AUTUMN 2012

european energyinnovation

Photovoltaics and our future energy supply

Netherlands

ICT

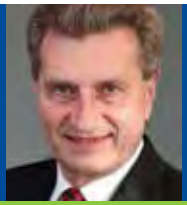
Hydropower

Special aviation supplement

Green skies – Green future

Includes editorial contributions from:

Siim Kallas
Vice President, European Commissioner for Transport



Günther Oettinger
European Commissioner for Energy

Philip Lowe
Director General for Energy, European Commission, DG ENER

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"The EU and its Member States will promote investment in renewables and safe and sustainable low-carbon technologies, and focus on implementing the technology priorities established in the European Strategic Energy Technology plan."

European Council

HUAWEI

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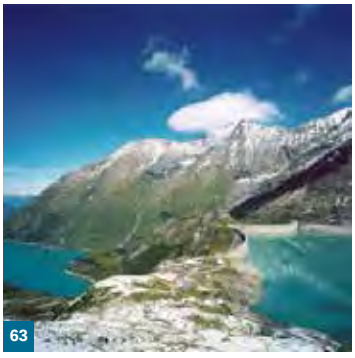
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Smart Solutions Forum

Smart Integration of Photovoltaic & other Renewable Energy Systems into the Network for a Sustainable Growth

The forum **Smart Solutions** is a parallel event organized in the framework of the 27th EU PV SEC. The forum will consist of three sessions related to Smart Buildings by using Information and Communication Technologies (ICT), Storage and Smart Integration Solutions. All three sessions will cover an overview on market and economic issues and their benefits. The target group are industrial representatives from the ICT sector, storage, transmission and distribution grid operators, consultancies, RTD research and those who are interested in integrating Photovoltaic in a smart way in the building sector and into the electrical grid.

Session I
Smart Buildings - Energy Efficiency

Session II
Storage

Session III
Smart Integration Solutions

25 September 2012
Messe Frankfurt, Germany

For more information, please visit
www.smartbuild.eu
www.photovoltaic-conference.com/parallel-events

Organized Jointly by
WIP / EU PVSEC and EU Photovoltaic Technology Platform

PhotoVoltaic TECHNOLOGY PLATFORM

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Foreword

Transport accounts about a quarter of EU greenhouse gas emissions. Transport-related emissions are rising, and the fastest growth comes from aviation. Something, it is clear, must be done; and we examine the major issues in our special supplement "Green Skies, Green Future".

EU Commission's Vice President Siim Kallas, in his role as Commissioner for Transport, contributes the keynote article "A clean sky for Europe: Technology for aviation in the 21st century". He points out that this growth in air transport creates opportunity for European business but threatens also to outstrip the environmental benefits achieved in the areas of fuel efficiency and noise reduction. In stressing the crucial importance of reducing dependence on fossil fuels, Mr. Kallas also discusses ACARE targets for fuel consumption and carbon and nitrogen emissions; and suggests three technological routes by which we might achieve cleaner skies.

We learn from Eric Dutriaut about a public-private initiative to reduce the environmental impact of aviation, while Luc Tytgat of EUROCONTROL explains the role of air traffic management and the potential for controlled descent to reduce aircraft fuel consumption, noise and pollution around airports. Dr Naresh Kumar tells us more about ACARE while discussing the need for more efficient aircraft and improved maintenance; and for greater understanding of the role of nitrogen and particulates. He also reviews the potential role of the Strategic Research and Innovation Agenda, to be published during the ILA Airshow in Berlin; itself reviewed in a little more detail by Dr. Ekkehard Münzing.

Something, it seems, is being done.

In stressing the need for to pay even more attention to existing 20-20 targets, Commissioner Günther Oettinger sounds a note of caution about energy consumption and discusses, amongst other things, the potential role of the consumer in the Commission's new Energy Efficiency Plan, while a thoughtful article from Deputy Director-General Stančič examines the potential role for ICT.

Elsewhere, the Commission's Director General Philip Lowe argues that many renewable technologies are becoming economically viable, while illustrating the overwhelming significance of hydropower in evening out fluctuations between demand and supply. Michel de Vivo of ICOLD extols the virtues of dams and explains the significance of the water-food-energy nexus.

Reinhold Buttgereit suggests that solar power may already be thought of as a mainstream source of energy, while Dr. Arnulf Jäger–Waldau reminds us that the vast majority of installed global PV capacity lies within the EU. He takes a look into a future in which almost 7,000 TWh might be generated annually by 2050.

Our country focus takes a look at The Netherlands. In a fascinating academic article, Birgit Dulski , Cees van der Vliet and Wim van Unen explore the complicated relationship between new technology and the preservation of cultural heritage. It might mischievously be argued that only the Dutch might be able to reconcile the irreconcilable! The IEA Technology Network takes us on a road trip from Groningen to Heerlen, in search of young energy professionals interested in Carbon Capture and Storage, Demand Management and Energy Efficiency. We also introduce another country-related feature that we call "Five Key Facts" and would welcome comment about the choice of information to be summarised in this manner. You already know how to contact us.

And you also know that there is a lot more to read inside…

Michael Edmund
Editor

Towards more efficient use of energy

By Günther H. Oettinger, European Commissioner for Energy

Energy challenges are among the greatest Europe has to face in the coming decade. We know that our economic competitiveness fully depends on a reliable energy supply: a safe, secure, sustainable and affordable energy supply is crucial to the EU's economic and strategic interests as a global player. The growing EU dependence on imports from third countries therefore represents a matter of great concern, in particular for oil (85 %) and gas (65 %) and explains why Energy Efficiency is to be found at the heart of the EU's Energy Strategy 2020 adopted in November last year.

In order to achieve the increase in energy efficiency a comprehensive mix of energy efficiency policies and supporting measures have been implemented at European and national level promoting a more efficient use of energy in end-use sectors such as buildings, household appliances and industrial equipment, transport, industry as well as in energy generation. However, despite the major progress made, recent Commission estimates suggest that we are on course to achieve only about half of our ambitious objective for 2020. If no further measures are taken, we will only cut our estimated energy consumption by 10% in 2020 - instead of our target of 20%. It is therefore essential that the European Union acts now to achieve its target and to give a new impetus to the energy efficiency agenda in the Member States. In fact, there is still a vast amount of untapped potential to save energy which would save money for individuals and businesses alike, and reduce waste.

To this end, the Commission decided to take determined action in order to tap the considerable potential for higher energy savings and energy efficiency throughout the sectors by adopting a comprehensive new Energy Efficiency Plan in March this year.

The Plan puts a strong emphasis on the buildings sector, where the greatest challenge is to trigger and accelerate a process of energy efficient renovations to reduce energy consumption in our existing building stock. It proposes

that each year 3% of existing buildings will be renovated. This is double of the annual rate for renovating buildings. But beyond the public sector, there is a need to create a European market for energy services. With common standards, targeted incentives and obligations, we would not only see our energy costs fall, we would create a dynamic market for new skills, jobs and businesses.

Energy Efficiency also represents the area where consumers can most directly influence and benefit from the long term sustainable energy system. Our energy policies therefore aim to be consumer-tailored with an emphasis on further transparency and information. Consumers should feel empowered in order to optimize their energy consumption and enjoy their right to basic energy needs at all times, including in a supply crisis. Our main challenge is to make these technologies accessible and cost-effective to the general public. The Energy Efficiency Plan therefore focuses particularly on measures improving the energy performance of households and devices used by consumers – such as appliances and smart meters. This of course also requires the development of appropriate standards for meters and appliances, obligations for energy suppliers to provide consumers with clear information and access to independent energy advice.

With our conventional energy resources becoming scarcer, we should use the current momentum to gradually shift to a resource efficient, low carbon society. Our initiatives for the development of new and renewable energy sources and for reaching a high level of energy efficiency therefore serve this objective.

Europe has currently some of the world's best renewable energy companies and research institutions and we undertake numerous research activities to find new, more efficient ways of producing and using energy. The main challenge today is to accelerate the market uptake of technologies. We need to demonstrate that sustainable energy technologies which contribute to ensuring the security of our energy supply are viable, cost-effective and good for the environment and our economy. I therefore call upon all stakeholders, businesses, citizens and policy makers alike, to join their efforts in supporting the European Union in achieving our medium and long term goals for the benefits of all of us.

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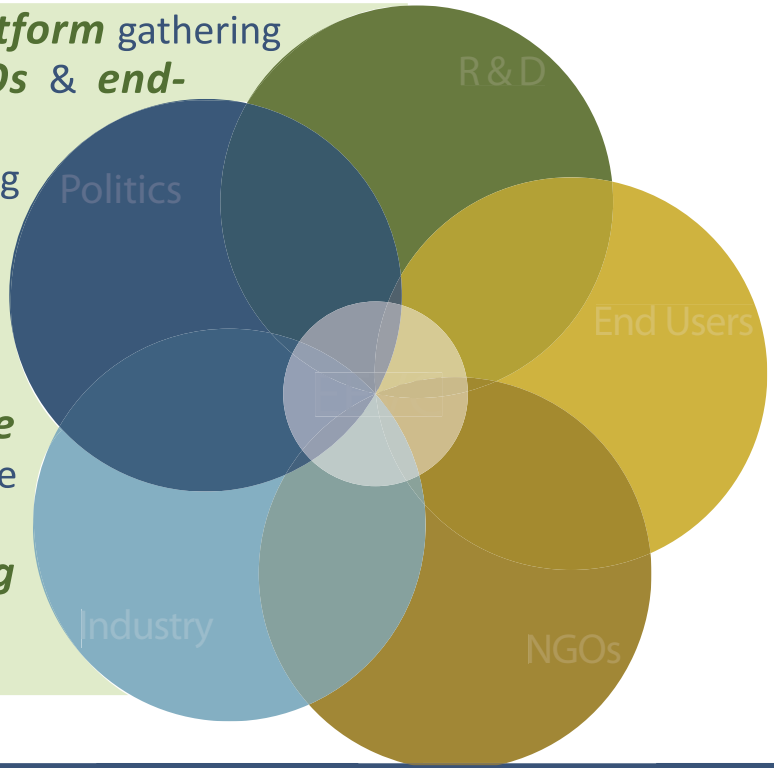
- To help defining the most promising solutions in ***eMobility***
- ***Optimal connection*** with the representatives of the European Institutions
- ***New mobility concepts, noise and health factors*** also to be discussed
- ***EU Project day overviewing*** all related funded projects
- ***Touch*** & ***drive***



Browse to **www.eevc.eu** for more info !

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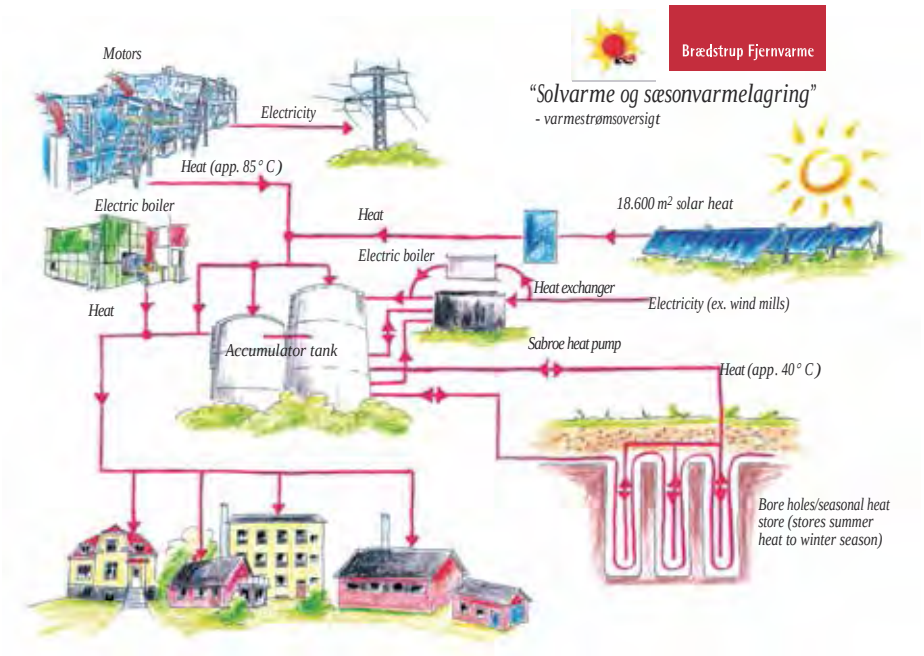
COMBINING TECHNOLOGIES IN NEW WAYS

And when combined with the use of renewable energy, SABROE heat pumps provide a CO2-neutral heating solution.

In a breakthrough solar-powered energy generation project in Denmark, these heat pumps help make it possible to store thermal energy underground in deep bore holes (the largest seasonal heat storage installation in Europe).

18,600 m² of solar panels generate about 8,400 MWh non-polluting heat annually. And SABROE heat pumps extract it as and when needed – regardless of season, weather conditions or time of day.

Johnson Controls includes a global centre of competence for sustainable refrigeration and heating based on natural refrigerants that neither contribute to global warming nor damage the ozone layer.



Source: Brædstrup fjernvarme/Denmark

GREEN CAST: A smart alternative to aerated autoclaved concrete

The project "Demonstration of innovative lightweight construction components made of recycled ash", also known as GREEN-CAST, is a project funded by the European Commission in the framework of the CIP Eco-Innovation Initiative, as one of the "first application and market replication project" of the 2010 call. This European alternative initiative aims to bridge the gaps between research and market, and help develop good ideas to produce innovative products that protect the environment and are commercially competitive.

GREEN-CAST targets the development of innovative and energy efficient construction precast elements made of recycled ash from thermal power plants.

This initiative is being led by ACCIONA (Spain) and supported by CETMA (Italy) and MOSTOSTAL (Poland) as partners in the consortium, and began in September 2011 as a three years long project.

As demonstration activity, precast elements will be manufactured and two first application huts will be built and studied in countries with very different climatic conditions: Spain and Poland.

BACKGROUND: FLY ASH AND LIGHTWEIGHT CEMENT BASED MATERIALS

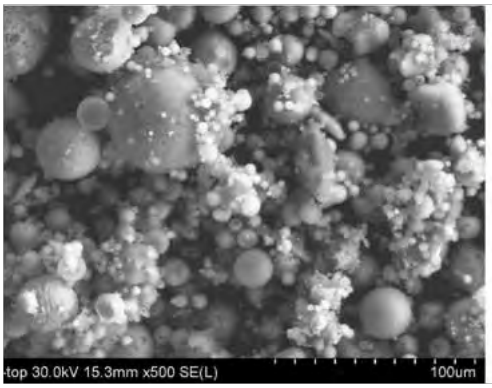
Every year 62 million tons of fly ash is produced as a byproduct of combustion processes in thermal plants within the European Union. Although fly ash has not been classified as hazardous waste, it causes environmental concern due to the trace concentrations of heavy metals and crystalline silica that are present in their composition, limiting the amount that can go to landfill, or be in contact with water streams.

On the other hand, fly ash can be classified as a pozzolanic material, which means that upon alkaline activation they harden exhibiting cementitious properties, and that is why they are mainly reused as a Portland cement substitute in cement and concrete composition.

Foamed or cellular concrete is defined as a cement-based material that contains at least 20% air in its structure. This ensures desirable properties such as low density and good thermal and acoustic insulation. The main drawback of conventional cellular concrete production is that has to be carried out in an autoclave process that involves high temperature and pressure.

Moreover, in the fabrication process of Portland cement CO_2 is released into the atmosphere in the same quantity as material that is produced. This CO_2 is produced in the burning of fossil fuels and the decarbonation of limestone which is used as a raw material for the clinker.

So far, in the preparation of cement based materials, fly ash has partially replaced commercial Portland cement in several types of cement up to 35%.



GREEN CAST SOLUTION

By considering all the facts outlines above, the GREEN-CAST project has emerged as a smart solution that proposes the full replacement of cement by fly ash, in order to obtain non-structural lightweight precast construction elements with good insulation properties, which is additionally efficient from an environmental point of view.

GREEN-CAST proposes to use fly ash as the main raw material, optimizing their management of waste, thus reducing their exposure to environment and therefore the associated risks related to their potential toxicity and environmental impact. Very importantly, compared to Portland cement, the CO2 released into the atmosphere will be dramatically reduced, since neither fossil fuel nor carbonates are present in the GREEN-CAST production process.

GREEN-CAST is produced at 80 ºC and atmospheric pressure, whereas the conventional autoclaved aerated concrete (AAC) requires around 190 ºC and high pressures. This combined with the absence of raw materials consumption, implies not only energy saving but also savings in terms of natural resources and money.

So far, GREEN-CAST formulation has been optimized at laboratory scale and its physical properties have been tested, obtaining similar results to those for well settled commercial products. Thus we propose that Green Cast is a very promising material, not only from the environmental point of view, but also fulfilling standard mechanical, thermal and acoustic requirements.

CHALLENGES

In spite of the environmental and economic potential advantages that GREEN-CAST offers, they have to tackle some barriers, mainly associated to the lack of normative for this new generation of products.

The validation and certification of construction elements prototypes is still an enormous challenge that researchers and companies along with national and European authorities have to go through, in order to foster those technologies that imply lower CO2 footprint, energy consumption and optimization of waste management in the construction sector.

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CETMA
MOSTOSTAL Warszawa

European shared vision needed for electro-mobility reality

By Frédéric Vergels, Senior advisor

There is clearly a need for a global platform to foster exchange of views between researchers, industry, authorities, end-users and NGO's representatives in the field of eMobility. In this respect, the European Electric Vehicle Congress strengthens its position!

As motivations and concerns are different for each of them, EEVC-2012, that will be held in Brussels from 19th to 22nd November 2012, has the:

- aim to gather all these groups with the objective that they understand each other's goals, needs & constraints;
- objective to help defining the most promising solutions to be selected, taking into account the research and development progresses, as well as the environmental and economical limits.

The venue is Brussels, so to ensure optimal connection with the representatives of the European Institutions that are considering Battery, Hybrid and Fuel Cell Electric Vehicles to play an important role to lower atmospheric pollution and to reduce oil dependency.

New mobility concepts, noise and health factors will also be issues to be discussed.

The day prior the Congress, a EU Project day will be organized to provide the audience with an overview of the different programs supported by the European Authorities (FP7, IEE, EUROSTAR, INTEREG, ...) & related funded projects dealing with eMobility, so to identify possible actions, overlaps, synergies and/or gaps.

Touch & drive will also be possible during the Congress. A special highlight of this Brussels week will be a parade of electric vehicles that will leave the Congress centre to the Brussels Grand Place for nice pictures. The convoy will then continue to the famous esplanade du Cinquantenaire for Ride & Drive as well as a memorable party in the Museum of the Automobile.

Most of the OEMs have already confirmed their participation with their latest electric hybrid or fuel cells but also some prototypes will join the show. Smaller companies working on eMobility as well as Universities and research groups also are considering joining this exciting event with their realizations. Last but not least, sev`eral EV enthusiasts already confirmed their presence with their EV converted vehicles.

Reverting to the congress, it should be noted that, as a response to the call for papers, over 170 proposals for presentations (22 countries) have been received. Each of them has been evaluated by three experts and, for quality seeks, 30% have been rejected. The Scientific Reviewing Committee is now selecting about 30 additional keynote speakers to be invited. This will lead to over 150 high quality presentations.

All info at www.eevc.eu
Contact: info@electri-city.mobi

Photovoltaics and our future energy supply

Solar energy is the most abundant energy resource on earth today, providing about 10,000 times more energy per year than we actually use. There is a whole family of solar technologies which can deliver heat, cooling, electricity, lighting, and fuels for a variety of applications. One of these technologies is photovoltaics which converts solar energy directly into electricity using semiconductors which exhibit the photovoltaic effect and are called solar cells.

The importance of renewable energy and amongst it solar photovoltaic electricity for mitigating Climate Change was highlighted by a special report of the Intergovernmental Panel for Climate Change (IPCC)[1] and recently by the *IEA Medium-Term Renewable Energy Market Report*[2], which forecasts a more than threefold increase of cumulative PV installations in 2017 compared with 2011.

Since 2000, total PV production increased almost by two orders of magnitude, with compound annual growth rates of over 55%[3]. The most rapid growth in annual cell and module production over the last five years could be observed in Asia, where China and Taiwan together now account for almost 60% of world-wide production. However, looking only at the cell production does not represent the whole picture of the PV value chain. In addition to the manufacturing of solar cells, the whole upstream industry (e.g. materials, polysilicon production, equipment manufacturing), as well as the downstream industry (e.g. inverters, balance of system (BOS) components, system development, installations) has to be looked at as well. It is worthwhile remembering that despite the fact that more than two-thirds of the solar cells which are installed in Germany are not produced there, more than 60% of the added value remains within the German economy.

Production data for the global cell production[4] in 2011 vary between 28 GW and 35 GW. The significant uncertainty in the data for 2011 is due to the highly competitive market environment, as well as the fact that some companies report shipment figures, others report sales and again others report production figures. In addition, the difficult economic conditions and increased competition led to a decreased willingness to report confidential company data. The year was characterised by a sluggish first half year and a boom in the fourth quarter of 2011.

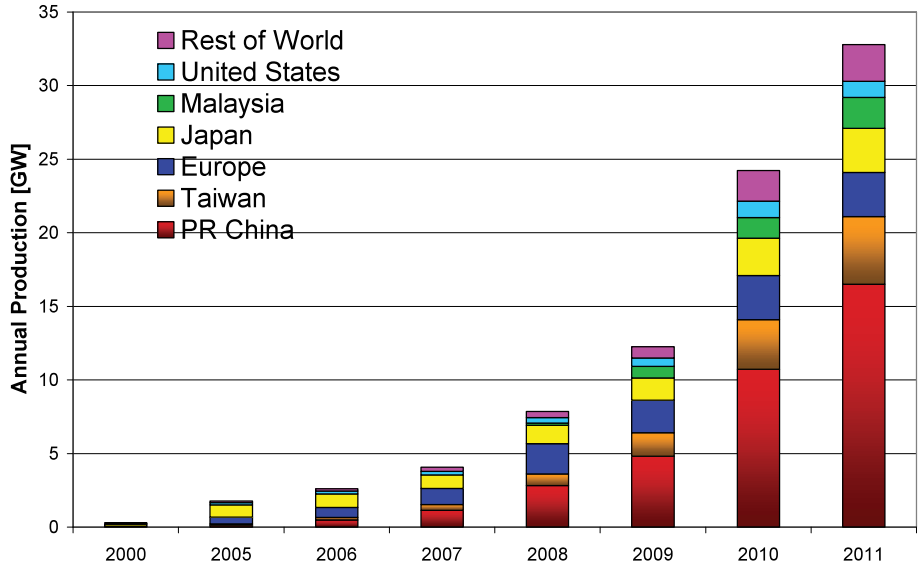
The presented data, collected and extrapolated from stock market reports of listed companies and colleagues were compared to various data sources and thus led to an estimate of 33 GW (Fig. 1), representing a increase of 37% compared to 2010.

In 2010 the world-wide photovoltaic market more than doubled, driven by major increases in Europe and

Dr. Arnulf Jäger–Waldau

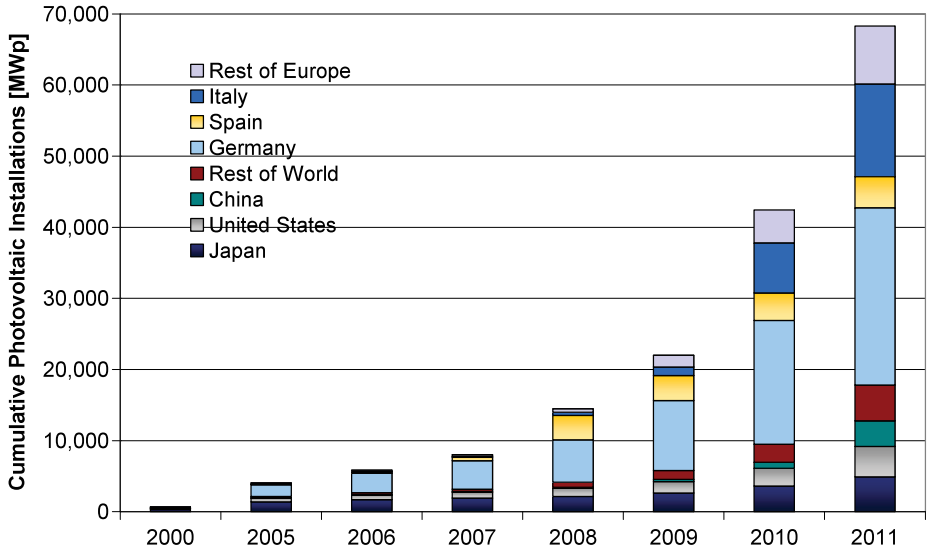
despite difficult economic conditions, the market grew again by about 20% in 2011. The continuation of a strong market in Italy and a year-end rush in Germany, where in the 4th quarter about 4GW (3 GW in December alone) in conjunction with rapid growing markets outside Europe in China and the USA resulted in a new installed capacity of about 25 GW. This represents mostly the grid-connected photovoltaic market. To what extent the off-grid and consumer product markets are included is not clear, but it is believed that a substantial part of these markets are not accounted for, as it is very difficult to track them. A conservative estimate is that they account for approx. 400 to 800 MW (approx. 1-200 MW off-grid rural, approx. 1-200 MW communication/ signals, approx. 100 MW off-grid commercial and approx. 1-200 MW consumer products).

Fig 1: World-wide PV Production from 2000 to 2010 and 2011 estimates (data source: PV News[5], Photon International[6] and JRC analysis)



With a cumulative installed capacity of about 51 GW, the European Union is leading in PV installations with a little more than 70% of the total world-wide 69 GW of solar photovoltaic electricity generation capacity at the end of 2011.

Fig 2: Cumulative Photovoltaic Installations from 2000 to 2011 (data source: EPIA[7], Eurobserver[8] and JRC analysis)



For 2012 analysts expect a moderate market growth, which could lead to a total capacity between 90 and 100 GW by the end of the year. However, there is an increasing pressure on company margins due to the fact that overall manufacturing capacity is still increasing despite that a significant number of manufacturers all over the world terminate or downsize production. Therefore, it is very likely that world-wide production capacity for solar cells will exceed 60 GW at the end of 2012. This indicates that even with the optimistic market growth expectations, the

TABLE 1: SCENARIOS FOR SOLAR PHOTOVOLTAIC ELECTRICITY GENERATION UNTIL 2050

Year	2010 [TWh]	2020 [TWh]	2030 [TWh]	2050 [TWh]
Estimated actual Electricity Generation	**45**			
Greenpeace* (advanced scenario)	17	594	1,953	6,848
IEA PV Technology Roadmap	37	298	1247	4,572
EREC (only Europe)	20	180	556	1,347

*extrapolated from 2007 and 2015 numbers

planned capacity increases are way above the market growth. The consequence will be either low utilisation rates or the build up of high inventories resulting in a continued price pressure in an oversupplied market. Such a development will accelerate the consolidation of the photovoltaics industry and spur more mergers and acquisitions.

Various Renewable energy scenarios including the International Energy Agency (IEA) and the European Renewable Energy Council (EREC) have been published over the years. So far the growth and contribution of photovoltaic electricity generation has been underestimated by every scenario compared to the actual development.

The latest scenarios by the IEA[9], Greenpeace[10] and EREC[11] predict shares of photovoltaic electricity between 10 and 18% of the electricity supply worldwide and up to 27% in Europe.

With worldwide about 70 GW cumulative installed photovoltaic electricity generation capacity installed at the end of 2011, photovoltaics is still a small contributor to the electricity supply, but its importance for our future energy mix is finally acknowledged.

Dr. Arnulf Jäger–Waldau is a Scientific Officer and Senior Scientist at the Renewable Energy 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 and their integration into energy infrastructures.
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 150 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.
Dr. Jäger-Waldau was a Lead Author for Solar Energy of the Special Report of the IPCC on Renewable Energy and Climate Change Mitigation, which was approved by the General Assembly of the IPCC in May 2011.
He serves as a member of the Executive Committee of the European Materials Research society (E-MRS), 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.
He is the Technical Chairperson of the 27th European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC) in Frankfurt 2012 and is the designated Chairman of the 2013 E-MRS Spring Meeting in Strasbourg.

1. Intergovernmental Panel on Climate Change (IPCC), Special Report on Renewable Energy Sources and Climate Change Mitigation, 2011; http://srren.ipcc-wg3.de/report
2. International Energy Agency, Medium-Term Renewable Energy Market Report 2012 - Market Trends and Projections to 2017, 182 pages, ISBN 978-92-64-17799-4 (2012)
3. PV Status Report 2011, Office for Official Publications of the European Union, Luxembourg, 2011, ISBN 978-92-79-20171-4
4. Solar cell production capacities mean:
   - In the case of wafer silicon based solar cells only the cells
   - In the case of thin-films, the complete integrated module
   - Only those companies which actually produce the active circuit (solar cell) are counted
   - Companies which purchase these circuits and make cells are not counted.
5. PV News, published by Greentech Media, ISSN 0739-4829
6. Photon International
7. European Photovoltaic Industry Association, Global Market Outlook for Photovoltaics until 2016, 2012
8. Photovoltaic Energy Barometer, Systèmes Solaires, le journal du photovoltaique no 7 – 2012, April 2012, ISSN 0295-5873
9. International Energy Agency, 2010, Technology Roadmap – Solar photovoltaic energy
10. Greenpeace/EREC, 2010, World Energy [R]evolution – A Sustainable World Energy Outlook, ISBN 978-90-73361-90-4
11. RE-thinking 2050 – A 100% Renewable Energy Vision for the European Union, European Renewable Energy Council (EREC)

Household carbon neutrality and energy autonomy

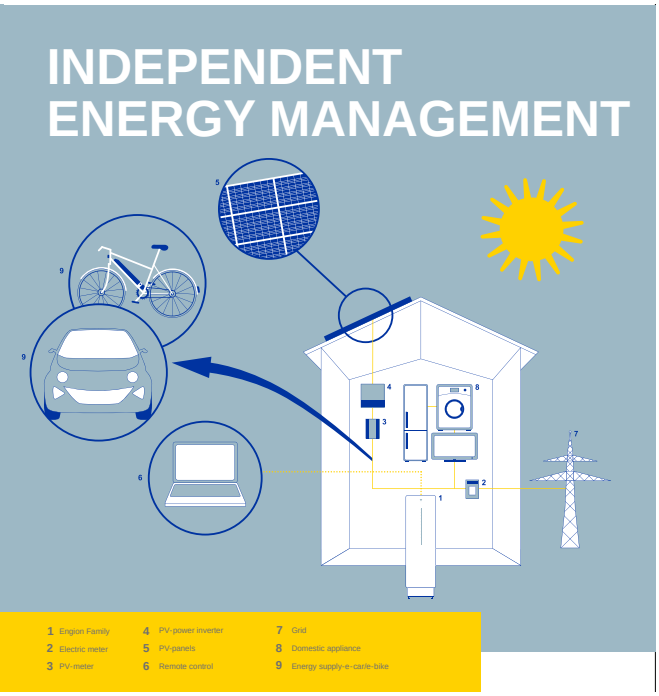
Energy storage systems for PV arrays: giving households a route to carbon neutrality and energy autonomy

By VARTA Micro Storage GmbH

It seems too good to be true: the potential to use free energy – the light from the sun – to power citizens' homes at night. Yet this is the promise of a new energy-storage technology being pioneered by one of the world's leaders in advanced battery engineering, VARTA Microbattery GmbH.

VARTA Microbattery headquartered in Ellwangen, Germany, is one of Europe's largest battery manufacturers with innovative technologies and a broad range of primary and rechargeable batteries. The VARTA Microbattery division produces more hearing aid batteries than any other manufacturer in the world.

VARTA Microbattery is also leading the development for new, more powerful and more efficient energy-storage technologies. Through a joint venture with Volkswagen based at its Ellwangen factory, VARTA is researching new battery technologies for the next generation of electric vehicles.



Now, through its VARTA Micro Storage subsidiary, VARTA has introduced yet another breakthrough: Engion Home, a modular, automatic energy-storage system. By day, Engion Home collects the electricity generated by photovoltaic (PV) solar panel arrays on a householder's roof, so that at night the power is available to run a home's lighting, heating and appliances.

As concerned citizens and governments work to de-carbonize Europe's economy, Engion Home provides a means to bring carbon-neutral energy autonomy within the reach of householders.

CHANGE IN THE ECONOMICS OF HOME POWER GENERATION

Interest in home energy storage is rising rapidly because governments are reducing the feed-in tariffs payable when households supply surplus solar energy back to the grid. At the same time, the price of energy sourced from the grid is rising rapidly, as utilities seek to recoup from consumers the cost of investment in new infrastructure.

A home Battery Energy Storage Solution (BESS) is the ideal answer: it offers consumers the chance to increase their energy independence, often generating up to 70% and even more of their own energy requirement, and therefore to reduce their usage of expensive grid-sourced energy.

But consumers should not undertake lightly the purchase and installation of a BESS: it forms an essential part of the user's autonomous power supply in tandem with the PV panels, and should last as long as the panels themselves – at least 20 years. This means that the quality and durability of the battery assumes great importance. And this is why VARTA has chosen to bring its expertise to bear on the problem of solar energy storage.

There are two fundamental features in the design of a BESS which dramatically affect how long it lasts, and how stable its operation is over its lifetime:

- cell chemistry
- circuit design

CELL CHEMISTRY: ENERGY DENSITY AND LONG LIFE

Battery packs or modules are made up of multiple individual cells, connected electrically so that they can be charged and discharged as a single large unit. (A module in a BESS is typically around the size of a standard car battery.)

Each cell contains a chemical compound which is able to

store electrical energy when charged. A number of different cell chemistries, each with its own set of characteristics, is in use in consumer and industrial batteries today. The most common in consumer batteries are nickel metal hydride (NiMH) and lithium-ion. Car batteries are traditionally lead-acid types.

Lead-acid batteries are unsuitable for a BESS because of their short lifespan, typically failing after 3-5 years of use. Conventional lithium-ion batteries, which are normally protected by complex electronics systems, pose a small risk of 'thermal run-away' – dangerous overheating which can cause the battery to combust. Any such risk is unacceptable in large home assemblies.

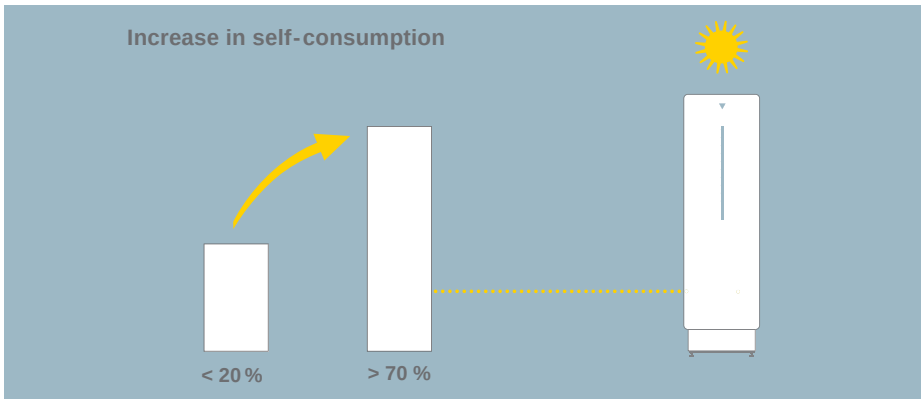
As a result, VARTA has pioneered the use of the lithium-iron-phosphate chemistry in home energy-storage systems. This offers energy density very nearly as high as lithium-ion, but poses no risk of thermal run-away, while offering the long operating lifetime required to support PV installations.

CIRCUIT DESIGN: A UNIQUE MODULAR SYSTEM

A BESS must operate so that:

- The failure of a single cell does not disable an entire module
- The failure of a module does not disable the entire BESS

A unique feature of Engion Home by VARTA Micro Storage is that modules can easily be added or replaced by the user, simply by slotting them into and out of the chassis at any point in the life of the system. New, improved modules will work alongside existing modules.



Each Engion module is rated for 6,000 charge/discharge cycles; this provides for more than a 20-year lifetime for typical residential users. Once a module has exceeded its rated lifetime or falls below its specified capacity, it can easily be removed and replaced with a new module.

In Engion Home, the modules form part of a fully integrated system, comprising an inverter, an electronic Energy Management System (EMS) and a battery which offers capacity ranging from 3.7kWh to 13.8kWh. The EMS automatically switches from charge to discharge mode and from PV supply to battery or grid supply as appropriate.

The features and advanced design of Engion Home from VARTA Micro Storage therefore give users confidence that their investment in energy storage will last as long as their PV panels, and that they can reliably power their home more independently of the grid over a potential 20-year lifespan.

For more information about Engion Home, go to www.varta-storage.com

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Moving forward with solar

By Reinhold Buttgereit, Secretary general of the European Photovoltaic Industry Association (EPIA)

Reinhold Buttgereit

Solar power is something most people favour – a recent Eurobarometer survey showed that 94% of Europeans support using solar power in their country – even if many may still think of it as an energy solution for the distant future rather than for today.

But what may surprise you is that solar photovoltaic (PV) electricity is already becoming a mainstream energy player, providing a growing share of the electricity market in many countries around the world. It's also an energy solution that works where it is needed, not just in sunny southern locations.

Consider two recent examples of how this is happening: On the weekend of 25-27 May, solar electricity production in Germany peaked at 22 GW, more than the output of 20 nuclear plants. And on a frigid day in February of this year, when Europe was suffering through some of the coldest temperatures in years, the demand for heat was so high in France that the country had to import PV electricity from Germany.

It's clear that solar is becoming more than just something people want for the future; it's technology that can provide solutions today. As many countries increase their focus on renewables in the wake of the Fukushima nuclear disaster, PV has shown that it is ready to be a mainstream energy source. PV modules have undergone significant price decreases, further increasing their attractiveness

to investors and accelerating the technology's drive toward competitiveness with conventional electricity

To be sure, there are challenges ahead as the PV industry weathers tough economic times. The headlines in much of the media about markets, industry consolidation and trade disputes may not be encouraging, but there are facts behind them that often get overlooked amidst all the heated rhetoric.

Let's not forget:

- Renewables – and especially solar PV – continue to gain strength and show promise as major part of the world's energy future. A new report from the United Nations Environment Programme and the Renewable Energy Policy Network for the 21st Century shows that investment in renewable energy sources surged by 17% in 2011 to reach $257 billion; solar was the top attraction, with total investment in solar power jumping 52% to $147 billion

- Solar PV is already a major provider of European electricity. PV can already produce more than 4% of the peak electricity demand in Europe; in Italy, PV can produce more than 10% of the peak electricity demand, in Germany more than 8%, in Spain more than 5%

- PV is now, after hydro and wind power, the third most important renewable energy in terms of globally installed capacity. The growth rate of PV during 2011 reached almost 70%, an outstanding level among all renewable technologies. For the first time in history, PV in 2011 was the number one electricity source in Europe in terms of added installed capacity, ahead of wind and gas.

- Going forward, PV has the potential to meet 12% of the EU electricity demand by 2020, providing a reduction of almost 200 million tonnes of CO_2 (the equivalent of taking 98 million cars off the road each year) and creating some 350,000 jobs. By 2030, PV could generate 2,600 TWh of electricity globally, satisfying the needs of nearly 14% of the world's population. By 2050, PV could provide more than a fifth of the global electricity demand.

So while the headlines have focused on uncertainty in the renewables sector and in the larger economic context, we should remember that renewables and solar PV are already starting to deliver on their huge potential to help achieve Europe's economic and environmental goals.

E²PHEST²US

Enhanced Energy Production of Heat and Electricity by a Combined Solar Thermionic-Thermoelectric Unit System

In the last decades, the search for a cost-effective and workable system, that efficiently turns solar radiation into electric energy, is leading the activities in the field of solar energy. Sunlight can be converted into electric energy using standard photovoltaic (PV) modules and concentrating solar power (CSP) systems, which have been merged in the so-called concentrated photovoltaic system (CPV). However the issue about the integration of PV cells in CSP systems has not been overcome and severe thermal issues are still pending.

The project starts from this background and aims to design and realize innovative and scalable components for CSP system that:

- efficiently generate electric energy and thermal power;
- reliably work at high temperatures (800-1000 °C);
- recover and exploit heat at intermediate temperature.

Fig. 1. CAD renderings of the frontal and back view of the CM and, on the bottom, the CM fabricated.

E²PHEST²US goal is the development of an innovative-solar energy conversion module (CM) to be housed in small-size CSP systems, based on a novel solar receiver, on integrated energy conversion processes and on innovative hybrid electrical/fluid connections. The performance improvements compared to present CSP systems is obtained by extending the upper limit of temperature operating range, up to 800-1000°C, by the introduction of a new concept thermionic-thermoelectric CM and related materials, able to convert directly energy into electricity.

The main impacts of E²PHEST²US project are:

- direct conversion of solar power to electrical energy, exploiting thermionic and thermoelectric processes;
- design and preparation of highly engineered solar-radiation absorbing, thermionic and thermoelectric materials;
- electrical conversion efficiency of the module potentially higher than standard PV semiconductor modules;
- high working temperature operations, with the possibility to provide also residual thermal energy as an output (cogeneration);
- no need for extensive areas of installation;
- no need of fused salt for heat transportation;
- a technology that can be potentially transferred to aerospace applications, or to other thermal energy recovery applications for process industry and automotive.

An original CM for the production of electric and thermal energy has been developed based on thermionic and thermoelectric direct converters, thermally combined in series to increase the efficiency (thermal-to-electrical maximum efficiency estimated to 30%). Fig. 1 shows the CM development from design to fabrication phase.

The use of engineered materials has enabled the exploitation of thermionic effect at temperatures around 800-1000 °C, thus enhancing the conversion performance of traditional thermionic systems which work at higher temperatures (>1500°C). At moderate temperatures (<400°C), thermoelectric devices perform better than thermionic ones. This complementary behaviour has allowed the development of a integrated system which makes the best use of thermal energy generated at different temperatures, achieving a higher value of total efficiency.

Innovative hybrid cables, able

Fig. 2. Scheme of the solar platform showing the position of the conversion module (CM), placed between the heliostat and the parabolic concentrator and the STP at the SHAP headquarters in Castel Romano (Rome-Italy).

Fig. 3. The conversion module CM installed on the parabolic concentrator focus.

to carry high-temperature fluids and electricity, have been also designed and tested during the project development.

The CM is housed in a solar test platform (STP) specifically designed, engineered and realized with particular attention to the optimization of the different subsystems involved (optical, mechanical and tracking), directed to provide a high concentration ratio radiation to the CM. The overall design includes the heat transfer fluid, piping, vacuum pumps. A scheme of the STP is reported in Fig.2, whereas Fig. 3 shows the CM installed on the STP focus.

E²PHEST²US PROJECT PRESENTATION

The E²PHEST²US project itself and the ongoing results and highlights have been presented at several conferences and events such as SunEC 2012 (Sun New Energy Conference on the 4th September 2012 in Sicily, Italy) by Mr D.M. Trucchi of CNR; at the Solar Paces 2012 (Concentrating solar power and chemical energy systems) on the 11th September 2012 in Marrakech (Morocco) by Prof. A. Kribus of TAU. At the Nanoforum 2012 (La Sapienza Univ. 24-26 Sept 2012) the project has a dedicated stand where the prototype of the Conversion module will be exposed.

Eventually on the 9th of November 2012, during the second edition of Solar Electricity Conference and Exhibition (SolarTR-2) in Antalya-Turkey from the 7th to the 9th of November, there will be the project workshop. The consortium will describe the research carried out to date within the project and report the main results achieved so far.

For more information please refer to the E²PHEST²US webpage: www.ephestus.eu

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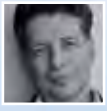

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Through the glasses of innovation
Solar energy technologies for a European solar future

by Professor Vladko Panayotov, MEP, (ALDE, Bulgaria)

Energy supply from the sun is virtually inexhaustible. Harnessing this inexhaustible energy potential can be largely beneficial in securing EU energy supply and in delivering sustained growth. Furthermore, it can be instrumental in meeting EU climate change objectives even in times of financial difficulties. However, the raw materials' supply necessary for harvesting the most power out of solar energy is exhaustible. The solar future Europe envisions will heavily depend upon the security of supply of the critical materials for the development of the very same advanced solar energy technologies necessary to transform this ambitious vision into reality. Research and innovation in solar energy technologies will be the ones that will make or break the deal for Europe's solar power.

Fostering continuous and well-targeted innovation along with research and development in solar energy technologies will be critical in meeting the challenge of strategic metals' availability for Europe and in carving a way out of the crisis of dependence on raw materials for the production, development and commercialization of solar energy technologies. An increasing participation of solar energy in the EU energy mix up to 2050 coupled with limited global supplies of critical metals, which are building blocks of PV solar cells and which Europe imports mostly from third countries, means an increasing risk of overdependence on imports of strategic raw materials for the production of PV technologies in the foreseeable future. Unless Europe develops viable substitute technologies and materials to mitigate the increasing risk of being affected by supply-chain bottlenecks related to the usage of these critical raw materials, basing its low-carbon future upon import dependence of resources means a 'death sentence' for that future.

The highest risk for security of supply is associated with several critical metals (tellurium, gallium, indium, sellenium among others) whose demand is expected to rise significantly in the mid- to long-term as solar energy technologies get deployed on a larger scale across Europe and globally. Within the context of increasing global demand for these materials, supply concentration in very few countries and geopolitical risks, the real constraints on the supply of strategic elements like tin, silver, selenium, cadmium, copper and aluminium become even more obvious and may endanger the production of solar technologies that predominantly use them.

While the development of alternative technologies is crucial to address these technological risks, it is not a silver bullet either due to constraints of metals' properties, supplies, extraction costs, and efficiency of energy conversion within applications. Crystalline PVs and thin film technologies currently dominate the market utilizing combinations of strategic metals like cadmium telluride,

copper indium diselenide, copper gallium diselenide etc. Research and innovation would be thus crucial for finding substitutes for these critical materials in solar cells and for developing optimal and efficient technological solutions. Innovation allows alternative and emerging technologies to develop without picking winners and proliferating path-dependencies; the case with solar energy technologies development shows for the moment a tendency of complementarities of different options in terms of benefits and drawbacks.

Emerging technologies like combined PV and thermal collectors, Concentrating solar power (CSP) applications, and solar heat for industrial processes are still at a demonstration or development phase but adequate policy and financial incentives for innovation can provide enough impetus to make them fully competitive in the near future. Organic cells which are still a niche market can offer further efficiency improvements for harnessing the most out of sun energy. Altogether, research and innovation into alternative materials and modern technologies can increase efficiency, bring down energy demand, and decrease prices for solar energy technologies which in the longer run will translate into lower costs for production, deployment and commercialization of solar PV and will make them competitive with other energy technologies.

Last but not least, research and innovation into the area of recycling solar panels is very important if Europe is to mitigate the risk of loss of precious metals (silver, gallium, indium, germanium), tackle its import dependence for these materials and eliminate negative impacts on the environment, such as leaching of toxic metals like cadmium and lead out of solar panels. Increasing the recovery rates of critical materials used in solar technologies and encouraging more efficient practices for primary production and by-product separation and recovery of some primary metals (like zink, copper, or aluminium for extracting tellurium, indium or selenium) are both vital in preventing waste of precious resources and in encouraging efficiency and sustainability of European industry. This type of innovation requires substantial additional research and investments in order to deliver advanced and efficient separation and recycling processes and technologies and to improve the recycling capacities and culture across Europe. Recycling and reuse can be effective mitigation strategies and some low-hanging fruits can be already reaped by encouraging more effective collection and sorting systems.

A holistic approach to innovation is crucial in order to address the problem of potential bottlenecks due to scarcity of critical raw materials for solar power. The EU should ensure a stable and predictable regulatory framework that supports simultaneously research and innovation along the entire value chain, from fundamental and applied interdisciplinary research, to development, demonstration and diffusion, and their technical connection to the energy grid system, keeping the long-term supply dilemma in mind.

Europe needs to invest strategically in innovation by pooling together the knowledge and financial capital it already has and by encouraging stronger cooperation between academia and businesses in order to bridge the “valley of death” for solar energy technologies. More efficient instruments for leveraging capital and for fostering development of these technologies will provide further stimulus to innovative ideas and projects that can make a difference. Only then could Europe capitalize on its scientific and research capabilities and realize the full potential of innovation. Innovation, supported by long-term objectives and milestones, will be the centripetal force holding the EU solar vision together with all its building elements reinforcing each other.

Europe needs to put on the innovation glasses in order to see clearly the details of its solar future; it can’t afford near-sightedness when it comes to creating this long-term solar vision. These glasses cost a lot, but without them there is no vision.

PVPARITY

Supported by INTELLIGENT ENERGY EUROPE

The Photovoltaic (PV) Parity project

The PV PARITY project aims at defining grid parity, i.e. achieving a stage of development of the PV technology, at which PV is competitive with conventional electricity in specific market segments. It will also provide relevant policy makers in the EU Member States with a clear understanding of the necessary measures to support solar PV technology in achieving grid parity. The project will also develop strategies for supporting the PV sector after grid parity is reached.

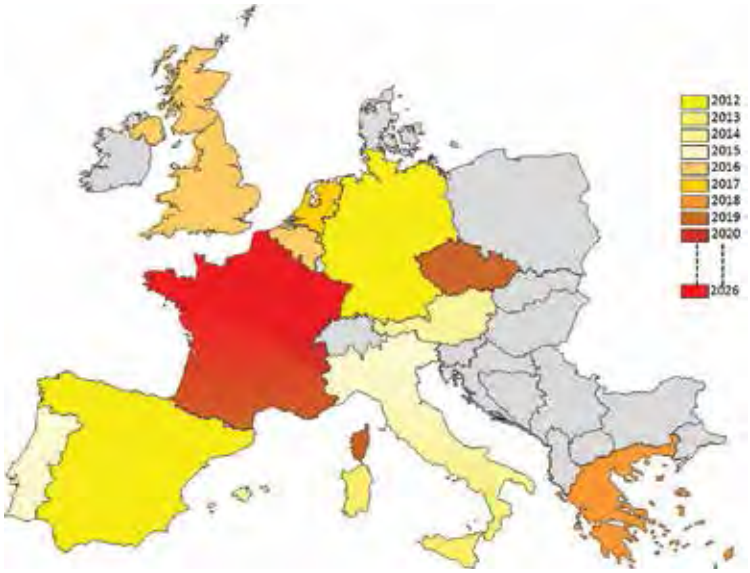

Figure1. Overview of achieving the dynamic PV competitiveness in the residential sector in different European Countries

OBJECTIVES

The long-term strategic objective of the PV Parity project is to ensure an appropriate policy framework in order to achieve up to 12% of the EU electricity demand by 2020. This target will imply reaching a total installed capacity of about 400 GWp in 2020.

INNOVATION AND RELEVANCE

European and National policy makers need to be provided with objective and transparent information on the potential of the PV sector, such as the competitiveness of electricity produced by PV systems, and on adequate support schemes to ensure a sustainable deployment of the PV sector, which can provide a relevant contribution to the achievement of the European RES 2020 Directive and to the Energy Roadmap 2050.

Several aspects of the PV Parity project show a high scientific innovation and relevance and are related to the approach used for the definition of the PV competitiveness, which was until now usually referred only to comparison between the evolution of PV generation cost and electricity prices. Additionally, the project considers also the Middle East and North Africa region.

RESULTS

The roadmaps have been developed per each market segment (residential, commercial / industrial and utility scale) of the 11 European target countries. The roadmaps have been based on a dynamic model developed and empirically scaled in the project “PV Parity”. An overview for all target countries and the calculated year for achieving PV competitiveness in the residential sector based on the dynamic model is shown in Figure 1.

CONCLUSIONS

In future PV will become competitive in more and more European countries for different market segments. This requires to develop alternative support schemes and to have them in place when PV competitiveness is achieved for those segments in the European countries.

Partners

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PV in buildings
Opportunities and innovation

Laura maturi, M.Sc. Eng, Institute for Renewable Energy, EURAC research.

European policy is setting ambitious targets for the next coming years to promote the use of renewables in the building sector, which accounts for over 40% of the European total energy use and for 24% of greenhouse gas emissions[1].

Considering that with 2020 all new buildings are expected to be nearly zero energy (see the EPBD recast[2] and the IEA Task 40[3] for the concept of "nearly zero energy building"), it is clear that PV will play an important role to cover at least part of the electricity demand to achieve these goals.

On the other hand, a large portion of the PV system potential in buildings still remains unused and this is due to several reasons, which include economic, technical and architectural factors.

An international survey among architects and designers carried out in the context of IEA Task 41[4] underlined the limiting factors for the diffusion of PV systems integrated in buildings: one of the main barriers identified is the lack of suitable products developed to satisfy the architects and engineers needs for high quality, formal and conceptual architectonical integration.

Thus, several recent research projects (e.g.[5] and[4]) aim to develop innovative concepts and prototypes of PV systems conceived for building integration, where the PV system is considered not only as a mean to produce electricity but also as a multifunctional element of the building envelope able to fulfill several requirements (e.g. PV modules able to provide water tightness, natural light penetration, solar and glare protection, etc.).

The development of such multifunctional building components entails the need for innovative test facilities able to evaluate their energy performance.

In fact, there is a need to monitor and test together their "passive" (e.g. thermal transmission properties)

and “active”(e.g. electrical and thermal production) performance and to understand the energy interaction between the active and passive layers.

An example of such a novel test rig was designed by Eurac[6], with the main objective to investigate and support the development of multifunctional building components.

Eurac laboratory includes a calorimeter equipped with a sun simulator and a hydraulic circuit for the assessment of advanced building envelope systems [6], and a PV module test facility for the specific evaluation of PV characteristics[7].

Coupling the two test facilities together is thus possible to test the PV modules and also to evaluate their active and passive behavior when integrated in building components in working conditions close to the real ones. The prototype of an innovative wooden prefabricated wall with integrated PV, was conceived and tested in these laboratories and its energy performance was investigated both in terms of electricity production and thermal transmittance[8,9].

These new test facilities, together with new products development, open new challenges and new opportunities to boost the use of solar energy in buildings and leads to a new concept of building envelope, conceived as an active system able to save and produce energy at the same time.

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Figure 1: INTENT and SoLaRE-PV Lab at Eurac[7].

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A clean sky for Europe
Technology for aviation in the 21st century

Siim KALLAS, Vice President in charge of Transport, European Commission

In recent years, air transport has grown faster than any other transport mode. This annual growth is expected to continue and rise even further in the years to come, representing a good economic opportunity for European industry.

However, while maintaining today's current high safety levels, this growth will be accompanied by more challenges that affect the competitiveness and sustainability of air transport. Reducing the impact of air transport on our environment, improving its efficiency and affordability, and reducing its dependence on fossil fuels are crucial to ensure its viability.

Despite the many industry improvements made in aircraft energy efficiency over decades - new aircraft are quieter than before and burn much less fuel – the effect of such intense demand for air travel will still outstrip these environmental gains.

So clearly, there is still a long way to go. Europe is determined to make substantial and sustained investment in research to develop more technologies for today, and the innovation that we will need for tomorrow.

Meeting the EU's wider climate change targets will require deep cuts in emissions from transport over the medium term. Transport, as a major polluter responsible for about a quarter of the EU's greenhouse gas emissions, will have to cut by at least 60% by 2050 compared with 1990 levels.

ACARE, the Advisory Council for Aviation Research and Innovation in Europe, has set a goal of reducing fuel consumption and carbon dioxide emissions by 50% per passenger kilometre by 2020, and emissions of nitrous oxides by 80% in landing and take-off.

And by 2050, the European Commission would like to see 40% of aviation fuel as low-carbon and sustainable, since the ultimate solution to decarbonising transport is to replace finite fossil resources with CO2-neutral alternative fuels.

So how can we make Europe's skies cleaner?

There are three technological ways forward which should be combined:

- promoting alternatives to replace conventional fossil fuels as aviation fuel;
- designing more energy-efficient and eco-friendly aircraft and engines;
- modernising air traffic management to cut congestion by optimising airspace capacity, aircraft routes and airport operations, to gain fuel and time efficiency.

Studies have shown that CO2 reductions of up to 80% can be achieved by using biofuels and optimally innovative technology, which is why a top priority in European aviation research today is to develop greener engine technologies which are compatible with biofuels.

This should lead to a new generation of aircraft and equipment that will consume less fuel, generate lower emissions and make less noise.

Firstly, with fuel, the challenge is to find a substitute for liquid kerosene as the power for

gas-fired aircraft turbines. A logical first step to be taken now would be to develop synthetic alternatives as a 'technology bridge' before progressing to the ideal solution: biomass-derived kerosene produced through 2nd and 3rd generation processes, unlikely to be available in large quantities before 2030.

Synthetic fuels are currently not cost-competitive, but a non-disruptive option to replace oil-based fuels; they also allow for a wide range in the blending ratio with mineral oil fuels to provide a smooth transition from fossil to renewable and sustainable fuels.

Moving further into the future, the ultimate goal would be to develop advanced liquid biofuels based on renewable material such as ligno-cellulosic feedstock and wastes, to be available as a high-energy density substitute for kerosene. However, sustainability criteria, supply of raw materials and final price will be major considerations.

A number of airlines in Europe have started to test using biofuels to investigate supply and operations, as well as to measure performance.

In research and development, the European Union already has several highly valuable cooperation programmes in place, some national and some EU-funded. Given that aviation has a very lengthy R&D cycle, the EU has a long-term commitment to invest heavily in this area.

While all the different programmes move in the same general research direction, none is as important or wide-ranging as the Clean Sky Joint Technology Initiative: the EU's largest ever aeronautics research programme, which covers operations from research and first testing to in-flight demonstrations eventually leading to commercialised deployment.

It is geared to developing technologies to reduce emissions of carbon dioxide, nitrous oxides and noise, while searching for innovation breakthroughs in more efficient propulsion systems, on-board flight management systems and in aircraft design for all main commercially used air vehicles.

This flagship public-private programme is looking at all possible and potential improvements - anything from new designs of wings and blades to reduce drag, to low-weight aircraft using smart structures, or advanced electrical systems to eliminate noxious hydraulic fluids and reduce fuel consumption.

Technology innovation must also go hand-in-hand with improvements to air traffic management, the third essential element in our strategy for improving performance in Europe's crowded skies.

This is where the Single European Sky initiative and its technological pillar SESAR come into play. They are designed to combine efficient fuel consumption with optimised aircraft access to airports and flight trajectory management, with the objective of making aviation more sustainable and better performing, and aiming to further reduce emissions by 10% per flight through ATM improvements. Developing and deploying a new air traffic management generation, with continued longer-term upgrading and improvement, are SESAR's core objectives.

When fully implemented and deployed, these ambitious programmes will address the current airspace capacity limitations, reduce fuel-wasting aircraft congestion and delays by aligning flight planning in the best way possible so as to meet expanding demand.

It is only by combining all three of these ways forward that we will be able to achieve a significant 'greening' of aviation and for this, it is essential for Europe's private and public sectors to work closely together. This is how we can move towards a cleaner European sky and allow aviation to play its full part in helping transport reduce its overall carbon footprint.

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Clean Sky 2

Eric Dautriat, Executive Director, Clean Sky JU

The air transport industry is paying a lot of attention to growing public concern about the environmental issues of air pollution, noise and climate change. Although today air transport only produces 2 % of man-made CO2 emissions, this is expected to increase to 3 % by 2050 with the continuous and steady growth of traffic.

Clean Sky, a Public Private Partnership between the European Commission and the Aeronautical Industry, was set up to bring significant step changes regarding the environmental impact of aviation.

Clean Sky is the most ambitious aeronautical research programme ever launched in Europe. Its mission is to develop breakthrough technologies to significantly increase the environmental performances of airplanes and air transport, resulting in less noisy and more fuel efficient aircraft, hence bringing a key contribution in achieving the Single European Sky environmental objectives.

The Clean Sky JTI (Joint Technology Initiative) was born in 2008. It is managed by the Clean Sky Joint Undertaking until 31 December 2017.

The programme gathers 12 industry leaders, 74 associates and around 500 partners (industries, academia, research organisations, SMEs) selected via calls for proposals.

The level of SMEs successfully participating in projects reaches up to 40% in the Clean Sky JTI calls for proposals, which makes our programme particularly “SME friendly”.

Today, the programme is well on track and the first technical results are delivered. But we need to look to the future, as Horizon 2020, the EU Framework Programme for Research and Innovation, is taking shape.

As everybody in the European research arena is expecting “simplification” from Horizon 2020, we have set an example with the possible continuation of the Clean Sky initiative: we just call it “Clean Sky 2”.

Through different steps, including a public consultation and a formal impact assessment, the relevant proposal from the industry should be ready before the end of this year.

Being part of the “Societal

Challenges" pillar of Horizon 2020, it will address further high technological maturity and high societal impact. It will build on Clean Sky and aim for a high level of integration on flying test vehicles. It will also prepare for the next wave of technologies able to answer the still more ambitious targets of Flightpath 2050 and the upcoming ACARE Strategic Research and Innovation Agenda, for the environment and for other goals like mobility and safety.

It will strongly contribute to the global leadership of the European aeronautical industry.

Clean Sky 2, building on a successful Public-Private Partnership, should still rely on the leadership of the major European aircraft and systems integrators, and be widely and efficiently open to competition through different kinds of Calls. The definition and prioritization of the projects should be objective-driven, for each of them to demonstrate its impact and its relevance.

These projects should start when necessary along the Horizon 2020 period, from 2014 onwards. The participation of SMEs, a strong asset of Clean Sky, should be encouraged and enhanced.

And of course, the lessons learnt from Clean Sky should drive the future programme into more efficiency and effectiveness. The Clean Sky Joint Undertaking is engaged in this process, interfacing with the industrial leaders, the European Commission and many stakeholders, be they already involved in the current Clean Sky or not. I have no doubt that the case for Clean Sky 2 will convince the European Council and the European Parliament in due time. ●

Schedule for Clean Sky 2

- 14 June 2012: First stakeholders meeting organised by Clean Sky
- Mid July 2012: First draft programme outline for the Impact Assessment
- Mid July 2012: Opening of the public consultation by the European Commission (Internet)
- June-September 2012: Impact Assessment by the European Commission
- 12 September 2012: public stakeholders consultation on Clean Sky 2, at ILA Berlin

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Advanced nondestructive testing

Wieslaw M. Ostachowicz, Polish Academy of Sciences (IFFM), Gdansk, Poland.

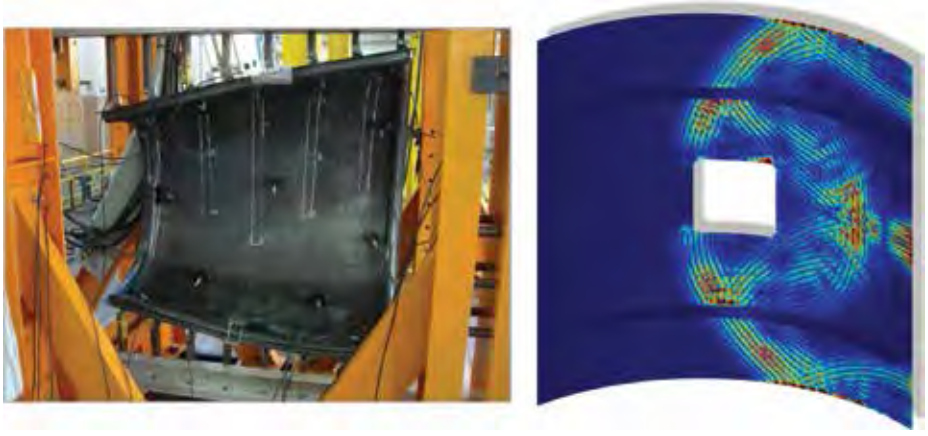
The IFFM PAS Team is a research group from the Department of Mechanics of Intelligent Structures of the Institute of Fluid–Flow Machinery (IFFM), Polish Academy of Sciences (PAS), lead by Professor Wieslaw Ostachowicz (www.imp.gda.pl/o4/z1/). For many years now the IFFM PAS Team has been carrying out its scientific research focused in the development of aircraft intelligent structural health monitoring (SHM) systems. The most important purpose of SHM systems is a significant increase in the safety and time of operational service as well as the reduction of costs related with exploitation of aircrafts.

The methods of structural health monitoring that have been developed by the IFFM PAS Team are based on the phenomena associated with propagation of guided elastic waves and thermography. In the case of the methods making use of the propagation of guided elastic waves structural defects of aircraft elements may be detected and localised based on the well–know phenomena of wave reflection and scattering at structural discontinuities. In this area of research the IFFM PAS Team has developed original engineering software for the Spectral Finite Element Method in Time Domain for numerical simulations of the coupled interaction between propagating elastic waves and thermal and mechanical defects as well as impurities of various types. The software developed enables one not only a better insight into the wave–damage interaction phenomena itself but also greatly helps in the research related with the most effective and optimal sensors placement for damage detection purposes. Additionally the IFFM PAS Team has developed a number of original SHM systems for damage detection and localisation based on the use of piezoelectric transducers fully integrated with hosting structures – Fig. 1. In such SHM systems two different damage detection strategies are employed: the pulse–echo strategy making use of various concentrated sensor networks of phased array type and the pitch–catch strategy taking advantage of distributed sensor networks.

The IFFM PAS Team has been also involved in the research related with the application of the 3–D laser scanning vibrometry for damage detection and localisation in various complex aircraft structures – Fig. 2. The effect of the research carried out by the Team has resulted in the development of very effective and robust SHM strategies. This has been very well documented by a published monograph of the Team entitled Guided Waves in Structures for SHM. The Time–Domain Spectral Element Method, a significant number of research papers published in top international scientific journals, numerous conference presentations, but most of all by two granted patents (including one for EU countries).

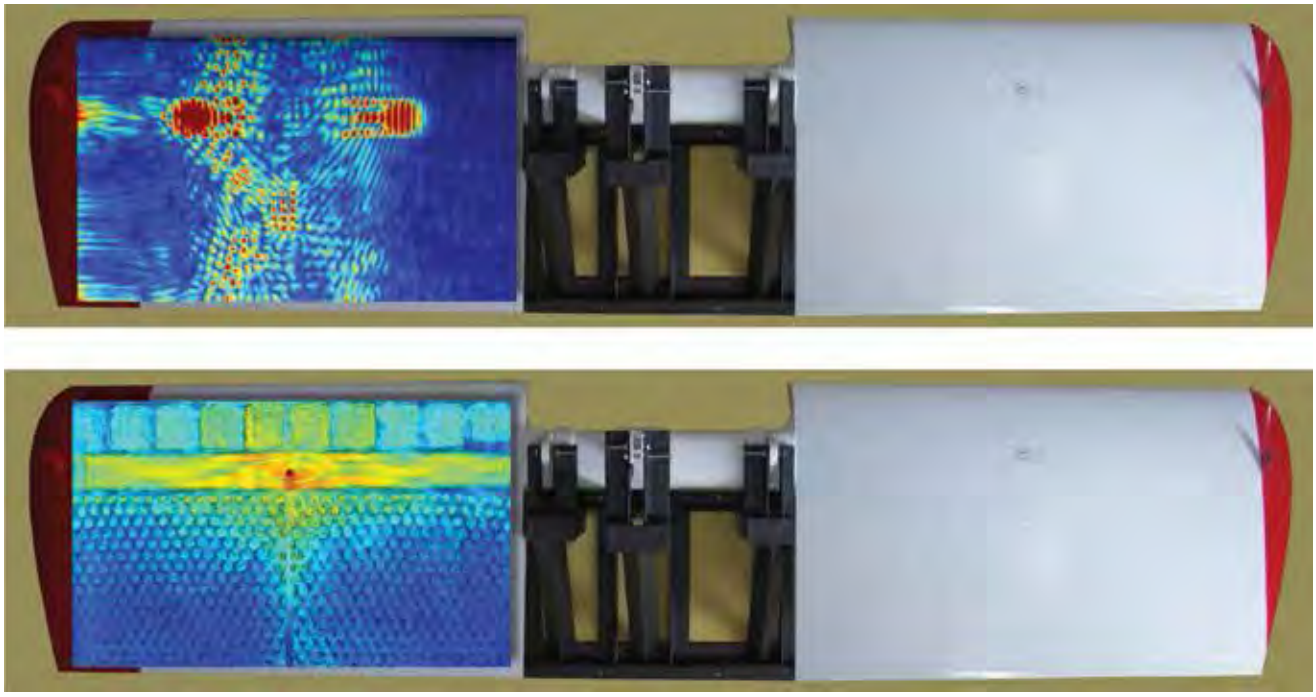
Thermography as a damage detection and localisation method is a measurement technique based on the phenomena related with subtle temperature changes in the damaged area that can be precisely detected and measured by thermographic cameras. The IFFM PAS Team has developed two measurement techniques making use of thermography. The first one employs the phenomenon of the transmission of thermal waves through the structures under investigation and their subsequent interaction of any damage related structural

Fig 1.



techniques for composite structures

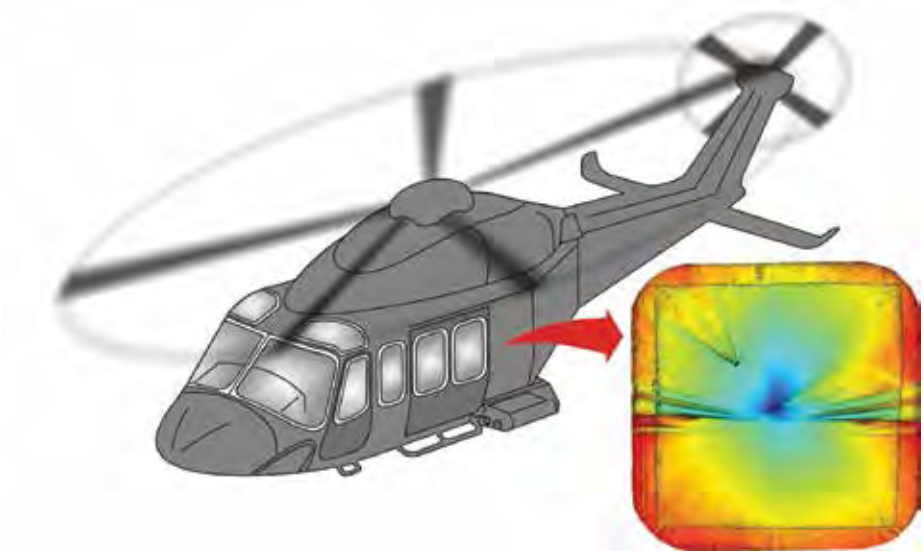
Fig 2.



discontinuities, while the second is based on the reflection of thermal waves. The results obtained by the Team has confirmed the usefulness of both these approaches especially in the case of structural aircraft elements made out of laminated composite materials that are usually characterised by strong material damping, which strongly limits the application of the guided–elastic–wave based approach – Fig. 3. Also in this case the significance of the results of the investigations carried out by the IFFM PAS Team has been clearly reflected by numerous conference presentations and research papers published in many scientific journals.

It should be strongly emphasised that the damaged detection and localisation techniques mentioned above has been developed as a result of close international collaboration under NATO, FP6 and FP7 EC research projects that involved such aircraft industry partners as European Aeronautic Defence and Space Company (EADS), Airbus, Boening or Aernnova.

Fig 3.



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ILA Berlin Air Show
The world's leading conference event for the aerospace industry

Dr. Ekkehard Münzing, Head of the ILA Conference Programme

Dr. Ekkehard Münzing

The ILA Berlin Air Show will take place on September 11-16, 2012 at its brand new exhibition grounds, ExpoCenter Airport Berlin Brandenburg. The biennially held fair – which was held in 1909 for the first time and is the oldest aviation show worldwide – ranks among the world's largest and most important aerospace trade fairs and is organized by the German Aerospace Industries Association (BDLI) and Messe Berlin GmbH.

In 2010 1,153 exhibitors from 47 countries presented their products and approximately 235,000 visitors (trade visitors: 125,000) attended the fair. Similar numbers are expected for this year's show.

This year's official partner country is Poland. Under the aegis of the Polish Ministry of Economics and the Polish Agency for Information and Foreign Investment (PAIIZ), Germany's neighbour will be represented at the Berlin Air Show with its biggest display to date. Poland's aerospace industry will be introducing itself as a modern, fast-developing sector, which offers outstanding opportunities for customers and

investors from around the world. The focus is on existing industrial production and on research and development within the industry.

As in past years ILA 2012 will host the most comprehensive conference programme of all the international air shows, underlining its role as the number one trade fair and congress for the entire aerospace sector. From 11 to 16 September, parallel with the Berlin Air Show, around 100 conferences, workshops and seminars await experts from all parts of the aerospace industry.

Numerous conferences will address the issue "green skies" in one way or the other. But the following three conferences deserve in the context of this journal special attention: "The Future of Alternative Aviation Fuels"-Conference, the "ACARE/SRIA Publication Conference" as well as the "4th Greener Skies Ahead Conference".

Alternative fuels are currently among the most dynamic developments in aviation. ILA Berlin Air Show 2012 will be a milestone for this up-and-coming sector. aireg (Aviation Initiative for Renewable Energy) and CAAFI (Commercial Aviation Alternative Fuels Initiative), the two alternative aviation fuels initiatives from Germany and the U.S., will make sustainable aviation fuels one of the major attractions of the trade fair.

The high-level conference "The Future of Alternative Aviation Fuels", one of the key conferences of ILA 2012, on September 12th, will discuss the ecological and economic prospects for biofuels in the aviation sector with senior decision-makers from politics and business. aireg and CAAFI will highlight areas where collective and cooperative efforts of aviation and biofuel industry leadership are leading the way in technology, feedstock development, facilitating deployment and investment to place aviation in a leadership role in the global transport sector. Dr. Peter Ramsauer, the German Minister of Transport, and Dr. Tom Enders, CEO of EADS, will be among the leaders addressing the forum. The projected signing of a US-German intergovernmental agreement, focusing on the bilateral advancement of R&D in alternative aviation fuels, will be the commencement of an even closer transatlantic cooperation.

On 13 September the "ACARE/SRIA Publication Conference" will present the latest strategic research and innovation agenda (SRIA) of the Advisory Council for Aviation Research and Innovation in Europe (ACARE) to the public. The advisory council is made up of members representing politics, aviation, technical colleges and major research institutes. The SRIA sets the pace for research and innovation in the aviation industry in Europe as well as global standards in this field. It translates the goals of Flightpath 2050, Europe's vision for aviation, into concrete research themes for the years ahead.

Taking place for the fourth time, the "Greener Skies Ahead – International Conference on Reducing the Environmental Impact of Future Air Transport" on 13 September will debate the technological challenges and the industry's technological concepts for eco-friendlier air transport. Among the topics addressed is the question how ecologically neutral growth and lower emission standards can be achieved.

Full details about the ILA conference program are listed on the ILA website. Listings are by date and individual key topics. Detailed information on the subject matter, on event dates and speakers as well as on conditions for taking part can be found at: **www.ila-berlin.com / Conferences.**

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Lombardy Aerospace Cluster
Distretto Aerospaziale Lombardo

There is not one way only to defend the viability of an industry. One of this is certainly the launch of research & development (R&D) programs that are in favor of the environmental sustainability. This is true also for one of the most advanced industry sectors like aerospace. One region in Europe where this is a reality is Lombardy, in Italy, where the Lombardy Aerospace Cluster is located: 185 companies, involving 15,000 employees, which contribute for more than 30% of total Italian aerospace export, where large enterprises that are global competitors (AleniaAermacchi, AgustaWestland, Thales Alenia Space, Selex Galileo, CGS), collaborate with a network of several small and medium enterprises that are first tier suppliers of the major world's aerospace players and can provide state-of-the-art R&D capacity and products, and that hosts top Universities and research centers that are involved in the major national and international R&T programs.

The Cluster (member of European Aerospace Cluster Partnership) is committed to sustain a more environmentally friendly aerospace sector through various projects. Major players in aeronautics like AleniaAermacchi and AgustaWestland are leaders, respectively, in Green Regional Aircraft (GRA) and Green Rotorcraft (GRC) integrated technology demonstrator (ITD) of the Clean Sky, the European joint technology initiative (JTI) for the aeronautic sector.

R&T programs are devoted to develop technologies for lightweight structures, higher efficient aerodynamics (for fuselage, rotors for helicopters),

active low noise technologies, control rotor blades for helicopter rotors, more electrical on-board systems (with energy recovery and high-density power generators), flight optimization approach procedures for lower fuel burn and emissions, advanced materials where the process are cleaner than conventional production systems (for example for mechanical systems and transmissions).

Calls about specific topics are published within the Clean Sky ITDs, and companies, universities and research centers in Lombardy are responding exploiting their key competencies in various fields, like Politecnico of Milan/ Dept of Chemistry and Centro Combustione Ambiente, with the development of numerical and experimental evaluation of emissions, helicopter active rotor wind tunnel testing coordinated by Politecnico of Milan/ Department of Aerospace, a more efficient on-board power conversion system proposed by Blue Electronics. Industries, academia and research centres operate also in Space sector to develop scientific payloads, technologies and data analysis that comply with specifications and requirements for the most space advanced missions.

A significant participation of organisations of Lombardy Aerospace Cluster is in the ESA/ EU programs, for example GMES the European Global Monitoring for Environment and Security, Galileo the European global navigation satellite system, SSA the Space Situational Awareness Programme and in Nereus, the European Network of Regions using space technologies.

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Reducing impacts, increasing benefits: How ATM is working to improve aviation's environmental performance

Luc Tytgat, Director Single Sky, EUROCONTROL

Aviation is a key provider of social and economic benefits such as employment opportunities, economic growth, international trade and increased mobility. But, as with most major economic sectors, such benefits have to be balanced against their environmental impact. For aviation these impacts include annoyance from aircraft noise and reduced air quality around airports, and emissions of greenhouse gases, such as Carbon Dioxide (CO_2), which contribute to global climate change.

The aviation industry has been proactively working to reduce these impacts and much progress has already been made. Market-based measures such as the European Union's Emissions Trading Scheme provide financial incentives to cut emissions, operational and airspace improvements have been made which reduce fuel burn and the impact of aircraft noise, and research is in progress to both improve technology to make aircraft cleaner and quieter and to develop more sustainable aircraft fuels. However, with the industry continually striving to lessen its impact even further, EUROCONTROL, the European Organisation for the Safety of Air Navigation, is working to develop new and innovative ways to reduce the environmental impact of a vital component of the aviation sector, air traffic management.

Air traffic management (ATM) is the integrated management of air traffic and airspace; in other words, where, when and how aircraft fly. These are factors which can have a significant influence on aviation's environmental impact. Historically, European air traffic management has been organised on a national basis with each country designating its own air navigation services provider (ANSP). However, the European vision is to have a Single European Sky, a seamless, centrally-managed European airspace without national boundaries. This will enable aircraft to fly shorter, more direct routes, thus cutting flight times, reducing delay and decreasing fuel use. This has

the double benefit of reducing emissions of CO_2 and lowering operating costs.

As an intermediate step towards this EUROCONTROL is providing support in the restructuring of Europe's airspace into Functional Airspace Blocks (FABs). Implementing FABs will allow for greater cross-border harmonistation thus already enabling more direct routes and shorter flight times with the attendant environmental benefits. For example, in 2011 the UK-Ireland FAB, the first European FAB to be operational, achieved fuel savings of 24,000 tonnes which in turn reduced emissions of carbon dioxide by 76,000 tonnes whilst cutting 17.8 million euros from fuel bills.

However, reducing CO_2 is not ATM's only environmental goal. One key project which reduces both aircraft noise and climate change impacts is the implementation of continuous descent operations (CDO) at European Airports. CDO is an operational technique which aims to keep aircraft higher for longer before performing a smooth single-stage descent which avoids level flight as much as possible. Minimising level flight reduces engine thrust which both decreases fuel burn and diminishes noise impact for the communities being over-flown as the aircraft stays higher, and consequently is quieter, for longer.

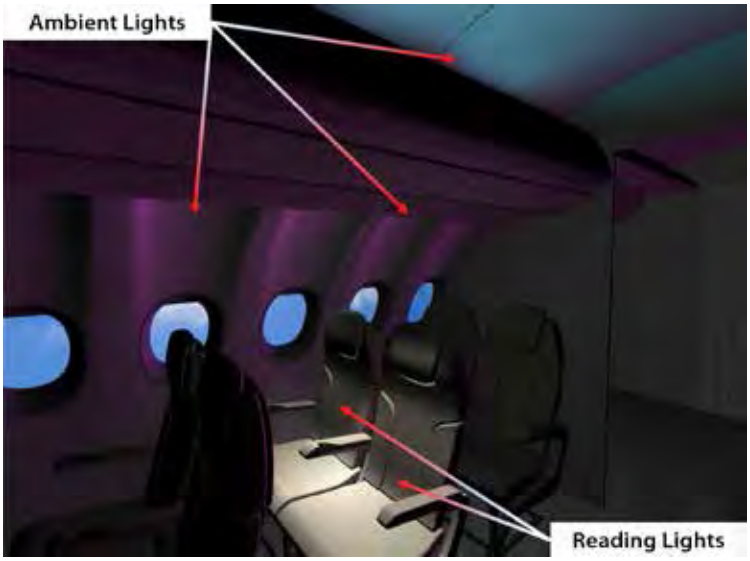
EUROCONTROL is facilitating the introduction of CDO at an ever-growing number of European airports. Take-up rate has been so good that an initial target of having CDO available at 100 airports by 2013 has been raised to 200 airports by 2014. Facilitated by the introduction of new technologies from the Single European Sky ATM Research programme (SESAR) the aim is to eradicate stepped descents entirely, so that by 2020 CDOs will be available at virtually all European airports.

The implementation of CDOs requires the co-ordination of the operational stakeholders at an airport; the ANSP, the airport operator and, of course, the airlines which use the airport. This can be facilitated by initiatives such as Collaborative Environmental Management (CEM), a protocol developed by EUROCONTROL whereby stakeholders at an airport collaborate on projects such as the redesign of arrival and departure routes or the introduction of operational initiatives such as CDOs. Establishing such a dialogue facilitates joint decision-making and thus is key to the successful implementation of multi-actor environmental improvements and achieving sustainability targets. It is EUROCONTROL's objective to achieve widespread adoption of CEM at European airports by 2013. This is being progressed by its inclusion in the European work programmes of two major industry bodies, the Airport Council International (ACI) and the Civil Air Navigation Service Organisations (CANSO), as well as the work being done by the CEM Implementation Team set up by EUROCONTROL to support operational stakeholders.

However, aviation is a global industry and therefore addressing its environmental impacts requires global collaboration. One example already in progress is the project for Atlantic Interoperability to Reduce Emissions (AIRE), a transatlantic initiative which is being collaboratively managed with the Federal Aviation Administration, EUROCONTROL's counterpart ATM body in the USA. As the global aviation market expands further such collaborative projects will increasingly be required.

Moreover, ATM is just one component of the aviation sector and the continuous improvements to aviation's environmental performance which are being achieved require the co-ordination of all actors. Not only are ANSPs, airport operators and airlines increasingly working together to minimise the environmental impact of aircraft operations but, as can be seen from the other articles in this edition, valuable work to improve technological performance and develop sustainable alternative fuels is also going on, supported by the Clean Sky Joint Technology Initiative and European Commission research programme. It is thanks to this concerted effort from all sectors of the industry that aviation's environmental performance continues to improve whilst still providing the social and economic benefits which society relies on.

Virtual prototyping in the aerospace industry



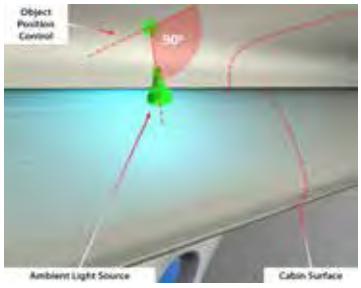
The **Laboratory for Manufacturing Systems & Automation (LMS)** is oriented in research and development on cutting edge scientific and technological fields. LMS is involved in a number of research projects, funded by the EC and European industrial partners. Particular emphasis is given to its co-operation with the European industry as well as with a number of "hi-tech" firms. LMS is under the direction and technical coordination of **Professor George Chryssolouris.** For many years, LMS has been involved in the aeronautics research, in co-operation with major European aerospace companies, such as EADS, AIRBUS, EUROCOPTER, BAE, ALENIA, DASSAULT etc.

Most recently, LMS coordinated an EC funded project, called VISION, targeting at the life-cycle human-oriented activities of aircraft-related virtual products, with the use of advanced immersive technologies. VISION reduces physical prototypes and the development time of aircraft products, thus minimizing the energy and material required for the designing of a new aircraft (see Figure 1). VISION technologies increase the efficiency and reliability of design activities, carried out on virtual aircraft prototypes, which have a great impact on the number of physical prototypes needed for product and process verification in aerospace industry. This approach results in a reduced consumption of materials and energy during the prototyping phase of product development.

The virtual prototyping technologies have demonstrated a significant potential for interactive applications to product and process development. Nevertheless, the proven quality of the underlying technologies still lack in satisfying the real-life needs of aerospace industrial practice. The objective of the VISION project was to specify and develop key interface features in fundamental cornerstones of the virtual reality (VR) technology, namely, in immersive visualization and interaction, so as to improve the flexibility, the performance and cost efficiency of human-oriented life cycle procedures, related to critical aircraft virtual products (e.g. virtual cabin design, see Figure 2).

VISION has followed an upstream research approach, in view of improving the underlying VR technologies, which have been considered critical for the human-oriented life-cycle use of the future aircraft-related virtual products. Human factors and their implications on human-machine interaction within the aircraft-related products have been considered in the definition of the technology specification framework. Specific human-oriented developments on visualization and interaction simulation features were the key results of the projects.

The visualization technologies, delivered by VISION, include ray tracing libraries together with distributed rendering capabilities and global illumination functionalities. The



specifications of this technology allow light designers and engineers to simulate light conditions with high fidelity on the aircraft interiors. Dynamic illumination and soft shadows provide physically correct simulation of light reflections. For the interaction with the virtual environments, a markerless body capturing technology was developed. This technology is aiming at body motion capturing capabilities in industrial environments, where the current algorithms lack in robustness and performance when compared with marker-based systems. Further to the capturing technology, advanced interaction techniques were developed for the human-centred activities of virtual aircraft products.
An interaction framework provides a generic, platform-independent architecture for the development of interaction techniques in a flexible and highly reusable manner.
A repository of advanced interaction metaphors includes techniques, specifically designed for addressing the requirements of aerospace industry. This repository was developed by following a generic and platform-independent architecture of the interaction techniques.
Three dimensional (3D) user interfaces were designed for the provision of an easy-to-use immersive application and system control on various tasks and parameters of the environment (see Figure 3). The design follows the task flow of the user and provides flexible configuration of the menus and interaction features (e.g. buttons). Several alphanumeric input techniques facilitate the easier and faster configuration of the parameters in the scene (e.g. luminosity of light source). Regarding object manipulation, the metaphors use algorithms for the adjustment of their behaviour to the surrounding objects (e.g. placing an object in respect to the gradient of the adjacent surface, see Figure 4). Finally, complex interactions support the simulation of human-based assembly tasks (e.g. drilling process simulation).

The validation of the technologies carried out in the context of VISION, have included both system validation and human factors assessment tests. The output of these tests proved the quality of the technologies developed and is reflected on the feedback and performance of the end-user during the test sessions. The technologies provide a robust and easy to use virtual environment for the performance of the necessary actions and tasks similar to the context of the use-cases, defined by the aerospace industry. The VISION technologies provide the basic structure for the development of virtual aircraft prototypes of design and validation without the need for physical prototypes. In complex products, namely an aircraft, the use of virtual prototypes reduces significantly the costs and time required for development. The benefit of energy and material consumption is substantial, while the reusability of such prototypes proves to be even more beneficial for future design implementations.

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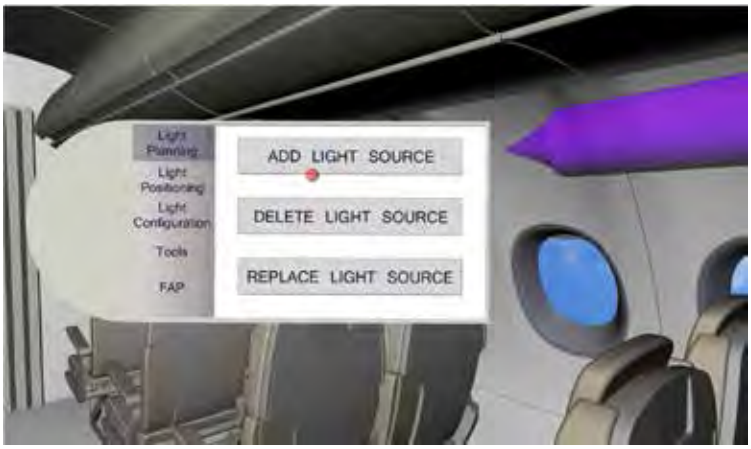


European aviation industry to protect the environment and the energy supply

By Dr Naresh Kumar, ACARE Communication Group Chair

Aviation serves society, brings people together and delivers goods, adding value through speed, reliability and resilience in a global network. It has a strong track record on reducing environmental impacts and also contributes to society in other critical, non-transport areas such as climate monitoring, emergency services, search and rescue and disaster relief.

Though in the global picture aviation industry is responsible for around 2% of human-induced carbon dioxide emissions it plays an important role in contributing to reduce greenhouse gas emissions as well as noise and local air quality. Demand for air transport continues to increase, meaning that air travel in the future will need to look very different than that of today to support sustainable growth.

More efficient aircraft and engines will need to be developed with radically new configurations to improve fuel efficiency and address climate change. Better operational and flight management procedures will also be needed to include improvement of air traffic management efficiency. Improved maintenance technologies will also help prevent degradation of fuel efficiency in ageing aircraft and thus reduce the flying fleet's emissions. Improved understanding of non-CO2 contributions to climate change - including NOx, particulates, and contrails and their dependence on operational parameters - will enable the sector to take a 'cradle to grave' approach to protecting the environment and the energy supply in aviation.

In essence, this is what - under the leadership of the European Commission – the High Level Group comprising representatives from the aeronautics industry, air traffic management, airports, airlines, energy providers and the research community, addresses in Flightpath 2050. This vision of how Aeronautics

and Air Transport in Europe will look and function by 2050 sets profoundly ambitious goals which will only be met if better methods and processes facilitate the search for new solutions. The targets set for 2050 include, amongst others: reduction of CO2 emissions per passenger kilometre by 75%, NOx emissions by 90% and perceived noise by 65%, all relative to the year 2000; emission-free aircraft movements when taxiing; design and manufacturing of recyclable air vehicles.

To achieve such goals, European aviation will need to deploy extraordinary technological effort to define the air vehicles of the future, implement improved air operations and traffic management and deliver improved airport environment to meet the needs of passengers. Aviation must serve society by providing transport for people and goods that is seamless, safe and secure, cost effective and interwoven with other transport modes.

But how will European aviation get there and realise that vision? This is the purpose of the Strategic Research and Innovation Agenda (SRIA). It provides guidance on the research and innovation actions needed to deliver the 'Flightpath 2050' vision and accounts both for the evolution of technology and for radical solutions or step changes. The full document will be published during the ILA Airshow in Berlin, in September and promoted throughout Europe with high level events at the Brussels EU Parliament, in Germany, Romania, Italy, France, Poland, Spain, and Sweden.

Through these events we hope to engage as many organisations as possible, large and small, to participate in this very ambitious and exciting programme so that Europe can maintain its global leadership for aviation and also meet the needs of citizens in the future. ●

About ACARE
ACARE, the Advisory Council for Aviation Research and Innovation in Europe, is a forum for Aviation stakeholders, which since 2000, has set the research agenda for delivering significant improvements in sustainable, reliable, affordable and passenger-friendly aviation. Significant progress has been made since 2000: new aircraft designs are quieter and burn less fuel per passenger kilometre which means lower emissions. ACARE has now set out challenging objectives for future decades in the European Commission's document Flightpath 2050 which was published in March 2011. This new vision was developed by a High-Level Group for aviation research and innovation under the leadership of the European Commission. With new membership, ACARE is developing the research requirements for the future – a Strategic Research and Innovation Agenda (SRIA) that will provide a pathway towards the vision.

More info: www.aera-pro-project.eu or www.acare4europe.org

Alternative aviation fuels for the future

By establishing an original methodology and by providing a corresponding web-based assessment tool, Steinbeis Advanced Risk Technologies GmbH with other partners (Airbus, EU-VRi, IATA, IFP, INERIS,…) in the EU-FP7 project Alfa-Bird (Alternative fuels and bio fuels for aircraft development), made it possible to analyze scenarios of future use of biofuels and other alternative fuels in aviation in a dynamic transparent and interactive way.

The socio-economic and environmental aspects play a key role in the decision on what kind of fuel would be the best option in replacing current fuels in aviation with alternative ones. In the Alfa-Bird project ("EU-Nr. ACP7-GA-2008-213266") an innovative model based on dynamic set of assumptions related to the future of the society and of the energy market has been developed. The core of the model is the dynamic technology competition approach (Lotka-Volterra). It allows to predict how the alternative fuels (e.g. biofuels) will "do on the market" and what their socio-economic and environmental impacts will be (the environmental impacts are considered primarily through the prism of CO_2 emissions and their monetary equivalents). The methodology and the corresponding web-tool enable interactive and transparent analysis of different future options under a large variability of input parameters and boundary conditions.

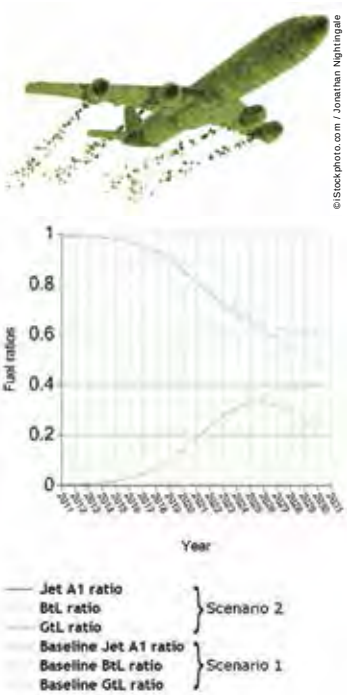
The tool allows to specify target capacities for market shares of GtL (Gas-to-Liquid), BtL (Biomass-to-Liquid) and CtL (Coal-to-Liquid) fuels. The number of plants required to reach this market share is then calculated and used to compute the development of production capacities. Oil price scenarios are specified through annual change rates over five year intervals. The model includes the use of carbon capture sequestration for GtL/CtL and the indirect land use change (iLUC) for BtL. The analysis is driven by the investment factor and the market factor and allows to compare different scenarios (see frame).

The model and the tool integrate the SEA methodology with Life Cycle Assessment, Multi-criteria Decision Making (MCDM) and the decoupling indicators (see the figure).

Within the project three main scenarios have been considered:

- "Business As Usual",
- "Low Environmental Incentives"
- "High Environmental Incentives"

For availability of project results after the project end (July 2012) please use the contact details below.



Predicting future of alternative fuels for aviation: Scenario with "high environmental incentives"

"…great insights to anyone who would like to address the extremely important topic of biofuel market introduction. …one of the highlights of the … project …"

Airbus

"…realistic models of relevant behavior."

IATA

The decoupling indicators (JRC Ispra, 2010)

Steinbeis Advanced Risk Technologies GmbH (Group) – is a Steinbeis (www.stw.de) enterprise dealing with risk analysis, assessment and management, offering products and providing services for industry and public sector. Steinbeis R-Tech is a member of EU-VRi (www.eu-vri.eu).

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Port of Amsterdam

Port of Amsterdam
Home to the biobased economy

Ports are hubs where raw materials, residual currents and energy production activities come together. These can be beneficial to each other, making it possible to set up valuable chains. A company's residual currents can be another company's raw materials or energy. Ports are therefore logical centres for the biobased economy. As an important energy and agricultural bulk port, Amsterdam naturally responds to the opportunity at hand.

PORT OF AMSTERDAM: THE FACTS

Amsterdam is the 4th port in Western Europe, the largest petrol and cacao port in the world and the second coal port in Europe. Located on busy shipping routes, in the large European delta with water connections reaching far into Europe (e.g. the Rhine), Amsterdam is a perfectly suitable European and international energy port.

EMBRACING RENEWABLE ENERGY SOURCES

Amsterdam supports the supply of green energy with specific incentives and a strict business planning. There is a distinct rise in the transhipment of biomass (e.g. wood pellets) and biofuels (e.g. bioethanol). Because of the existing positions in the mineral energy and food & feed industries, the required infrastructure and knowledge are already available. In the Netherlands increasingly more coal-fired power stations are using biomass and Germany too is a potential large-scale user. To see to these demands Amsterdam is the perfect supply and transhipment port.

PRODUCTION OF GREEN ENERGY

Port of Amsterdam is also dedicated to producing renewable energy. Waste is recycled to provide 360,000 homes with energy (1 million MWh) annually. Residual heat is used for district heating, which suffices for 25,000 households. The port is also home to a wind farm generating a power capacity for 40,000 households.

TEST GROUND FOR THE BIOBASED ECONOMY

Port of Amsterdam welcomes renewable energy and raw material companies, and has been creating smart business clusters aimed at the mutual reuse of residual currents, energy and heat. Innovation in this area is encouraged, for instance through a special subsidy fund and a project called 'Waste = Raw Material'. The project involves the biogas and phosphate cycles.

BIOBASED IS BUSINESS

In the 'Greenmills' joint venture, valuable raw materials and energy products are derived from organic residues such as used frying oil, supermarkets' remaining stocks and biodegradable waste. Cargill is among the suppliers. A pipeline is used to ship residual fruit juice pulp to Greenmills. ICL Fertilizers Europe will be processing phosphate-rich residuals from the port and city area into raw material used to make artificial fertilisers. The port-based Waste and Energy Company (in Dutch: AEB) turns 99% of all waste into raw materials and energy.

AMBITIOUS

Port of Amsterdam seeks to be one of the most sustainable ports in Europe by 2020. Companies actively dedicated to renewable energy and the biobased economy are offered optimal conditions for building a healthy and durable business.

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Dijken, debates and discoveries

By Mike Edmund

The very name Nederland offers an obvious insight into the complicated long-term relationship that the Dutch people have had with the sea. This relationship may perhaps even be the defining national characteristic, and it is not hard when travelling through the country to find the basis for the reference. The famous polder landscape, characterized by dikes, dams and windmills, is the result of a combination of the geology of the area and centuries of local agricultural practices.

To counter the constant threat of inundation, a great degree of co-operation, discussion, debate and agreement was (and still is) required: the *waterschappen* came into being centuries ago so that people from many villages could negotiate such matters as the height of the dikes. It seems that many characteristics thought to be typical of the Dutch, such as awareness of the environment; tolerance and freedom of speech; and of course the seemingly inexhaustible capacity for debate and negotiation, might all have their roots in the war against the waves.

Today, climate change and the possibility of rising sea levels can only serve to sharpen that focus: meanwhile, those characteristic windmills surely represent an early use of renewable energy technology in Europe – long before the Industrial Revolution. Indeed, wind energy still forms a significant component of Dutch renewable energy production: in 2009, around 37% of renewable electricity was generated in this fashion, with the remainder coming largely from biofuels (29%) and incineration of municipal waste (25%). (data: IEA)

But all is not necessarily going well for green technology in the Netherlands. The country was already a long way short of the 20-20-20 targets for carbon emissions when it abandoned its commitment to them in 2011. In the year before it did so, 3.8% of the country's total energy came from renewable sources, which was even less than the 2009 figure of 4.1%. (data: Eurostat).

There is certainly no shortage of effort or innovation within the Dutch renewable energy industry: according to Dutch Green Technology, many enterprises in the provinces of North-Holland and Utrecht are at work in the fields of sustainable energy, waste management and sustainable construction. Elsewhere, a delightfully simple invention by Pieter Hoff may significantly extend the area of land on the planet that may be cultivated, and even offers the tantalizing possibility that mankind might reclaim once-fertile lands that he has degraded. Hoff's

observations of, among other things, morning dew on grass and bird droppings, led him to design the Groasis Waterboxx, which won the Popular Science Green Tech Best of What's New Innovation of the Year award in 2010. His remarkable technology mimics the natural processes by which plants extract moisture from the air at night, allowing tree saplings an early opportunity to establish themselves in even the most arid and unpromising of environments. The box has been tested at the Oudja University in Morocco, where it increased the survival of plants by over eightfold to nearly 90%.

Nor is there a lack of awareness of anthropogenic impact upon the atmosphere. It was Dutch physicist Paul Crutzen who sparked debate about the potential role of nitrate fertilizers in damaging the ozone layer, when he pointed out that atmospheric nitrous oxide may be converted into nitric oxide when it reaches the stratosphere. Other factors have surely influenced the Dutch decision on emission targets. The first is that Holland has vast proven reserves of natural gas, and this generates around 90% of the country's electricity (data: CIA factbook). Although its combustion clearly releases CO_2 into the atmosphere, gas is usually considered a relatively "clean" technology. The Dutch have also renewed their interest in nuclear power, with the recent decisions concerning the future of its only nuclear power station at Borssele, which supplied about 4 billion kWh in 2010. Meanwhile, in 2006 the Dutch Environment Minister proposed conditions for the development of new reactors that include reference to a coastal site.

That "complicated long-term relationship" seems to be entering a new phase.

Impressive results from the Dutch Economic Subsidy Programme concerning innovation and energy

Femke Schaefer, Marketing Manager.

RESULTS OF DUTCH GOVERNMENT POLICY

In recent years, Dutch subsidy policy has been targeted intensively at the theme of innovation and energy via its subsidiary, 'Agentschap NL'. In 2010, the policy was converted into a 'green deal' approach, with the government becoming more indirectly involved. The integration of the themes of energy and innovation has however very much remained the goal of the approach. Subsidies were previously allocated primarily through a "tender set-up", using a weighted evaluation system; a kind of innovation contest. In 2005/2006, Bronswerk Heat Transfer reached two top places in this system with its RADIAX®-compact pumps, compressors and turbines and the Whizz- Wheel® industrial fan projects. Both are innovation-intensive novelties for two energy usage fields which account for around fifty per cent of all electricity worldwide. The potential energy savings for both projects could make a very significant contribution to worldwide CO2 reductions, but will certainly enable an extensive range of equipment relating to heating, cooling and industrial process improvements to function more effectively.

The new fans that were developed with the support of the subsidies consume fifty per cent less energy and are also 6dBA quieter; they are applicable in a wide range of markets. The RADIAX® ultra compact compressor can achieve savings of seventy to eighty per cent in heat recovery processes.

From idea to real life energy innovation, A-frame condenser with Whizz-wheel fans

MARKETS AND MARKET PENETRATION PHILOSOPHY

The target markets for the two energy-saving products and technologies are oil/ gas, refrigeration technology, air conditioning, computers (and data centres and servers in particular), domestic appliances, car cooling systems and ventilation, electric motors, and boiler superchargers. Equipment in these markets often needs to last for decades, which is why the markets are often hesitant when it comes to highly innovative technologies: they have to be reliable, long-lasting, and capable of integration with existing equipment.In the last five years, however, companies have been increasingly active in adopting new technology that saves energy while respecting the environment, all based on a sustainability philosophy. Another important reason for their doing so is the growing realisation that selectively implementing energy-saving equipment can help deliver a better process economy. For example, an ever-greater number of companies aim to see the costs of their investment repaid within around five years, which amounts to a return on investment of about 20%. The major energy companies seek

to achieve repayment within ten years (which is still a return of 10%). The support of the government /'Agentschap NL', through energy and environment convenants, creates a stronger platform for the introduction of breakthrough innovations – pioneering technologies that can bring about significant changes in organisations, and for which a strong entrepreneurial and investment-minded company attitude is required.

The business-outlook has become more favourable thanks to this change of policy, but the current uncertain financial climate is markedly making it more difficult to secure financing for projects. However, in many markets there are companies with very healthy cash flows, which are not particularly dependent on banks or their government. Offering customers convincing financial and technological benefits means it is easier for them to make decisions based on sustainability. Even the most conservative markets are now coming round to this well-founded philosophy.

FAN TECHNOLOGY

More than two years after the market introduction of the new fans, there has been a worldwide response and intensive interest from the very markets and geographical areas that were not directly approached. The basis for this interest appears to be the outstanding performance of the systems in practice, about which information has now found its way onto the internet. There is no stopping the worldwide flow of information on the almost unbelievable performance: a 50 % reduction in energy consumption, noise levels that are 6 dBA lower than the quietest existing fans, in addition to which the fans are much more compact, lighter, and produce a 50% smaller carbon footprint. There already are a significant number of licensing partnerships that account for a major proportion of the markets in which the new fans could be used. The licensing partners can see the real prospect of 'game-changing' fan technology. Huge amounts of energy can be saved every year, and much more quickly than previously envisaged.

HYBRID FLOW MACHINES

Processes for which pumps, compressors and turbines are used almost by definition involve highly complex systems for handling a wide range of liquids, gases and multiphase mixtures. Safety is a predominant factor here, given the high pressures combined with high temperatures and chemical compatibility. The variety of machines is great. The novel hybrid flow machines have similar energy saving potential as the new fans, and worldwide interest has been correspondingly high; the addition of new thermodynamic features means even more savings. One particularly outstanding feature is the reduced space they occupy – about ten times less than conventional machines, thanks to the complete integration of the electric motor with the flow machine. This removes the need for engine rooms and thereby drastically reduces total installation costs. In addition, unique flow features allow new thermodynamic processes of wet compression and expansion, that can cut energy consumption still further. The market introduction of complicated processes and machines is a more gradual one than is the case with fans used for handling air. Company practices will be turned on their head, given that the process of understanding and accepting the new energy and mechanical 'laws' of the hybrid flow machines will require a high level of knowledge exchange. The first high-capacity applications are now found in an unexpected quarter: in the 'large' foodstuffs industry, where sustainability is already well established. The potential energy savings for these applications could be as much as around seventy or eighty per cent.

SUBSIDY EFFECTIVENESS AND ECONOMIC SIGNIFICANCE

For successful projects, the return on investment for the government is exceptional, both directly and indirectly, and easily makes up for the flops that inevitably occur. Projects would certainly be more effective if there were a less complex system of subsidies, such as a simple taxation measure rather than series of committees and mountains of paperwork. This would make it easier to 'measure' the economic benefits – perhaps it is time to revive the Dutch W.I.R law (Investment Account Act).

Staying on top
About the new Dutch innovation policy

The Netherlands is a prosperous country due to an entrepreneurial spirit, business acumen and capacity for innovation. Yet, the Dutch do not take this continued prosperity for granted. Social and economic challenges at national and international level demand policies that give rein to the Dutch innovative strength and entrepreneurial spirit.

ENTERPRISE POLICY

In 2011 the Dutch government launched a new enterprise policy. This policy puts companies in charge and facilitates to them to do business, to invest, to innovate and to export their products and services. After all, it is entrepreneurs who recognise and capitalise on economic opportunities, thereby creating economic growth, jobs and prosperity.

The policy goals are threefold. It is aimed at conquering a position in the top five of the Global Competitiveness Index of the World Economic Forum by 2020 (The Netherlands currently holds position 7). The policy should also result in an increase in Research and Development (R&D)-expenditure to 2.5% of the Gross Domestic Product by 2020 (at the moment R&D expenditure is about 1.8%). Another policy goal is to unite companies and research centres in order to speed up and focus research and innovation and capitalise on their results.

The new policy is characterised by a generic approach that aims at reducing the number of subsidy schemes in exchange for increased tax rebates on R&D, fewer and simpler rules, greater access to corporate financing, better use of the knowledge infrastructure by the private sector and closing the gap between the requirements of businesses and fiscal, educational and diplomatic activities. In addition, there is a specific approach that focuses on a limited number of sectors where the Netherland hold an excellent international position or are likely to do so. This is called the Top Sector approach

TOP SECTOR APPROACH

The Top Sector approach is characterised by three aspects: demand driven, focus and a climate in which innovation and valorisation are stimulated. Central starting point in this approach are the company demands and entrepreneurial initiatives. This is combined with the strength of research institutes, materialised in a common integral research and innovation agenda. Research institutions and enterprises will share the same objectives and maximise synergies. Since it is impossible to excel in every sector or aspect focus is essential so choices were made based on (future) strengths, knowledge and economic position. The approach also supposes a government that stimulates a good climate for innovation and the valorisation of knowledge.

TOP CONSORTIA LEAD BY TOP TEAMS

Business people and researchers formed teams with the mission to draft common research and innovation agenda's and organise themselves into Top Consortia to carry out these agenda's. In many cases these consortia were built upon existing forms of cooperation, but also new structures were formed. A prerequisite for the consortia is that they are to be financed by at least 40% from private funds by 2015. This exercise was done for nine sectors in which the Netherlands hold excellent international positions (so called Top Sectors). For each Top Sector this process was governed

by a Top Team, consisting of top-level representatives form business, research and government. These Top Teams were requested to focus the research and innovation portfolio based on opportunities and threads for their sector and to provide proposals for meeting social challenges and improve and bolster the country's competitiveness. Their reports and the government's reaction resulted in nine so called Innovation Contracts which hold the common research and innovation agenda and the (financial) agreements between enterprises, researchers and government. For 2012 2,8 billion euro's is allocated, of which government will account for 1 billion while the Dutch industry will be responsible for the other €1,8 billion.

ENERGY AS A TOP SECTOR

The energy sector is one the nine sectors that were selected. It is a largely diversified sector in which the Netherlands are facing major challenges moving to the (EU) objective of a carbon-neutral energy sector in 2050. The ambitions to improve the sustainable development of the sector and the economic objectives go hand in hand. Successful breakthroughs will contribute to affordable energy options while strengthening the positions of the involved enterprises and making (strong) progress towards a renewable energy supply.

INNNOVATION CONTRACTS AND TKI'S

The Innovation Contract for the Energy sector consists of 7 subcontracts related to solar energy, off shore wind energy, gas, smart grids, bio energy, industrial energy efficiency and energy efficiency in buildings). At the same time Human Capital Agenda's were presented which hold proposals of the Top Sectors to enhance the connection between education and the labour market and to further improve the quality of the present labour force. At present, the Topconsortia which will be responsible for carrying out the contracts, are being formed legally. The TKI's were requested to submit their statutes by August 1st. Furthermore, there has been a start-up of R&D-lines and regulation for financial support is being made.

From fundamental research to market introduction, a bottom-up approach who place entrepeneurs and researchers together with the government behind the steering wheel and communities with common objectives and agenda's for R&D, human capital and international positioning. The Top Sector approach has been received with open arms and has also led to new and even more intensive contacts between researchers, entrepreneurs and the government releasing – inevitably- a great deal of new energy.

More information on the Dutch approach can be found at www.top-sectoren.nl/energie which will be extended with an international page within a few months.

IEA Technology Network tours the Netherlands from north to south

Raising awareness of the IEA Energy Technology Network amongst the future generation of scientists, researchers and young energy professionals in the Netherlands

How to bring students, researchers and young energy professionals into contact with the work of the IEA. IEA Netherlands will go in search of this next generation of scientists and young energy professionals at different universities and within related businesses. For three days – from 21st to 23rd November 2012 – the IEA Road Show will tour the Netherlands from north to south.

The Road Show will kick off in Groningen in conjunction with the Energy Delta Convention, where the focus will be on carbon capture storage. The second stop will be in Arnhem at DNV Kema and will focus on demand-side management, and the final destination is Zuyd University of Applied Sciences, (Zuyd Hogeschool), Heerlen in cooperation with the Technical University of Eindhoven, where the subject is energy efficiency in the built environment. The idea is to promote the wealth of information within the IEA on energy technologies, in particular in the technology areas mentioned, to highlight relevant news from the Energy Technology Perspectives and World Energy Outlook, and to provide networking opportunities to students, researchers and young energy professionals in energy-related companies. A speaker from the IEA in Paris, who is one of the co-authors of the "IEA Energy Technology Perspectives" will also participate.

The idea for the Road Show came about from a conference hosted in the Netherlands in 2010 on promoting opportunities of the IEA to government authorities and the research and business communities. The turnout was good, but there was one thing missing – the younger generation. Since the IEA also has a lot to offer to students and young researchers, the idea came about to organise an IEA Road Show specifically for this target group, highlighting the importance of the IEA. University students and young researchers were the target audience for last year's Technology Network Road Show organised by NL Agency of the Netherlands. Representatives from a number of IEA technology programmes presented to students at three different university campuses – the University of Twente, the University of Amsterdam and the Technical university of Delft, with three different themes – energy storage, smart grids and the bio-based economy. Participants were most enthusiastic. Some feedback included: Rob Kleinlugtenbelt, Consultant at IF Technology: "It is nice to see that so many students are interested in sustainable energy. It is a good initiative to bring this to the attention of the people who will shortly be joining the business community." Liselotte Smorenburg, researcher at the Amsterdam Centre for Environmental Law and Sustainability said: "I concentrate on European law, and what I heard today was very interesting. The IEA is a much broader concern than I thought. I always had the idea that it just involved 'oil barons'. It is good

to know that there is so much data available at the IEA. I will certainly be bookmarking the website in my list of 'favourites'." Wiebren de Jong, university associate professor at TU Delft added, "It was a good meeting with nice presentations. I also enjoyed showing exactly what we are doing."

IEA ENERGY TECHNOLOGY NETWORK ROAD SHOW PROGRAMME 2012

This year at each location the IEA will be presented with a special attention to the new IEA publications "Energy Technology Perspectives 2012" and the "World Energy Outlook 2012". This will be followed by an overview of the different IEA Implementing Agreements (IA) in which the Netherlands

participates and how we communicate information from these Implementing Agreements within the Netherlands. Then we will zoom in on the IEA IA in question. The idea is then to have an interactive discussion on a specific research project/ proposal/ subject related to the chosen technology – for example in Groningen there will be a debate on the social acceptance and legislation regarding CCS. In Arnhem the focus will be on the new Task 23 of the IEA Demand-side Implementing Agreement - "Consumers and smart meters" – from a "push" to a "pull" instrument. In Heerlen the focus will be on the IEA Implementing Agreement Energy Conservation in Buildings and Community systems (ECBCS). Discussions will take place on, for example, the development of innovative building materials and systems and integrated approaches to energy efficiency.

This event coincides well with the current role of innovation in the Netherlands in solving societal issues and boosting the competitive strength of the Dutch economy.

Enterprises, knowledge institutes and the government have recently signed innovation contracts that will generate approximately 2.8 billion Euros in 2012 alone for research and development of innovative products and services in the top sectors of the economy.

"The IEA Road Show is designed to open the doors to a wealth of knowledge on international research and development of the IEA in energy-related technologies. To show to the research community and young energy professionals what is happening in the international arena in the chosen subject areas like carbon capture storage, demand-side management and energy efficiency in the built environment. And to broaden the knowledge and expertise of the Dutch future generation of scientists, researchers and young energy professionals", said Rebecca van Leeuwen, IEA Netherlands, NL Agency, the Netherlands.

Go for more information about this year's IEA Technology Network Road Show, the Netherlands to **ieanederland.nl** and click on IEA Road Show 2012

How progressive can cultural heritage management be?

Birgit Dulski (Nyenrode Business Universiteit), Cees van der Vliet (Municipality Utrecht), Wim van Unen (Municipality Delft)

The Netherlands, like other EU countries, aim to reduce the CO_2 emissions for 2020 by 30% compared to 1990. Many Dutch municipalities have even higher aspirations. As the construction sector in the Netherlands is responsible for 33-40% of CO_2 emissions, an essential contribution is expected from this sector. However, the proportion of new construction projects is low and – due to the current economic crisis – is greatly reduced. It is expected that at least 90% of the buildings in 2020 are already built now. Thus the existing buildings will have to play an important role to reach the climate ambitions. Avoiding vacancies will be a great challenge for the coming years. Energy saving interventions are needed to keep energy bills affordable and the comfort acceptable. This also applies to our historic buildings, which are our most vulnerable buildings. Only 1,7% of the existing buildings in the Netherlands are listed monuments and 350 valuable historical urban ensembles are, protected town and village faces (preservation areas). At first glance, the proportion of listed buildings may seem small, but about 20% of Dutch homes were built before 1940, about 5% before 1900. Thus, the historic buildings offer a great potential for energy savings. However, the possibilities for intervention are limited and require customized solutions, as otherwise we will lose heritage values. Although the majority of the historic buildings is not officially listed as a monument, they do possess cultural and historical values which means that the possibilities for energy saving interventions are limited. As many Dutch cities have a historic centre the question becomes increasingly urgent: How can we combine the preservation of historic values and the identity of these special areas with our climate goals?

Photo: Peter Dulski

The responsibility for cultural heritage management in the Netherlands recently shifted more and more to the municipalities. They develop their own local policy, and the local Commisions for Aesthetics and Monuments' advice instead of decide whether a license is given for planned interventions in new and historic buildings. This leads to significant differences between the municipalities: Interventions which are accepted in one municipality are rejected in another and vice versa. Two municipalities who deliberately look for opportunities for a progressive heritage policy are the municipalities of Delft and Utrecht. Both cities have a historic centre, cherished by the inhabitants and visited by many tourists. During the past centuries many interventions were realized in the historic buildings. Thus, both historic centres and the buildings themselves, already have different layers. Current interventions add a new layer. But what should be accepted for this layer? Are there also possibilities for win-win-situations, meaning that energy consumption/CO_2 emmissions


Photo: Huis de Witte Roos, Delft

can be reduced while keeping, or even improving, historic values? The search for answers to these questions is illustrated by two examples: the solar energy policy in Delft and the attempt to realize collective thermal storage and heat pumps in Utrecht.

DELFT: CREATING HISTORY

Unlike in many other Dutch municipalities the owners of historic buildings in Delft may install photovoltaic cells on the roofs without a license of the municipality based on the advice of the local 'Commission for Aesthetics and Monuments'. One condition is that the panels are not visible from the streets or public spaces. It is thus accepted that the panels can be seen for example from the towers of the churches or from backyards. Another condition is that the intervention is reversible. It has to be possible to remove the panels in the future and the historic tiles must still be present. As the panels have to be fixed on the roofs a limited damage to the old materials is inevitable, 100% reversibility is thus not realistic. Nevertheless, in Delft these interventions are considered acceptable. This has to do partly to do with the acceptance that in the past many interventions were realized. The solar panels and photovoltaic cells add a new layer to the different existing layers in these buildings. But there is also another consideration that influenced the local heritage specialists: They expect that the technical development in the coming years will go fast. Possibly, the solar panels and photovoltaic cells will in the future be replaced by other solutions. As one of the heritage specialists said:' In the years ,60-,70 many television antennas were placed on historic roofs. They are all gone now due to modern technologies'. The antennas were just a temporary solution and the historic roofscapes benefit from the recent technological developments. If solar panels and photovoltaic cells are expected to be a temporary intervention, and if the intervention is carried out reversibly, then it is easier to accept them on historic roofs.

The importance of reversibility is controversial among Dutch conservationists. They fear that lower quality solutions are accepted just because they are reversible. Once the interventions are realized, they often remain in situ for a long period. Conservationists


Photo: Municipality of Utrecht, A. Boudestein

therefore consider the quality of the interventions at least as important as the reversibility. That means that solar panels have to be carefully designed and adapted to the specific situation. In Delft, like in other Dutch cities, experts also search for solutions with solar panels as design objects, separated from the buildings.

UTRECHT: TRUST THE FUTURE – CREATE YOUR CITY!

We pick up again the example of the church tower: Standing on the Cathedral Tower (former Episcopal Church) it is seen that on numerous historic roofs airconditioning is installed. Also from the street air conditioning is visible on some facades. Conservationists consider these interventions as undesirable, but also from an energy point of view this is not a good solution, as air conditioning is very energy intensive. Also the use of air conditioning produces noise which is unpleasant for the people who live or work in the surrounding. In Utrecht conservationists and climate experts seek together for better alternatives. Their thoughts go for a collective thermal storage system in the groundwater combined with heat pumps. In the Netherlands the great majority of buildings are heated with gas. Although Utrecht is one of the Dutch cities that has district heating, the municipality looks for more sustainable opportunities. Heat pumps are promoted by the municipality, partly because it is expected that the consumption of gas will decrease in the comming decennias and heat pumps are seen as a sustainable alternative for heating and cooling. Shops and office buildings can deliver dissipate heat to the system in exchange for cold extract. Houses can use the system for heating.

The city of Utrecht was of great significance for the religious history of the Netherlands. We still find many churches in the city. They are a special challenge, given the limited budgets, large volumes and irregular use. Innovative sustainable solutions are needed to keep the operation costs affordable. But in the historic centre of Utrecht there are also many other entities present, like shops, cultural facilities, restaurants, offices, housing etc. This mixed use, results in a spread of heat and cooling demands, offers the potential for a collective thermal storage system combined with heat pumps. Technically, it all seems to be possible, the main question now is: How can the

various owners of the buildings in the historic centre be stimulated to participate in such a collective system? Because not only are there many functions in the historic centre, but there are also many owners!

In 2010 the Business Universiteit Nyenrode initiated the network ‚Sustainable Cultural Heritage' for Dutch governmental organizations. Besides the municipalities of Utrecht and Delft several other major municipalities, one regional government and the State Agency for Cultural Heritage participate in the network. The purpose of the network is to share and develop knowledge and experiences. The above mentioned examples of Utrecht and Delft illustrate the common search for a combination of preservation and innovation. In addition both municipalities participate in international networks. Delft also is partner in the EU-project Urbact-LINKS (www.urbact.eu)

Call for knowlegde exchange: The authors of this article want to come into contact with professionals in other countries that have experience with energysaving measures or renewable energy in historic cities. Do you want to share your experience? Please contact: b.dulski@nyenrode.nl

EIT: Excellence for energy in Dutch and European regions

Lambert van Nistelrooij, MEP, Rapporteur for Regional Policy 2014-2020

In the European Parliament I am part of the negotiation team for the Horizon 2020 Research Program and the Strategic Innovation Agenda of the European Institute for Innovation and Technology (EIT) on behalf of the European People's Party. The EIT facilitates and encourages cooperation in education, research and innovation between universities, research institutes and industry.

The objective of the EIT is to encourage innovation in Europe. Essentially this means that industry and researchers have to cooperate. Not just in the labs, but also with students, multinationals and start-ups. In this way, the knowledge base can be strengthened and innovative breakthroughs on the market can be achieved. It is the first institute that focuses on the entire innovation chain; from education, to research to the application by industry.

The Horizon 2020 proposal raises the annual budget of the European EIT substantially: from 309 million euros to 2.8 billion euros for the period 2014-2020. By default, the Netherlands will continue to benefit from this budget given that it is already a strong EIT participant.

The EIT has a lot of attention for energy issues. Knowledge and Innovation Community (KIC) InnoEnergy is a world class alliance of top European players with a proven track record. KIC InnoEnergy's challenge is to create a sustainable, save and low carbon energy supply for Europe. By closing the innovation gap and boosting innovation in Europe KIC InnoEnergy comprises 28 top European players in industry, research institutes, universities and business schools.

The Netherlands already participates quite actively in the EIT. Brainport Eindhoven is a participant in both the KIC for InnoEnergy and ICT. Wageningen UR, TU Delft and Utrecht University have joined the Climate KIC and organized a joint scholarship program to attract the best brains on climate change mitigation and prevention. Within the KIC for InnoEnergy, Eindhoven focuses on Intelligent Energy-efficient Buildings and Cities.

In the light of the new legislative proposals, in June 2012 I launched a new idea that receives broad support in the European Parliament. Besides the KICs I have advocated for Regional Innovation Communities and Implementation. The RICS will contribute to the development of local knowledge hubs that are not yet fully able to compete with the best in Europe, such as Brainport Eindhoven already can. Ultimately, it is intended that the RICS will form part, or become part of the best knowledge hubs in the EU.

The Eindhoven region is already taking steps towards this aim. By creating the Smart Energy Regions Brabant for example. It is the first regional project to develop and implement new sustainable energy technology in a region. This University Eindhoven initiative, which is supported by the Province of Noord-Brabant, allows businesses in this region to be co-financed in 65 new R&D-projects in the region Zuidoost-Brabant.

We must be smarter and more efficient. We should therefore act on a European scale and use our resources more efficiently and smarter. Not only because we will have to meet the criteria of the new European fiscal compact, but because the Netherlands and Europe are engaged in a global battle for talent which we cannot afford to lose. Knowledge is a resource, one which Europe, has quite a lot of. But knowledge is not fixed but free floating, so let us unite on a European scale in order to lead the world in high-quality, innovative products that create jobs and welfare for all levels of society. We have so much brainpower, so let's get the best out of it.

Hydropower is at the heart of flexible power generation

Philip Lowe, Director General for Energy, European Commission

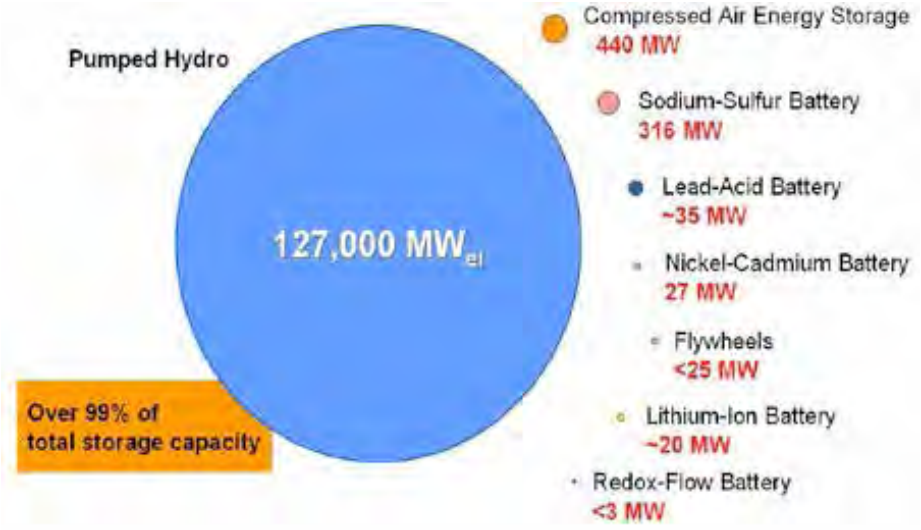
Our goals to decarbonise the EU energy system by 2050 and enhance the security of supply are ambitious. We have to do this in a cost-effective way to boost the competitiveness of our economy. This requires a solemn effort in all areas of the energy system. Increasing the renewable energy share to at least 20% by 2020 in the EU overall energy consumption is one effective way of making our energy supply more environmentally friendly. It will also help diversify our energy sources and reduce our dependence on fossil fuels. Furthermore, at a time of economic uncertainty, the renewable energy technology industry can offer more opportunities for development and create new jobs.

As renewable technologies have matured, production of renewable energy has risen steadily, and costs have come down. Today, under favourable conditions wind, hydro, biomass and solar-thermal sources of energy are in principle economically viable. But often the variable nature of renewables, such as wind and solar, makes it difficult to integrate them on a very large scale in our energy system and reap all the possible benefits they can offer.

Hydropower, which accounts for 16% of the European electricity generation portfolio, has today a competitive advantage compared to other renewables. This is mainly related to its capability to efficiently even out fluctuations between demand and supply. Pumping water to a high storage reservoir during off-peak consumption times and using it for hydroelectric generation during peak demand hours can provide a rapid response to cover transient peaks in demand.

As pumped water systems can come on-line very quickly, practically within seconds, they can also be used to smooth out errors in wind forecasts where storage has to step in to fill the time gap between the fall

Pumped hydro storage in Limberg, Austria
Photo: European Hydro Equipment Association



Installed power of energy storage (Worldwide)

down of wind and the ramping up of gas and coal fired power plants. Pumped hydro storage has an excellent capacity to deliver electricity very quickly. A rapid rise in wind-based electricity may be evened out by rapid take-up of pumping for stabilising the grid for a short period. Therefore, hydropower has almost like a two-in-one effect: as a renewable energy source in itself it serves our climate and security of supply goals and as storable energy it contributes to the stability of the grid.

The new and changing energy market needs more power and more flexibility. Energy experts claim that the unavailability of sufficient energy storage is one of the major challenges of the energy system today. When the variable energy share is lower than 15% to 20% of the global energy consumption, the grid operators are able to compensate the variability in the energy production. This is not always the case when the share exceeds this amount. More energy storage would help to tackle this challenge. More energy storage will accelerate the large-scale market introduction of renewables, ensure security and efficiency of energy supply, supply more flexibility and balancing and accelerate the decarbonisation of the electricity grid. It will reduce unplanned power flows, grid congestion, voltage and frequency variations. It is also expected to contribute to stabilising the electricity market prices. However, in economic terms, energy storage does not make much business sense today as it is rewarded only for the kWh it provides and not for many positive services it provides to the grid; In addition, cross-border trading is very difficult because of major differences in national regulations for storage.

40% of the world's existing electricity storage is in Europe and in its neighbouring countries.

Today and for the next 10 to 15 years, over 99% of utility scale storage will be provided by pumped hydro storage. Hydropower is and will remain an essential piece in the energy puzzle.

At the same time, research and development of new storage technologies, such as hydrogen, batteries, etc. is also necessary.

I believe that synergies between the internal energy market and the storage technologies should be further explored. A favourable framework and consistent signals should be given to the industry and investors. Europe has a chance to become a world leader if the right market conditions are created and the right long-term signals are given to our industry to massively invest in the development and deployment of these technologies.

A new golden age for dams Hydropower's positive role finally recognized

Michel de Vivo, ICOLD Secretary General

It's a new golden age for dams. During the 90s, some western nations and institutions seemed to have forgotten the major role dams played for their development. Although there were some lawful critics of the dams negative social and environmental impact, the dams positive impact on economy and development was completely put on the side.

In major emerging countries, though, like China, Brazil or India, there was no debate: dams were considered as a crucial tool for development and betterment of the standard of living in the world.

But things have changed: major western institutions, like the World Bank and the Worldwatch Institute, now acknowledge the role of dams for development. The 6th World Water Forum has recognized a crucial concept: the Water-Food-Energy nexus. Problems about Food, Water and Energy are closely interlinked and it is hardly possible to think about them separately. Something the dams specialists always defended in explaining the multipurpose nature of the reservoirs: power production, but also food production through irrigation, flood mitigation, water reserves for cities, industries and navigation on waterways, etc. This is also reflected in the World Declaration on Water Storage for Sustainable Development recently issued by ICOLD* jointly with three other international science institutions: ICID, IHA and IWRA.

Reflecting this new reality, a total of $40-45 billion was invested in large hydropower projects worldwide in 2010. The global use of hydropower increased more than 5 percent between 2009 and 2010. Hydropower use reached a record 3,427 terawatt-hours, or about 16.1 percent of global electricity consumption, by the end of 2010, continuing the rapid rate of increase experienced between 2003 and 2009.

In Vital Signs Online, the Worldwatch Institute's last publication, it is concluded that: "In the future, hydropower is likely to continue to grow because of its competitive price and climate benefits, which make it an attractive option as countries seek to lower their greenhouse gas emissions".

Of course, Europe has already built many dams for hydropower production, but there is still large capacities to be developed, particularly in South eastern Europe, where it is estimated that only 40% of hydropower potential has been developed. We have also explained here (see the Summer 2011 issue) that the pumping storage will fast develop in Europe and this has been confirmed by the April 2012 initiative launched by Germany, Switzerland and Austria to build more pumping-storage plants.

A 2010 report by Deutsche Bank Research also clearly states that there are "major trends to make hydropower a winner in Europe" and gives three reasons: "the trend towards zero-carbon power generation", the "rising electricity prices", "the growth in global energy consumption and the associated increasing relative scarcity of fossil fuel sources". Finally, Eurelectric has taken a strong stand in a September 2011 report (Hydro in Europe: Powering Renewables), calling the policymakers to "promote with all possible means the sustainable development of remaining hydro resources". ●

*ICOLD, International Commission on Large dams **www.icold-cigb.org**

Michel de Vivo

New hydropower technology for very low head differences

Fig. 1: Hydrostatic Pressure Machine, Prototype River Iskar / Bulgaria

Hydropower with very low head differences below 2.5 m has an estimated potential in Europe of 4-5 GW. This renewable resource is currently however mostly unused, due to the lack of an economic and ecologically effective hydropower converter. Within the FP7 funded project Hylow, new concepts were employed to develop hydropower converters for three such applications:

1. Run-of-river, with head differences between 1 and 3m
2. Exploitation of river currents
3. Energy in water supply systems / pipelines

Run-of-river: The Hydrostatic Pressure Machine (HPM, Fig. 1) was developed for river applications with head differences between 1 and 3 m. Two field installations with 5 kW and 10 kW power rating and 1.20 m head difference were built and tested. Mechanical efficiencies ranged from 65% to 92% in model tests, and from 60% to 82% at prototype scale. The ecological characteristics of the machines were found to be very favourable: sediment can pass the HPM easily, and fish passage studies indicated mortalities of less than 1% with injury rates below 5% - values significantly lower than those for comparable turbines. The simplicity of the HPM indicates good cost-effectiveness.

River currents: The floating Free

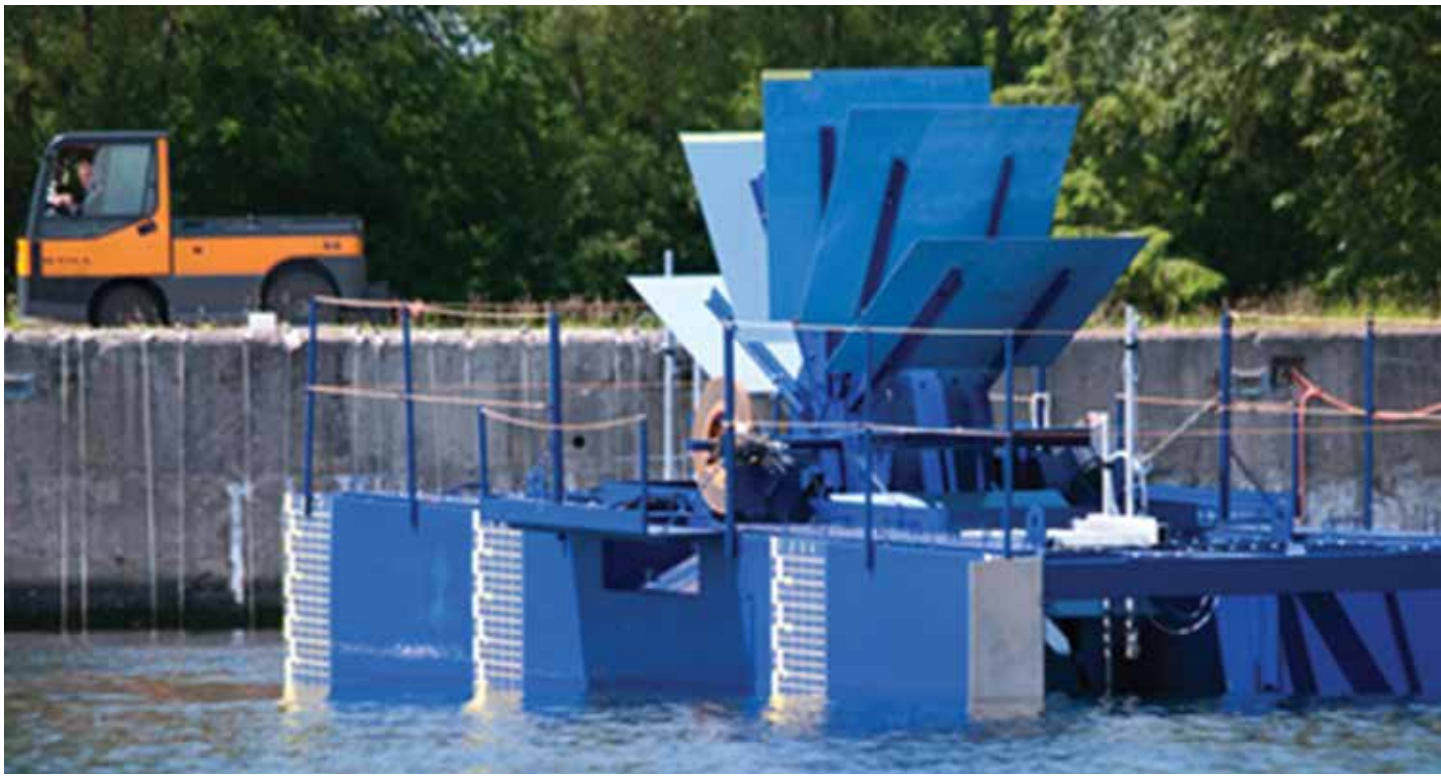
Stream Energy Converter (FSEC, Fig. 2) was developed using model tests, and a 7 m long, 2.4 m wide prototype was then built. With 25 to 32%, efficiencies were good for a kinetic energy converter. The combination of low energy density in river currents and low efficiencies however indicates that this technology is best suited for decentralised energy production e.g. in developing countries.

Water supply systems: Micro-turbines for energy generation from pressure drops in drinking water pipelines were developed. With efficiencies of 40 to 80%, and comparatively low costs, such turbines were found to be economically very attractive (Return-on-investment less than four years)

Outlook: the Hydrostatic Pressure Machine appears to be the most promising technology developed under Hylow, and will allow for the economical and ecologically acceptable exploitation of the mostly unused ultra-low head hydropower. Prototype measurements showed its possibilities and the significant potential for further development. The simple construction and power ratings of 20 to 250 kW means local design and manufacture, and decentralised close-to-user production of electricity – beneficial for the environment and the creation of employment. Further development areas are seen in the field of tidal energy and in the international market, and in particular in the large irrigation systems where e.g. Pakistan alone has an unused low-head potential of 19 GW.

Contact: Dr Gerald Müller
www.hylow.eu

Fig. 2: Free Stream Energy Converter for exploitation of river currents



Small hydropower
Back to the future now?

Oliver Jung
Policy & Project Manager, ESHA, European Small Hydropower Association

In the beginning of life there was water. This is why our planet is so different from any other. Water was also at the start of civilisation. History teaches us how first settlements, villages and cities and whole national economies have grown around streams and rivers. For centuries, mankind has taken advantage of the power of water.

Once used by Greeks to grind wheat into flour, the water wheels of the past have been updated to become the first devices for electricity generation in many European countries in the beginning of the 20th century. This is not surprising since using water to produce electricity offered many advantages at that time.

First, Small Hydropower (SHP) was one of the most efficient, reliable and cost-effective forms of electricity production. Water provided a steady and secure source to produce electricity.

Second, SHP meant local energy production, granting a certain degree of energy independence to territories benefitting from it while at the same time securing energy access in remote areas.

Third, a hydro power plant offered multiple purpose applications (such as water supply, flood control, irrigation, etc.) which were beneficial to local communities and regional development.

Surprisingly, policy-makers around Europe appear to have forgotten that SHP still offers these advantages today! It seems that SHP has grown out of fashion on our continent (but not worldwide). Renewable energy is now assimilated to (less stable) technologies from intermittent sources...

Is it the aim of policy makers around Europe to consider SHP as a "vintage" technology which has only a mere cultural dimension to preserve? Or is there a chance that the solution for many of our societies' challenges arises again from water?

SHP can play a key role in the reduction of greenhouse gas emissions since it demonstrates the best performance when it comes to emissions measured on a life-cycle basis. Still it represents only 8% of electricity production within the renewable energy mix[1].

In addition, through its balancing potential, SHP provides compensation for intermittent energy sources. In other words, SHP indirectly favours the deployment of wind and solar.

SHP has also an important economic value for Europe. Promoting this sector, means favouring the expansion of an industry which currently accounts for at least 2,000 companies and 29,000 direct employees, as well as giving a boost to growth in our regions.

It has been calculated that SHP could annually produce additional 50 TWh in the EU-27 if the current conditions were improved.

This would require more consideration to be given to a sector which was negatively impacted in the last years by overshooting environmental measures (resulting from some national implementations of Natura 2000, Directives on Environmental Assessment, the Water Framework Directive, etc.) often lacking sound scientific basis.

It is time that SHP – which does neither consume nor pollute water when producing electricity – is assessed not only with respect to alleged possible negative impacts on the environment but also with respect to its contribution to the renewable energy mix, as well as to the social and economic benefits it brings and has brought for an long time to society.

It is also time that licensing procedures and issuing permits around Europe rely on simple, fair, solid and transparent procedures so that the SHP sector does not face too many administrative barriers and is confronted with fair and stable market rules.

It is finally time that support mechanisms take into account the multipurpose features of hydropower, the growing costs arising from environmental obligations and that appropriate funding is secured to further deploy green and fish-friendly technologies.

There could be a new beginning for water. But mankind needs to find the energy for that.

Note: In general, small hydropower (SHP) stands for a plant with an installed capacity of up to 10 MW. With 13,000 MW of total installed capacity in EU-27, SHP can supply enough electricity for 13 million households. For more information on the European Small Hydropower Association (ESHA) and small hydro power, please visit www.esha.be

1. Figures found on www.streammap.esha.be/.

Leveraging ICT's potential

Leveraging ICT's potential in the major emitting sectors to reduce energy demand, better integrate renewables and activate consumers

Information and Communication Technologies (ICTs) have enabled many businesses to revolutionise their operations and achieve enormous efficiency gains in the process. These include banks, airlines, publishing, and entertainment to name but a few. The energy sector has so far been largely unaffected by advances in ICTs. However, threats to energy security, coupled with the imperative to increase the share of renewables in the energy mix, imply that ICTs are now being leveraged more and more in this sector.

But it is not only the energy sector (and especially energy distribution), but also the transport as well as the construction sectors, where we see enormous potential for green benefits from leveraging ICTs. The *Digital Agenda for Europe* speaks of these as the 'major emitting sectors', identifying them as priority areas for establishing partnerships with the ICT sector. The green benefits we can reap are first and foremost decreased energy consumption, as well as reduced emissions by increased efficiency of energy use and better integration of distributed, micro- and consumer-generated renewables. This will be achieved through bidirectional communication links and sensor networks alongside the energy distribution chain, on roads and inside buildings, with fast data integration and predictive analysis at the core.

Mr Stančič
Deputy Director-General,
European Commission
Directorate-General for Communications
Networks, Content and Technology

To make this more vivid, think of the construction sector where ICT enables energy management and decision support systems for the individual building and beyond in order to cut energy consumption. Together with storage solutions, this allows a better alignment of renewables' generation patterns with our energy consumption. To fully reap the potential benefits, the individual building, neighbourhood or even district must not operate in isolation. Rather, it ought to contribute to overall grid balancing also, for instance by enabling the individual consumer-turned-prosumer to sell excess energy from microgeneration back to the European grid. Again, ICT plays a crucial enabling role firstly by providing the communication infrastructure and secondly by leveraging existing know-how for meeting new service provision needs that come along with smartening up the grid. Lastly, the transport sector has a major role to play in our drive towards more sustainable energy generation and consumption in the EU: be it as part of the smart grid directly (vehicle-to-grid) or through ICT-enabled real-time traffic information systems leading to less energy-consuming individual transport and more efficient public transportation.

It has hence become increasingly difficult to neatly demarcate sectoral boundaries between ICT, energy, construction and transport. Indeed, these sectors are

intimately intertwined in the context of working towards our green goals and it is precisely at their intersection that we see great innovation potential for strengthening Europe's industrial leadership in sustainable technologies.

It is quite clear that it is in the urban context in Europe that most of such innovations takes place and are most needed. Not only does a city provide an attractive demand side, which is important for piloting novel solutions, it often already has advanced ICT infrastructure in place, as well as established networks of trust between stakeholders from the different sectors and public authorities.

We have translated these observations into the launch of the *European Innovation Partnership on Smart Cities and Communities* this summer as the latest addition to the European Innovation Partnership (EIP) family. Under the leadership of European Commission Vice-Presidents Kroes and Kallas and Commissioner Oettinger, the Commission plan to co-fund lighthouse projects to catalyse the market entry of innovative smart city solutions as well as taking specific horizontal actions and market-oriented measures to speed up their wide-scale commercial deployment.

As a first step, joint calls for projects on smart city solutions are planned in the Work Programme 2013 of the EU's Seventh Framework Programme for Research and Technological Development.

Furthermore, under the *Connecting Europe Facility*, which the Commission has proposed for adoption by the European Parliament and Council, a total of €9.2 bn (to be combined with significant private financing) is foreseen for digital infrastructures and services which as well as broadband deployment could include the development and piloting of smart energy services.

To close with, let me stress three boundary conditions that we see on the part of the ICT sector and its solutions so that they may fully realise their enabling potential towards more sustainable energy generation and consumption.

Firstly, interoperability is a must, especially for smart city solutions. A novel market such as this one must be an open market with low entry barriers and solutions must be adaptable enough to capitalise on new breakthroughs.

Secondly, the host of data already produced (e.g. by smart meters) and still to come must be made available as much as possible to third parties and it must be done in a transparent way and in common formats – while respecting the privacy of consumers, of course. Indeed, this is going to be the resource from which novel applications targeting the end user will be built and these are essential to achieve behavioural change.

Last but not least, the ICT sector itself must further work on reducing its environmental footprint. Currently, ICT services and products are already responsible for around 8 to 10% of our electricity consumption and up to 4% of our emissions – and this is expected to double by 2020! The sector must also continue its work in adopting common standards to measure this footprint, as transparency is a precondition for progress.

"This paper expresses the personal views of the author and in no way constitutes a formal/official position of the European Commission"

The ICT sector's role in making Europe's energy market more sustainable

Maurice Borman, Senior Consultant, Huawei Technologies

Modern life is about balancing priorities. Governments are facing tough economic times yet have entered into firm commitments to reduce environmental impact; businesses are under pressure to reconcile financial priorities with sustainability targets; and homeowners, much more aware now about man's impact on the environment than they were a generation ago, are nevertheless keen to keep energy bills down.

ICT (Information and Communications Technology) makes both cost and energy saving a reality. 'Smart' technologies like smart grids and smart meters allow information on energy to be relayed to consumers and appliances in real time. The ability to easily track and monitor energy consumption through devices like smart phones and tablets empowers consumers to make environmentally and financially responsible choices about their behaviour; and it means demand can be better matched with the supply, hence flattening the peak demand.

Telecommunications networks and IT platforms are key components to deliver smart grid services. Increasingly, therefore, the ICT sector is forging a crucial link between utility companies and consumers. At Huawei, we have partnerships with utility and telecom companies across Europe and we provide end-to-end solutions including network and service delivery platforms. In the UK, for example, we are working with the world's smart meter leader, Landis+Gyr. This strategic partnership aims at the development of smart metering and smart grid solutions targeted for commercial launch from mid-2012 onwards.

It is easy to see where the motivation comes from on smart energy technology usage for end consumers. According to the European Commission, installing a smart meter saves the average household up to □60 each year, and cuts energy use by some 10%.

The ICT sector also has an important role in addressing the data security and privacy concerns that threaten the take up of smart technology. Security issues are new territory for utility companies – we can use our expertise from the communications industry to support energy companies in developing privacy and security policies that instill trust in the grid across the whole value chain.

There are still obstacles to overcome. More needs to be done to educate consumers about what is available to them, for example. Utility and ICT sectors should work together in achieving this common goal of smart energy, and EU policy makers should support their efforts, including by ensuring their investment is justifiable. Harmonised standards availability is also key to the deployment of smart energy; within Huawei, we are contributing towards smart grid standardisation - the first set of European standards will be available by the end of this year.

Smart technology demonstrates just what can be achieved when industries work together to innovate. Within Huawei, we have already worked hard to reduce the ICT industry's power consumption: through collaboration, we hope to make these results commonplace across Europe.

Energy efficient ICT by optics
Designing low carbon footprint optical access networks

by Bart Lannoo and Peter Van Daele from INTEC, Department of Information Technology at the Ghent University. Van Daele is an active member of the European Photonics Industry Consortium EPIC.

ICT (Information and Communication Technology) has an increasing impact on our society and societal behavior. Mobile phones, high-quality video, everywhere access to internet and social networks, sensors to supervise the quality of the food chain, sensors in cars, electronic tags on products,... and many more devices and applications are taken for granted by everyone. All of this ICT equipment, all of these applications and all of the networks connecting all those billion devices consume lots of energy. The worldwide use of this equipment represented a considerable carbon footprint of an estimated 168 GW in 2008, i.e. more than 8% of the global electricity consumption. In the coming decade, the footprint of ICT is expected to grow to more than 14% of the electricity consumption by 2020. This is mainly caused by an exponential demand growth, induced by three factors: growth in absolute user numbers, a growing number of devices per user and growing file sizes and bandwidth requirements per device. As a consequence, energy efficiency in ICT equipment in general and communication networks in particular has received more and more research attention in recent years.

Already in 2007, the department of Information Technology (INTEC) at Ghent University, as part of the Interdisciplinary Institute for Broadband Technology (IBBT, www.ibbt.be) established a research track that concentrates on innovative ways to make ICT, and especially the communications network, more energy-efficient. Several possible ways to reduce the ICT footprint - without jeopardizing the network performance - through novel

Bart Lannoo and Peter Van Daele (right)

network and ICT architectures are investigated. Moreover a data base on power consumption reference values of ICT equipment is developed (http://powerlib.intec.ugent.be).

Since many years the use of optics in communication networks has been established. Long-haul communications (the so-called "back-bone") of the network makes use of optical fibers to cope with the long distances and high bit rates. Gradually, over the past decades, optics has migrated closer and closer to our homes as bandwidth demands went up, but the final connection to our homes, is still predominantly electrical at this moment.

Today, about 80-90% of the communication network power is consumed in this access network. The larger part of this fraction is consumed at the customer premises, with about 10W per user being dissipated mostly by wired network home gateways. The current engineering approaches to minimizing the power consumption, such as ASIC (Application-Specific Integrated Circuit) integration, migration to smaller scale CMOS (Complementary Metal-Oxide Semiconductor) technologies, efficient cooling, dynamic power management and sleep modes, will not be sufficient to keep the power consumption and CO2 emissions at the current level, considering the exponential growth of traffic in the future. The need for dramatic improvement in energy efficiency will mandate disruptive changes in the design and operation of access networks.

Optical access networks - ranging from fibre to the cabinet (FTTC) over fibre to the building (FTTB) to fibre to the home (FTTH) - are currently being rolled out. This optical-fibre based technology is designed to replace current copper-wire based technologies (i.e. xDSL and Coax) by providing significantly higher bit rates at reduced power consumption. According to some studies, optical access network technologies (in particular passive optical networks - PONs) already offer a reduction up to 40% of the power consumption compared to their copper-based counterparts. However, there is still a wide interest in further reducing the consumption in current and next-generation optical access networks. Many solutions are being explored; most interesting are temporary switching-off components (e.g. applying intelligent sleep modes at network elements that do not transmit or receive traffic for long times), virtualization (e.g. adapting virtual home gateways by running functions as routing and security on a central server) and load reduction (e.g. introducing adaptive link rates as the power consumption of telecommunication devices is typically proportional to the peak load they are required to handle).

At INTEC/IBBT the research is focusing on designing energy efficient optical access networks of which the carbon footprint using a power reduction of more than 90% (i.e. a power consumption of less than 0.5W per user) can be reached by introducing optics closer, and even inside our homes and by combining several of these innovative and creative approaches. ●

About the authors:

Bart Lannoo received an MSc degree in electro-technical engineering and a PhD degree from Ghent University (Belgium) in July 2002 and May 2008, respectively. Since August 2002, he has been working at UGent-IBBT/INTEC in the IBCN (Internet Based Communication Networks and Services) research group, where he is currently a postdoctoral researcher. His current research interests are in the field of fixed and wireless access networks, focusing on MAC protocols, Green ICT and techno-economics. He has been involved in various national and European research projects. Since September 2011, Bart Lannoo is coordinating the Green ICT research at IBCN. He is author or co-author of 70 national and international publications, both in journals and in proceedings of conferences.

Peter Van Daele obtained a PhD in Electrical Engineering in 1988 at Ghent University. From 1984 he worked at the former Laboratory of Electromagnetism and Acoustics, now Department of Information Technology (INTEC) of Ghent University in the field of optoelectronic devices. From 1988 he is a permanent member of staff from IMEC at INTEC where he is responsible for optical packaging, optical interconnections and optical sensors, as part of the Center for Microsystems Technology (CMST). Since 2002 Peter Van Daele is also involved in the work at the INTEC department on the multi-disciplinary approach towards Broadband for All and the research work on Optical Networks.

Since April 1st 1993, he is part time professor at the University of Ghent. Peter Van Daele is author or co-author of about 400 publications.

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Dr. Hans Nikol
VP LED Technology Strategy, Philips Lighting, Netherlands

"LED Technology Overview & Trends"
Summary of recent LED technology trends and strategies for future lighting system developments.

Prof. DI Andreas Schulz
Professor HAWK Hildesheim and CEO LichtKunst Licht AG, Germany. Member of the IALD Board of Directors

"Challenges and Opportunities of LED Technology in Lighting Projects"
Demonstrating state-of-the-art technology for LED lighting designs using the example of a museum project.

Prof. DDr. Sergei Ikovenko
Director and Chief Specialist, Innovation Leadership Programs. Massachusetts Institutes of Technology (MIT), USA

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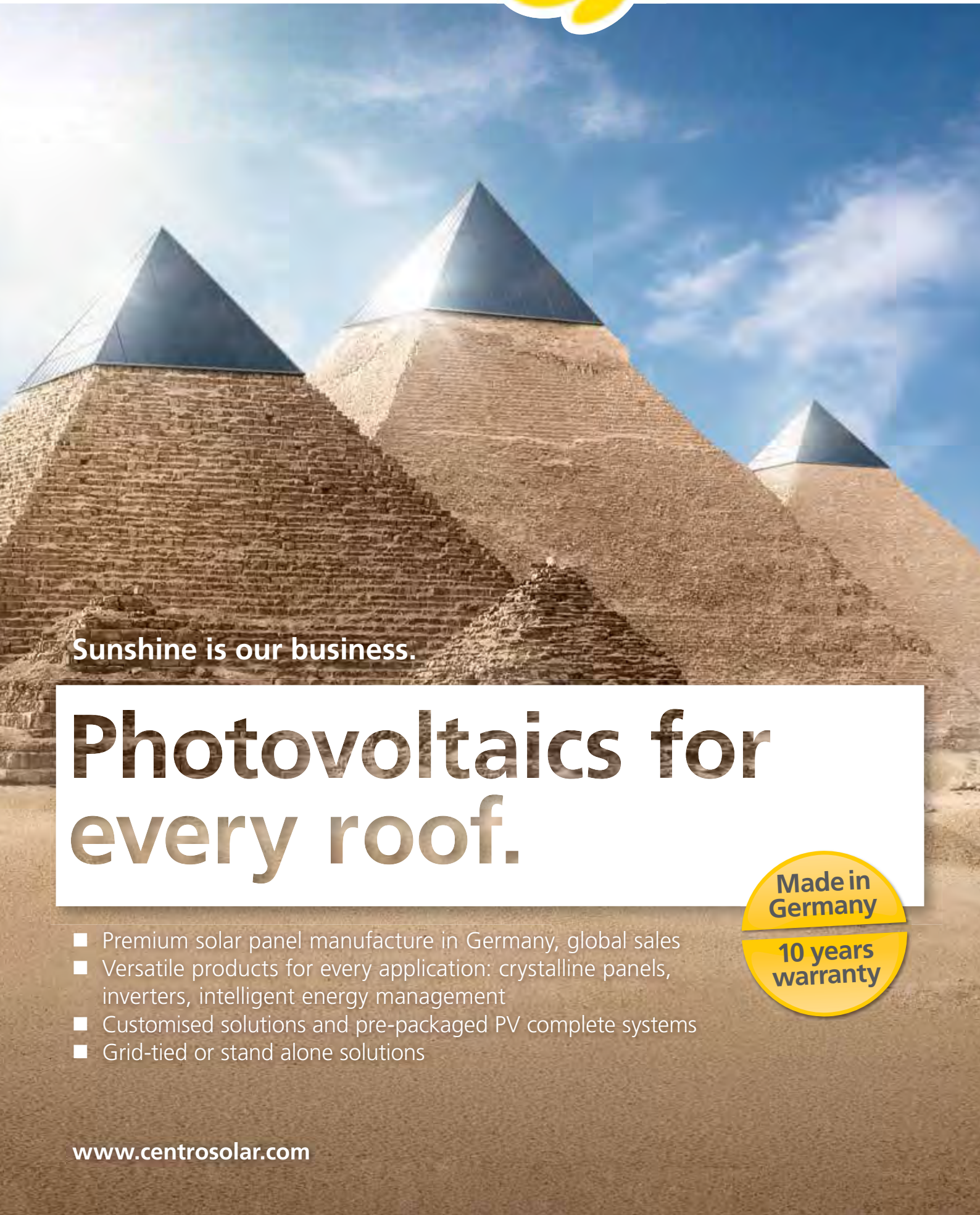

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