional development. The methodology uses an interregional approach that will engage and target policy makers from different European regions to reduce CO_2 emissions while simultaneously accelerating the transition towards sustainable development at local, regional, national and European levels. Through this interregional cooperation regions will identify, share and transfer innovative methodologies, technologies, processes and good practices in developing and implementing NZCO2EB policies, targeting new constructions and retrofitting of existing buildings.

ZEROCO2 places special emphasis on greening the building sector through enhancement of various ecofriendly energy sources and technologies, consequently serving as an incubator for new markets in the field of energy, technologies, services and business models. ZEROCO2 will represent and implement NZCO2EB in policies addressed in a similar fashion to that which was done for near zero energy buildings, which means that buildings do not produce CO_2 emissions due their use. The ZEROCO2 partnership will meet the flagship initiative: "Resource efficient Europe" to help decouple economic growth from the use of resources, supporting the transition towards a low carbon economy. All in all, ZEROCO2 will support the growth in the use of renewable energy sources and promotion of energy efficiency through improved regional policies.

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European Union | European Regional Development Fund

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The StableNextSol COST Action Project: Towards Stable Organic and Perovskite Solar Cell Technologies

Flexible Organic Solar Cell by Heliatek (a StableNextSol partner).

The COST Action MP1307 project 'Unravelling degradation mechanisms of organic and perovskite solar cells by complimentary characterization techniques (StableNextSol)' is a network of more than 470 leading European and international experts from more than 35 countries and 22 industries. The project aim is the realization of highly stable PV devices and modules through the study and understanding of the degradation mechanisms occurring in state-of-the-art PV devices.

CONCEPT

Organic and hybrid perovskite solar cells are among the top 10 emerging technologies of 2016. They are made of low cost and earth abundant materials which can be fabricated by inexpensive processes on large areas that can result in light weight, flexible, transparent and colourful solar cells and modules. With power conversion efficiencies that currently surpass 22 %, emerging photovoltaic technologies can significantly contribute to a clean electricity supply for the future. However, device stability is still a pending issue; it should at least match its commercially established competitor technology, silicon-based solar cells, at a guaranteed lifetime of more than 20 years. Thus, lifetime is one of the main hurdles for the successful and large-scale market introduction of these new promising photovoltaic technologies. The degradation mechanisms in these devices are hierarchical and complex, they can take place at variable locations in the device: in the light harvesting material, at the interfaces or at the contact electrodes. Thus, the in-depth understanding of their

Members of the StableNextSol COST Action MP1307

complex and diverse degradation paths is an essential step towards achieving long lifetimes. Due to the complicated interplay of chemical and physical degradation, knowledge in this area can only be acquired through the application of an extensive and complementary chemical and physical characterization. The StableNextSol project combines, in a highly interdisciplinary network, different sectors from academia, public authorities and industry, engaged in sharing their expertise on the different complementary analytical techniques required for the study and understanding of the degradation of these state-of-the-art emerging solar cells. The project, which has been running since March 2014 and is coordinated by Prof. Mónica Lira-Cantú from the Catalan Institute of Nanoscience and Nanotechnology (ICN2, Spain), integrates and generates fundamental knowledge and expertise to foster disruptive innovations targeted to mitigate device failure and to propose and develop new concepts for more stable emerging solar cells. Benefits are created along the entire value chain of photovoltaic research at European and international level, influencing also a variety of decision makers in the public sector which are supported by specialisation policies, testing protocols and standards.

IMPLEMENTATION AND OBJECTIVES

The StableNextSol project, as an instrument for the promotion of excellent science, aims at identifying the principal degradation mechanisms in state-of-the-art organic and perovskite solar cells. Our resources encompass the expertise in areas such as photovoltaic nanomaterials, device fabrication, characterization techniques, manufacturing, testing protocols and standardization, and lifetime of individual solar cells and complete modules.

We take advantage of different and complementary analytical techniques and know-how available within the network of partners of the consortium to study and understand the degradation ocurring in these emerging photovoltaic technologies. These studies are carried out through the organization of a series of experiments, interlaboratory collaborations and round robins in which more than 54 partner laboratories, research centres and photovoltaic industries are involved. As a solid networking tool, the project promotes collaboration among partners by the organization of conferences, workshops and industrial days. It also gives special emphasis on the training of the next generation of PV scientists through summer schools and short term scientific missions (STSMs).

The goals of the project are divided into Networking and Scientific/ Technical objectives. A bit more than half way through the project, we have made good progress on the set targets:

A) NETWORKING OBJECTIVES

- To establish a multidisciplinary network of research laboratories to share expertise and knowledge on the different characterization techniques required for solar cell analyses. Our project has grown from an initial 60 members up to more than 470 research scientists and experts on organic and perovskite solar cells.

- To create long-term collaborative research teams. An important objective is to continue and reinforce existing collaborations among partners, which is evidenced by more than 20 joint publications and several joint H2020 project applications.

- To train and prepare the next generation of research scientist experts on solar cell stability, for which we have organised more than 45 STSMs.

Glass based Perovskite Solar Cell demonstrator by Dyesol (a StableNextSol partner).

- To encourage the participation of female researchers, which currently stands at 38%.

- To strengthen networking between European and International research laboratories around the world in order to unify protocols and rise expertise in the degradation and stability studies of organic and perovskite solar cells. Our next meeting (to be held in Lisbon, Portugal the 6-7 of April, 2017, http://daysol17.lx.it.pt/index.html) will encompass an industrial day and a session on the best practices and characterization protocols, as well as standarization of perovskite solar cells where experts from Europe, USA and Japan will discuss about these important issues.

- To encourage and benefit from the different European research infrastructures available among members partners in order to optimize the use of existing resources.

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B) SCIENTIFIC/TECHNICAL OBJECTIVES

- To fabricate reproducible and scalable solar cells and test structures.

- To create awareness of state-of-the-art technologies, degradation protocols, standards and policies in the PV sector.

- To follow, to propose and to modify internationally protocols for the degradation/stability analysis of organic and perovskite solar cells. We are actively working on the preparation and publication of further journal articles and technical documents related to the revision of the current standards and degradation protocols for emerging solar cells, in some cases as a joint collaboration with international laboratories.

- To apply non-destructive and destructive characterization techniques to study degradation and elucidate degradation mechanisms of OPVs and PSCs.

- To determine of reliable acceleration factors that allow for a fast evaluation of device behaviour under real life conditions and allow the extrapolation of a guaranteed lifetime.

- To propose disruptive alternative materials and device structures to reduce or eliminate the degradation paths and to fabricate of next-generation organic and perovskite solar cells with enhanced lifetime.

IMPACT

The expected impact of the StableNextSol project is to increase awareness of the many instability issues of emerging photovoltaic technologies and the synergies across different technologies. This will enable the development of highly stable solar cells and modules. On the European societal level, we expect to eliminate the last remaining barriers still observed for organic and perovskite solar cells technologies to reach the marketplace.

The outcome of the Action StableNextSol, which is the development of stable devices and modules, will accelerate the access to secure and affordable energy for everyone to meet the needs of the European society and the growing world population.

While organic and perovskite solar cells are on the side of energy production, to make renewable energies fully work for the benefit of society, they have to be well integrated into the larger framework of energy production, transport and consumption. The StableNextSol project considers these emerging technologies part of this larger framework and policies, and promotes energy literacy, fact-based policies and standards, supported by robust and objective data.

"COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation."

INSPIREgrid
emPOWERing people

How to better involve stakeholders when planning new high-voltage power lines?

While many details of the future European power system remain highly disputed at national and European levels, one parameter seems to be very clear to a vast majority of policy-makers: the modernisation of the current electricity infrastructure is indispensible for the further integration of the European internal energy market as well as the integration of increased shares of renewables. However, the latest ACER monitoring report on PCIs published in July 2016 showed once again: many projects to further develop electricity grids are delayed – mostly due to challenges related to the permitting procedure.

This phenomenon has been present in many European countries over the last couple of years: it does not matter whether they are called Monsterplyons (in the UK) Monstertrasse (in Germany) or Monstermaster (in Norway)- newly planned power lines are often not very popular. So what can be done to better integrate the views, concerns and beliefs of stakeholders into the planning and permitting procedure?

The interdisciplinary consortium of the project INSPIRE-Grid, coordinated by RSE and comprised of research institutes, TSOs and the stakeholder platform Renewables Grid Initiative, has been working together for the past three years to tackle this question. At the beginning, the German research institute IZES took a closer look at different stakeholder groups that are normally involved in grid development projects – from citizens to environmental groups, farmers to planning authorities. At the end, psychologists from IZES came up with a stakeholder map that captures their main findings (an interactive version can be accessed on the INSPIRE-Grid website). Also during this early project phase, social scientists from ETH Zurich looked into projects, both in electricity infrastructure and other industries, to identify and analyse existing best practices in public participation and stakeholder engagement. Researchers from Poliedra, Armines and RSE took a closer look at different methodologies to include stakeholders during the consultation and decision-making stages, namely multi-criteria analysis, Web GIS and life-cycle assessments.

In a second phase of the project, researchers collaborated closely with the two TSOs Statnett and RTE in order to go out into the field and collect data in three different case studies – Aurland-Sogndal, Bamble-Rød (both Norway) and Cergy-Persan (France). Social scientists from PIK and engineers from Poliedra jointly conducted interviews and tested assumptions on MCA, LCA and Web GIS.

In the end, ETH Zurich validated the conclusions drawn in the other work packages with the help of different workshops both including TSO staff and external stakeholders.

The final recommendations of the project will be published in January and presented at the "Conference on Public Participation - State of the art approaches to stakeholder engagement in electricity infrastructure projects" on 25 January in Brussels. More information about this event, the project itself and all publications are available on the project website (www.inspire-grid.eu).

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SEVENTH FRAMEWORK PROGRAMME

International collaboration to promote Smart Grid as an enabler for sustainable development
Electricity system challenges

By Karin Widegren (pictured) Adviser to the Director General at the Swedish Energy Markets Inspectorate

The transformation of our Energy systems to the long-term energy and climate policy goals in the EU and worldwide, is one of the most challenging missions of our time. To fulfil these goals, future electricity systems require to be considerably "smarter" than today, substantially changing how electricity systems are planned, operated and controlled. Smart grid is a key enabler in reducing carbon emissions and improving energy efficiency by:

- facilitating higher penetration of renewable (e.g. wind and solar) by ensuring power system reliability as uncertainty and variability increase;
- helping consumers participate in the market not only by valuing their flexibility and increasing energy efficiency but also by allowing consumers to act as producers (prosumers) selling back their excess electricity;
- managing challenges posed on the distribution network e.g. by larger shares of distributed renewable generation and electrical vehicle infrastructure;
- improving over-all efficiency of the network and reducing network power losses;

Furthermore, with the need to replace/refurbish an increasingly ageing electrical infrastructure, the necessity of extensive investments in smart grids

becomes even more evident. Smart grid captures a range of advanced information, sensing, communications, controls and energy technologies, resulting in an electric power system that can intelligently integrate the actions of all connected users – from power generators to electricity consumers, to those who do both. Smart grid solutions are also found across the entire electrical system, from the high voltage transmission grid, through the distribution grid and finally on consumer level.

Rapid developments in information and communication technology are facilitating the modernization of the electricity system and the introduction of new market solutions that can contribute to crucial changes in the way customers participate on the market. New technology, new market models and regulatory approaches that help to increase flexibility throughout the system will enhance the functioning of the market to the benefit of consumers. It is in this perspective that the need to further develop and invest in smart grids is to be considered.

INTERNATIONAL COLLABORATION THROUGH ISGAN

The opportunities provided by Smart Grid is basically determined by the same set of drivers in different regions of the world, but with different priorities. In the developing world, demand is growing rapidly. Driving the need for massive investments in grid to connect more and more people while delivering high level of services. Developed countries face problems with an aging infrastructure. In Europe policy goals like the full integration of the internal electricity market and the integration of renewables as well as increasingly constrained networks have been identified as the dominant drivers. It is therefore no generic solution or size that fits all for the solution towards the smart and strong grid. At the same time there are generic solutions and findings from experiences that can be adapted by other countries to make local implementation faster and more efficient.

ISGAN (International Smart Grid Action Network) is an IEA Technology Collaboration Program (TCP) with the vision to accelerate progress on key aspects of smart grid policy, technology, and related standards through voluntary participation by governments in specific projects and programs. ISGAN is also an initiative of the Clean Energy Ministerial (CEM) and was formally established at CEM2 in Abu Dhabi, in 2011. As the only global government-to-government initiative for sharing information, best practices, and competence on electricity networks ISGAN helps to identify solutions to accelerate smart grid deployment, enable replication of proven ideas, and support greater national ambition in developing and deploying smart grids. In addition, ISGAN facilitates dynamic knowledge sharing, technical assistance, and project coordination, where appropriate. ISGAN participants report periodically on progress and projects to the Ministers of the Clean Energy Ministerial, in addition to IEA reporting requirements.

Membership in ISGAN is voluntary, and currently includes Australia, Austria, Belgium, Canada, China, Denmark, European Commission, Finland, France, Germany, India, Ireland, Italy, Japan, Korea, Mexico, the Netherlands, Norway, Russia, Singapore, South Africa, Spain, Sweden, Switzerland and the United States.,

ISGAN plays an amalgamating role between government and related private sector in both informal and formal ways. ISGAN focuses its activities on those aspects of smart grids where governments have regulatory authority and expertise.

ISGAN ACTIVITIES AND ACHIEVEMENTS

The present ISGAN membership includes countries responsible for more than 80% of the global GHG emissions and promoters of more than 90% of green energy technologies investments. The experience expressed in this context is therefore potentially unique and the reports and tools developed within ISGAN and beyond can find a very fertile terrain for new developments, validation and deployment. Policy relevance is a top priority for ISGAN. The unbiased technical expertise and the direct interaction with policy makers are the two major assets on which ISGAN can base its leadership.

The collaborative efforts of ISGAN focuses on development of protocols and best practices, identification of environmental issues and mitigation options; and by publicizing its member countries' and industries' newly developed tools, techniques, R&D, and country support policies, ISGAN contributes to a global benchmark and collaborative attitude among participating countries.

ISGAN activities are conducted in several areas:

- The working group on smart grid case studies captures and shares important lessons learned from the many smart grid pilot, demonstration, and deployment projects completed or underway.

- A cost-benefit analysis working group collects and evaluates existing methodologies and tools and develops new tools for assessing grid maturity and measuring smart grid benefits and costs.

- A working group on strategic communications helps other ISGAN activities translate complex information on smart grids for decision makers and highlight areas for further ISGAN or CEM attention.

- The Smart Grid International Research Facility Network (SIRFN) brings together world-class

research and testing facilities to exchange knowledge, coordinate joint assessment, and advance global best practices on electricity system testing.

- A power T&D networks working group supports joint consideration of the technical needs and related policy–regulatory–institutional considerations for future, smart, sustainable electricity networks.

- An ISGAN working group focused on the smart grid transition examines the institutional change management considerations that will support or impede the evolution to smart energy systems.

- The ISGAN Award of Excellence is an annual competition that showcases global leadership and innovation in smart grids, highlighting the value that smart grids provide for specific objectives, such as renewables integration.

- The ISGAN Virtual Academy is a new online curriculum for smart grid professionals that will augment or reinforce national and regional training programs and accelerate international best practice exchange

To sum up ISGAN activities showcase good practices for smart grid pilots, demonstrations, and deployment; identify areas for increased attention and investment; improve international collaboration on smart grid testing and evaluation; and support a global community of smart grid practitioners. The outcome of these activities are leveraging organisational and institutional learning and innovation process across sectors and disciplines accelerating the deployment of smart grid solutions and applications including new market arrangements as demand response and energy storage. Energy and the ICT Industry, research institutions, the relevant bodies of the public sector as well as new market actors and early adopting customers are all key actors in this process defining and verifying smart grid solutions to improve electricity system over-all efficiency to the benefit of consumers.

The long-term and sustainable planning of the future electricity system will require a broad and holistic approach also looking on synergies of the electricity network with other energy carriers and infrastructures like for example gas grids and storages, heating and cooling systems as well as electro mobility. Across this landscape of change, it is crucial for policy makers to understand the possible synergies and the need for a system view in which global know-how and best practice can be shared. This is a global challenge that requires global cooperation.

Biography Karin Widegren

Karin Widegren holds a position as Adviser to the Director General at the Swedish Energy Markets Inspectorate, the Swedish energy regulator, with policy development in relation to electricity market design and implementation of new technology with focus on smart grid and demand side flexibility as her main expertise. Since spring 2015 Karin Widegren is Vice Chair of ISGAN (International Smart Grid Action Network) an IEA Technology Collaboration Program. Karin Widegren has also served as the Director of the Swedish Coordination Council for Smart Grids, assigned by the Swedish government for the period 2012 – 2014 with the scope to develop a national action plan for smart grid. Karin Widegren is also one of 18 members of the Forum for Swedish Smart Grids, appointed by the Swedish Government and lead by the Ministry of the Environment and Energy with the mission to implement the action plan proposed by the Swedish Coordination Council for Smart Grids.

Before joining the Council Karin Widegren held a position as Director of International Affairs at the Swedish Energy Markets Inspectorate. Her career also includes a position as Science and Technology Attaché at the Swedish Office of Science and Technology in the USA and as Deputy Director for Energy Market Policies at the Swedish Ministry of Industry, Employment and Communications. As a former Research Project Manager within Vattenfall, Karin Widegren has gained a broad experience from corporate energy research.

Further information can be found on the ISGAN website http://www.iea-isgan.org/

SCARLET
Scale-up of Calcium Carbonate Looping Technology for Efficient CO_2 Capture from Power and Industrial Plants

Calcium Carbonate Looping (CCL) is a highly efficient post-combustion CO_2 capture technology utilizing limestone based sorbents (see Fig.1). CCL is particularly suited for retrofitting power plants as well as industrial plants (cement, steel, etc.). For power plant applications, CCL combines low net efficiency penalties of 5-7 %-points (incl. CO_2 compression) with low CO_2 avoidance costs below 30 €/t_{CO2}. The feasibility of CCL has been proven by various pilot plants.

The **SCARLET project** aims to bring CCL to the next level of maturity by obtaining reliable information and tools for scale-up of the technology, including the following activities:

- Pilot testing at 1 MW_{th} scale
- Development of scale-up tools
- Engineering for a 20 MW_{th} pilot plant
- Techno-economic/environmental assessment for power, cement, steel sector

A highly qualified consortium consisting of academic partners (Technische Universität Darmstadt, University of Ulster, CERTH), technology providers (GE Carbon Capture, Steinmüller Babcock Environment, Lhoist, SWR Engineering) and end users (Uniper, RWE, ArcelorMittal, CEMEX) provides the expertise that is required for successful scale-up of the CCL technology.

Four **long-term pilot tests** (4 weeks each, 24/7) have been performed at the 1 MW_{th} pilot plant at TU Darmstadt (see Fig. 2). CO_2 was continuously captured for more than 1,200 hours from coal originated flue gas under a wide range of conditions. Overall CO_2 capture efficiencies up to 97 % were achieved proving the high potential of the process.

Scale-up tools have been developed and validated against experimental data of the pilot tests. These include a steady-state process model for heat and mass balance, a dynamic process model for flexibility evaluation as well as various Computational Fluid Dynamics (CFD) approaches for 3D reactor simulation of fluidized bed reactors.

Figure 1: CCL process scheme

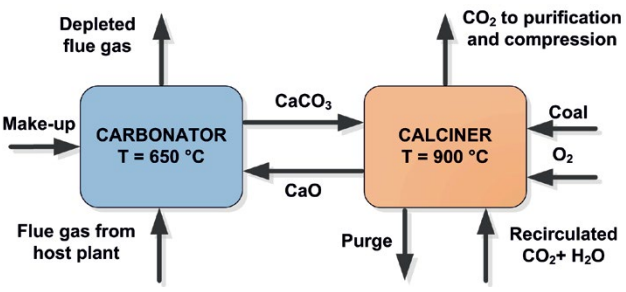

Figure 2: 1 MW_{th} CCL pilot plant at TU Darmstadt

A **20 MW_{th} pilot plant** will most probably be next step towards full-scale demonstration of CCL technology. The basic design and engineering of such a pilot plant are carried out considering UNIPER's Emile Huchet (France) hard coal power plant as the host site. Health and safety analysis as well as technical risk assessment are conducted for this pilot plant.

The **full-scale integration** of CCL into various power (hard coal, lignite) and industrial (cement, steel) plants is assessed for selected host sites of the industrial partners. Heat and mass balances for various retrofit scenarios are established to determine the energy requirements as well as CO_2 avoidance costs. The environmental impact of the technology is assessed by life cycle analysis (LCA).

Save the Date! – The **2nd Public Workshop** will take place on 23rd March 2017 at Technische Universität Darmstadt presenting the final results of the SCARLET project. There will be the possibility to visit the CCL pilot plant. The workshop will be free of charge. Registration can be made via email.

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TCM ensures global progress of carbon capture technologies

By Vegar Stokset

TCM and its owners, technology suppliers and other partners, are making new and important progress at Mongstad on the road towards making full-scale carbon capture better and cheaper.

The unique Euro 650 million test facility in Norway has become a crucial test ground for companies around the globe. Close international collaboration is key to succeed with making Carbon Capture and Storage (CCS) one of the three most important climate change solutions, and representatives from US and Norwegian authorities were present when American technology vendor ION Engineering started its ground-breaking test campaign at TCM a few weeks ago.

"This project represents a significant step toward commercially deploying carbon capture technologies that reduce greenhouse gas emissions," said Doug Hollett, DOE's Principal Deputy Assistant Secretary for Fossil Energy.

"It also embodies the importance of the ongoing collaboration between the U.S. and Norway on clean energy technology development," he said.

ION Engineering, with funding from the DOE, is the first project from DOE's Carbon Capture program to be located at an international host site. TCM, adjacent to Statoil's Mongstad refinery in Norway, and owned by the Norwegian state, Statoil, Shell and Sasol, is the world's largest and most advanced carbon capture test facility. Work conducted at TCM will be funded through a $7.6 million award from the DOE with a $6.7 million cost share provided by TCM.

CLOSE US-NORWAY COLLABORATION

"We are happy about the close collaboration with the US Department of Energy and very satisfied that ION Engineering is starting their testing at Mongstad. We will continue the close dialogue with DOE and hope to see more American technology companies headed for TCM in the future," said Roy Vardheim, Managing Director of TCM. Alfred Brown, CEO and Chairman of ION Engineering said:

"TCM provides ION with tremendous opportunity for advancement of our technology. At the 12 MWe scale, TCM is a vital step in the scale-up process as ION continues to make positive strides towards world-wide deployment of our CO_2 capture technology at commercial scale facilities. We look forward to working with the world-class team at TCM."

The purpose of the test campaign is to demonstrate the performance of ION's solvent by investigating amongst others energy consumption, CO_2 loading, corrosivity, degradation, water balance management and emissions.

HIGH TRANSFER VALUE

Testing of CCS technology under industrial conditions like at TCM has significant transfer value for full-scale CO_2 capture plants. Relevant players in Norway and internationally now have a better foundation for planning and building full-scale capture facilities at a reduced price and with reduced risk.

TCM, which is currently in its fourth year of operation and has a flexibility and

design which allows suppliers to test using flue gas from gas power plants and flue gas from the cracker at the Mongstad refinery. This makes TCM a unique arena in a global context for targeted testing, development and qualification of technology.

TCM is unique in a myriad of ways, including its scale, flexibility and organisation. At TCM, suppliers can conduct tests that are relevant for both coal-fired and gas-fired power plants, as well as refineries and other industrial activities. There are no other test centres of TCM's size that are openly available for international players and that have the flexibility to test different technologies.

KNOWLEDGE BENEFITS THE ENTIRE WORLD

In addition to the test campaigns carried out by the technology companies Aker Solutions, Alstom (now GE), Shell Cansolv, Carbon Clean Solutions and ION (ongoing), the owners have also carried out their own test campaigns via TCM based on the MEA solvent. MEA is not protected by patents so results and experience from these campaigns can be freely shared. For every technology that has been tested, the results and feedback from the players show that there have been significant technology improvements.

TCM is also in a league of its own as regards equipment. It is a high-standard 24/7 operations plant at industrial scale, with 4000 online instruments, workshop, offices, lab, and onsite staff. The facility also provides a flexibility that makes it possible to optimise and verify models over a broad area.

Knowledge sharing is an important aspect of TCM's activities, both via the owner companies, technology suppliers and in open forums. Much of the work carried out at TCM has been shared at international conferences, with networks and in research papers that are available to the general public.

The test results have provided new knowledge and expertise development that benefit sub-suppliers, Norwegian and international research institutions, as well as authorities.

INTERNATIONAL TEST CENTER NETWORK

Formed in 2012, at the initiative of TCM and National Carbon Capture Center/Southern (US), ITCN facilitates knowledge-sharing among carbon capture test facilities around the world. The NCCC currently chairs and operates the ITCN with DOE's Office of Fossil Energy, a role previously held by Technology Centre Mongstad of Norway.

ITCN now includes: TCM, NCCC (USA), CO2CRC, Australia, CSIRO (Commonwealth Scientific and Industrial Research Organization), Australia, CERI (Huaneng Clean Energy Research Institute), China, KIER (Korea Institute of Energy Research), Korea, SaskPower, Canada, SINTEF Norway and UKCCSRC, United Kingdom.

Overall, TCM has provided substantial contributions towards maturing carbon capture technologies, and has thus helped strengthen the likelihood of global application of a climate measure

Delivering a European CCS Network

December 2015 marked a historic moment in tackling global climate change, when 192 countries came together and signed the Paris Agreement, with the goal of limiting the global temperature increase to well below 2°C. If we thought achieving the 2°C limit would be challenging, then achieving less than this will be an even greater battle. We will need all tools at our disposal whilst keeping costs down as much as possible. Carbon Capture and Storage (CCS) will be a vital part of the solution – the IPCC has estimated that the costs of meeting global climate change targets without CCS could increase by 138%.

The reason CCS is so important comes from its ability to reduce emissions from a number of sectors. Industrial sectors such as steel, cement, chemicals and refining will be very dependent on CCS to achieve significant emissions reductions. This is because these sectors produce carbon dioxide as part of the process (for example to make steel in a blast furnace, you need to use coking coal and carbon dioxide is a by-product of this process).

So CCS will be crucial to ensuring a long-term, sustainable future for these industries. In the power sector, fossil fuel power with CCS will be vital as a flexible source of low-carbon electricity that can complement other options. As climate change targets begin to bite for other sectors (e.g. aviation), the benefits of negative emissions technologies will become increasingly important. Bioenergy with CCS currently represents the best option for producing large-scale negative emissions and a number of countries are developing projects in this area.

So, one year on and what impact has the Paris Agreement had with regard to CCS? There are signs that climate change is being taken more seriously in the private sector; for example the Oil and Gas Climate Initiative (OGCI), a group of ten leading global oil and gas companies, announced in November the establishment of a $1billion investment fund to support low-carbon technologies. A large proportion of this fund will be dedicated to CCS.

A number of countries are making good progress with operational CCS projects. Norway is this year celebrating the 20-year anniversary of the Sleipner CCS project – the world's first CO_2 storage project which has so far stored just over 16 million tonnes of CO_2 since it began operating in 1996.

Norway is now expanding its CCS portfolio and recently announced its intention to further develop CCS projects in three very diverse industries; ammonia, cement and waste management & energy recovery.

And only last week, the Netherlands announced the Dutch Energy and Climate Plan, which emphasises the importance of CCS to meet climate change targets – particularly for industrial sectors. The plan also highlights the ROAD CCS project; a collaboration between Uniper (previously E.ON) and ENGIE (previously GDF Suez) which could potentially represent the first step in developing a large-scale CCS network, able to transport and store emissions from industrial and power sectors across Europe.

Turning to developments in Brussels, CCS is increasingly being incorporated into new policies and funds. For example, signatories to the Strategic Energy Technology Plan (SET Plan) have recently adopted ten new specific targets for Carbon Capture Utilisation and Storage (CCUS). This is a positive development and helps to move CCS discussions forward in Europe. CCS transport infrastructure projects are also eligible under the Connecting Europe Facility, a European fund set up to support Projects of Common Interest (PCI). The European Commission is currently designing the criteria against which CCS transport projects will be judged.

However, more is needed. The Global CCS Institute recently published its 2016 Global Status of CCS report, in which they found that by the end of 2017, 21 large-scale CCS projects are likely to be in operation around the world. Together these projects currently capture and store around 40 million tonnes of CO_2 per year. To meet even a 2°C goal by 2050, the GCCSI estimates that the world will need to capture and store almost 4000 million tonnes per year – so we need to significantly pick up the pace with CCS.

Let's not forget that CCS also represents an important industry with the potential to create and retain thousands of jobs in the power and industrial sectors, as well as prolonging the life of oil and gas fields and delaying decommissioning.

In years to come, the Paris Agreement could mark the turning point in our fight against climate change. However, it is only the beginning and the real work to implement the actions begins now. We must ensure that policies are developed to deliver technologies like CCS that have the potential to drive a fundamental step-change in reducing emissions.

IMAGE ©: Statoil

Winter Energy Package: towards a battery revolution?

By Francesco Gattiglio (pictured), EU Policy Officer, EUROBAT (Association of European Automotive and Industrial Battery Manufacturers)

The long-awaited Winter Energy Package was published by the European Commission on 30 November. The jumbo-package (more than 1000 pages and 8 new legislative proposals) includes several norms and new legislation on energy efficiency, energy market design, eco-design and renewables: more importantly for battery energy storage, it finally includes an appropriate framework for energy storage. However, the package includes also some worrying signals for renewable energy sources. The European Commission decided to establish a conservative 2030 target for renewables (27% of renewables in the final energy consumption) and substantially limits priority of dispatch.

Despite these signals, batteries will be fundamental to properly integrate renewables in the future energy system. Batteries can store energy from on-peak renewable energy and release it when it is more needed, in central, de-centralized and off-grid situations. Variable renewable generation, combined with energy storage, represents a fixed generation capacity which can be valued on capacity markets. Additionally, storage devices can compensate for the destabilizing effects of variable generation on grid stability

Batteries can also offer grid support services like voltage control and frequency regulation, so maintaining grid stability and flexibility. These battery services improve the working conditions and stress-resistance of the grid, extending its capacity and making it more secure, reliable, and responsive. Battery energy storage can thus extend the life of existing infrastructure, either allowing deferral of investment or entirely avoiding the need to make expensive investments in transmission/ distribution system upgrades.

At household level, a battery system connected to a PV or small wind generator can increase the percentage of self-consumed electricity from about 30% without storage to around 60-70%, optimizing efficiency and reducing the amount of additional power needed from the grid. Besides, the batteries of electric and hybrid cars, as well as motive power batteries of machineries for material handling or ground support equipment, can also be source of flexibility for the grid though demand response and aggregation.

Overall, batteries can bolster Europe's use of renewables, as well as its energy efficiency, sustainability, independence and security. Despite technological advances, cost reduction and relevance of services offered by the four battery technologies (lead, lithium, sodium and nickel), battery energy storage has so far been hampered by serious and unintended legislative barriers and the lack of an appropriate framework. The proposal of the European Commission addresses most of these barriers, recognizing the importance of battery technologies and creating positive conditions for Europe to fully embrace the battery energy storage revolution.

As EUROBAT, as highlighted in our paper on barriers, opportunities services and benefits of energy storage, we believe that a first and very important decision is the inclusion of a definition of energy storage in the Electricity Directive: for the

legislator, "'energy storage' means, in the electricity system, deferring an amount of the electricity that was generated to the moment of use, either as final energy or converted into another energy carrier". This definition finally recognizes the existence and relevance of storage for the electricity system and it is a first step towards the establishment of energy storage as a separate component of the energy system (besides generation, transmission/ distribution and consumption) with its own characteristics and properties.

Another extremely important decision is the proposal to remove discriminative network tariffs against energy storage. Storage systems take electricity from the grid when they are charging and inject electricity into the grid when they discharge. However, since some member states impose taxation on both generation and consumption, storage system owners often have to pay double grid fees. The proposal of the Commission is the first step towards the elimination of these unnecessary and unjustified double grid fees.

It is also important that all market participants shall be financially responsible for imbalances they cause in the system, thus incentivizing the providers of flexibility services such as battery energy storage. Electricity prices actually reflecting actual demand and supply will be important tools to send correct market signals prices for demand-response, smart appliances (including electric and hybrid vehicles and motive power batteries) and storage solutions like batteries and would generally act as a critically important tool for ensuring flexibility.

On the negative side, the Commission also stated that Transmission System Operators (TSOs) and Distribution System Operators (DSOs) shall not be allowed to own, develop, manage or operate energy storage facilities. Exceptions to this rule are included in case of market failures. However, this provision could limit the market potential and full deployment of batteries.

Grid operators have a clear interest in directly operating storage systems to balance the grid, and having direct control over them would allow a safer and prompter balancing of the electricity grid. A "build or buy" choice would have been preferable, allowing grid operators to procure system flexibility services from storage facilities in the market or fulfil their needs themselves, depending on case by case situations. The creation of a proper market for storage services, allowing also small players to participate on an equal stand, individually or through aggregation, is anyway a positive news of the package.

Overall, and despite some shortcomings, EUROBAT members are convinced that the European Commission has decided to take the right decisions to stimulate the creation of a proper market for advanced batteries for energy storage. Also the measures to promote the deployment of hybrid and electric vehicles go in the right direction. It will be important that in the coming months the European institutions will keep working to promote the role and competitiveness of European battery producers, to keep the production of such a key enabling technology in Europe and take full advantage of the battery revolution.

The port of Oostende

Home for the Blue Growth cluster in the Southern North Sea

The port of Oostende is one of the 4 Flemish Sea ports in the Southern North Sea. It is a traditional city port, where the inner port stretches for 7 km alongside the canal, linking Oostende to the European inland waterway network. It is well connected by motorway and rail. Considering the pressure of real estate developers and "visionary" urbanists, it is not longer possible to expand the outer port. The nautical access allows vessels with a maximum length of 200 meters and the depth is situated at 8 LAT.

In traditional economic and logistic thinking, where the importance of ports is calculated on the basis of number of crates handled in and out of ports with ever bigger vessels, it is clear that one can ask questions about the future and viability of small and medium-sized ports in the North Sea.

But there is more than cargo traffic in the North Sea. A strategy paper of the European Commission to the European Parliament in 2012 outlines this very clearly: "Blue Growth, opportunities for marine and maritime sustainable growth". In other words, the potential for maritime economic growth is situated at sea.

THE EARLY DAYS OF BLUE ENERGY AND OFFSHORE WIND AT THE PORT OF OOSTENDE

The port of Oostende started in the blue growth in the sector in 2007-2008 with the construction of the first phase of the C-Power offshore wind park. This new economic activity needed a specially dedicated infrastructure and space within the outer port, in order to be able to realize construction at sea. Considering the licenses were given for the construction of 8 offshore wind parks by the Belgian government, it was clear that the port of Oostende had to rethink its elementary infrastructure in order to be able to handle the installation and maintenance of the offshore wind parks. In 2009, the port revised its core strategy and embarked on its ambition to become "The Flemish service port for the Blue Growth economy".

This has resulted in the set-up of a Public-Private partnership, involving ARTES constructions, Deme Blue Energy, Offshore & Wind assistance, Participatiemaatschappij Vlaanderen and the port of Oostende, called NV REBO (Renewable Energy Base Oostende). The goal of NV REBO is to become an efficient and cost effective offshore terminal for handling, lifting , storing, assembling and transporting all kind of offshore components. In 2011, the port of Oostende and NV REBO invested more than 5 000 000 euro in the building of the heavy load quay, and developed office and storage space for the different service providers in the offshore industry.

THE POLICY FRAMEWORK.

The wind farms in the Belgian North Sea make an important contribution to achieve the Belgian renewable energy targets. Today, 182 wind mills have been installed, producing energy for approx. 600 000 households. The aim is to install 450 wind mills with an overall capacity of 2 245 MW and an annual electricity output of 7 700 000 MWH. This is equivalent to 9 % of the total electricity consumption in Belgium (8085 TWh).

BLUE ENERGY AND OFFSHORE WIND TODAY AT THE PORT OF OOSTENDE

The operational mission of the port of Oostende is to become a home for all the enterprises related to the offshore industry and to cluster the knowledge, technology and industry in this sector. To achieve this the port makes the necessary investments to facilitate the installation, the management and the maintenance of the offshore wind parks.

As to the installation, one has learnt that every project is different, and has its own challenges. The evolution of the quality and design of offshore components is enormous, and experience has shown that every sea has its own characteristics: what counts for Belgian waters, does not

work in Danish waters. Therefore, it is of outmost importance that the offshore components are prepared in a specialized service port before they are mounted at sea. The idea that a wind park can be built with a computer program somewhere from an office in Barcelona, linked with an accountancy spreadsheet , is a mere illusion. The efficient and cost effective handling of the offshore components is a key task for the management of the port and of REBO : together with the client they investigate the different options to organize the operations within the port. The construction and the transport at sea of the 6 gravity-based foundations, with an average weight of 2700 tons each is still a landmark within the history of the port. Installations vessels like the Bold Tern (Fred Olsen) the Innovation and Neptune (Deme Group) are regular guests at the port of Oostende, and on the 28th of April, Queen Mathilde will rebaptize the Vidar (Jan De Nul Group) .The port works hard to improve the nautical access, and improve the swing-circle as well as straightening the quay walls.

For the management of the offshore wind parks, the electricity production at sea needs to be monitored in function of the supply to the grid for an efficient price-setting, and increasing the profitability of the investments. As to the technical aspects, it means that the wind park managers have a daily interaction with the different subcontractors, service providers and turbine manufacturers. Wind park owners/developers C-Power, Otary (Rentel, Seastar, and Mermaid) and Parkwind (Rental, Seastar and Northwester2) have chosen to establish their headquarters in the port of Oostende, overlooking a permanent monitoring of their sea parks.

The operations & maintenance of the wind parks are vital to keep the wind mills operating with optimal efficiency. Several service companies have set up their offices at the port in order to oversee the maintenance, and more companies have asked to open a representation in the Oostende offshore village. Considering the permanent growth of the cluster, the port management has developed a sustainable master plan to install the different enterprises on site, for reasons of safety, security and sustainability. The implementation of this process is a daily and ongoing business operation. At present, the management is investigating the economic opportunity of installing a prototype Xant (mid-seize/100kw) wind mill in to provide the site with electricity.

In the Oostende offshore village, the turbine manufacturers, Senvion, Vestas and Alstom have their offices, warehouses and workshops in order to be able to intervene in case of emergency maintenance. The port has refurbished several buildings next to the REBO terminal and built new premises. A wide range of subcontractor services have found their way to the port of Oostende, from IT to training: enterprises like e-Bo, CMI, Multitech, G4S, CG, Buijsse and Falck Safety services have found their place in the Belgian offshore world.

And there are no activities of operations & maintenance without crew transfer vessels. More than 3500 calls per year are registered by the Ensor-system. A lot of shipping-companies, operating these kinds of vessels are active at the port. Companies like Windcat, Nordfjord, Sima Charters, Sea Contractors, MPI, MCS, Stemat, Turbine Transfers,e.o. operate sailings between the Belgian wind parks and the port of Oostende. Most of the shipping-companies have their headquarters in

the UK, Denmark or Norway. But there are also Belgian operators: Geosea and OWA (Offshore Wind Assistance) are represented. And GEOxyz, which specialises in high technological underwater surveys and crew transfer, have based their fleet of 17 ships at the port in order to safeguard the maintenance and fleet management. Next to GEOxyz, Survitec has opened a new premise to secure the safety and security on board the vessels.

In order to support this activity, the port of Oostende will invest in additional efficient mooring infrastructure, as well as a performing IT-systems to secure efficient communication with the port users and the nautical authorities. More land will be made available for a ship-building company that wants to provide innovative solutions for developing more efficient vessels and satisfy the needs of the wind park operators.

BLUE GROWTH AT THE PORT OF OOSTENDE: A PERMANENT CHALLENGE.

The construction and maintenance of the offshore wind parks represent the most important parts of the Blue Growth development at the port of Oostende. Apart from wind energy, the port is also considering other sources of blue energy: together with Marintek, Sintef, Highlands & Islands Enterprise, the universities of Aalborg and Brindisi, an analysis has been made of the role that small and medium-seized ports can play in the development of wave and tidal energy (www.beppoproject.eu). The port also actively supports several practical projects from experimental development up to full scale testing. The wave projects Flansea and Laminaria, that have been testing in and around the breakwaters of the port, are excellent examples.

In addition to the production of the energy at sea, other opportunities can be realized within the the Blue Growth strategy. As a result of current climate conditions, the North Sea is facing a rising of sea level. In order to cope with this challenge it is important to develop new techniques and technologies for the monitoring of the sea level as well as the hydraulic and underwater constructions on shore and at sea. The project "the Vlaamse Baaien" has provided a positive input towards opening the door for developing new technologies in this field. Also, the port is investigating the possibility of establishing temporary and permanent test facilities in close cooperation with the marine and maritime industry. Moreover, the wind parks offer an opportunity for the offshore aquaculture to establish new projects in cooperation with the wind park managers within the framework of marine spatial planning. In this spatial plan, there is also room for the exploitation and management of the seabed, the promotion of marine biotechnology, the cultivation of algae, in full respect of the eco-system of the North Sea.

In order to realize these ambitions and targets, the port of Oostende is working in close cooperation with different organizations and institutions that have established themselves at the port. An important partner in these developments is the POM (Regional Development Agency) of West-Vlaanderen, which launched "the Factory of the future Blue Energy" in 2012, to support the clustering and branding of the marine and offshore industry in coastal regions. A joint venture has been set up with the University of Gent which has resulted in the building of the Greenbridge incubator centre in the inner port, hosting start-ups and companies, finding their way in renewable energy and blue growth. Other knowledge centers that have established their headquarters are ILVO and VLIZ . ILVO is the Flemish institute for the research in fisheries and agriculture, which investigates new technologies for fishing and the management of fish stocks in the North Sea. VLIZ is the Flemish institute for the Sea and functions as a coordination- and information-platform for all scientific marine and maritime research in Flanders. It has its own research vessel, the Simon Stevin, and has built its own data-center which has gained international recognition. UNESCO has also established its project office for the International Oceanographic Data & Information Change (IODE) at the port. Close relationships with industry have been established. In 2010, the port of Oostende was one of the founding fathers of the Flanders Maritime Cluster (FMC), an interest group for all industries active in and around the sea. It has its offices in the port house in Oostende. And recently, the Belgian Offshore Cluster (BOC) has been established, gathering different industrial players in the offshore wind sector: they have organized the second edition of the Belgian Offshore days at the port of Oostende in April 2016 and were present as a cluster at Wind Energy Hamburg in September 2016. They play an important role, especially as the Flemish government in Brussels still has not discovered the added value of this blue industry. Finally, the port is investigating opportunities for cooperation with the airport of Oostende-Brugge, for crew transfer and cargo supply.

CONCLUSION

The port of Oostende is a traditional port: general cargos, cruises, roll-on-roll off, fisheries, bulk are core activities within the port of Oostende and they are taken care of. New projects are established in the inner port within the field of circular economy, fine chemicals (SEVESO-site) and the improvement of the facilities for inland navigation. Somehow, the port of Oostende has decided some years ago to diversify the economic activities: the strategic choice for the blue growth and the investments in the development of the blue industry, have given the port of Oostende a new important pillar to guarantee its viability as a small and medium-sized port in the North Sea.

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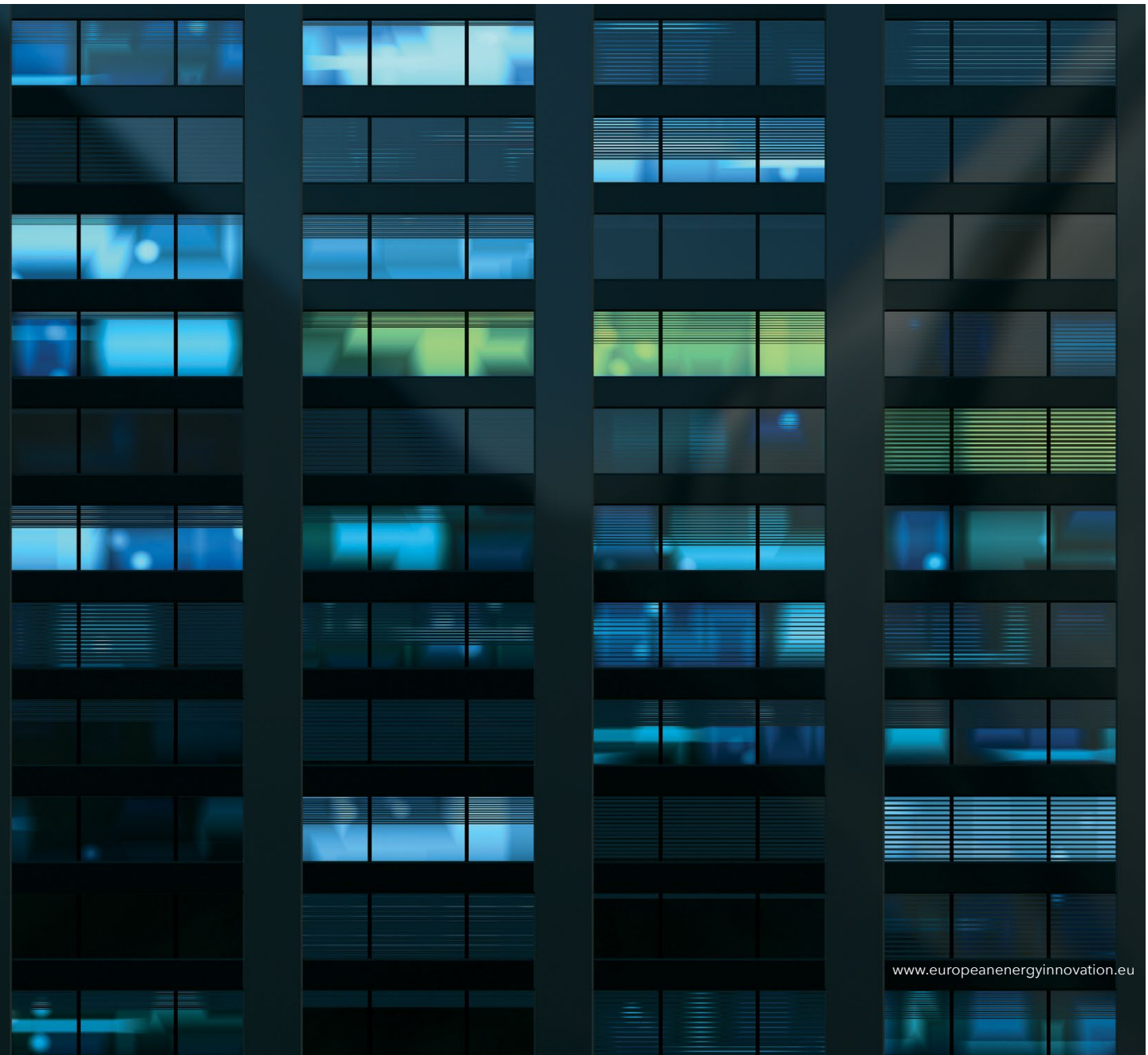
The smart meter revolution: paving the way towards consumer empowerment

By Hans ten Berge, Secretary General, EURELECTRIC

New technologies enabling smart grids, smart metering, smart homes, self-generation and storage equipment are progressively empowering citizens to take ownership of the energy transition and to participate actively in the "smart, new energy market". But what does this mean in reality?

The two-way communication between utility and consumer – made possible through smart meters – will stimulate changes in energy usage habits by allowing consumers to make more informed choices, and notably to manage their demand and reduce their costs. Smart meters will allow for an accurate and certified measurement of consumption, generation and



actuated flexibility. They will also bring benefits to consumers in the form of better products (e.g. flexible payment schemes and new tariff models such as time of use prices) and a range of value-added (energy management) services.Smart meters will also make retail market processes (switching, billing, moving, etc.) and network operation more efficient.

SMART METERING DEPLOYMENT IN THE EUROPEAN UNION

The rollout of smart meters at European level is, however, taking place at a slower pace than expected because of varying cost-benefit analysis outcomes in different European countries, as well as data privacy and security concerns. Although the Third Energy Package set the goal that 80% of the consumers should have a smart electricity meter in 2020, current estimates vary from 60-72% in those Member States that have assessed the rollout to be economically feasible.

For now, 17 Members States have decided on a full rollout with the minimal requirements included. Out of these 17 Member States, about four have coverage of 80% of consumers or above. A few more are currently between 30% and 80% and some are between 10% and 30% ; eight Member States have just started or have yet to start implementation. We are still far away from the original expectations.

Cautious of the situation, the European Commission decided to use its Clean Energy Package to step up pressure on Member States to rollout smart meters. The revised directive requires Member States that proceed with deployment to adopt the minimum functional and technical requirements for smart meters recommended by the European Commission. It also requires Member States who decided not to roll-out to periodically revise their assessment. Finally, where smart meters are not rolled-out, Members States shall ensure that every final consumer is entitled to have installed or upgraded a smart meter equipped with basic common

functionalities that would include, for example, the possibility of performing remote operations, the capability to provide actual, close to real time meter readings or the possibility to support advanced tariff schemes.

INTEROPERABILITY OF SMART METERS

The interoperability of smart meters has been a key issue since the European Commission issued the standardisation mandate M441 in 2009 promoting interoperability and security of the interfaces in the infrastructure, including those used by consumers to get access to their data. Both the smart meter coordination groups, CEN-CENELEC, and the Expert Group (EG1) of Smart Grid Task Force set up by the European Commission have shown that standards are available, but also that just selecting a standard is not sufficient to reach full interoperability. In the coming years, the European Commission will follow the implementation of standards delivered by European standardisation bodies. It will also analyse whether the European Standards for smart grids and smart metering systems, as well as the recommended functionalities for the latter, are consistently applied to ensure that they deliver the desired functionality and interoperability.

Currently, there is a need for a harmonised process for the exchange and access to meter data. This is mainly because the supplier must get consumption/generation measurements from any meter operator independent of its location, in the same way that consumers must be able to get their historic data after having moved to another location. The EG1 is now looking at these processes used by EU Member States and how they could be aligned.

PRIVACY AND SECURITY

Attitudes towards privacy and security may vary across Member States, but all consumers will only be comfortable with access to - and use of - their data if they are confident that their data is secure and that their privacy is safeguarded. The public acceptance is needed for a successful smart meter rollout.

Unlike PCs, tablets or smartphones – which may generate much more personal data than smart meters – smart meters are generally 'imposed' on consumers by industry policy and regulatory choices. Suppliers and DSOs must, therefore, take the time to explain carefully why smart meters are needed, prove - through innovative services - the added-value they represent, how they will benefit consumers and, crucially, how/by whom the data generated by such meters will be used.

Setting up of some minimum requirements for security at European level is crucial in this regard.

Power Set to be Key Battleground for 5G

By Mauro Boldi, ETSI, and Xiaobao Chen, 3GPP

Although energy efficiency was important in previous generations of mobile communications standards, such as UMTS and LTE, far greater emphasis will be placed upon this as a key performance metric in the forthcoming 5G standard. With each new generation of mobile communication technology, the energy consumed by the network has grown significantly, as the number of subscribers and the level of carried data traffic have both continued to rise, despite the consumption of the equipment being utilized actually decreasing slightly. If this dynamic was to continue then migration to 5G would be difficult from both an economic and an ecological standpoint. Consequently, energy efficiency will be one of the highest priorities for the 5G era.

Next generation networks will be expected to support dramatically higher user experienced data rates – up to 1 Gbps in some specific areas, such as indoor hotspots, and 50 Mbps for everywhere under 5G coverage – and a far larger number of connected devices. Some estimates expect up to 50 billion in total, though most agree it will take several years before this level is reached. The volume of traffic will grow as a wider array of applications emerge that are reliant on elevated data rates and the content that users want to transfer over the network keeps expanding. Increased use of video streaming, plus new services such as those based on augmented reality, will contribute heavily to this. Further down the line, industrial, automotive and medical applications are certain to ramp up the data overheads still higher.

DATA GROWTH AND ENERGY USE

Among the fundamental objectives that have been defined for the 5G standard is for the network's data capacity to go up 1,000 fold during the course of the next decade. The intention is to simultaneously achieve a 50% reduction in the global network's total energy usage, including that of existing legacy technologies. For this to happen, clearly the overall energy efficiency of the network has to improve substantially.

Reducing the ongoing operational expenses of the network and environmental footprint, such as CO_2 emissions, will be among the main motivations spurring operators to move to 5G, and power consumption is a key area where cost savings need to be witnessed. As well as the benefits experienced by the operator, there is a need to improve the user experience too. The goal here will be to allow smartphones to connect to the network while managing to run for much longer periods between recharges – thereby offering greater convenience for mobile subscribers.

MULTIPLE USE CASES

One element that makes 5G quite different from previous mobile generations is that its operational

Mauro Boldi (left) is vice-chairman of the EEPS (EE Eco Environmental Product Standards) group in the Energy Efficiency Technical Committee. Xiaobao Chen (right) is the rapporteur of 3GPP SA

characteristics will need to satisfy a plethora of different, often quite unrelated, demands. This time it is not simply about raising the data capacity (though that will be important of course) but also about supporting new communication use cases.

The emergence of the Internet of Things (IoT), in particular, will have major implications, with many IoT deployments having their own distinct set of requirements. Remote sensor nodes, responsible for monitoring a certain parameter in smart cities for example, or industrial M2M terminals, may need the massive connectivity that 5G affords, but a high data rate will not be of great value in this context. One of the most significant factors here will be keeping the power consumption to an absolute minimum. These sensor nodes will only be operational for a very small proportion of the time and the data they need to transmit will be very modest. 5G must be able to accommodate the minimal throughput and irregular connectivity that characterises this type of use case, while operating within the power constraints of sensor nodes whose batteries must last up to 15 years.

NEW NETWORK STRUCTURES

The way that 5G networks are constructed will be essentially different from the approach of previous generations. These new networks will rely much more on the deployment of pico, femto or moving cells, which will effectively mean that the user is brought a lot closer to the point of transmission and the power needed to transmit the signal will consequently be lowered. Utilisation of the Cloud is also expected to be of great importance. Virtualization of network functions promises to deliver both increased flexibility and efficiency. This will mean that rather than transmission being the dominant component of overall power consumption, there will be a shift to the more manageable computational power dimension (though this will also present the industry with certain challenges).

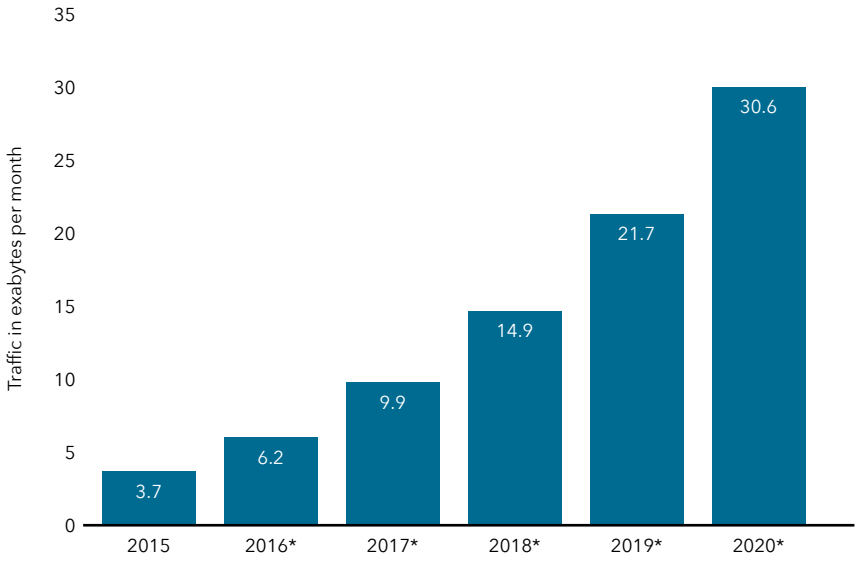


Figure 1: Global Mobile Traffic in Exabytes/Month [Source: Cisco]

The implementation of massive MIMO (multiple-input, multiple-output) transmission techniques will also prove to be advantageous – compensating path loss and enabling stronger signals while consuming less energy. This, along with adaptive beamforming, could help to counter the limited range of mm wavelength transmission (which will begin to be employed to boost data rates). Having enhanced the power performance of the underlying network technology, there will subsequently be an opportunity to make greater use of alternative energy sources, such as photovoltaics, to supplement the conventional power supply.

5G needs to furnish operators with a business model that is sustainable in terms of the financial investment required and the day-to-day running costs, as well as in relation to its long term effect on the environment – so that international legislative guidelines can be met. The technical obstacles that operators face in respect to power efficiency will be challenging but are not insurmountable. Improved energy efficiency needs to be a consideration of each constituent part of the proposed network technology, covering everything from how the system architecture is implemented right through to facets of functional design. This will allow operators to obtain the system-wide energy savings they need.

As an organisation working to define global standards that enable more productive and environmentally sustainable technology developments, ETSI is focussing closely on energy efficiency within the next generation communication networks. ETSI has recently embarked on an investigation into possible new metrics for energy efficiency within 5G systems. The results are due to be published in a Technical Report towards the end of 2017. Meanwhile, 3GPP has been actively involved in a study of energy efficiency of mobile networks taking in the implications of various deployment scenarios, operating conditions and coordinated energy saving between different parts of the network. ETSI and 3GPP are also heavily engaged in determining the exact system architecture and functional requirements of the 5G standard and methods of monitoring and controlling power consumption will be at the heart of this.

Contact details:

www.etsi.org

Leading a Revolution in Deep Geothermal Innovation

By Valentina Pinzuti, European Geothermal Energy Council

A European Technology and Innovation platform (ETIP) working on the development of deep geothermal energy in Europe has recently been established in the framework of the European Strategic Energy Technology Plan (SET-Plan). Made up of stakeholders from industry, research and policy, the overarching objective of the new Deep Geothermal ETIP is to identify the ways in which new technologies and methods will shape the future of geothermal and how they can be cost-effectively bought to market, allowing more citizens to benefit from this renewable, stable resource.

THE STATUS OF DEEP GEOTHERMAL

Geothermal energy is a valuable and local source of energy that can cost-effectively provide base- load/ dispatchable electricity, heat or a combination of both. It has great potential as a renewable source, not only in Europe but also globally, and in particular in some developing countries. Its potential is inexhaustible in human terms, comparable to that of the sun.

Deep geothermal energy, which can be directly used as heat or converted into electricity, is nowadays directly used, depending on its temperature, in a number of sectors: from bathing and swimming to industry, agriculture and district heating, this latter being the most promising sector for geothermal heat. In Europe there are 257 geothermal district heating systems, with total installed capacity of 4.6 GWth (EGEC, Market Report 2015).

According to the EGEC Market Report Update, in 2015 the installed capacity for geothermal electricity generation in Europe amounts to around 2.2 GWe, of which 0.95 GWe is in the EU, and it is expected to reach 3.5 GWe in 2018, mainly thanks to the very promising Turkish market.

The relevant resources, though, are far from being fully developed.

Recent modelling results by the JRC-EU-TIMES model predict geothermal power production of 540 TWh in 2050 under a long term decarbonisation scenario. This would mean that geothermal power could provide 12.5 % of the EU electricity demand while exploiting about 20 % of the available geothermal technical potential. This market share might be increased significantly if cost reductions associated with drilling will be realised.

Geothermal energy has an excellent potential in Europe, and in a number of NREAP (National Renewable Energy Action Plan) there are ambitious, yet far to be reached, targets for it. Recent technological developments have made it possible to cost-effectively produce electricity from geothermal energy with fluids at lower temperatures and there is an increasing awareness of the potential of geothermal heat, but in order to allow geothermal energy to fully meet its potential in the renewable energy mix it is necessary to tackle some issues to improve performance and reduce costs, and make widespread implementation possible.

DEEP GEOTHERMAL ETIP

The European Commission's Energy Union strategy, adopted in February 2015, dedicates one of its five dimensions to research, innovation and competitiveness. Under the integrated SET-Plan, which defines the EU's Research and Innovation strategy for coming years, the European Commission has recognised the European Technology and Innovation Platforms (ETIPs) as an important tool to strengthen cooperation with Stakeholders.

It is in this framework that the geothermal sector created, in March 2016, a European Technology and Innovation Platform on Deep Geothermal, which was then officially recognised by the European Commission, DG RTD, as an ETIP in July 2016.

The Deep Geothermal ETIP is an open stakeholder group, including representatives from industry, academia, research centres, and sectoral associations, covering the entire deep geothermal energy exploration, production and utilisation value chain. Its mission is to provide a framework for stakeholders to define and implement an innovation strategy to increase the use of geothermal and to foster the growth and the market uptake of the relevant European industries.

The purpose of the platform is to enable deep geothermal technology, and in particular Enhanced Geothermal Systems (EGS), to proliferate and move from the current European R&D and pilot-sites to other European countries and different geological situations. The primary objective is overall cost reduction, including social, environmental and technological costs.

These goals are addressed by the strategic targets of the Declaration of Intent on Deep Geothermal Energy, adopted in September 2016, which are:

The Rittershoffen project (Alsace, France) is an EGS project supplying heat to a local starch producer and biorefinery.

1. Increase reservoir performance14 resulting in power demand of reservoir pumps to below 10% of gross energy generation and in sustainable yield predicted for at least 30 years by 2030;

2. Improve the overall conversion efficiency, including bottoming cycle, of geothermal installations at different thermodynamic conditions by 10% in 2030 and 20% in 2050;

3. Reduce production costs of geothermal energy (including from unconventional resources, EGS, and/or from hybrid solutions which couple geothermal with other renewable energy sources) below 10 €ct/kWhe for electricity and 5 €ct/kWhth for heat by 202515;

4. Reduce the exploration costs by 25% in 2025, and by 50% in 2050 compared to 2015;

5. Reduce the unit cost of drilling (€/MWh) by 15% in 2020, 30% in 2030 and by 50% in 2050 compared to 2015;

6. Demonstrate the technical and economic feasibility of responding to commands from a grid operator, at any time, to increase or decrease output ramp up and down from 60% – 110% of nominal power.

Five working groups are operating to reach the objectives, focusing on: exploration; deep drilling; reservoir performance, production and well field development, including reservoir, operation flexibility, corrosion and scaling; surface equipment; non-technical and environmental issues.

Concrete steps can be taken to bring geothermal technologies to full commercial scale and to allow for widespread use of geothermal, and the Deep Geothermal ETIP and its working groups are working towards the goal.

Interested parties are welcome to join the platform by visiting www.geoelec.eu/etip-dg/.

A successful energy transition can only work with flexibility

By Thomas Speidel (pictured), CEO of ads-tec GmbH and President of the German Energy Storage Association (BVES)

A permanent balance between generation and demand is the precondition for a stable and reliable electricity grid. In the past, the energy system consisting of the three parts generation, transport and consumption was acting in a very predictable way. The fast roll-out of renewable energy sources in a more and more de-centralized system sets some significant new challenges for the system.

A lot of discussions in the last couple years were always about whether we need either storage or the grid to facilitate the renewable infeed. The answer is, that for a successful and widely accepted energy transition we will need both.

We need the grid – there is no doubt about it - but grids can only do one thing. They are only able to take energy from one place to another. They are a one-trick pony.

In 2015, the cost for redispatch in Germany came into the range of one billion Euro already – and this especially, because the grid isn´t apt to bring the electricity to where it is needed.

Energy storage can act like a „Swiss armyknife" that unfolds its different tools depending on the specific application and particular requirements. All energy storage technologies offer different services and are the perfect enabler for flexibility in every scenario – also cross-sectoral.

Pumped hydro storage has been integrated successfully in the energy system for many decades and has proven its relevance for system stability.

Battery Storage Systems (BSS) are in the current center of attention, because they can combine many business models. They react within milliseconds and serve in many applications. They are excellent for the provision of control energy in large scale applications, but also and especially in residential areas for the optimization of self-consumption. Through the combination of photovoltaic (PV) and a battery storage system also households move their "private energy transition" forwards and become more independent from the rising electricity price at the same time.

Currently there are around 45,000 storage systems installed in German households. With around 1,6 million PV systems on German roofs, the retrofit potential is enormous and by 2020 the number of residential batteries is expected to grow to about 170,000. The constant growth of self-consumption "behind-the-meter" sets new challenges for the grid operators, because not all systems act in a grid-supportive manner. Furthermore it implies a continuous and serious loss in clients which is a big challenge for many local utility companies.

To tackle this problem, mixed models are in the current center of attention, e.g. in swarms or quarter storage projects. Besides the optimization of self-consumption, other applications are e.g. the provision of control energy or arbitrage businesses. Taking part in several market segments allows higher returns and thus a faster amortization. In a quarter storage concept, households do not even have to invest in their own battery system, because they only lease their required capacity in the centrally located storage unit.

But also the grid operator profits of those models by getting the opportunity to control and monitor the system. Additionally he can benefit from grid supporting services provided by the storage system/s. Furthermore, also the regional utility company benefits from such models that bring new business cases and economic value. Another very worthwhile fact to mention in this context is electro-mobility as bidirectional charging (grid-to-vehicle or vehicle-to-grid) brings another valuable effect for grid flexibility. In Germany, the ambitious aim is to pass the threshold of 1 million electric vehicles in operation by 2020.

That equals a total storage capacity of 25 GW which is an enormous amount compared with 7 GW of all German pumped hydro storages.

The variety of technologies is also reflected in the capability to transform electrical energy to other energy sources, e.g. to gas by "Power-to-Gas" (PTG) or to heat by "Power-to-Heat" (PTH). By linking the different sectors, the excess electricity can be stored for days, weeks and months. This offers a huge potential to augment the efficiency of the whole systems and as well to reduce carbon emissions, having in mind the goals of the Paris agreement. Focusing only on the electricity sector we would have to have a renewable share of 65% by 2025 in Germany, which is all but impossible to reach.

So, as we see, there a lot of different technologies and business models, that are evolving very fast. However, the actual legal and regulatory framework in Germany is not adapted yet to the recent developments.
So far neither on an European nor German level there exists a definition of storage. In most contexts energy storage is assigned to the role of consumption, which results to be a serious disadvantage, because the grid-related fees are imposed for every kWh that gets stored.

The same charges are imposed again, when the same kWh is reaching the final consumer, so that we are facing the absurd situation, that those fees are charged twice. For Power-to-X the situation is even more tense, because when no reconversion to electricity takes place, the full range of fees and charges apply.

Source: BVES e.V., German Energy Storage Asscociation

Nevertheless, some outstanding projects have been already realized so far, that are significantly underlining the trend to the smart connection of generation, grid and consumption. In conclusion, energy storage plays a key role in the renewable concert of today and will even more in the future. There are only a few parameters, that still need to be adjusted to pave the way to a sustainable level-playing field and into the market.

Biography Thomas Speidel

Thomas Speidel, graduated in Electrical Engineering at the University of Stuttgart, is CEO of ads-tec, a medium-sized family owned company located in Nuertingen and Dresden. Business areas are the development and production of high-end and long-term available "Industrial IT" and "Energy Storage" systems based on li-ion for Home & Small Business applications as well as for Industrial & Infrastructure surroundings. Through the initiatives in numerous projects funded on the state and national level, ads-tec maintains close relations to businesses and research institutions along the entire value chain. Since March 2016, Thomas Speidel (CEO) is president of the German Energy Storage Association (Bundesverband Energiespeicher e.V.).

BVES – German Energy Storage Association

The BVES is the industrial association of German energy storage companies that is open to all technologies in the areas of electricity, heat and mobility. As a dialogue partner for politics, administration, science and publicity, BVES is trying to improve the German regulation and policy framework with targeted lobbying. In addition, the BVES monitors research and development activities.

Did you hear the Netherlands is saying good-bye to gas?

By Maya van der Steenhoven and Babajide Owoyele of the programme for heating and cooling South Holland

The Netherlands is making a fast transition away from gas heating. The Climate Conference COP21 in Paris, and the recent earthquakes in Groningen (the Dutch province where gas is being produced), have created enough urgency for the Netherlands to decide about it's route away from gas.

This puts the Netherlands on the verge of going into the biggest transition of the century. With 7 milion households and buildings currently being heated by gas, and gas being the main source for cooking, the transformation will be immense. In the next 20 years these households will have to be taken off gas and isolated and equipped with different heating and cooking solutions. 350.000 houses a year. This is generic to both existing houses and newly built ones and, although the major task will be in the hands of grid companies, municipalities and the governments, this will affect everyone in the Netherlands..

To take its responsibility in the national challenge, the province Zuid-Holland has almost completed the mapping out of the province's regions, municipalities and even districts, to show all heating possibiliities. These maps give insights into the optimal technical preferences for substituting gas heating to electric heatpumps, biogas or collective heating systems per district. This also gives insight into the opportunities of locally generated (waste) heat or geothermal heat sources. Using this information a bottom-up process is being initiated with local stakeholders to discuss their possibilities for change and local preferences.

SOUTH HOLLAND TAKES A LEADING ROLE IN THE TRANSITION

South Holland is not a typical province in the Netherlands. The energy consumption in the South Holland region accounts for aprox 800 PJ which is around 25% of total energy consumption in the Netherlands, with an estimated 1% coming from renewable sources. South Holland is very much an industrialised region: Industry uses the largest chunk of this energy (an estimated 650 PJ). The petrochemical industry and refineries use three quarters of this, supplying the European or global markets. Half of this is used as raw material for producing plastics and chemicals. The enormous horticultural sector in Westland and Oostland used 45 PJ of heat in 2014. Not only has South Holland got a large demand for heat, but it also has an abundance of heat resources . South Holland has an enormous supply of residual waste heat and in some areas (Rotterdam, the Hague, Westland) terrific conditions for geothermal heat. The growth

in renewable energy (mainly wind and sun) will also provide for excess renewable electricity when the supply supersedes the demand, which power can be converted to heat and stored.

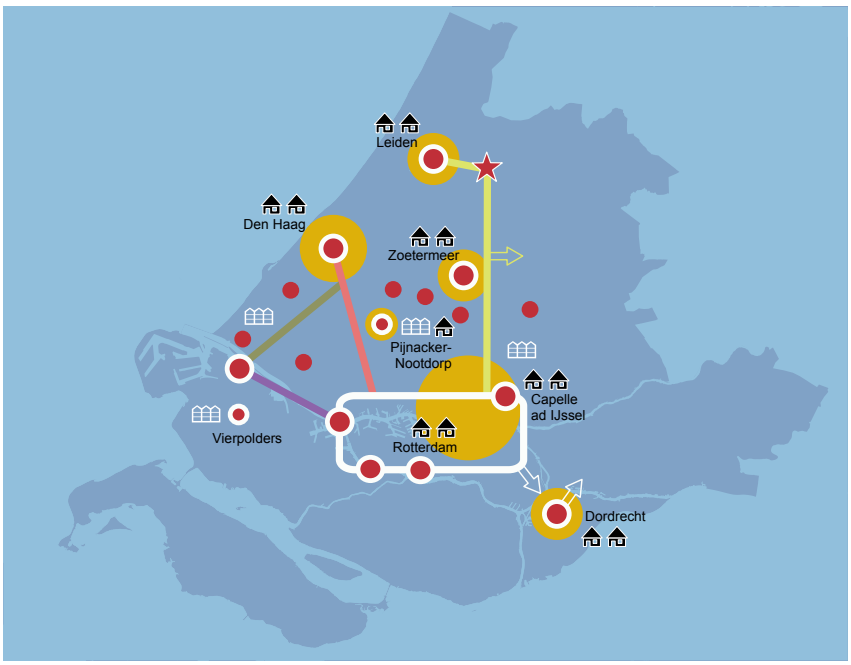
Next to this close proximity of heat demand and supply South Holland is also a densely populated region with 3.6 million people (1,6 milion households) living in an area of 2,818 km2. The majority of these houses have been built before 1960 which makes it more difficult to fully isolate. There are also apartments in buildings with 4 levels and above. This provides South Holland with great economical and technical possibilities for collective heating systems.

With all the right conditions all-in the same region: (1) being a densily populated area and, (2) both a big demand for heat and an abundance of heat; a great possibility for a network for heat comes up, named the heat roundabout

FOCUS ON THE IMPORTANT ROLE FOR INDUSTRY AND HEAT IN THE TRANSITION

"No matter how many homes and schools we help to become energy neutral, nothing will structurally improve if we do not focus on the industries" – Arash Aazami

Most policies and subsidies in the Netherlands focus on making electricity in households sustainable. A considerable effort goes into energy efficiency measures (led lamps, and energy saving appliance usage) and the production of solar and wind power to produce this electricity. Only a small amount of effort goes into measures for efficiency and more green production for industry as well as domestic heating. Considering that household electricity consumption accounts for only less than 2% of energy use in South Holland, while industry and heating account for 75%, this situation needs to be more balanced.



It is also notable that the industry in Rotterdam discharges every year an enormous amount of waste heat 150 PetaJoules. At the same time households use 73 PJ for heating yearly. Providing these households with waste heat would save that same amount of gas and deliver a considerable lowering of CO2 emissions – over 4 Mton.

INNOVATIVE APPROACH OF THE HEAT ROUNDABOUT IN SOUTH HOLLAND

"If waste is a resource, use and reuse of excess heat becomes an essential opportunity"

Unique opportunities, therefore abound, if and when heat sources and heat consumers in Delft, The Hague, Rotterdam, Leiden and Westland are effectively matched and integrated.

This innovative solution in the heat roundabout, "an infrastructure in which water conveys heat to various customers in the southern part of the province of Zuid-Holland" is exemplary in four distinctive ways:

1. ***Integration of multiple sources of heat***
   A heat infrastructure, in which heat sources will include waste heat from the Rotterdam port and industrial complex, as well as local waste heat, power to heat, solar thermal and sources of geothermal energy. It is therefore flexible and inclusive.

2. ***4th Generation grid***
   This infrastructure includes a transition path into low-temperature space heating, Smart Thermal Grids, low-temperature networks, the growth of local renewable heat sources and other innovative measures.

3. ***Transition path for waste heat***
   The transition of the harbour into a circular harbour. As the harbour will become less reliant on fossil fuel and more sustainable, the waste heat will become completely CO2 neutral. The harbour aims to transform its current important fossil energy based function into a renewable energy function.

4. ***Smart multi commodity grid***
   Dynamic energy management of multiple energy sources like electricity, hydrogen, heat and biogas aggregated efficiently in one hub system offering flexibility and storage.

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