SPRING 2012

european energyinnovation

2nd European Conference for Energy

Denmark

Transport

Photonics/ Nanotechnology

Includes editorial contributions from:

Siim Kallas
Vice-President,
European Commissioner
for Transport

Günther Oettinger
European Commissioner
for Energy

Martin Lidegaard
Minister for Climate,
Energy and Buildings,
Denmark

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Foreword

The issue of climate change now commands a great deal of attention in an increasingly pressurised, some would say frenetic, world. Others might add that in order to compete for that attention, some of the debate has been more about the rhetoric than the rationale. EEI has always sought to cut through this clamour to discuss the issues that really matter, and to present the best thinking and balanced opinion.

Now, to join a growing list of distinguished contributors to the magazine, we are delighted to feature articles by Vice President Siim Kallas, who is also Commissioner for Transport; by Günther Oettinger, Commissioner for Energy; by Liam Breslin, who is Head of Unit at DG Research & Innovation and by Kyriakos Maniatis, Principal Administrator at DG Ener. And as if this were not impressive enough, we continue to feature high quality articles from Industry and Academia.

Vice President Kallas discusses the future for sustainable European transport systems, discussing two strategic policy initiatives and outlining the crucial role for research and innovation in keeping European technology at the forefront. One such initiative concerns essential technologies, and the other deals with clean transport systems; and he notes that we have no time to lose as we make plans for plan the long-term future. Meanwhile, Commissioner Oettinger outlines five themes upon which he suggests European energy strategy should be based over the next ten years. These naturally include energy saving, but also examine technology and a single energy market. In a striking echo of Vice President Kallas' comments, the Commissioner for Energy suggests that we cannot afford to wait to deal with the energy challenges we already face. Elsewhere, Liam Breslin outlines the Transport Research Arena 2012, which brings together European stakeholders from all areas of transport to hear about the proposed €7.7 billion transport component of Horizon 2020, the European Commission proposal for a new Research & Innovation Framework Programme. On the same theme, Professor Andrew McNaughton, Chairman of the European Rail Research Advisory Council ERRAC, discusses the contribution of improvements in the rail sector to the single transport area roadmap. His counterpart at the European Road Transport Research Advisory Council ERTRAC is Professor Wolfgang Steiger, who reviews the goal of increasing road transport efficiency by 50% by 2030. Kyriakos Maniatis and Julie Tolmie review The BIOMAP, a biofuels information tool initiated by the European Commission to provide information on the contracts supported by its various Framework Programmes.

We have three articles on the subject of photonics, including an abstract of a speech on the role of green photonics for sustainable production, and one showing how research at the nanoparticle level suggests that LED technology can cut energy waste by approximately 90%. This is very significant because lighting accounts for as much as 20% of domestic energy consumption.

We also introduce a new feature in which we focus on the green technology initiatives and issues within a particular member country. To coincide with Denmark's term of EU presidency, we take a closer look at a country that is aiming to supply 100% of her energy requirements from renewable sources by 2050. That's ambitious, to say the least, and Martin Lidegaard, Minister for Climate, Energy and Buildings, explores the role of Policy as a key factor in green growth. We catch up briefly with the European Inventor of the Year, Jens Dall Bentzen, who won this coveted award for his design of a greatly improved biomass furnace, and we show how the Danish island of Samsø is already carbon neutral. It's clear that the Danes are some way towards meeting their ambition. Now, that would really make the news.

Oh, and there is a great deal more to read inside..

Mike Edmund

European Energy Conference - E2C

17 – 20 April 2012, MECC, Maastricht

The European Forum for Energy Research

Chaired by Prof. Harald Bolt, Forschungszentrum Jülich, Germany

Under the Patronage of Günther H. Oettinger, EU Commissioner for Energy

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Fraunhofer IPA

A clean LED production for a clean environment

The production of electricity is responsible for approx. 40 percent of the world's CO_2 emissions. A substantial proportion of the power produced is used for lighting – around 15 percent. However, with the use of light emitting diodes (LEDs) as a light source, there is now an interesting and promising technical alternative: the small light-emitting elements can be implemented just about anywhere as an effective replacement for conventional lighting systems.

Not only do they consume much less electricity but they also have an extremely long service-life. By using LED technology, the hope is to drastically reduce the amount of power consumed due to electrical lighting by up to 80%.

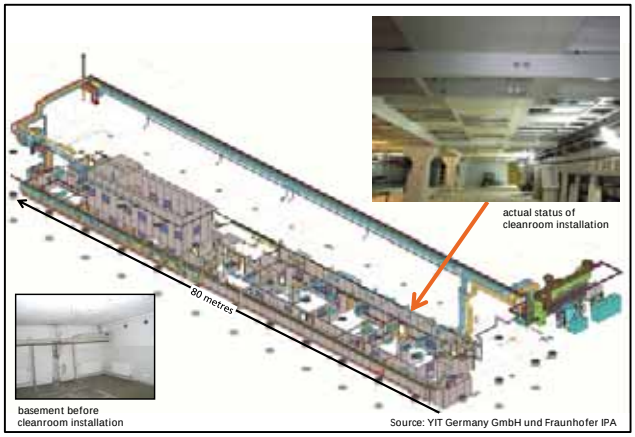
The ecological as well as economical advantages of using LEDs has led to a continuous rise in worldwide demand, which is why the Romanian electronics manufacturer Microelectronica S.A. has decided to construct a factory to produce LEDs in Bucharest. The project has been chosen by the EU as part of its structural policy to support economically weak regions.

Producing LEDs is associated with a number of challenges because a clean, dust-free environment is required.
In the special case of the manufacturer Microelectronica S.A., the situation is even more complex due to the fact that the company is installing its LED production in the basement of a closed-down semiconductor factory where space is limited and humidity a problem.
In spite of this, specialists at the Fraunhofer Institute for Manufacturing Engineering and Automation IPA in Stuttgart are currently planning how to achieve optimum conditions for a LED production. Planning the cleanrooms is only the first of many steps to be taken. Thus the Fraunhofer team is also developing strategies to set up a research line for process optimization. The new information obtained will be used to optimize factory planning. The engineers at the Fraunhofer IPA are also coordinating all the construction work to ensure that a turnkey LED factory will be ready to go into operation by the end of 2012.

Discussions are presently being held about continuing both the project and the technical alliance with the Romanian project partner: the aim is to conceive and erect a research and production area for OLEDs, i.e. organic LEDs. OLEDs are even cheaper to produce than conventional LEDs. As well as being utilized as a display for screens and mobile phones, an excellent future for OLEDs as a light source is also anticipated. Through the use of EU structural funds, a decisive advantage can be created for the EU core country compared to other regions in the world.

Once in operation, the benefit for other European R&D and industry partners is already predicted.

Clean LED production



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The Energy Roadmap 2050

By Günther H. Oettinger, European Commissioner for Energy

Energy is one of the biggest challenges Europe is confronted with today. While being at the helm of the fight against climate change, our economic competitiveness fully depends on a reliable energy supply at an affordable price. And in turn, this depends on adequate infrastructure. Until the end of the 1990s, boosting demand was more important than energy efficiency and energy suppliers primarily served national markets. From now on energy systems need to be designed to run on variable renewable and low-carbon fuels at continental level. Is Europe ready and able to take up the challenge? Will Europe be able to reduce greenhouse gas emissions by at least 80% by 2050 and maintain competitiveness? The European Commission is launching the debate with the publication of the Energy Roadmap 2050.

WHAT DOES THE ENERGY ROADMAP 2050 SAY?

Through an analysis based on scenarios, the Roadmap 2050, indicates possible pathways to achieve the decarbonisation of the EU energy system. The purpose is not of choosing one over another, rather of identifying the common emerging elements that support long-term approaches to investments. The real world will never look like these models, but the conclusions drawn from them give fundamental signals for our future policy.

The main conclusion of the Roadmap is simple:

transformation of the energy system is technically and economically feasible – if we make the right choices.

Five key lessons can guide us in making the policy choices to shift our energy system towards a more sustainable future.

(1) Energy savings are crucial

There is a vast amount of untapped potential to save energy. Significant energy savings would need to be achieved in all decarbonisation scenarios. Primary energy demand drops in a range of 16% to 20% by 2030 and 32% to 41% by 2050, as compared to peaks in 2005-2006. Thus, energy efficiency is crucial for the energy system transformation – at the stages of production, supply and end use. Maintaining our efforts at the current level, we would not achieve enough progress. In a recent proposal for an Energy Efficiency Directive, the Commission has spelled out where we need urgent action. The directive needs to be quickly adopted if we want to deliver on potential savings.

But we must be more ambitious. In the long-run, higher energy efficiency in new and existing buildings is crucial. Nearly zero energy buildings should become the norm. Products and appliances should fulfil the highest energy efficiency standards. In transport, efficient vehicles and incentives for behavioural change are needed. All this requires more action both at EU and Member State level.

(2) The share of renewables rises substantially

The analysis shows that the biggest share of energy supply technologies in 2050 comes from renewables. In 2030, all decarbonisation scenarios suggest growing shares of renewables of around 30% in gross final energy consumption. In 2050, renewables will achieve at least 55%, up 45 percentage points from today's level. This is both a huge change and a challenge. Renewables will play a central role in Europe's energy mix, from technology development to mass production and deployment, from small-scale to large-scale,

from subsidised to competitive. All these shifts require parallel changes in policy. Incentives in the future have to become more efficient, create economies of scale, and lead to more market integration.

(3) Building the necessary infrastructure is key

With electricity trade and renewables' penetration growing up to 2050 under almost any scenario, adequate infrastructure at distribution, interconnection and long-distance transmission levels becomes a matter of urgency. The existence of adequate infrastructure is a condition sine qua non. In the long-run, the extension of the current planning methods to a fully integrated network planning for transmission, distribution, storage and electricity highways looking at a potentially longer timeframe will be needed. And above all, we need to develop more intelligent electricity grids, able to deal with variable generation from many distributed sources, allowing for new ways to manage electricity demand and supply.

(4) The European energy markets needs to be fully integrated

A European market offers the right scale to assure access to resources and to provide the huge investments needed. The single energy market must be fully integrated by 2014. An additional challenge is the need for flexible resources in the power system, as there will be more variable renewables. Access to flexible supplies of all types (e.g. demand management, storage and flexible back-up power plants) has to be ensured. Another challenge is the impact of renewable generation on the wholesale market prices. Whatever the answer, it is important that market arrangements offer cost-effective solutions to these challenges. The cross-border impact on the internal market deserves renewed attention. Now more than ever, coordination is required. Energy policy developments need to take full account of how each national system is affected by decisions in neighbouring countries.

(5) Investing in low-carbon technologies

Carbon pricing can provide an incentive for deployment of efficient, low-carbon technologies across Europe. The ETS is a necessary condition for the energy system transformation, but it is not sufficient. Higher public and private investments in R&D and technological innovation are also crucial in speeding-up the commercialisation and the modernisation of all low-carbon solutions, whatever are the sources. In particular Europe will certainly have to develop further Carbon Capture and Storage (CCS) from around 2030 onwards in the power sector in order to reach the decarbonisation targets.

NEW OPPORTUNITIES FOR EUROPE

Indeed, it is cheaper and easier for Europe to work together. The European market gives us the chance to make economies of scale and speed up new markets for low-carbon technologies. Between now and 2050, there must be a wide-scale replacement of infrastructure and appliances throughout the economy including consumer goods in people's homes. Modernizing the energy system will bring high levels of investment into the European economy. It can bring more jobs more quality of life, and more growth. Decarbonisation can also be an advantage for Europe, placing itself as an early mover in the growing global market for energy-related goods and services. Energy system transformation also helps reducing import dependency and exposure to the volatility of fossil fuel prices.

THE WAY FORWARD

The debate is launched. In the next months all actors in all Member States will continue an open debate, discussing milestones and the policy framework for 2030. These will help providing Member States and investors with the certainty they need. We cannot wait anymore: we need to act now for the future. What we are doing already is helping reduce our carbon footprint. But we need to step up our efforts: more renewables, more clean technology, more investment in networks, more integration, and more energy efficiency. We need decisions and investments. We need political will.

Nanomaterials for sustainable energy – An assessment of mutual EU-India research and training needs

Sustainable energy technologies such as clean coal (including CCS, carbon capture & CO_2 sequestration), solar & photovoltaic (PV), batteries & super capacitors, and fuel cells are decisive in nations' economic & social well being and stability in the world. Materials significantly contributed to solve issues for the safe, reliable and efficient use of energy and natural resources. With the advent of nanomaterials, materials research is thought to play an increasing role to bring about further technology advancements.

While the EU has developed a number of key policies to address pressing issues such as security of energy supply, sustainability, economic growth, industry competitiveness, climate change, and globalization & citizen concerns with a number of policy instruments and research programme notably the framework programme (FP), these challenges & issues are not pertinent to Europe but equally important to other world regions especially India, an emerged economic power.

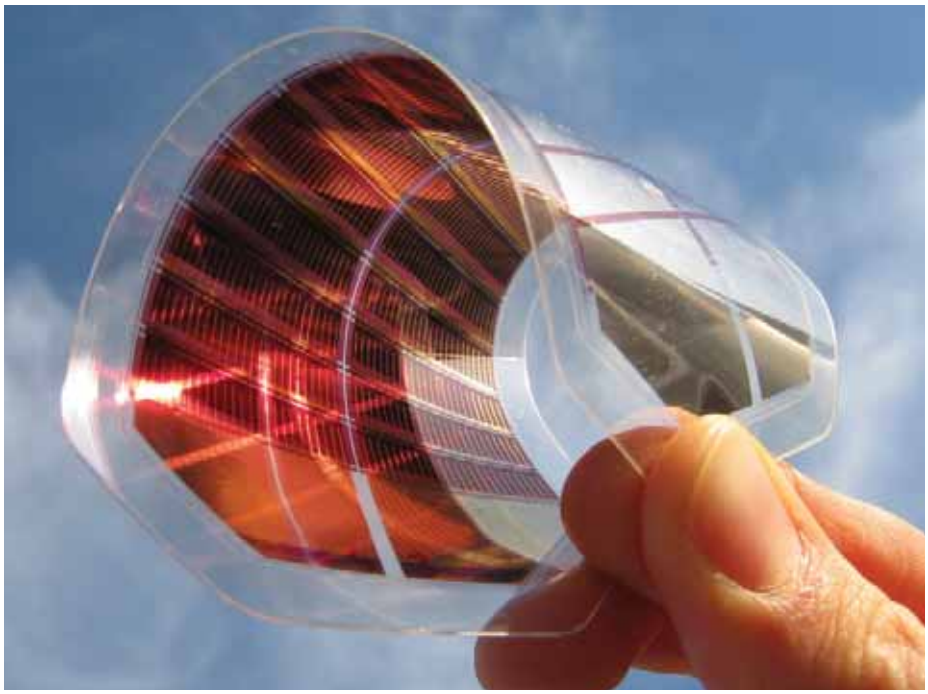
When it comes to research, a stronger and deeper bilateral EU-India coordination particularly in programme theme setting and joint funding is required and a more focused cooperation is of increased importance in a competitive, globalized world anticipated in Horizon2020 and foreseen in the EU-India S&T agreement.

EiCOON (www.eicoon.eu) funded by FP7 (Grant 233 466) is about the strategic assessment of mutual EU-India nanomaterials research needs in sustainable energy technologies and of researchers training needs and to establish an exchange forum through the organization of scientific events to spread the regions' research acquis to stakeholders.

By means of an assessment workshop and a synergy analysis, EiCOON made topic suggestions for possible Joint EU-India Calls for Proposals:

- Nanomaterials in energy conversion & storage

Flexible solar cell



regarding synthesis, manufacture, processing, characterization, processing-structure-properties relations, and modelling;

- Mapping & gap analysis of research competencies and of available research infrastructures including development of access schemes;
- Establishing standardised methods to assess & validate nano scale effects in materials for energy applications through inter-laboratory comparison;
- Socio-economic studies on the use and effectiveness of nanomaterials in energy applications including required spending, and societal benefits & impacts;
- Organization of joint workshops on energy policies and research;
- Development of common training materials and organization of joint training courses piloting their use;
- Establishment of staff exchange programme between the regions' academia & industry.

It will now be for DG RTDI (of the European Commission) and DST (Department of Science and Technology of the Government of India) to assess whether a dedicated Joint Call on these topics is required.

Project partners include MESA+, IET-JRC, SPI, VTT, ENEA, IoN, IIT Delhi, IIT Kharagpur, NCL, SNBNCBS, JNCASR, and CII.

For further information, please contact Dr M Huijben (MESA+, University of Twente; m.huijben@utwente.nl) and Drs T Malkow & G Tsotridis (IET, JRC Petten; Thomas.malkow@jrc.nl)

2nd European Energy Conference (E2C)

The European Forum for Energy Research – 17-20 April 2012, Maastricht Exhibition & Congress Centre, NL

Harald Bolt, Conference Chair, Forschungszentrum Jülich

The second European Energy Conference will take place at a time for strategic decisions. Energy is vital to our society and economy. The future European energy system has to be sustainable in terms of environmental and climate impact and also in terms of security of supply and societal acceptance. It is imperative to bring in line these demands in an objective and competent way, requiring a broad view and intense discussion.

The European scientific community has the potential to provide the necessary interdisciplinary cooperation and communication in energy research, technology development and the support to innovation. The European Science Foundation (ESF), the European Materials Research Society (E-MRS) and the European Physical Society (EPS) are organizing the European Energy Conference on the basis of their common understanding that advances in research and development are urgently needed in order to accelerate the transformation of the European energy system towards sustainability.

The biennial European Energy Conference series, launched in 2010, promotes, consolidates and communicates the vitally necessary synergy of scientific and technical competence with knowledge on environmental and social implications.

The conference will provide participants with a view and a vision on how the future of energy supply in Europe will look like. It will be the forum to define the role of energy science and research in the transformation process towards the future European energy system.

PROGRAMME

The programme combines plenary keynote presentations on diverse energy themes with devoted symposia in specialised fields.

Plenary lectures will be given in the mornings on overarching subjects of energy and associated climate research. The impact of this research on the transition of the European energy system towards sustainability will in the focus of keynote lectures.

Specific symposia in the afternoons will cover the key fields which are essential for the development of our future energy system.

Energy Systems and Sustainability

Symposium Chairs: Hardo Bruhns, University of Heidelberg, Cayetano Lopez, CIEMAT, Spain

Sciences for Energy

Symposium Chairs: Sven Kullander, Royal Swedish Academy of Sciences, Sweden; Bengt Kasemo, Chalmers University of Technology, Sweden

Primary Energy Conversion

Symposium Chairs: R. Van de Sanden, DIFFER, NL, Claude Degueldre, PSI, Switzerland; Claude Ayache, CEA Grenoble, France

Energy Networks and Storage

Symposium Chairs: Teresa Ponce de Leao, LNEG, Portugal; Martin Greiner, Aarhus University, Denmark

Efficient End Use of Energy

Symposium Chair: Brigitte Bach, AIT, Austria;

At the last day of the conference the European dimension of research and development will be discussed with the audience by first rank panelists.

Main topics of this discussion will be: the strategy of the European Commission, the European Strategic Forum for Research Infrastructures (ESFRI), the European Energy Research Alliance (EERA) and the EIT-KIC activities in the field.

I would like to cordially invite you to join this important conference which will provide you with a wealth of new insights, impressions, ideas and important contacts.

Symposium sciences for energy

E2C Conference Maastricht 17-19 April 2012
Co-Chairs Sven Kullander, Bengt Kasemo

In August 2009 the highest ever reported sun-to- electric efficiency of 41% for a 3-junction cell used to receive a 454 times concentrated sunlight was reported. Frank Dimroth who is one of the keynote speakers obtained the 2009 Louis D prize for this accomplishment.

The highest reported efficiency today is 43 % under concentrated sunlight.

The world is facing a challenge of historic proportions in the field of energy. Sustainable alternatives to the fossil fuels have to be developed for large-scale deployment in a relatively short time.

Solutions must take into account that there is an increasing world population, needing supplies of food and water, and that the damage to the natural environment - geosphere, biosphere, climate - must be kept at an acceptable level. The challenges encompass many levels of complexity, from natural science research and engineering to social sciences, systems solution and actions and agreements at the global political level.

During the European Energy Conference to be held in Maastricht from April 17th till 20th 2012 many Europeans will get together to exchange information in the field of energy. One of the five symposia is the symposium Sciences for energy which will focus on materials and processes of potential interest for future energy systems.

The symposium will especially provide a forum for novel and ground-breaking ideas in energy research. Progress in the nano-sciences leading to improved materials for solar cells, batteries, fuel cells and thermoelectric materials are important for energy generation and energy storage. Also materials for energy usage such as organic and inorganic light emitting materials for efficient illumination are of interest. New fuels for replacement of fossil hydrocarbons may be produced in many different ways for example by natural and artificial photosynthesis or by bacteria and algae. In many cases some sort of catalytic mechanism is needed for getting a sufficient yield of fuels.

More than 90 papers in the form of abstracts have been received. Out of these, 15 papers have been invited for oral presentations and 50 papers have been selected for poster presentations. During three afternoons there will be 5 sessions. In each of these there will be one invited keynote speaker and three invited speakers. A session on low carbon energy takes place Tuesday 17th in the afternoon. Of special interest are presentations on the catalytic conversion of CO2 to methanol.

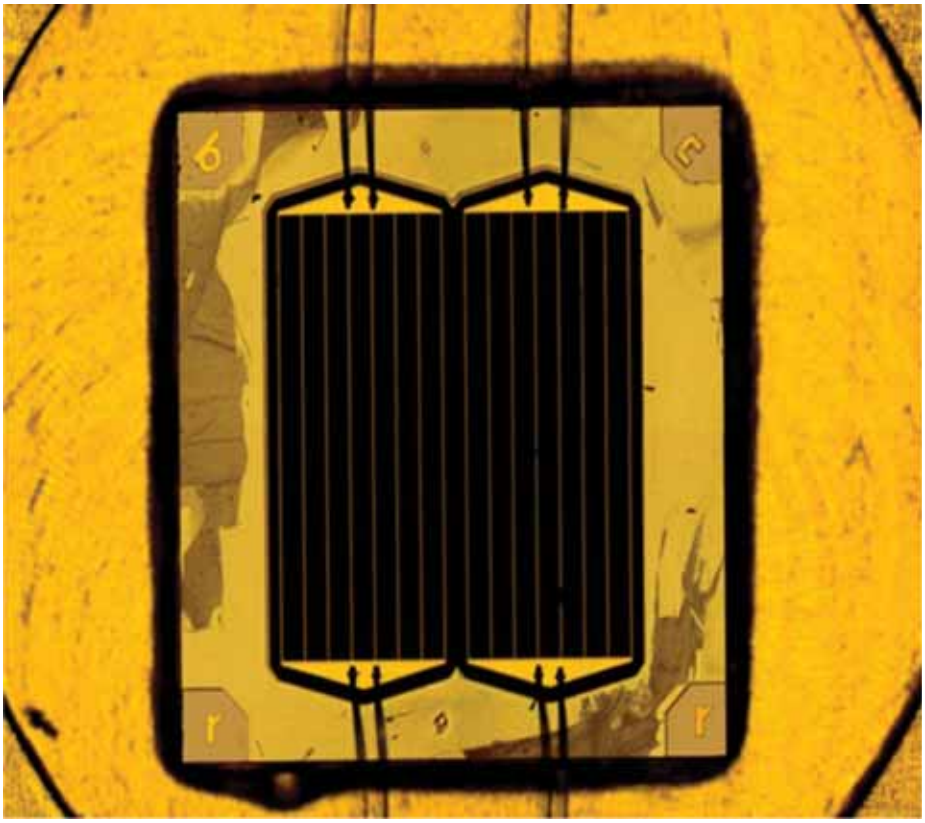
Wednesday the 18th there are two sessions on materials. In one of these sessions, advanced fuel cells and Li-ion cells are presented. The other session includes presentations on high temperature and thermoelectric materials.

In the two solar sessions on Thursday the 19th, there are invited talks on nanowires and nanostructured solar cells. A talk summarizing many contributed papers from Taiwan on metal-based dye sensitized cells is included in the session.

Key-note speakers are Edward Jobson from Volvo, Robert Schögl from Berlin, Frank

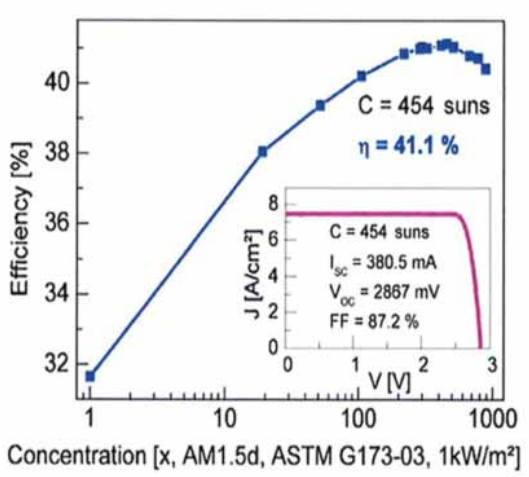
Dimroth from Freiburg and Leif Hammarström from Uppsala.

The poster sessions take place in the afternoons. Altogether 50 high quality papers have been selected, covering the fields low carbon energy, materials and solar energy. One of the papers, A *European Joint Programme to bridge basic science and sustainable energy challenges*, does not communicate a scientific result, but describes an initiative with a similar objective as the symposium Sciences for energy. This Joint programme includes 25 European Research Organisations or Universities, and an international workshop shall be organised in autumn 2012, to further and strengthen this collaboration. Its main objective is to harness and integrate materials science and process innovation for high performance sustainable energy technologies, in order to enhance the long-term competitiveness of European Industry.



The 2009 world record solar cell area of 5.09 mm².

$Ga_{0.35}In_{0.65}P/Ga_{0.83}In_{0.17}As/Ge$ reported in 2009 by Frank Dimroth and his colleagues



Concentrating PhotoVoltaics.
A 3-junction cell gives 41% sun-to-electric efficiency!
(Frank Dimroth et al Freiburg)

We have a clear position on **energy**

Energy is available to most of us, as much as we want, whenever we want it. But there is one problem: most of the energy production is based on fossil fuels and we are spending the stores of our planet at a rate which is far from sustainable. What has been taken for granted is likely to become inadequate and unreliable and very expensive, unless we act accordingly.

District energy has for many years been one of the most obvious answers to the question of "what can we do about it?" The various concepts of co-generation of heat and electrical power have seen a fast growing interest over the last 20 to 30 years, because it is the most direct route to a dramatic increase in energy efficiency. It is no coincidence that Lord Mayor of Copenhagen Frank Jensen points to the district heating system in Copenhagen as a good example of a successful green solution, being the reason why Copenhagen for the past 10 years has reduced CO2 emissions by 20% (Hot Cool 4/2011).

With district energy all the conditions for an efficient and reliable heat supply could be fulfilled but it takes a dedicated and professional approach to make sure that we have the right security of supply. Therefore it is crucial that activities in innovation and research are ongoing. The members of DBDH are perfectly good examples of being active in these fields.

The superior strength of district energy is the ability to do something about the unsustainable global waste of perfectly good energy. District energy is the best way of converting a low-value energy product, which in some countries is still regarded as mere waste, to serving a high-value purpose of comfort. District energy consciously handles energy with care, thereby creating sustainable societies. We therefore fully believe in the new energy slogan mirroring a hierarchy: Reduce, Recycle, Replace – in that order.

DBDH is a private organisation representing the leading actors within the Danish district energy sector encompassing heat and combined heat and power production companies and waste incineration companies; heat transmission and distribution companies; private consulting companies, R&D institutions and training institutes; manufacturing companies of plants, systems, components and products for the sector; and contractors.

DBDH

For further information about DBDH or the Danish district heating sector, please visit our website **www.dbdh.dk** or contact DBDH directly by phone at **+45 3818 5440** or e-mail at **dbdh@dbdh.dk**.

Energy policy as the key to green growth

By Martin Lidegaard, Minister for Climate, Energy and Buildings, Denmark

Denmark will create green growth through ambitious policy goals and investments in energy research, technology development and demonstration. Energy efficiency, electrification and renewable energy are key words.

By 2020 half of the Danish electricity consumption will come from wind energy, and by 2050 all Danish energy supply will be renewable. These are the Danish energy goals which - according to the International Energy Agency (IEA) - are ambitious but possible to meet, as Denmark is "already a world leader in implementing well-designed policies for renewable energy, energy efficiency and climate change".

However, the latest country review from IEA also points to some challenges that need to be solved if we are to meet our ambitious goals. Integrating a large volume of variable electricity supply in our grid is one of them. Another is keeping our technology research and development at a sufficiently high level to deliver a low-carbon future.

I am proud of the high marks from IEA, and I am happy to say, that the new Danish Government is already taking serious steps in order to meet these huge challenges.

The new Danish energy plan 'Our Future Energy' presents a package of initiatives which will boost the transition

towards a fossil free economy with investments in energy efficiency, electrification and renewable energy and in research, development and demonstration.

The energy plan also boosts green growth. In 2010, Denmark exported energy technology and equipment worth DKK 52.2 bn. Boosting incentives for investment in energy efficiency and renewable energy, "Our future Energy" is expected to create 6400 extra green jobs just in 2012-13.

Wind energy supplies already 28.9% of Denmark's electricity consumption. Integrating even larger volumes of variable electricity supply will require an intelligent system, with flexible consumption, an intelligent regulation and an efficient international market. A number of initiatives such as intelligent electricity meters, dynamic tariffs and new transmission lines will take Denmark towards such a stronger and more flexible system.

A number of additional technological challenges are to be overcome. These include energy storage, green transportation and improved renewable technologies.

Therefore, the government is presenting an array of initiatives to enhance Danish energy-technology research, development and demonstration. Since 2006 the public funding for this purpose in Denmark have more than doubled and grants of more than DKK 1 billion (135 million Euro) have been established in the 2012 Finance Act.

A substantial part of the funding is devoted to the Energy Technology Development and Demonstration Programme, EUDP. EUDP provides funding for industrial led innovative projects which contribute to the overall political goals while developing Danish commercial potential for green growth. In a typical EUDP project, enterprises planning to commercialise project results will cooperate with a knowledge institution, for instance a university. In average, the project is financed 50/50 by EUDP and project partners.

A sister programme, "Green Labs DK", provides funding for facilities for large scale testing and demonstration. Four Green Labs - open to enterprises in EU and abroad - are now under establishment. One of them, "Power Lab DK", a test center for Smart Grid technologies, opens on 15 March 2012.

The Danish energy policies needs a good European framework. As President of the Council of the European Union, Denmark feels responsible for the development of well-designed EU energy policies, which are robust to rising oil prices. In this context, the Energy Efficiency Directive and energy-related RD&D in the EU budget are particularly important.

With the next framework programme, Horizon 2020, and the Strategic Energy Technology plan (SET-plan), new financial instruments and focus on cross-border and cross-thematic cooperation, the stage is set for EU to be at the forefront of energy technology development.

Denmark is prepared to contribute actively for these actions to be a success, as we are willing to be a first mover, test new solutions and share our experiences.

Energy policy is the key to combat one of the largest challenges facing the world: how to create wealth and jobs and combat climate change at the same time. This holds for Denmark and for the EU.

A research alliance:
Enabling and governing transitions to a low carbon society

Developing knowledge and strategies for enabling and governing transitions to a low carbon society

Michael Søgaard Jørgensen, Ulrik Jørgensen, Erik Hagelskjær Lauridsen
Department of Management Engineering, Technical University of Denmark, Building 424, 2800, Kgs Lyngby, Denmark

Introduction

Most of the research on low carbon society in Denmark has hitherto focused on developing scenarios and analyzing possible policy instruments, including market mechanisms, costs and impacts in relation to known options and impacts. The Danish Council of Strategic Research funds the four year research alliance "Enabling and governing transitions to a low carbon society" during 2010-2013. The aim of this alliance is to conceptualize the dynamics of transition processes towards a low carbon society by involving the diverse set of actors from consumers to governmental agencies, companies and organizations.

Transition as a challenge

Transition of the path-dependent, socio-technical regimes in the energy system is a governance challenge, since transitions need to occur simultaneously in different arenas without necessarily having a specific 'centre' of co-ordination. Changes of regimes require innovative breakthroughs in technology, changes of institutional frames and changes in social practices, but also increased utilisation of well known solutions is important.

Empirical focus

The research alliance focuses in a number of inter-linked projects on five overall transition arenas in society: ***standards and certifications, households, companies, cities, and national and international policy***.

Methodology

The research alliance builds upon a combination of theories including:

- Social practice theory: fluidity and inertia of the daily flow of activities in households etc.
- Innovation economy: path dependency and path creation in socio-technical changes.
- Institutional theory: guidance by rules, norms etc. of issues as they emerge and persist.
- Actor-network theory: shaping of systems as interactions among human and non-human elements.
- Governance theory: how authority is developed and stabilised in societies.

Through a combination of historical analysis, case studies and action research, the research alliance analyses the roles of socio-technical experiments, creation and utilisation of 'windows of opportunity' and stabilisation of changes in societal niches into regime transformation.

Standards and certifications

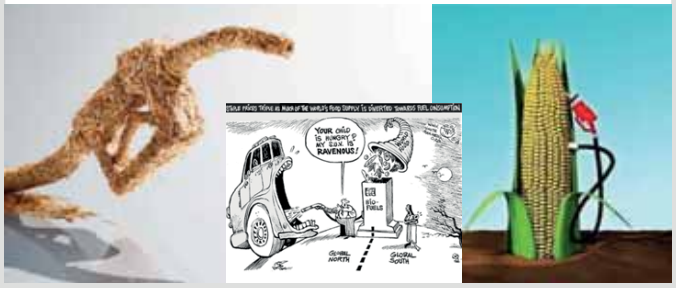
Analyses of interactions between market-based instruments, regulatory policy and voluntary certification, like certification of biomass and calculation of carbon footprint of products

Households

Analyses of the challenges to everyday household practises, especially during the design and implementation of smart grids for coordinating electricity production and consumption

National and international policy

Analyses of the challenges to governance of bio-energy from international trade, liberalisation of the energy sector and national and international environmental regulation



Companies

Analyses of innovation dynamics in energy systems of production, use and savings, for example in relation to energy system concepts, wind turbines and LED-lightening

Cities

Analyses of the role of municipalities as intermediaries in reconstruction of relations between cityscape and mobility

Expected results

- Methods which enable stakeholders to make continuous adjustments of objectives and means in conflict ridden transition processes.
- Analyses of how key measures and institutions at different societal levels might contribute to transition processes.
- Characterisation of 4-6 typical sustainable transition set-ups as complex contexts, which are identifiable to actors in similar situations.

Participants in the research alliance:

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Environmental problems do not stop at borders

By Mike Edmund

Offshore wind turbines at Samsø

Almost exactly five years ago, on Wednesday, March 21, 2007, The New York Times published an article by James Kanter, in which he wrote: "Viewed from the United States or Asia, Denmark is an environmental role model." Kanter also quoted Frances Beinecke, who is currently the president of the influential Natural Resources Defense Council (NRDC), and who described Denmark as "what a global warming solution looks like."

It was about that time that the Danish Ministry for Energy announced a competition to find a community that could present the most technically and organisationally sound plan for achieving 100 % self-sufficiency in renewable energy (RE). One obvious priority was reducing energy consumption; another the degree of local participation, but each community that entered also had to show how, if it should win, it would address its newfound status as a 'shop window' for Danish RE technology.

The winner of that competition was the island of Samsø. Now

And neither do environmental solutions

the face of Denmark's green energy revolution, Samsø has acquired a worldwide reputation and offers further justification for Kanter's accolade.

100% WIND-POWERED, 70% RE-HEATED.

In 1997, the island set itself a principal objective of self-sufficiency in RE electricity (which would require the production of approximately 11MW) within ten years. It did not even take them three. Eleven onshore wind turbines provided the necessary capacity, but importantly, a local ownership scheme helped both the finance and the engagement of the community. The island's larger towns rely on district heating programmes, while many individual households have installed a mix of solar heating and wood chip burners, so that around 70% of domestic heating now comes from renewable energy. But the green revolution on Samsø is still not finished: transport still relies upon internal combustion engines, and initial plans to switch entirely to electric vehicles have proved too optimistic. Alternatives such as biodiesel from rapeseed are under consideration, but Samsø has also set about building a further ten offshore wind turbines with a total capacity of over 20MW, and the island now produces surplus electricity which it exports to the mainland. The carbon impact of domestic heating and transport emissions can be offset against that of the surplus renewable energy, so the island has effectively been carbon neutral for many years. Samsø provides a clear example of how the right mix of government and local investment, and local awareness and action can create a low-carbon economy at the local level.

And Denmark is now planning to use its EU Presidency to promote green energy initiatives at the European level. One aspect that may be reviewed is the energy road map for 2050, where Denmark has indicated it will seek more ambitious carbon dioxide emissions targets. Meanwhile, the Danish Commission on Climate Change Policy reported last year that Denmark could be independent of fossil fuels by 2050 with a concomitant reduction in greenhouse gas emissions of the order of 80 percent compared to 1990 levels. In a clear reflection of the success on Samsø, some of the key concepts expressed here by the Danish Commission involve major contributions from wind and biomass, while overall energy costs in 2050 are seen to be capable of minimisation through increased import-export of electricity in an expanded North European grid.

Interestingly, Gallup has recently found that the majority of Americans currently feel that economic growth should be given priority over the environment. At the same time, Gallup also found Denmark to be the happiest country in the world last year. Yet again. Perhaps Kanter and Beinecke, and others, can still look to Denmark for inspiration.

Samsø's Energy Accademy

A Bright Green Future?

By Mike Edmund

The raw material for a heating revolution?

Jens Dall Bentzen is an inventor, a businessman and a person with a vision. This might fit the description of most successful inventors of course, but when EEI caught up with Mr Bentzen recently, he told us that more than anything, he considers himself an engineer. “It’s a particular way of thinking”, he said: “looking at an existing system, analysing its problems and trying to solve them; it’s all about how to make things better ”.

Mr Bentzen founded Dall Energy in 2007. And this young company has an ambitious vision, too: to develop and provide new and improved energy technologies to the global market. It focuses on inventing new and improved ways of generating green energy from biomass, and providing innovative solutions for biomass-based energy plants. And as well as their biomass heating systems, the company is also building something of a reputation. Their innovative designs have won them several awards, including the Innovation Award 2010 at the 2010 Valladolid Expobioenergía in Spain. Meanwhile, Mr Bentzen himself was awarded the prestigious European Inventor Award, Europe’s highest distinction for inventors, at a ceremony hosted by the European Patent Office last year.

The story began when Dall Energy identified the lack of innovation in medium-sized biomass technology,

Photo: European Patent Organisation.

Jens Dall Bentzen is congratulated on receiving The European Inventor Award 2011

with consequent significant market potential in this sector. *(Typically, this would involve biomass furnace systems with outputs in the 15MW range, suitable for district heating programmes – Editor)*. They set about designing a brand-new biomass-to-energy system. The results are impressive: improvements in fuel flexibility, maintenance costs and impact on the environment. For example, the innovative design also means that the furnace can burn biomass with a moisture content as high as 60%, so kitchen waste, garden waste, indeed almost anything that nature provides can be used to provide heat. And not only does his system produce as much as 30% more useful heat than existing technology, but as much as 20-30% of the total energy requirements in many countries can realistically be derived from this resource according to Mr Bentzen.

With support from the Danish R&D programme (EUDP), the initial concept was proved, and the technology developed and verified at a 2MW pilot plant: the next step was a full-scale unit. According to Mr. Bentzen, the furnace design can be scaled to provide a wide range of outputs, and an 8MW unit was selected by the town of Bogense to provide the power for its district heating project. So Bogense's heating is now carbon neutral, and EEI asked Mr Bentzen if the 6,000 people who live there know how they get their hot water. He replied that there might have been a little flurry of interest when the project started up, but now people turn on their hot water and it's there. Biomass-powered hot water has become just a part of everyday life, which pretty much sums up Jens Dall Bentzen's approach: "Replacing use of fossil fuels for producing steam and hot water, is the main vision of Dall Energy, so we are glad that the first projects we are doing are "fuel-switch projects". We hope that our innovations can contribute to less emissions, a better environment and more jobs in the future. Within, and also outside Europe".

This is a surely bright vision of the future. And it is green.

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EPHOCELL

Making the most of solar photons

The solar spectrum received at the Earth surface covers a wide range of wavelength from 290 nm to 3790 nm. In an ideal situation, the absorption spectrum of photovoltaic (PV) materials should perfectly match the entire solar spectrum in order to convert the maximum photons from solar radiation to electricity. However the absorption band of the best PV materials can be found between 400 and 1200 nm depending on the case.

The main objective of the EHOCELL project is to develop easy-to-implement wavelength modulator device for maximizing spectral matching between the Sun and different PV technologies (a-Si, InGaP, DSSC or polymer solar cells, among others). The devices will combine both down-shifting and up-conversion processes for improving the efficiency of the PV panels. Briefly, down-shifting process converts high energy UV photons into visible ones. On the other hand, the up-conversion process converts low energy NIR photons into visible ones.

The consortium, coordinated by LEITAT Technological Center, consist of leading R&D institutions and companies: Max Planck Institute for Polymer Research (DE), Sofia University (BU), ICTP-CNR (IT), UPC (ES), DIT (IR), Cidete Ingenieros (ES), Daren Labs (IS), MPBata (ES), LEITAT (ES).

Significant progress has been achieved so far during the first 3 years:

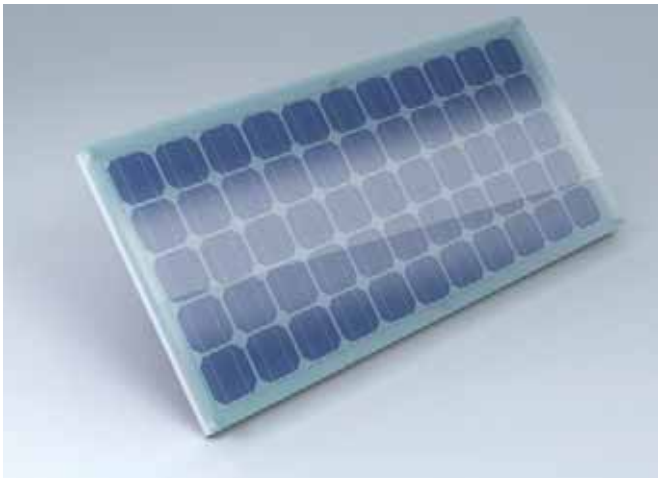
- High efficiency up-conversion systems in different spectral ranges. NIR-to-Vis up-conversion demonstrated
- High efficiency down-shifting systems for appropriate optical coupling with up-conversion
- Novel polymeric matrices for photoactive molecules (including quasi-solid gels)
- Stability evaluation under accelerated ageing studies
- Ray trace and thermal modelling tools for guiding device development
- Opaque and semi-transparent solar cells for optical coupling

Present activities include modelling of suitable device configuration, the construction of functional devices and the validation of the technology.

The EPHOCELL technology proposes notable innovations in materials and sustainable energy as well as industrial solution of a medium/long term nature. By combining state-of-the-art PV cells with the technology, the efficiency of some technologies like organic solar cells can be clearly become more competitive with respect to present alternatives.

The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement nº 227127

Possible representation of the Ephocell technology



EPHOCELL: "Smart light collecting system for the efficiency enhancement of solar cells"
Contact person: Dr. Laurent Aubouy
Duration: February 2009-Jaunary 2013.
Budget: €3.4 milion
Funding: €2.5 milion
www.leitat.org/ephocell

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Photon management for high efficiency solar cells

Stefan Schweizer[1,2] and Ralf B. Wehrspohn[3,4]

Photon management concepts are aiming for high efficiency solar cells by better utilization of the solar spectrum. Optical nanostructured materials serve as spectral converters or lead to a better distribution of the photon flux in multi-junction solar cells.

A conventional mono-bandgap solar cell cannot take advantage of the entire solar spectrum; the UV- and IR-wavelength regions are particularly problematic. Light harvesting materials are applied as an additional "down-shifting" layer to the top or as an "up-converting" layer to the reverse side without modifying the solar cell itself.

The "down-shifting" top layer absorbs a high-energy photon and subsequently emits a photon with lower energy that is absorbed more efficiently by the underlying solar cell. It has been shown in initial experiments that fluorescent glasses and glass ceramics doped with appropriate rare-earth ions such as europium, samarium, or terbium placed on top of a solar cell (see Figure 1) lead to an increased short-circuit current in the UV spectral range. In case of the more efficient glass ceramics, the next steps are to create completely transparent systems to avoid scattering losses in the visible and near-IR spectral ranges.

Figure 1: Samarium-doped glass on a CdTe thin film solar cell under UV excitation.

"Up-conversion" is the sequential absorption of two low-energy infrared photons by a rare-earth ion such as erbium followed by a subsequent emission of a visible photon. The efficiency of this process is dependent on the lifetime of the intermediate energy level of the ion, which itself depends on the phonon energy of the host material. Here, low-phonon energy glasses such as fluorozirconate-based glasses being additionally doped with the trivalent erbium ions emit a much stronger "up-converted" fluorescence than high-phonon energy glasses. However, the "up-conversion" efficiency is usually extremely low and high excitation intensity is needed. Future experiments will aim to increase "up-conversion" efficiency, which could be achieved by increasing the erbium doping level or by using glass ceramics such as a glass containing fluorescent nanocrystals.

In thin-film silicon tandem solar cells consisting of a hydrogenated amorphous silicon (a-Si:H) front absorber and a microcrystalline silicon (µc-Si) bottom absorber,

enhancement of the overall efficiency can be achieved by increasing the current density in the a-Si:H top cell. The external quantum efficiency (EQE) of the top cell differs from that of the bottom cell due to an unbalanced distribution of the absorbed photon flux between a-Si:H and µc-Si under AM1.5 irradiation. The front cell produces a lower electrical current than the bottom cell, which reduces the overall efficiency since both cells are connected serially. To reduce this current mismatch and to operate the tandem at its maximum power point, intermediate reflective layers (IRL) may be introduced between the a-Si:H and µc-Si to optically alter the photon distribution.

Three main requirements for the IRL can be deduced: First, it should provide for spectrally limited back reflectance for the a-Si:H top cell, where the EQE of both junctions overlaps. It should also be transparent to red and IR light to avoid a negative effect on the bottom cell. Finally, it must exhibit sufficient electrical sandwich conduction, as the tandem is connected serially. Three-dimensional thin film photonic crystals have been suggested as an integrated reflector to optically match the current by appropriate photon management between the two absorbers. An initial prototype using a smooth substrate layer, as shown in Figure 2, was produced. EQE measurements have shown that the cell constitutes a proof of concept because the absorption is enhanced in the spectral range of the designed back reflectance of the IRL.

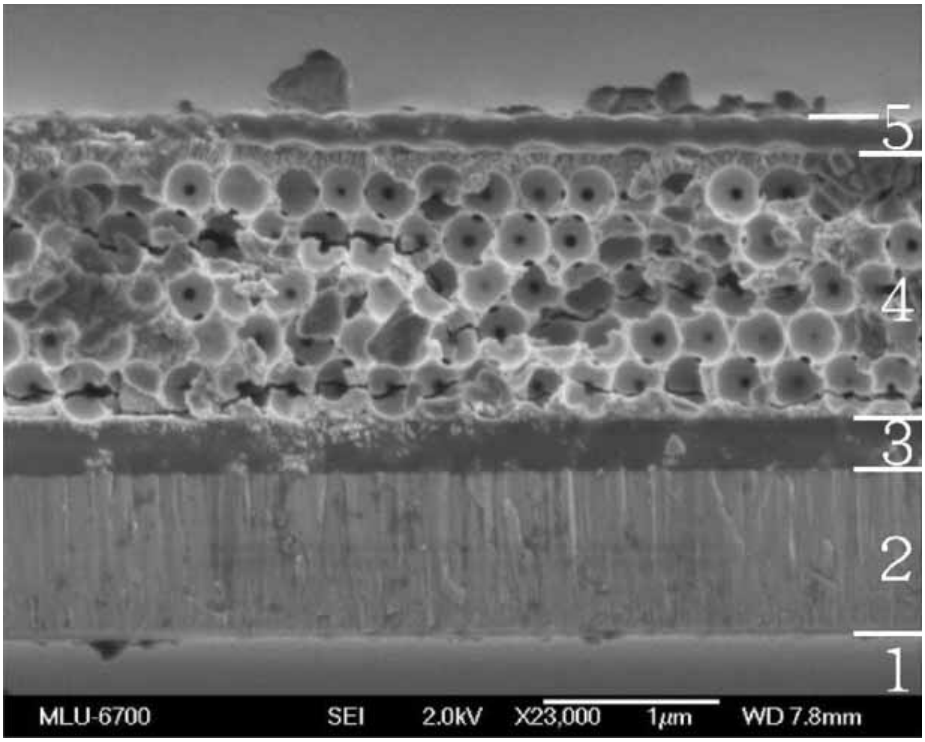

Figure 2: Scanning electron microscope image of the prototype's profile: 1) substrate layer, 2) transparent conducting oxide (TCO) front contact, 3) a-Si:H top cell, 4) photonic IRL, and 5) back-side silicon and metal back contact.

Future work will cover the study on the assembly process of inverted opals on textured substrates and the optical properties of these photonic films. The aim is to realize experimentally a fully integrated 3D inverted opal IRL within a randomly textured tandem cell.

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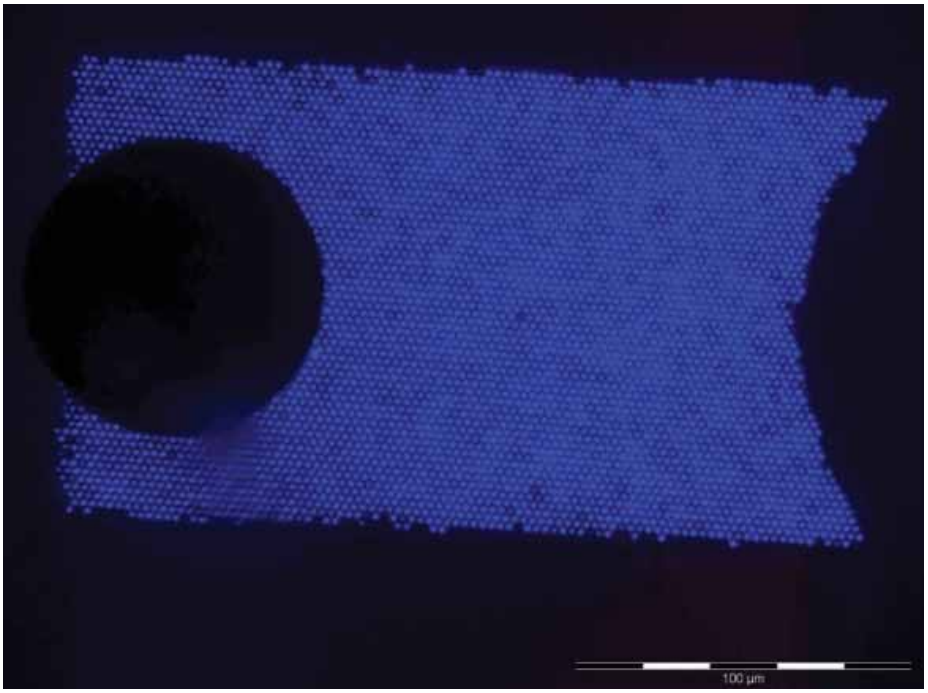
SMASH
Smart nanostructured semiconductors for energy-saving light solutions

Solid state light (SSL) sources based on compound semiconductors are enabling a new era in general lighting and due to their high efficiency potential will contribute significantly to a sustainable energy saving. To reduce the fraction of energy used for lighting, it takes highly efficient light sources especially since the worldwide light consumption increases due to high demand in developing countries e.g. for replacing problematic fossil fuel light sources. The overall goal of SMASH is to establish new materials solutions and process technologies based on nanostructured gallium nitride (GaN) semiconductors for low-cost, energy-efficient light sources.

To enable further up-scaling and to achieve synergies with the established silicon-based electronic industry, strong efforts have been made towards the combination of GaN based LEDs and silicon substrates during the recent decade. However, there is still a performance gap compared to GaN LEDs grown on conventional sapphire substrates. Besides the vast progress achieved so far, LEDs still have a large potential for efficiency improvements in order to fully implement the projected energy savings. Extension of the spectral range towards yellow and red for GaN based LEDs and increase of the light generation volume per given chip area are additional potentials to be explored.

Electroluminescence of an array of nano LEDs fabricated in a top-down approach. *Courtesy of OSRAM Opto Semiconductors GmbH, Germany*



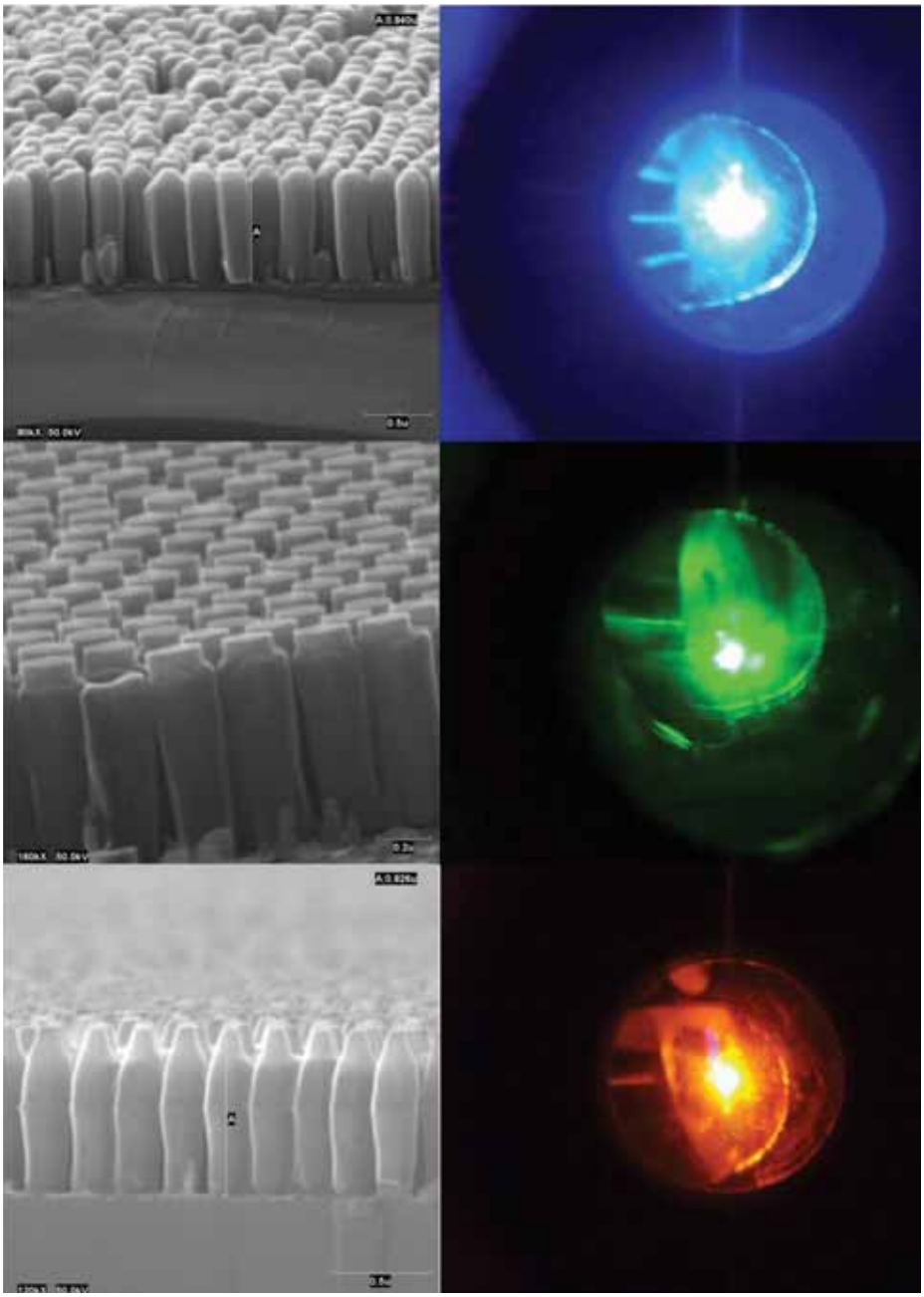
Two new, disruptive technologies exploiting novel 3D nanostructures are explored to address these key factors: Passive nanorod templates for defect reduction in GaN technology and active nanoemitters for phosphor-less white LEDs are the two core directions of SMASH.

Profound understanding of the growth mechanisms of ordered arrays of GaN-based nanorods and of their electrical, structural and optical properties was obtained. New process technologies

(wafer-scale nanoimprinting, dry etching, epitaxial growth, device processing) have been applied and optimized in order to allow the processing of 3D nanostructures by technologies primarily developed for planar geometries.

In particular, the nanoemitter approach yielded breakthrough progress. All-InGaN phosphor-less white LEDs have been realized by molecular beam epitaxy (MBE) using an Indium gradient in a several 100 nm thick active volume. Single color nanorod emitters even for amber and red wavelengths were demonstrated which is impossible by state-of-the-art planar GaN technology. Core-shell nanorods with an aspect ratio of up to 10 were grown by MOVPE on large-scale reactors suitable for mass production. Both approaches increase the active volume by more than an order of magnitude and hence allow to operate LEDs close to their efficiency maximum.

By coalescing nanorod arrays the density of threading dislocations of GaN grown on silicon substrates could be reduced to the lower 10^8 cm^{-2}, which is about a factor of 2-3 better than state-of-the-art. By the end of the SMASH project, this process will allow white LEDs with an efficacy of 130 lm/W. By facilitating easy transfer to large area substrates, this technology can enable significant cost reduction. This is a prerequisite for the complete penetration of the general lighting market by energy-saving LED technology.



MBE-grown nanorods and their photoluminescence in blue, green and amber. *Courtesy of Prof. Calleja and Prof. Sanchez Garcia, ISOM-UPM, Madrid, Spain*

Acknowledgement:
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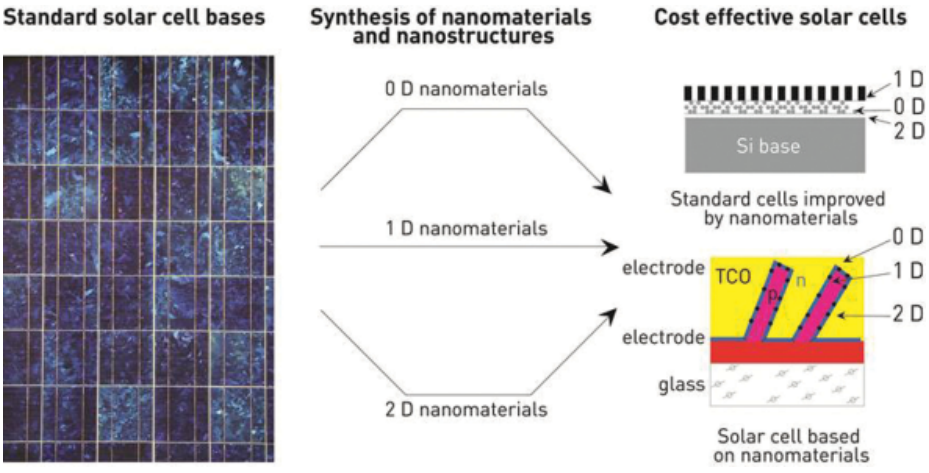
Nanomaterials and nanotechnology for advanced photovoltaics

The NanoPV project http://www.sintef.no/Projectweb/nanoPV/ aims at making a breakthrough step-change in photovoltaics by the removal of a set of bottlenecks which have been identified to block the application of nanostructures for high-efficiency, low-cost solar cells. The bottlenecks arise from the present lack of up-scalable processes that can meet the needs for nanomaterials in PV applications, and the lack of relevant equipment and industrial lines. In order to remove these bottlenecks, the main objectives of NanoPV are: (i) to develop technologies that can increase the efficiency and reduce the processing cost of existing silicon solar cell technologies using nano-scale effects provided by nanomaterials to above 20% for wafer based and above 15 % for thin film silicon based solar cells at a processing cost for modules well below 1 €/watt; (ii) to design and to fabricate low cost solar cells entirely from nanomaterials by using nanostructures (Fig.1). An efficiency of above 10 % at processing costs well below 1 €/watt is targeted with potential of further significant improvements in the future; (iii) to develop up-scalable cost effective processes and equipment in order to implement both enhanced standard solar cells and solar cell based on nanomaterials as well as related modules to existing pilot and industrial lines; (iv) to create new market opportunities for the industrial partners.

Nanotechnology is applied for both already existing conventional Si solar cells (wafer and thin-film based) and for advanced solar cells entirely based on nanostructures. The main scientific efforts are focused on understanding and exploitation of such nanomaterials as: (i) 0D quantum dots, nanocrystals and nanoparticles, (ii)1D nanowires and nanorods, and (iii) 2D nanomaterials such as ultrathin layers.

A large number of specialised technologies under the consideration in the project. Therefore, in order to ensure successful completion, a comparatively large consortium of 9 complementary research partners: Stiftelsen SINTEF, Norway (Coordinator); Energy Research Centre of the Netherlands (ECN, Netherlands); Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (HZB, Germany); University of Valencia (Spain); Walter Schottky Institute, Technical University Munich (Germany); Institute of Photonic Technology (IPHT, Germany); Consiglio Nazionale Delle Ricerche, Laboratorio Nazionale MDM (CNR, Italy); Rudjer Boskovic Institute (RBI, Croatia); Central Laboratory of Solar Energy and New Energy Sources Bulgarian Academy of Sciences (CLS); and 3 industries: Oxford Instruments Plasma Technology Ltd. (OIPT, UK); SCHOTT Solar AG (Germany) and Innovative Materials Processing Technology Ltd. (IMPT, UK) has been assembled.



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How research on nanophotonics can contribute to more efficient energy conversion

Andreas Ostendorf, Ruhr-University Bochum, Conference Co-Chairman SPIE Photonics West 2012

For non-professionals nanophotonics seems to be primarily a playground for basic research where scientists can investigate fundamental aspects of light in combination with nanosized structures. However, when looking deeper into this topic one might realize that nanophotonics with its radical new phenomena can contribute in many actual fields of engineering. Among those, there are certain potential applications in the field of energy harvesting. Due to the emerging areas of applications nanophotonics will be a major part of SPIE´s Photonics Europe conference which will take place April 19-23, 2012 in Brussels.

One of the energy related technologies which could directly benefit from nanophotonics is photovoltaics. In fact this is the technology where photonics and energy transformation merged their fields of expertise. The ultimate goal of all solar cells is a high quantum efficiency, i.e. almost each incident light photon is converted into an electron-hole pair which are then separated in the junction zone between two different semiconductor materials. In a conventional silicon solar cell the theoretical maximum quantum efficiency with respect to the spectrum of the sunlight is around 30%, i.e. about 70% of the incident photons are reflected by the surface or wasted by generated heat. However, materials and nanophotonics researchers have just demonstrated that with specifically doped graphene layers up to 100% of the incident photons can be converted into electricity. The invention of graphene, which is a single-atom planar carbon sheet with unique electrical and optical properties, has been awarded in 2010 with the Nobel prize. However, these approaches still have to be scaled up to make them attractive in industrial mass production. Another very interesting technology is the design and use of metamaterials. Metamaterials are artificially designed regular structures on the sub-wavelength scale that allow tuning the dielectric permittivity and the magnetic permeability. By appropriate design of these nanostructures light at a specific wavelength can be absorbed by 100%, i.e. there is no transmittance or reflectivity. Similar strategies are being followed by integration of nanowires or nanorods into solar cell materials. The incident sunlight is highly amplified in the nearfield of these structures which also act as nanosized antennae for light. The higher intensities are then able to generate more electrons and thus, higher efficiency solar cells will result.

It is well known that besides the generation of energy the saving of energy is at least as important. In private houses today up to 20% of the total energy is consumed for lighting. Still a huge amount of the input energy is converted into heat. In future, inorganic and organic LEDs are able to reduce the energy waste in lighting by approximately 90%. Similar to the solutions in photovoltaics nanophotonics research in LED lighting focuses on integrating nanostructures in LED devices in order to improve the quantum efficiency which in this case is defined by the ratio between incoming electrons and generated photons. Also by nanostructures like those in the wings of butterflies (see Fig.) the emitted wavelength are can be tuned resulting in very effective and tiny light sources of almost any colour. In summary, by applying the numerous nanosized effects in optoelectronic devices an optimisation of the energy conversion in either direction i.e. from electrons to photons (lighting) and from photons to electrons (sensing and photovoltaics) can be achieved. The major challenge, however, is still the large scale cost-effective production technology of nanophotonic devices. However, history has shown that often this problem has also been solved once the fundamental effects are well understood.

Picture of butterflies with colourful wings. The colours originate from photonic nanostructures. Picture of Exeter University.

The role of green photonics for sustainable production

Abstract of a speech held at the SPIE Eco Photonics Conference, March 2011, Strasbourg, Palais de la Musique et des Congrès

LED street lighting in the historic city of Regensburg, Germany

Photonics is the science of light and its generation, manipulation, and capture. We use photonic technologies to light our homes, offices and cities, to harvest renewable energy from the sun, to make telephone calls or surf the Internet, to enable early medical diagnosis and treatments, to establish clean and efficient manufacture of everyday products, or to provide reliable security systems. Photovoltaic solar energy systems also provide clean electricity to millions of people.

'Green photonics' [i] describes the application of photonics technologies that can generate or conserve energy, cut greenhouse gas emissions, reduce pollution, or yield environmentally sustainable outputs. Green photonics covers a broad range of technologies and applications, including photovoltaic electricity generation, solid-state lighting (SSL), new energy-efficient communication technologies, optical sensing for improved energy efficiency and reduced pollution; and clean manufacturing using laser processing. In spite of the recent recession, the overall market demand for green photonics technology is expected to achieve a 2009-2020 CAGR of approximately 20% [ii] The two green photonic technologies expected to have the largest impact in the short term are solid state lighting (SSL) sources such as light emitting diodes (LEDs) and organic LEDs (OLEDs)), and photovoltaic cells.

SUSTAINABILITY AND PHOTONICS

Photonics technologies offers benefits to sustainability (termed eco-efficiency) in three main areas; industrial design, products and production techniques.

Eco-efficient design

Photonics technologies, most notably using a laser, are being

applied in manufacturing, allowing processes to be handled automatically, rapidly and flexibly, producing components and products with extraordinary quality and accuracy. They provide the ideal tool for fabricating lightweight and high-strength constructions.

Eco-efficient products

Solid State Lighting

LEDs and OLEDs represent the light source with the highest energy efficiency, outperforming existing light sources, thus saving significant amounts of energy and reducing CO2 emissions.

Optical Fibre Networks

The total energy required to power the Internet, including data centers, network nodes and user terminals, amounts to about 3% of today's energy generation capacity – more than is used for global air traffic! With Internet traffic growing at nearly 50% each year, advanced photonic technologies offer significant opportunities for reducing the inevitable increase in demand for energy.

Organic Photovoltaics (OPV)

OPV technology may be applied directly in thin films to many urban surfaces, including windows and facades, without interfering with existing functionality. This may allow energy-harvesting capacity to offset energy consumption in buildings, where more than 40% of global energy is used.

Eco-efficient production

Photonic sensors for monitoring and controlling will play a crucial role for sustainable manufacturing by enabling zero-loss and thereby economical and ecological efficient production . Laser processes allow for very precise, well-controlled and therefore highly efficient energy deposition on the work piece.

UNFORESEEN OFFSET EFFECTS

One potential – and unforeseen - consequence of developing technologies for lower power consumption devices is enhanced performance of the devices, which offset the reduced power consumption. This can be seen in several product sectors, such as in flat screen TVs, where the trend is for increasingly larger screens, and in LED lighting, where increased energy efficiency makes people less likely to switch lights off at night, and where many new designs, especially in the architectural sector lead to illuminations where so far no lights had been used before.

FUTURE STRATEGY

It is clear that eco-efficient products & technologies enabled by photonic technologies offer huge opportunities for the European economy. Globally, this will put Europe at the forefront of providing technological solutions to the major challenges faced by countries across the world. This will result in improved global competitiveness, major economic benefits and the need for a highly skilled workforce within Europe. ●

Photonics contribution to a Sustainable Economy

Sustainable Energy Generation

- Photovoltaic solar energy

Reduced Energy Consumption

- Solid-State Lighting (SSL)
- Communication Technologies

Enabled Eco-friendly Design & Production

- Light-weight product design using advanced laser processing
- Material savings by precise laser cutting
- Control of production processes by sensors
- Laser processing for clean manufacturing

Reduced Risk Potential

- Sensor networks for higher safety & security
- Environmental monitoring by sensors

REFERENCES

[i] The term Green Photonics is trademarked by the OIDA. (www.oida.org)

[ii] http://www.businesswire.com/news/home/20090324006339/en/OIDA-Proposes-Criteria-Optoelectronics-Carbon-Economy-European

[iii] Berit Wessler, Member of the Board of Stakeholders Photonics21, OSRAM GmbH, Hellabrunner Str.1, 81543 Munich
Ursula Tober, Economist/Consultant, VDI Technologiezentrum GmbH – Photonics21 secretariat, VDI Platz 1, 40468 Duesseldorf

[iv] For more information please go to our Website: http://www.photonics21.org/downloads/download_presentations.php



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Dall Energy

New biomass technologies

Dall Energy is dedicated to meet the climate challenge through innovative biomass based energy plants

Dall Energy is a young, Danish innovative engineering company. The vision of Dall Energy is to develop and provide new and improved energy technologies to the global market.
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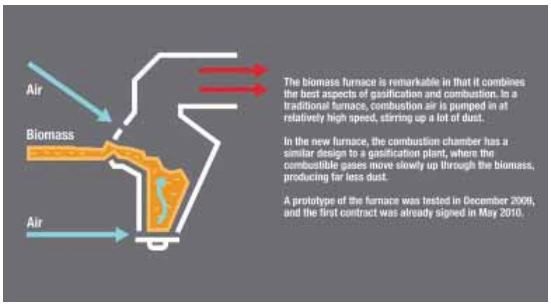
• No hot moving parts • 10%-100% regulation • Ultra low dust • Low NOx and CO • Low carbon in ash • 20% higher energy efficiency

Jens Dall Bentzen wins the European Inventor award 2011.



8 MW heating plant in Bogense, Denmark.

Acknowledgement: The development of the Dall Energy Technology has been supported by the Danish Energy Agency and The Danish Agency for Science, Technology and Innovation

Towards a sustainable transport system – the role of research and innovation

Vice-President Siim Kallas, European Commissioner for Transport

Research and innovation will play a vital role in European transport in the years ahead as we tackle some inevitable challenges that will undoubtedly alter the business landscape. Sustainable transport has significant local environmental, social and economic benefits whilst contributing significantly to tackling climate change.

The EU has set itself ambitious targets for cutting greenhouse gas emissions by 2050. For that, transport will also clearly have to pull its weight, reducing its emissions by at least 60% compared with 1990 levels. We have many ideas for achieving these goals, including using innovative technologies to alleviate congestion and thereby making Europe's cities cleaner places to live.

Decarbonising Europe's transport system will require a great deal of innovation combined with investments in infrastructure and research, to create the required efficiency improvements.

We will also need significant shifts in type of transport use to counter the polluting effect of intense road demand, by making more and better use of

cleaner – and often cheaper - alternatives like rail and waterborne travel.

With innovation, for example, there is enormous potential to 'green' our transport system, as well as to make it more sustainable and efficient, and safer.

That's why we are investing heavily in research and development to ensure Europe stays at the cutting edge of technological advances in transport.

It is also why 'smart, green and integrated transport' is identified as a major challenge for project funding within the Commission's proposed 2014-2020 research programme, "Horizon 2020". This will be about resource-efficient transport that respects the environment across all the different modes of travel.

We have already launched several successful initiatives to help prepare the transport sector for a low-carbon future – projects to develop 'clean cars', or fleets of electric city buses, e-freight, to name but a few. Green technology is an effective way to help reduce transport's carbon footprint and also offers European companies a huge commercial opportunity.

We urgently need to develop alternative fuels as a sustainable energy source: clean and energy-efficient technologies deployed in new-generation vehicles using electricity, hydrogen, natural gas and biogas or liquid biofuels, for example. All of these alternative fuels can be made from low-carbon or carbon-free sources.

We are also working hard to develop intelligent transport systems, to deploy novel technologies that improve road safety and contribute to fuel efficiency by saving energy, which in turn leads to lower environmental impact. Such systems take many forms, including the deployment of key urban applications covering travel information, for example, or 'smart ticketing' and traffic management to embrace different transport modes.

At the other end of the scale, in aviation we have SESAR: the technology arm of the Single European Sky project, an impressive example of how research and innovation are helping to improve transport's environmental performance.

SESAR aims to modernise and develop Europe's air traffic control infrastructure to ensure the safety, sustainability and fluidity of global air transport over the next 30 years while achieving significant cuts in aviation emissions. By 2020, CO2 emissions per flight should be reduced by 10%, via fuel savings (with existing technology).

On policy, the Commission is working on two strategies for next year, starting with a medium-term vision for research and innovation: the strategic transport technology plan. This focuses our efforts on essential technologies over the whole product development chain - from research and innovation, to demonstration and market introduction – based on a vision of an integrated, efficient and environmentally friendly and safe EU transport system by 2030.

That will be followed by an initiative on clean transport systems, which will be a comprehensive long-term fuel strategy for gradually substituting fossil fuels with alternative energy sources.

While we are preparing for the long term, 2050 and beyond, there is no time to lose. Europe must make the most of research and the development of new technologies to innovate for the years ahead, so that we can guarantee a sustainable, efficient and environmentally responsible transport sector for the future.

Transport Research Arena, TRA 2012

Athens, Greece, from 23rd to 26th of April, 2012.

TRA is more than a conference, is an arena which aims at bringing together European stakeholders from all areas of transport and transport-related activities. TRA 2012 will for the first time, deal extensively with all surface transport modes: road, rail and waterborne, and underline interlinks between them. This conference will bring together representatives of the surface transport modes from industry, public authorities (national and local) and from the research providers. In a recent message, Máire Geoghegan-Quinn, Commissioner for Research & Innovation, stated that "TRA2012 in Athens will be a unique platform for public and private stakeholders to start mobilising towards setting priorities for Horizon 2020, in particular via the various European Technology Platforms, and gearing towards EU policy orientations and the expectations of society".

At TRA2012 the audience will learn all about Horizon 2020, the European Commission proposal for a new Research & Innovation Framework Programme coming into force in January 2014 and have the privilege of getting first-hand information on the proposed €7.7 billion transport component of this programme and contributing to its priorities.

Today, one of the main societal challenges is to achieve a European transport system that is resource-efficient, environmentally-friendly, safe and seamless for the benefit of its citizens, economy and society. This is reflected in the four activities of the new 'Smart, green and integrated transport' component of Horizon 2020 and their more specific objectives that will be presented at TRA 2012 for the first time.

Right from the opening session through to the closing session, the attendees will be able to take part in a series of 13 strategic sessions covering all modes and tackling the entire spectrum of activities envisaged by the Framework Programme to achieve smart, green and integrated transport for Europe.

Targets include better mobility, less congestion, more safety and security, with a substantial reduction of traffic congestion, improvements in the mobility of people and freight, developing and applying new concepts of freight transport and logistics and reducing accident rates and fatal casualties and improving security. Global leadership for the European transport industry will investigate developing the next generation of transport means, on-board, smart control systems, advanced production processes and exploring new transport concepts. Evidence-based transport policy for the long term will provide foresight for long term scenarios, policy support and impact studies, as well as mobility models, transport economies and business models.

TRA 2012 will enable researchers and transportation practitioners from around the globe to get together and exchange ideas and thoughts on some of the most pressing problems that the Transport sector is facing in our times.

TRA 2012 will also facilitate the interaction between researchers and industry representatives; it will provide an opportunity for the private sector to cooperate with leading researchers in practical applications and/or breakthrough solutions in the field of transportation.

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Railways and Energy Moving forward into a sustainable future

Prof Andrew McNaughton, ERRAC Chairman

Prof Andrew McNaughton, ERRAC Chairman
Below: Catenary wire renovation equipment

THE CHALLENGE

The European Commission "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" states that "the challenge is to break the transport system's dependence on oil without sacrificing its efficiency and compromising mobility".

The railway sector can look back on over a century of successful implementation and development of electric traction, and electric rail is now highly energy efficient. The rail sector is well-prepared for being able to help develop a more sustainable future for European transport. In contrast, the automotive sector has only recently started to look seriously at mainstreaming electrification concepts.

THE BACKGROUND

Energy consumption for passenger and freight transport has increased in line with the rise in transport demand experienced over the last few decades, putting heavy pressure on fossil fuel resources as well as increasing emissions of greenhouse gases. The EU's 2011 transport White Paper proposed reducing greenhouse gas emissions from transport by at least 60% by 2050 compared to 1990. This will inevitably lead to radical changes compared to current trends, in particular much greater use of electricity for powering transport.

Railways are very energy efficient compared to other modes of transport: rail's share of transport energy consumption in the EU is less than 3%, while its market share is around 6% (passenger) and 10% (freight). Its efficiency is mainly due to lower rolling and air resistance combined with a controlled driving pattern. The main disadvantages of electric traction are the high costs for electrification and the vulnerability of the electric infrastructure, especially the overhead catenary system. To remain economically competitive and minimise the impact on the environment, railways must continue to increase their overall energy efficiency – not the least to enjoy strong political support. That's why European railways have set an ambitious vision.

THE VISION

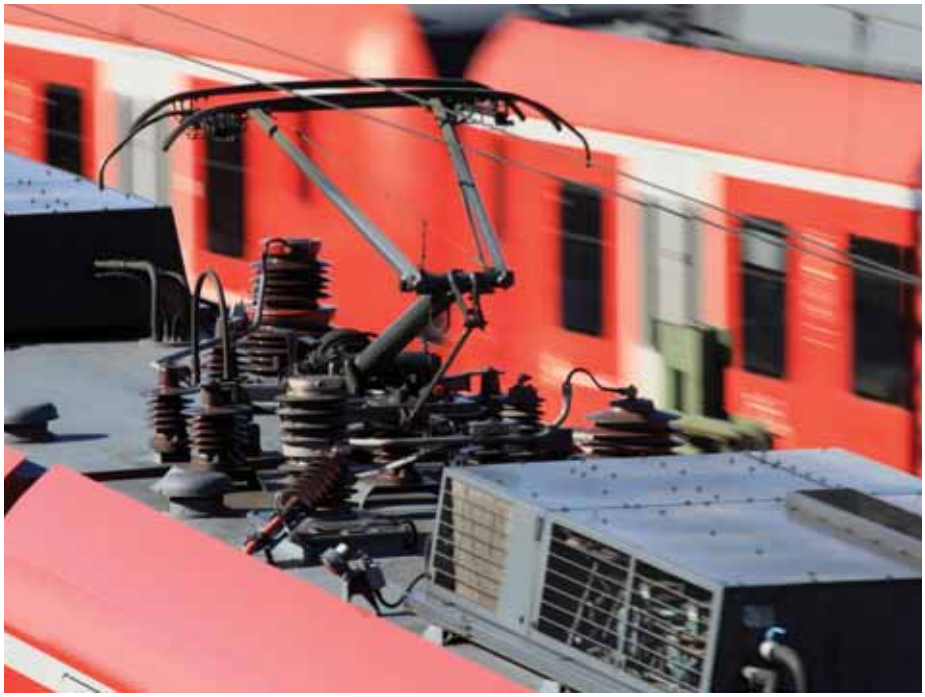
By 2030 the European railways will reduce their specific final energy consumption from train operation by 30% compared to 1990; measured per passenger-km (passenger service) and gross tonne-km (freight service)[1].

Moreover, by 2050 the European railways will strive towards halving their specific final energy consumption from train operations compared to 1990.

TRANSFORMING A VISION INTO A ROADMAP

ERRAC, the European Rail

S-Bahn Munich



Research Advisory Council, aims at fostering innovation and guiding research efforts in the railway sector at European level. ERRAC has launched an initiative to develop precise and detailed roadmaps on common European research areas. The ERRAC Roadmap "Energy"[2] describes the various fields where railways can improve their energy efficiency:

RAILWAY SYSTEM AS ENTITY

Managing the electrified system as smart grid networks is highly promising. The electricity regenerated during railway operations can be stored in the railway system or fed back to the public grid. Storing energy will be part of the management of peak demands. The hybridisation of energy (management of various sources of energy) will be developed.

ROLLING STOCK

Some efficiency improvements will be achieved by the use of better control strategies, and more efficient traction motors (e.g. synchronous traction motors with higher efficiencies than traditional asynchronous traction motors). However, no significant improvements regarding the efficiency of such equipment is expected in the near future.

The most energy consuming elements of modern railway vehicles are 'comfort systems' such as air conditioning, heating and ventilation. That's why different technologies will be installed to enhance the energy efficiency.

INFRASTRUCTURE

Optimising the use of energy for electric infrastructure can be done by developing smart grid networks where the energy is stored and used according to demand.

In particular, energy can be saved in DC systems by reusing the braking energy through energy storage systems and minimising the losses in the electric railway infrastructure.

OPERATION

Traffic Flow Management is a highly promising way of allowing smooth traffic flow including energy efficient driving with the additional benefit of an increase in rail capacity.

ALTERNATIVE FUELS

Railways are seeking to increase the share of electric traction and at the same time reduce diesel traction wherever economically feasible. The challenges to be solved for the remaining diesel traction are the scarcity or absence of mineral oil by 2050 and the further reduction in exhaust gas emissions. There is clearly a need to investigate the use of alternative fuels in the long run.

SUMMARY

Rail already has a strong focus on how to continuously improve its sustainability performance. The European rail sector has an ambitious and clear energy roadmap and will continue seeking improvements to its environmental performance in order to remain a competitive, highly energy efficient and low-impact mode of transport.

1. "Moving towards Sustainable Mobility: Rail Sector Strategy 2030 and beyond – Europe, CER/UIC, Brussels and Paris, 2011
2. ERRAC Roadmap – WP 01 The Greening of Surface Transport – Deliverable "Towards 2030 – Energy Roadmap for the European Railway sector", Paris, 2011

ERRAC
The European Rail Research Advisory Council

ERRAC was set up in 2001 with the ambitious goal of creating a single European body with both the competence and capability to help revitalise the European rail sector and make it more competitive, by fostering increased innovation and guiding research efforts at European level. Within ERRAC, all major rail stakeholders are gathered. ERRAC comprises of 45 representatives from each of the major European rail research stakeholders: manufacturers, operators, infrastructure managers, the European Commission, EU Member States, academics and users' groups. ERRAC covers all forms of rail transport: from conventional, high speed and freight applications to urban and regional services.

ERRAC is chaired by Mr. Andrew Mc Naughton (NetworkRail). The Vice-Chairmen are Mr. Dan Otteborn (Bombardier Transportation) and Mr. Manuel Pereira (IST Lisbon).

Electromobility and smart grids:

Harald W. Scholz, Geert van Grootveld, Alois Krasenbrink EC Joint Research Centre

Electromobility is seen as a new paradigm, with a lot of advantages on the environmental side. First, there are the pros of substantially reduced vehicles' tailpipe emissions of critical air pollutants and noise, and a new frontier to reach consistently higher overall energy efficiency in road transport, improving on today's GHG emissions from this sector. Economically, electrification of vehicles promises important new market opportunities. Politically, the possibility to reduce oil dependency adds an important argument: Can the EU afford an oil bill of more than €200bn per year, ever on?

The European Commission's White Paper on transport in 2050, the Green Cars initiative and the massive governmental push for electrical vehicles (EV) have set big hopes.

But all this is not just a one-dimension innovation, only replacing all our fossil-fuelled cars with battery cars. It goes hand-in-hand with the introduction of smart power grids and standardised two-way communication between users and utilities. This will enable affordable charging time choices (so-called "demand valley filling"), and should increase the use of electricity from renewable sources and other, energetically and environmentally beneficial strategies. Electric vehicles can only be as climate-friendly as the electricity they are charged with. But if they enable us using the generation capacity in a more efficient way and to inject low-carbon electricity more easily, their environmental benefits increase. Notably in agglomeration areas, where environmental advantages will be most obvious, the paradigm change may include new concepts of integrated services: Fitting mobility needs, and billing methods as easy as today's mobile-phone services; some may even overcome the traditional concepts

A team of JRC's vehicle emission and electrification laboratories (VELA) at work, preparing on-the-road testing of a hybrid car, fuelled with biofuel.

The European Commission Joint Research Centre's activities

of car ownership. Several innovation strains have thus to be implemented in parallel. Increased standardisation and regulation efforts, ideally applicable also at global level, are key for guaranteeing interoperability of what is currently a plethora of concepts and products - for a future, several hundred billion € market ahead for the next decades.

This is the backcloth, in front of which the Institute for Energy and Transport of the Joint Research Centre (JRC) is setting up a whole teams' work programme for electric vehicle / smart grid interoperability. The VELA laboratories at Ispra (IT) are currently being extended to deliver on electric vehicle assessment, testing, and homologation methodology, researching in a pre-normative way on the embedding of EVs and their charging equipment into smart grids. The laboratories at Petten (NL) will perform research into batteries and other components, and on smart grids and the related ICT components and systems, using the Ispra test site whenever needed. In partnership with the Argonne National Laboratory, JRC will be able to test plug-in hybrid (PHEV), range-extended hybrid (REEV), and battery electric vehicles (BEV) as well as Fuel-Cell powered ones (FCEV). It will address charging and grid-communication even under adverse environmental (e.g., meteorological) conditions as well as drive-cycle and range tests of EVs. Portable measurement equipment within EVs will allow comparing roller-bench tests in the lab with real-world driving results. A Hardware-in-the-loop system will be dedicated to test Heavy Duty hybrid engines. First results will be fed to three "clients":
a) The European Commission - as technological input for urgently needed regulations, notably on future world-wide drive-cycles and homologation;
b) the European and international regulators' and standardisation organisations' efforts to guarantee a level playing field in this world-market development; and
c) the new EU-US agreement for direct collaboration on electric vehicles / smart grid interoperability. In view of a sustainable, smart future, the JRC provides a service to society as a whole.

ESTRELIA

First Battery Management solutions that enable significant improvements for fully electrical vehicles: 'So driving feels the same'

EU FP7 project 'ESTRELIA' demonstrates a successful example of collaborative European Research contributing to the EU 2020 CO2 reduction objectives by enabling and demonstrating innovative IC products manufactured in Europe.

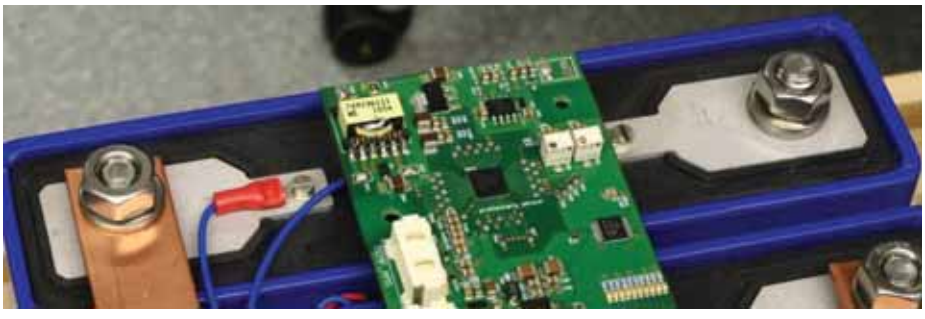
On behalf of the ESTRELIA (Energy Storage with lowered cost and improved Safety and Reliability for electrical vehicles) project consortium leader austriamicrosystems, a leading provider of high performance analog ICs for consumer & communications, industry & medical and automotive applications, announces successful progress of the first six months of the EU FP7 project ESTRELIA.

ESTRELIA PROJECT DEVELOPMENT GOALS

High costs together with concerns for driving range, reliability and safety are still the main hindrance for market adaption of full electrical vehicles (FEVs). The project ESTRELIA aims to provide building elements with enhanced reliability and safety at lower costs for smart energy storage for FEVs. This will be accomplished through a modular approach based on optimized ultracapacitor power packs developed by Valeo. Corning will provide prototype ultracapacitor cells projected with up to a 50% energy density advantage over commercially available products. The performance of the power packs will be evaluated by Austrian Battery Research Lab. New Battery Management (BMS) ICs from austriamicrosystems will for the first time provide a flexible active cell balancing chip set also suited for the high accuracy demanding monitoring of Li-Ion batteries.

The BMS ICs and architecture proposed from Fraunhofer IISB will be verified on prototypes built by E4V. Tests with new HV test equipment developed by Active Technologies will proof test isolation protection in the environment of several 100's V as present in FEVs. The new BMS IC concept will enable higher efficiency by lower energy loss and improved long term reliability and will lower the electronic component costs for BMS of Li-Ion energy packs.

ESTRELIA will also develop new safety sensors which are based on silicon based MEMS approaches delivering enhanced safety functions at lowered cost compared to existing solutions. While the gas sensor will allow detection of very low levels of volatile organic compounds as emitted in thermal overruns of battery packs, the new spark detector concept will enable general safety functions by flame detection from all hazardous components in a FEV. Finally the development of new low cost power antifuses by Fraunhofer IISB together with the new energy management hardware (BMS IC) and software will enable dynamic reconfigurable topologies in the energy storage unit, thus providing limp-home functionality to the FEV despite single cell failures.



SUCCESSFUL PROJECT PROGRESS

The consortium led by austriamicrosystems (AT) includes Valeo Electrical Systems (FR), Fraunhofer IISB (DE), Corning SAS (FR), Austrian Battery Research Laboratory (AT), AppliedSensor (DE), CEA LETI (FR), Active Technologies

ESTRELIA
Safe Batteries with power

(IT), E4V (FR). All consortium partners are leaders in their respective areas of expertise. "After six months of successful cooperation we are progressing very well with the results so far achieved. Our half year project team meeting was very productive and we have been able to solve open issues", stated Ewald Wachmann from austriamicrosystems who leads the coordination team of ESTRELIA.

The project results after the first six months are:

Based on several inputs from car manufacturers the IC specification and design for the Battery Management ICs is progressing very well. A detailed concept using self-triggered power antifuses to bypass faulty battery cells has been developed and supported by device simulation. This is a first step to provide a cost effective solution to single cell failure for the future. Also the development of the very important safety sensors for EV's is on schedule. For the new gas sensor, the first modified samples for battery testing have been provided, and, for the MEMS based spark detection sensor, the appropriate piezo resistive concept has been selected and the design optimization is running.

First samples of the ultracapacitor cell samples with high energy densities in the range of 7-9 Wh/L have already been investigated. By the end of the project, up to 50% higher energy density in the power pack is intended as innovation of the ESTRELIA project.

ESTRELIA PROJECT PRESENTATIONS

The ESTRELIA project itself and the ongoing results and highlights have been presented at several conferences and events such as the Auto.E-Motion Event ("European Conference on Nanoelectronics and Embedded Systems for Electric Mobility") on 27th September 2011 at the headquarters of austriamicrosystems in Unterpremstätten (Austria), at the ECPE (European Center for Power Electronics) meeting in Munich on 24th November, at the Green Cars Initiative PPP Expert Workshop 2011 "Europe's Strengths, Competencies and Job Opportunities in Electric Vehicle Battery Manufacturing" on 7th December in Brussels and at several regional and local meetings of all the project partners.

For more information please refer to the ESTRELIA webpage http://www.estrelia.eu

austriamicrosystems | TAOS

About austriamicrosystems

austriamicrosystems is a leading designer and manufacturer of high performance analog ICs, combining 30 years of analog design know-how with state-of-the-art manufacturing and test facilities and production partnerships. Operating worldwide with more than 1,200 employees, austriamicrosystems focuses on the areas of power management, sensors & sensor interfaces and mobile infotainment in its markets Consumer & Communications, Industry & Medical and Automotive. Through the acquisition of TAOS, a world leader in advanced light sensors, austriamicrosystems has expanded its innovative sensor offering for growth markets such as mobile devices. For more information, **please visit www.austriamicrosystems.com**

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ERTRAC – Research and innovation for a 50% more efficient road transport system

Prof. Wolfgang Steiger

The road transport sector is facing today major challenges, with energy efficiency and decarbonization being very high on the agenda. ERTRAC - the European Road Transport Research Advisory Council - is a platform gathering all the actors involved in research: industry, research centres and universities, and public authorities. In its 2010 Strategic Research Agenda, it has set a guiding objective that the road transport system should be 50% more efficient by 2030.

Improving the efficiency of transport as a system requests to take a system approach with integrated efforts on the key research domains. For the challenge of decarbonization, it is for example key to combine efforts on increasing the energy efficiency of the vehicles, e.g. by introducing innovative powertrains, with a decarbonization of the energies used in transport, e.g. by increasing renewable energies in the energy mix. Research activities have therefore to be performed in parallel on vehicle technologies, on fuels, but also on ICT to enable vehicle-to-vehicle and vehicle-to-infrastructure integration.

The role of research is to pave the way for these efficiency gains in all these domains. From university labs to large companies, research is taking place with as final objective the deployment of innovative technologies. Considering that no single actor can alone bring forward the necessary step change, a collaborative approach to research is necessary, gathering actors involved at the different phases of the innovation chain. And a Public-Private Partnership approach is then very helpful to coordinate and plan the efforts, such as it is being done successfully by the European Commission with the PPP European Green Cars Initiative (www.green-cars-initiative.eu).

The changes in transport that will occur in the coming decades will be societal changes. The energies used in transport will evolve, in particular through progressive electrification. The vehicle designs will be multiplied, with new ones adapted to the new powertrains. New mobility services will be developed, integrating these different energies and vehicle types according to specific transportation needs. Also the integration of networks, between private and public transport, or between transport modes e.g. road and rail, should take place and bring to an end the today's fragmentation, which holds back the efficiency and the reliability of transportation from a user point of view.

An efficient and an affordable transport system is fundamental for Europe's economy. Also, because the transport industry is so important in the European economy, the evolution of the transport system will have large social impacts. With the developments of new vehicle concepts and powertrains, the automotive industry, with the multiple actors of its supply chain, and with its influence on many raw materials industries, will live important modifications of its structure, implying impacts on employment and changes on the skills required. This scenario is played moreover on an international perspective, where European actors have to position themselves globally, anticipating demands both within Europe and across the world. The role of Research and Innovation is therefore to bring efficiency to the transport system, to deliver solutions for tomorrow's mobility, but also to ensure a lighter future to Europe's economy.

ERTRAC on the move to TRA 2012 – In order to discuss research and innovation priorities for the transport sector, ERTRAC will participate to the TRA 2012 conference, held on 23-26 April in Athens, Greece. This major conference for European transport research, supported by the European Commission, will gather researchers from road but also rail and maritime sectors. More info on www.traconference.eu

An Idea conquers the world

Sattler AG is a traditional family-owned company with a long history. 30 years ago in 1981, the sector of biogas storage was revolutionised with our invention of the double membrane gas storage tanks.

The production of biogas has become an essential aspect of the sustainable-energy economy.

The applications are equally diverse and varied all around the world. The application of gas storage in sewage treatment plants, agriculture, and industrial facilities makes energetic use of the resulting “residual” biogas possible.

Since its development over 30 years ago, the double membrane gas storage tank (DMGS) in the form of a three-quarter sphere has been sold in more than 50 countries from Chile to China, and has brought the Environmental Engineering sector to life.

Protected by patents, Sattler AG continues to develop gas storage products and can offer the customer an optimal solution for their system concept.

Membrane technology from Sattler stands for 30 years of high quality, easy installation, long life, and reliability.

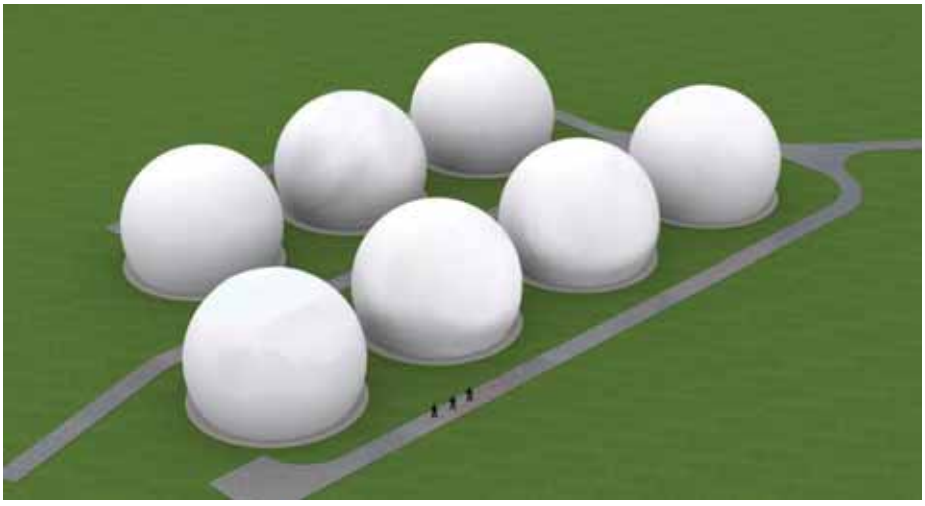
On the occasion of this year’s anniversary celebration, we have introduced our new slogan,”30 years of biogas storage”, beginning with the IFAT Shanghai, China in May 2011, and ending with the IFAT Munich in May 2012.

During our anniversary year, we have landed our largest contract in the field of wastewater treatment. Our double membrane gas holders will be used to store a total of 60,000 cubic meters. This is the largest plant ever built using membrane construction, at Atotonilco in Mexico

Wastewater from Mexico City flows into the Mezquital valley in the State of Hidalgo, some 80-km north of the Mexican capital. Here, although it has not been clean for over half a century, this polluted water is used to irrigate 80,000 hectares of agricultural land, posing a contamination risk to the local agricultural industry.

The treatment plant will have a maximum capacity of 42 cubic meters of sludge per second. The methane gas that is produced by the anaerobic digestion of sewage sludge will be converted into electricity in a cogeneration plant. With this power, the plant can cover its energy needs.

Double membrane biogas storage tanks.



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The BIOMAP: An indispensable tool

Julie Tolmie, Mapping Book
Kyriakos Maniatis, Principal Administrator, European Commission, DG ENER

THE BIOFUELS SECTOR: A COMPLEX AREA WITH A MATRIX OF NUMEROUS TECHNOLOGIES

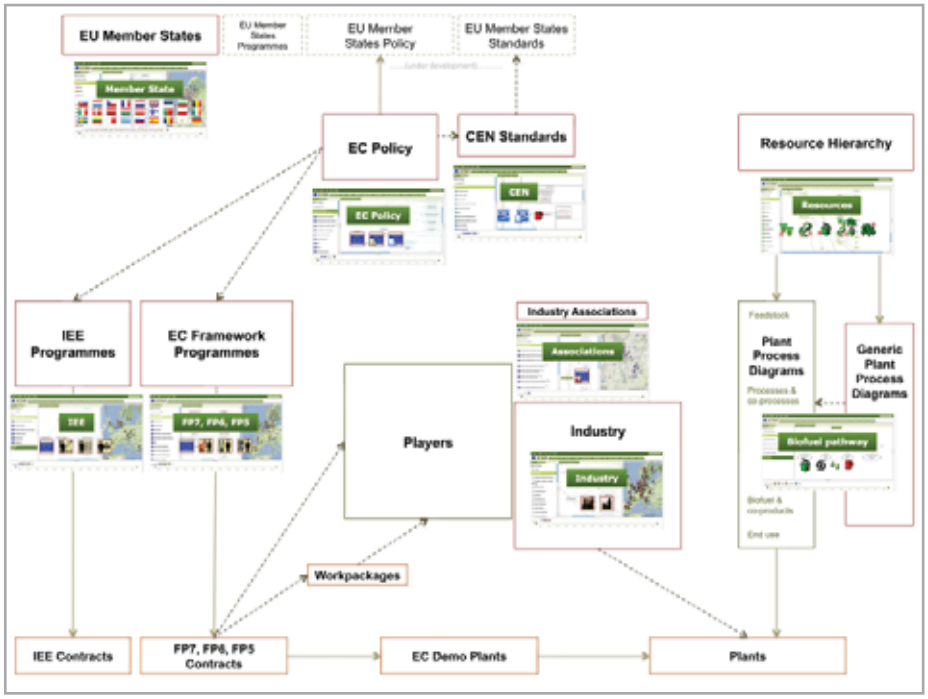


Fig 1 (top): BIOMAP Data & Visualisation Model, structure diagram

Fig 2 (bottom): Programmes, showing EC contracts and demonstration plants mapped geographically

Bioenergy in general is a very complex area and within bioenergy perhaps the most complex sector is that of biofuels. There are numerous technologies to produce biofuels for transport from practically every type of biomass available and these are expanding with new technological breakthroughs. Till few years ago bioethanol and biodiesel (fatty acid methyl ester, FAME) were the biofuels of interest, these were overtaken from the point of view of technology development by the so called 2nd generation biofuels aiming to produce biofuels from lignocellulosic biomass moving away from the grains, starches and sugars. Recently processes are under development to produce paraffinic biofuels from sugars and from microbial conversion.

Access therefore for qualified information is of paramount importance and need not only for the research community but also for the industry itself, the resource producers, Member States, NGOs and any other stakeholder.

THE BIOMAP

The BIOMAP is a biofuels information tool initiated by the European Commission (EC) in order to facilitate access to general but also specific information. The original objective was to provide information on the EC contracts supported under the various Framework Programmes (FPs) with main emphasis on the 7th FP. Soon it became apparent that more information could be added on commercial plants which had received no EC support at all, and with consistent efforts the information could expand to include data

on biofuel information

on biofuel standards, EC legislation, Member States institutions, information on various stakeholders such as associations, industry etc.

The work was based on various templates that were developed by the authors and experts from ePURE (the European Renewable Ethanol Association) and EBB (the European Biodiesel Board). These were sent for completion to the EC contract coordinators, commercial plant operators via ePURE and EBB, and representatives from the above mentioned stakeholders via the EC. The submitted information was incorporated in the BIOMAP by Dr. Julie Tolmie. When the EC contract was completed in October 2010, the BIOMAP was transferred to the Joint Research Centre SETIS (Strategic Energy Technology Information System) . The BIOMAP needs to be further updated with new information from the missing information but still at this stage provides valuable information to the reader. The EC aims to continue its population with information on all types of data.

THE BIOMAP STRUCTURE

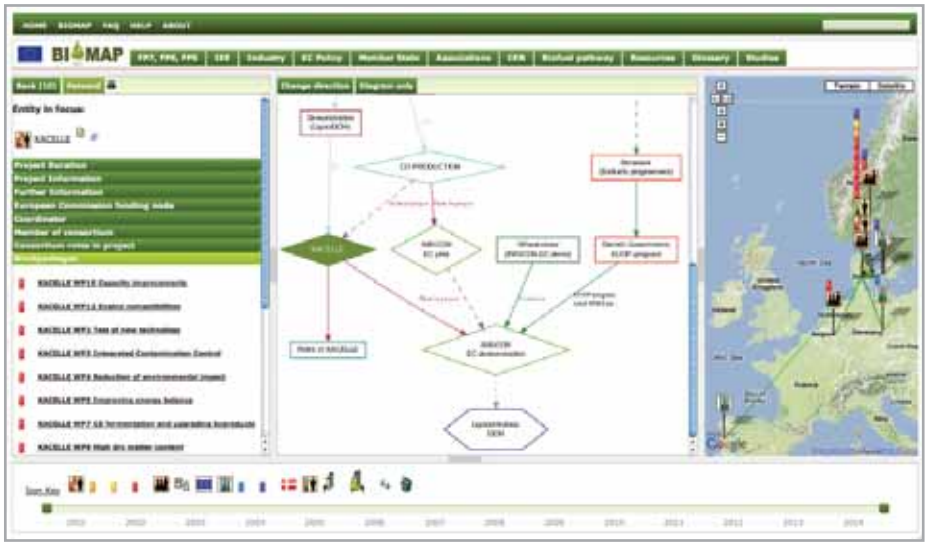
Basically the BIOMAP is structured on “players” who are linked together across and along the various sections of the BIOMAP. It has a Google map basis and several structures or “hierarchies” to facilitate the reporting of the information and its navigation by any person looking for information on biofuels. Active buttons facilitate access to key areas while links are provided to other sites wherever possible. The BIOMAP also has a built-in time function that allows the searcher to analyse information over a specific time window (in years) or a specific year. The overall structure is shown below.

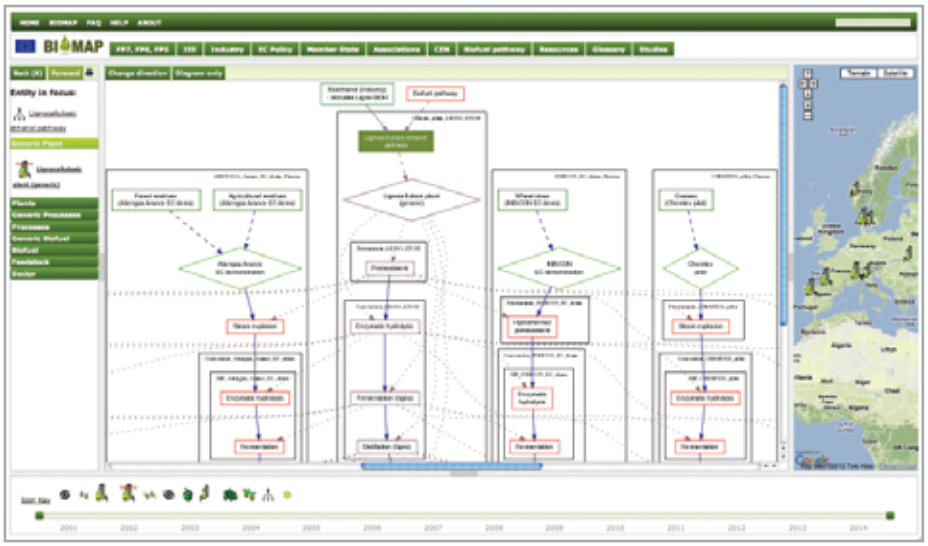
The structure of the BIOMAP has been designed to:

- enable an analysis of changes in funding priorities over time, eg new methods, new technologies

Fig 3 (top): EC contract, its workpackage icons stacked on top of workpackage leaders

Fig 4 (bottom): Player, its collaboration with other players displayed on the geographical map





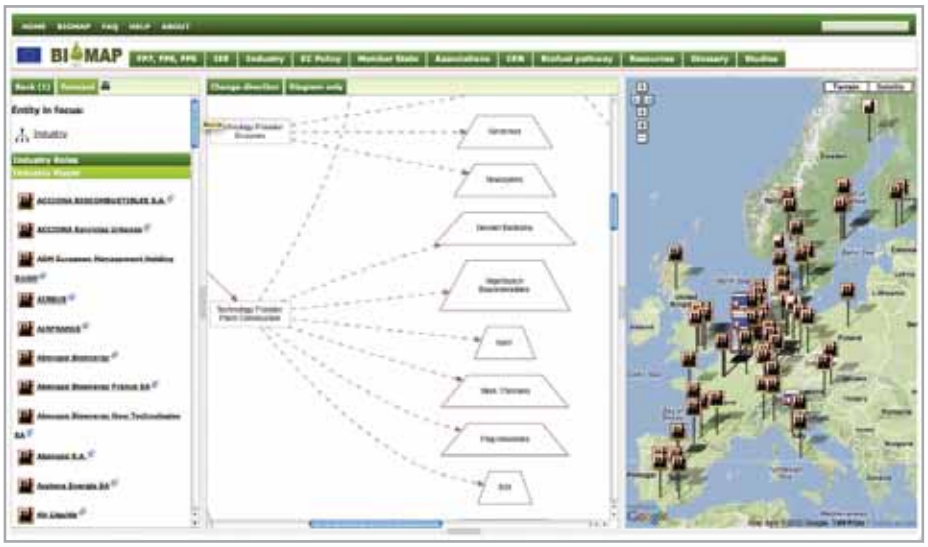


Fig 5 (top): Lignocellulosic ethanol pathway, generic process flow diagrams linked by process to three plant diagrams

Fig 6 (bottom): Industry map, uses non-geographical diagram to classify large industry players

programmes, the research questions and demonstration challenges posed, and the results obtained

- look for following uses of the same feedstock in different biofuel pathways using different processes and technologies
- assist in understanding the relationships between various EU Policies eg the Fuel Quality Directive and the Renewable Energy Directive
- compare the implementation of EU policies and and/or standards in different national member states

BIOMAP DATA AND VISUALISATION MODEL

SIX GROUPINGS

The BIOMAP Data and Visualisation Model shown in fig 1 has six main groupings: EC contracts, players, plants, programmes, policy and standards, resource hierarchy and biofuel pathways. The information for each member state can be considered to span across all of these six main groupings.

GEOGRAPHICAL VS NON-GEOGRAPHICAL ENTITIES

The first three of these groupings, EC contracts, players and plants, can be mapped geographically. In Fig 2 we see an entity in the BIOMAP, 'Programmes' where the EC contracts and the plants are mapped geographically on the map.

- look at different industry roles in the sector, for example starting from a player as providing technology to multiple plants mapped, the user can go back up through the industry hierarchy to look for other players who fulfill these roles
- assist consortia when writing a project proposal – a user can look across similar projects that have already been funded, vis a vis the structure of previous consortia and work

The other three groupings, the EC framework programmes, the policy and standards, the resource hierarchy and the biofuel pathways, cannot really be mapped geographically. They are non-geographical entities. For example Demonstration (LignoEtOH), Research (LignoEtOH), are categories under which EC contracts and plants are mapped.

EC CONTRACTS

Starting at the bottom of the structure diagram, EC contracts, in this case, FP7, FP6, FP5 contracts, are mapped underneath the EC framework programmes. The contracts involve workpackages which in turn involve players, which by virtue of the contract or otherwise will collaborate with one another. To see this in the BIOMAP interface, click (for example) on the project KACELLE, then open the workpackages heading in the list to display the different types of workpackages in which players collaborate as shown in Fig 3.

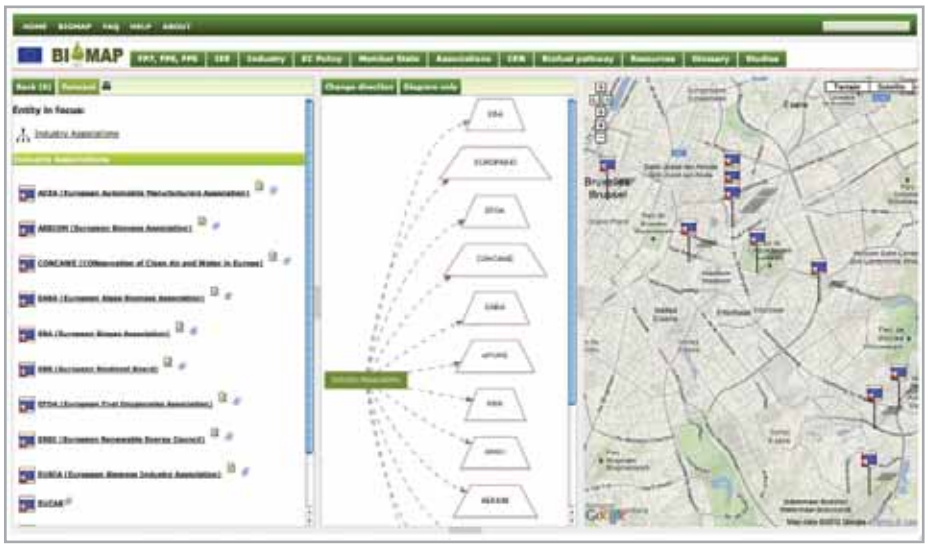
By selecting a member of the KACELLE project on the map, for example the German Biomass Research Centre, the non-geographical diagram shifts to display the projects of which they are a member, while the players with whom they collaborate with are now located on the geographical map as shown in Fig 4. In this way, when EC contracts are mapped, because of the relationships between workpackages and players, collaboration is mapped between the players, and navigation is enabled through the BIOMAP.

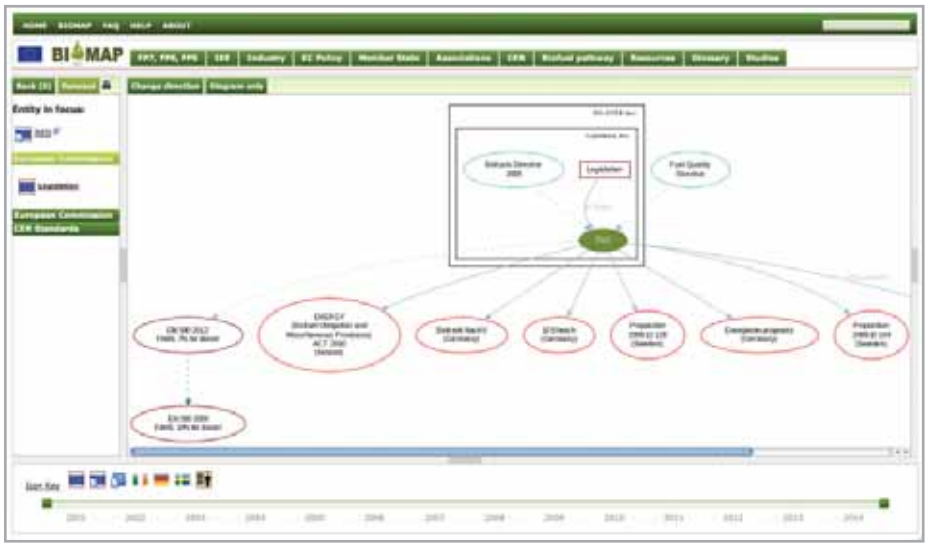
PLANTS

In the bottom right of the structure diagram are plants: these are demonstration plants if they are in EC contracts, but otherwise they are industrial plants. Each is located under a biofuel pathway, which is in turn located under the resource hierarchy.

Fig 7 (top): Industry Associations

Fig 8 (bottom): EC Poiicy, relation to other EC policies, to CEN standards, and to its implementation as legislation in a number of member states.





A biofuel pathway as shown in fig 5 is represented using process flow diagrams. These diagrams assist the mapping of similar structures and processes across all of the plants in each pathway. This approach enables the use of the generic process as an indexing structure for the occurrence of that process in all plants of that biofuel pathway. More generally, generic plants index the specific plants that are mapped.

PLAYERS

In the Industry map (Fig 6), large industry players are classified by type, for example as technology providers for: catalysts, enzymes, components, plant construction, or biomass conversion. In the case that industry players are linked to plants mapped in the BIOMAP as technology providers, plant owners, or plant operators these links are encoded.

Industry Associations (Fig 7) are included in the Industry map, but are also accessible from a dedicated Associations section in which further information is provided on each.

POLICY AND STANDARDS

The BIOMAP data and visualisation model contains a section on policy and standards. European Commission Policies are mapped under an EC Policy hierarchy structured by different Directorate Generals, for example Renewable Energy Directive (RED) is mapped under DG ENER.

On its non-geographical diagram (Fig 8), RED is located underneath another EC Policy, the Biofuels Directive 2003, indicating a (temporal) relationship between the two policies. RED is also linked to the Fuel Quality Directive, indicating a relationship from the Fuel Quality Directive of DG ENV to RED of DG ENER, across two different Directorate Generals. In addition, RED is linked to two CEN Standards, as links between EC Policy and CEN Standards, where they occur, are encoded into the BIOMAP. Finally RED is linked to its implementations in National Member State legislation, in the case that those Member States have provided information.

SUMMARY

In summary, the Data and Visualisation Model enables the different areas of the biofuels sector to be connected by the natural links that occur between the entities in the map. The players, of various types, are linked across all of the different areas: to programmes through the contracts, to plants through the functions of a technology provider, plant operator, plant owner, enzyme provider, to the plant process diagrams, and to generic plant process diagrams, by the type of process they are involved in, to the resource hierarchy if they are suppliers, to Policy and Standards, if they are Associations. In addition, players come from various Member States, so the players really are at the centre of the diagram.

However, the BIOMAP is not completed with all available information which is an ongoing process. When sufficient new information is collected the database is updated accordingly. Any organisation wishing to provide information to be included in the BIOMAP should contact the second author at Kyriakos.Maniatis@ec.europa.eu.

1. Mappingbook Ltd, London UK
2. The views and opinions expressed in this article are purely personal and cannot be held to reflect views of the European Commission or any of its departments
3. The BIOMAP was supported under contract FP7-2007-219042-BIOMAP
4. http://setis.ec.europa.eu/, see toolkit N°4 on the right hand site or use directly the url http://setis.ec.europa.eu/BIOMAP/

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MixBioPells: Enhancing the market relevance of alternative and mixed biomass pellets in Europe

Currently, small-scale combustion units in Europe are fired almost exclusively with high quality wood fuels. However, caused by the growing demand for material and energetic use wood is getting scarcer nowadays. Consequently, alternative solid biomass, like low quality wood or straw, is experiencing growing interest as alternative fuel source. In most European countries preliminary activities in industrial as well as in public sectors have been started to integrate these alternative solid biofuels. However, the market integration of alternative biomass pellets is still hindered by various constraints. To overcome these constraints and to strengthen the drivers the transnational project MixBioPells was initiated. Moreover, the aim is to identify promising market introduction concepts and to enhance the relevance of alternative pellets in Europe.

There are significant differences for the types of the available raw materials and the local frameworks in the European countries and even between the regions of one country. Thus, the situations in seven European regions are analysed. Local bio-business activities will be supported based on a close cooperation with local key actors amongst the whole supply chain. The objective is the development and the creation of regional case studies to gather information about successful technical developments, available raw materials, basic and economic conditions and problems during the build-up of new regional bio-business activities. To ensure a transferability of the results of each region, the current situation concerning technical possibilities in production and utilisation of alternative and mixed biomass pellets in the European partner countries are monitored and summarised. This includes national conditions and available pelletising and combustion technologies which are investigated by literature research and market surveys as well as interviews with key actors.

Finally, the regional conditions and technical solutions are compared with the accordant national frameworks to identify common constraints and drivers.

Harvesting of grapevine pruning (left) and storage of chipped material (right).
Source: MixBioPells Biomass Report, 2011 (www.mixbiopells.eu)

Fuel Mix

Combustion Flame

mixBioPells

Market Implementation of extraordinary biomass pellets

On this basis, recommendations on favourable legal frameworks are given and regional concepts for the market implementation of alternative pellets with regard to the existing frameworks are developed. The results will be included in the MixBioPells "Initiators Handbook". Advisory papers for EU politicians and politicians and stakeholders in each partner country will be provided shortly. Furthermore, a labelling system for alternative pellets and combustion systems with regard to possible concepts for the distribution of alternative pellets and the implementation in existing legal frameworks is under development in close cooperation with the European pellet Council (EPC). To increase the market implementation of alternative and mixed biomass pellets, a website including a searchable and multilingual database with facts and figures related to alternative pellets in different European countries and side-workshops are organised at national and international conferences. Thus, the MixBioPells project provides up-to-date market information as well as an "Initiators Handbook" based on a comprehensive data collection for representative European countries and regions. The latter will help bio-business initiators to start initiatives in the field of production and combustion of alternative and mixed biomass pellets.

All information is available at www.mixbiopells.eu.

Miscanthus pellets

Source:MixBioPells Best practise example production / Germany, 2011 (www.mixbiopells.eu)

Almond shells

Source: MixBioPells Biomass report, 2012 (www.mixbiopells.eu)

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News

A bio battery that runs on waste paper...

Japanese electronics giant Sony has been working on biologically-powered batteries for some time, and it recently unveiled a prototype battery powered by waste paper.

The system generates electricity by turning shredded paper or cardboard into sugar, from which it appears possible to generate sufficient current to charge portable mobile devices. Sony estimates that a single sheet of paper may be able to provide the equivalent output of no fewer that six AA batteries.

This novel technology takes its cue from nature in a most interesting way: the enzyme cellulase is used to digest shredded paper and cardboard, and so produce glucose.

Further enzymes are then used to combine the glucose with oxygen, so releasing electrons and hydrogen ions: it is the subsequent movement of the electrons that constitutes an electric current.

Researchers involved in the project have compared this process to that used by termites to digest wood and turn it into energy.

Apart from potentially consuming a waste product, the process appears to have at least one other green benefit: one of its by-products is the compound gluconolactone, a food additive (E575), which also finds a use in cosmetics. The other by-product is water. According to Yuichi Tokita, senior researcher at Sony's Advanced Material Research Lab. "Of course, this is still at the very early stages of its development, but when you imagine the possibilities that this technology could deliver, it becomes very exciting indeed."

...and another that runs on waste water

Researchers from Pennsylvania State University have built a prototype device that they say can generate electricity from waste water. It has already been shown that electricity may be generated from the salinity difference between salt and fresh water with a technique known as reverse electrodialysis (RED); and scientists in the Netherlands have been exploring the idea of using RED to generate renewable power along the country's coastline, where rivers meet the sea.

Now, the Penn State research team, led by Professor Bruce Logan, has combined one RED technology with another: microbial fuel cells (MFCs), which create an electric current from organic matter in solution.

EEI has previously featured the production of electricity from urine in this way, but Professor Logan's team used waste water in their system. They also replaced the salt water with ammonium bicarbonate solution, meaning the system could now be put to work far from the sea. According to Professor Logan, using the two technologies in this fashion serves two purposes: the first is the treatment of the waste water and the second is increased generation of electricity.

He adds that the process could potentially be used to provide both clean water and power to communities in developing countries.

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