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Connecting Europe's Stakeholders in Energy and Transport

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Includes editorial contributions from:

Kathleen Van Brempt
MEP

Arnulf Jäger-Waldau
European Commission

Professor Joeri Van Mierlo
Director of MOBI

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OÖENERGIESPARVERBAND

CONTENTS


6


12


24


34


46


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Foreword

Welcome to the Autumn Issue of EEI: it has been an eventful summer! As proud media partners of the European Sustainable Energy Week we note this year's impressive figures: over 2290 participants and 399 speakers at 63 policy sessions; 16 permanent exhibitors and 34 Networking Village activities. Meanwhile, The New York times reported US President Trump's announcement of his country's withdrawal from the Paris climate accord. He stated that he had been "elected to represent the citizens of Pittsburgh, not Paris": climate change being a global phenomenon, the irony of this statement seemed somewhat lost. Elsewhere, formal Brexit negotiations now generate much hot air of their own: irony, it seems, is in short supply.

Our readers can reacquaint themselves with Arnulf Jäger-Waldau's mastery of detailed figures, logic and argument as he explains why Europe needs more PV. Europe must generate as much as half of its electricity from renewable sources to meet its own 2030 targets, and an even higher proportion by 2050. Against a fall in PV installation, he concludes that the size of this market must triple if we are to breathe life into the Paris Agreement. An article from Kathleen van Brempt MEP, who chaired the Dieselgate inquiry committee, urges us not to waste that crisis: she advocates increased electrification of transport, before cautioning that the emerging disparity between US, Chinese and EU NOx emission standards has implications for vehicle sales. Referring to the growing number of countries committing to phasing out ICEs, she calls for a "progressive legislative approach" to transport emissions. Elsewhere, Professor Joerli Van Mierlo provides us with the challenging thought that, were they to run on sustainable electricity, EVs could reduce CO_2 emissions by a factor of 19. "This", he says, "is the way to go". His article does not however forecast how many EVs will be on the road by 2050. That, he argues, might better be answered by asking how many we might need.

Rémi Mayet examines how EU Ports policy may contribute to the decarbonisation of Transport. Noting the importance of shipping to European jobs and its economy; and that both the size and number of ships are likely to increase, he discusses the legislative landscape, State Aid, alternative fuels and the simplification of information reporting, before concluding that the greening of Ports offers great potential in the energy transition. Echoing the theme, Brian Simpson explores how Motorways of the Sea, which form part of the EU's TEN-T policy, can contribute to environmentally-friendly shipping. He illustrates how the CEF supports MoS with projects involving alternative fuels such as LNG and methanol; and Zero Emissions Ferries.

In sombre mood, Seán Kelly MEP reviews the impact of Brexit upon Ireland's energy supply. There is, he argues, no upside – the question is how bad it will be. Noting Ireland's dependence for its gas upon the Moffatt Interconnector from Scotland, and her likely increase in demand for gas, he examines the potential of LNG for the only EU country with a land border with the departing UK. He concludes that the more independent Ireland can be, the better the prospects for the EU as a whole.

There is no irony at all in that conclusion, just a lot more for you to read inside…

Michael Edmund
Editor

Never waste a good crisis: how Dieselgate must encourage us to leapfrog right into the electric era

By Kathleen Van Brempt (pictured), MEP, Former chair of EMIS ("Dieselgate" inquiry committee)

We are at the dawn of a new era of electrified, autonomous and shared mobility. The advantages of electric driving are overwhelming. Electric vehicles are super convenient, chargeable at home or at work, quiet and clean and don't fund oil dictatorships. In combination with renewable energy, they will contribute to the decarbonisation of transport, helping us to meet our climate targets.

The question is not whether this revolution will take place, but when, at what speed and whether the European industry will play a role in the value chains that will underpin it. Speeding up the electrification of transport will enable Member States and cities to reduce air pollution in order to meet the European air quality standards. It will help the EU to deliver on its promises made at the COP21 Paris Climate agreement. Imagining them as "computers on wheels", electric vehicles are well suited for car sharing services.

Speeding up the electrification is of the utmost importance for European industries. If they lag behind in this revolution, they will soon loose market shares once electric cars or mobility services become cheaper than combustion-engines. If we are not able to bring European industries at the forefront of the new powertrains and batteries, future markets will be flooded with imported cars and business models. EU manufacturers will end up in a sunset industry.

To foster the electrification of transport, we need to cross the "valley of death" between laboratory and market. This needs both a technology push and a market pull. We need more targeted strategic investments in research and development of battery technologies, battery recycling, 3-D

printed parts and logistics, electric power trains, interconnected mobility services... to move forward. On the other hand, demand must be ramped up via green public procurement – purchasing of electric vehicles by public authorities for own use or for public car sharing programs – and via Zero Emission Vehicle (ZEV) quotas for car manufacturers. These measures must create the needed scale to decrease the costs, rendering electric cars affordable for consumers. An increasing share of e-cars (imposed via ZEV quotas) obliges car manufactures to develop them for lower income groups and not only for the premium segment.

Politics is catching up. More and more countries are announcing measures to phase out the internal combustion engine. Next to Norway, also France and the UK wants to get rid of the dirty tailpipes. The European Parliament voted with an overwhelming majority the recommendations on clean cars policies made by the EMIS inquiry committee that I was privileged to chair. These voted recommendations[1] call for the introduction of Zero Emission Vehicle (ZEV) mandates in the upcoming proposal on CO_2 standards for cars and vans "with the aim of phasing out new CO_2-emitting cars by 2035". The Commission is following cautiously. In its Communication on the Mobility Package – "Europe on the Move" – it expresses its intention to consider the inclusion of specific targets for low and/or zero-emission vehicles in its upcoming proposal on the post 2020 CO_2 standards. CO_2-standards for heavy duty vehicles such as lorries, buses and coaches are also "under consideration". Also here, the EU risks lagging behind since fuel economy standards for heavy duty vehicles were already introduced in other parts of the world, such as in the US, Japan and China. In the decarbonisation of the heavy duty transport, electrification will only be part of the solution. For long distance transport, other technologies such as fuel cells and alternative fuels will have to play a role.

The EU must learn to see legislation as the standard bearer of new technology. ZEV mandates were first introduced in the Clean Air Act in California, before ZEV technologies even existed. European manufactures must learn to bring their technology in line with the legislation we want instead of trying to get our legislation in line with the technology they want.

Without EU policies that force the European car industry to move ahead, our industry will face a "clean-tech leakage". This might even be the case for these manufacturers that keep on swearing by the diesel technologies. The emission limit standards for NOx in the US are already more stringent than the Euro 6 standards applicable in the EU. And a new policy briefing of the ICCT[2] shows that from July 2023 onwards, the Chinese emission standard for NOx will lay significantly below the Euro 6 level. From that date on Chinese cars will be saleable in the EU, but European cars could not be sold in China.

A progressive legislative approach tackling both CO_2 emissions and the emissions of air pollutants in our car fleet is imperative to preserve the competitiveness of our industry and to protect the environment and public health. As former Commissioner Potocznik said in an EMIS hearing: "We end up killing industry with kindness by giving in to the calls for less ambition, longer time to achieve it, and allowing loopholes." Let's hope this lesson from Dieselgate is learned. ●

1) http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+TA+P8-TA-2017-0100+0+DOC+PDF+V0//EN
2) http://www.theicct.org/sites/default/files/publications/China-LDV-Stage-6_Policy-Update_ICCT_20032017_vF_corrected.pdf

Brexit and Ireland's energy supply: time to look seriously to LNG?

By Seán Kelly MEP (pictured)

The United Kingdom's decision to leave the EU has brought with it significant uncertainty that has been well documented at this point. There is no EU Member State that stands to be more affected by Brexit, and the ongoing negotiations, than Ireland. With the Irish and UK economies still closely linked, particularly in terms of trade, for Ireland there is no upside to Brexit - the question is, how bad will it be? One area that has been given less media attention thus far, yet is probably one of the key issues in the Brexit talks is energy, and particularly how Ireland will be impacted.

Ireland currently has two main sources of gas supply - the Moffatt Interconnector from Scotland, and the Corrib gas field off our west coast. Up to recently, Ireland was around 95% dependent on the Moffatt Interconnector for our gas supply. While Corrib gives us some temporary relief from this almost total dependence, we will likely be back to that situation again sometime in the mid-2020s as the Corrib resource depletes. During this time, according to Gas Networks Ireland, our gas demand is set to increase – likely by around 30% by 2025. This increase will be mainly due to a move away from coal and peat, and indeed the completion of the North South Interconnector between Ireland and Northern Ireland, creating additional gas demand in the power sector.

This projection also accounts for the expected drop in residential demand due to increased energy efficiency, demonstrating that the expected additional contribution of gas to the Irish power mix is significant. On top of this, as part of the Clean Energy Package, the Commission proposes to put an emission performance limit on electricity capacity payments, which would effectively rule coal out of such subsidies. It is clear, therefore, that for Ireland, as an island country, gas will continue to have a crucial role in the medium term at least. Maintaining a secure and competitive supply will be vital for Ireland's economic prosperity post-Brexit.

A key point here is that we are not fully clear exactly what impact Brexit will have on the Irish energy system. While we do not necessarily have an impending security of supply crisis, some interesting points made by commentators recently raise some important concerns. Firstly, the UK will no longer be under the same regulatory regime as the EU, nor under the jurisdiction of the European Court of Justice.

Regulatory divergences down the line could put additional costs onto the gas that Ireland imports. Additionally, as pointed out recently by Dr Thierry Bros of the Oxford Institute for Energy Studies, imposing regulations on EU-UK pipelines to push up UK energy prices could be tempting for some EU Member States seeking to increase their competitiveness against the UK, something that would not be in the interests of the Irish energy consumer. Similarly, Ireland's security of supply is something that the UK could potentially use as a bargaining chip in Brexit negotiations; the UK is well aware that EU negotiators cannot put at risk the energy security of one of their most pro-EU members.

A diversification of Ireland's supply would therefore seem to be very much in the interests of the EU-27.

The IEA's recent report "Gas 2017" offers some very interesting insights into global gas markets and their rapid development. Gas demand is expected to grow by 1.6% year-on-year to 2022, with the growth in LNG supply capacity predicted to grow at a faster rate than global demand. The most interesting parts of this report relate to the development of US LNG exports. US production is expected to increase at an annual rate of 2.9%, and this is bringing changes to the international gas market. LNG is creating competition with pipeline gas, and price and contractual rigidities are softening.

While piped gas will continue to dominate the European market, LNG now offers significant market benefits, as well as an option to diversify supply and to mitigate the risk of shortages. Improving the EU's capacity to buy LNG on the global market - which includes the better utilisation of existing regasification capacity - will increase flexibility and exert downward pressure on the European gas spot prices, to the benefit of EU consumers and industry.

With Brexit, Ireland's case is slightly different and arguably more pressing given our reliance on a country currently preparing to leave the EU. An LNG terminal in Ireland would reduce our exposure to any potential supply shocks; lest we forget, Ireland's storage capacity is limited, and post-Brexit, the UK will not be subject to EU solidarity rules on security of gas supply. Most importantly though, the option of LNG imports could shield us against the effects of some of the longer-term market uncertainty I have mentioned above. An LNG terminal would bring market flexibility and enhanced supply security for Ireland and ultimately contribute to further eliminating our historical economic dependence on the United Kingdom.

The European Commission's Projects of Common Interest (PCI) offer probably the best solution as Brexit looms. The proposed Shannon LNG terminal in Co. Kerry on our South-West coast has been identified as a key project for the completion of the internal EU gas market, and in the context of Brexit I feel that this project now becomes more of a priority. The project offers a ready-made solution to all of the above, and I believe that it is time for political leadership to ensure that the project comes to fruition as soon as possible. The more independent from the UK the Irish economy can be, the better the prospects for the EU-27 as we face into two more years of Brexit negotiations.

REEMAIN project, paving the way to sustainable manufacturing of biscuits, denim fabric and cast iron parts

By Anibal Reñones, REEMAIN project coordinator (pictured)

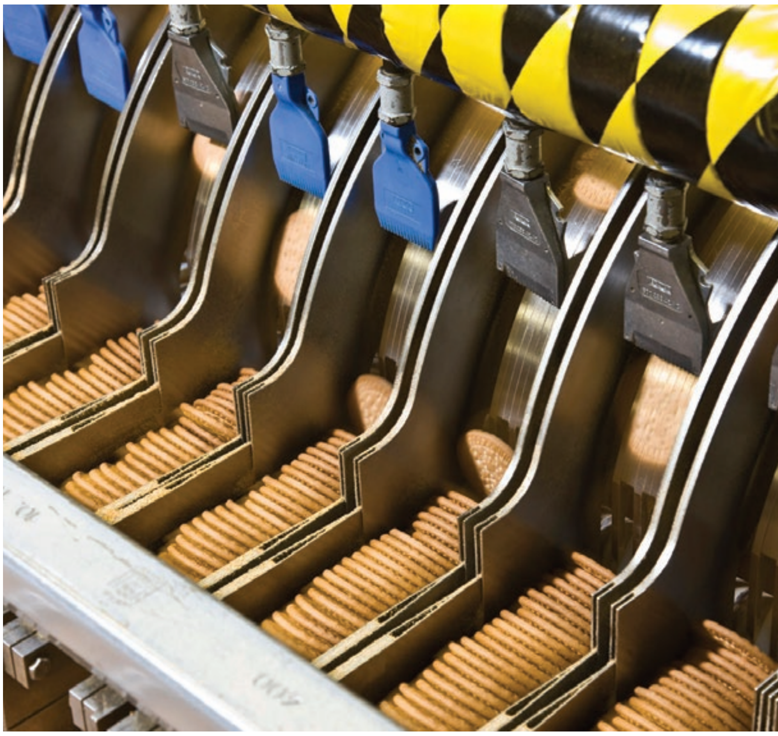
REEMAIN is an FP7 project about resource and energy efficiency solutions for factories. We have designed and tested during the last 4 years several innovative solutions in 3 different factories (cookies, textile and foundry) to prove that production can remain efficient and sustainable, while cutting energy bill and CO_2 emissions. We intended to reach these goals through waste energy recovery, production optimisation and integration of renewables. Along the project, factory owners faced energy efficiency improvement in a new way. Usually, companies buy solutions. In REEMAIN we made the factories the main characters, collaborating with them, exploring the options for efficiency, helping them choosing the best solution and then making an evaluation without bias. One example of tested technologies can be found in the biscuit factory where we took advantage of outside cool air and save an enormous amount of electricity used for water-cooling. Airside Free-cooling is a well-known technology for buildings but their usage into a factory is challenging because the temperature limits are very strict and may affect the final product. Factories use to prefer a simpler (although more inefficient) 24x7 electricity-based cooling water system rather than a more complex system capable of taking advantage of the outside renewable cool air. The appropriate control of this energy technology is key. In the textile factory, we tested the impact of organic raw materials on the production processes and the use of carbonic acid instead of sulphuric acid for the wastewater treatment. The key here was achieving higher levels of sustainability and reduction of environmental footprint, without compromising quality and energy spent.

One of the most challenging objective was the integration of renewables. Due to high costs, poor ROI and self-consumption legal uncertainties, we did not integrate renewable electricity into factories. It i s more a market constraint than a failure. Indeed, from the technical point of view, direct integration of small-medium shares of renewable electricity into a factory is quite simple, but lot needs to be done at political level to foster the wide adoption of renewables in the manufacturing sector. Another challenge was to recover heat from the cupola furnace in the Foundry factory. The high variations of temperature and the harsh environment created by the exhaust fumes put a lot of pressure on the heat exchanger materials and on the control needed to recover as much as possible waste heat. Current foundries need to waste a lot of energy to cool down the exhaust fumes of their furnaces. Hence, when the exchanger technology is mature it will have a huge impact on these industries.

Among the different solutions created, we are particularly proud of the simulation tool software that relies on information such the technical description of the factories including the envelope and how the different machines are interconnected and create their products (cookies, metal pieces or cool denim fabric in REEMAIN). The tool also relies on data about production history and energy use. With this information, the tool analyzes the working profiles and gives the manager a preliminary advice where to save energy and resources. Having identified these efficiency spots and taking advantage of a digital model of the factory, one can simulate different solutions, like a PV solar roof. The simulations provide its optimal size so it covers enough electricity demand and have an appropriate ROI. In this case the tool informs about the percentage of renewable electricity coverage and when is happening according the manufacturing schedule. Therefore, the tool allows you to mix your real factory with "virtual" solutions before commit an investment.

Apart from the technical solutions tested, we are compiling into an e-book a set of best practices that gathers interesting practical experience gained during our project. For example, the installation of efficiency measures into the factories has brought to the surface quite a large number of small faults and mismatches in existing measurement and control systems. The fact that one system provides the required energy does not mean necessarily it is performing in the most efficient way.

The final suggestion from our side to factories is that they should embrace the change when it comes to energy efficiency and rely on internal experience and energy use data. Data is highly relevant to find opportunities for improvement. As Peter Drucker said "If you can't measure it, you can't improve it".



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Interview with Daniele Agostini

Daniele Agostini, Vice Chairman EURELECTRIC WG Energy & Resource Efficiency and Head of Low Carbon and European Energy Policies, Enel

Q A lot of progress has been made to reduce overall levels of greenhouse gas emissions in Europe. However, emissions from transport continue to rise. What do you think is the key solution to cutting emissions from this sector?

Indeed, transport is responsible for about a quarter of EU greenhouse gas (GHG) emissions and it is almost exclusively dependent on oil for fuel. It is actually the only major sector in the EU in which GHG emissions are still rising – this is why it's crucial now to put a special focus on the transport sector.

Even though much can be done in areas such as logistic optimisation and light weighting, we see the electrification of transport as the only solution to move forward. I am not speaking only about passenger cars, but also about light and light duty vehicles, as well as buses.

Battery electric vehicles reduce drastically the GHG emissions of road transport. They do not have any tailpipe emissions and all emissions linked to power generation are subject to the EU ETS and thus capped. Even if we wanted to count these emissions as transport emissions, with the current European power mix, electric passenger cars emit 50gCO_2/km[1], already significantly less than the 2021 fleet emission limit for new cars of 95gCO_2/km.

In 2016, the average emissions of new cars sold was still 118gCO_2/km[1]. Although there is still some room for improvements in internal combustion engines, they will not be sufficient to get us even close to decarbonisation of the transport sector. Let us also not forget that other pollutant emissions, such as nitrogen oxides and dust, major causes of smog in our cities, can be drastically reduced by switching to electric cars, delivering an additional big plus for air quality improvement.

This is becoming increasingly urgent as according to the 2016 EEA Report on air quality 85-91% of the EU urban population is exposed to concentrations of PM2.5 above the WHO guideline value (data refer to 2012-2014). Poor air quality needs to be addressed as it causes serious problems to human health, making it the number one environmental cause of premature death in the EU. The European Commission[3] estimated that total health-related external costs of poor air quality in 2013 were in the range of €330–940 billion.

Q What role do you see for the electricity industry now and in the future in contributing to the transport emissions challenge?

I believe that the electricity sector has come a long way in its transformation towards low carbon generation. In 2015, we generated 56%[4] of all the EU's electricity from carbon free sources and this share continues to increase every year. We are investing widely in low-carbon and innovative solutions to achieve our commitment to deliver carbon-neutral electricity supply by 2050, and this year we have stated our intention not to invest in new-build coal-fired power plants after 2020. Therefore, electrification is the obvious choice for driving the decarbonisation of the transport sector.

We are therefore committed to provide a decarbonised transport fuel. But in order to continue this process of decarbonisation, we need to engage openly with non-energy industries, such as automotive, construction and ICT, to create value outside our traditional boundaries. The transformation that we are all facing requires collaboration and coordination among industries


Daniele Agostini

and among countries to create a more efficient system. It is the only way to upscale and accelerate the emission reductions effort required by the Paris Agreement. Such cross-sectorial partnerships are already blooming, with many Eurelectric members playing a key role in their creation. Public policy should catalyse such process by promoting initiatives supporting collaboration across sectorial boundaries.

Q We are waiting for the second part of the Mobility Package from the European Commission. What do you expect from the package? What actions are now needed at the EU level to boost electrification and the transition to low carbon transport?

We expect clear, long-term and ambitious CO_2 emission performance standards that will lead to the accelerated uptake of zero emission vehicles. These standards will also send a strong political message while ensuring long-term investment and innovation. They must be properly verified and set on vehicles actually sold, not only on vehicles offered on the market.

We call for the introduction of mandating quotas on vehicle manufacturers in order to ensure that a proportion of their car sales is made up of zero-emission vehicles. Such provision would give a great boost to EVs early deployment, offering both manufacturers and infrastructure providers a clear signal on the direction Europe is taking.

If we can be sure that electric vehicles deployment will speed up in the coming years, investments in charging infrastructure will also speed up.

Therefore, overall, we want to see an integrated approach to electro-mobility. We see that there is huge potential in smart charging infrastructure. Careful management of the charging process will not only help to optimise grid usage, but also facilitate the integration of intermittent renewable sources. Obviously, the power sector holds a lot of expertise that will be extremely valuable in this context.

Q Why is it important to keep an integrated approach to electro-mobility?

Europe has to meet several targets on decarbonisation, energy efficiency and RES integration. We have to keep this in mind and consider EVs when it comes to reaching various EU targets. For example, electric engine is up to five times more energy efficient than corresponding internal combustion engine.

Moreover, according to Transport and Environment, EVs are by far more efficient than to other alternative fuels vehicles, considering the well to wheel efficiency (i.e. 73% EVs vs 22% Hydrogen and 13% Power to Liquid). EVs are thus an important contributor to reaching the EU's efficiency targets.

In addition, EVs will help us integrate the ever-increasing generation of renewable energy and store it in their batteries. EVs will be enablers and benefiters of a smarter energy system, which is already developing. For instance, Smart Charging and Vehicle-to-Grid (V2G) technologies allow EVs to provide flexibility services to the power system: depending on grid load conditions and network operators' demand for grid services, they could either modulate their charging rate. or even return to the network previously stored electricity.

At the same time, an integrated approach also means to support the development at different levels (European, national and local). While CO_2 standards are valid at European level, the Alternative Fuels Infrastructure Directive obliges Member States to ensure the installation of a certain number of refuelling points for alternative fuels. Last, but not least, the upcoming revision of the Clean Vehicles Directive, is set to increase the public procurement of clean vehicles.

It is critically important for policymakers to realise the need to avoid the risk of working in silos. Transport policy making needs to increasingly work together with energy and environmental policy making. Policy coordination needs to rapidly evolve in seamless policy integration. As mentioned earlier, cross-sectorial public policy and industrial planning will become an imperative to meet the challenges posed by the Paris Agreement goals.

Q Who do you think will be dominating the future market for EVs?

Time will tell. What I can say is that the European car industry is capable of leading the transition if it focuses on innovation and does not shy away from the challenge. Other markets, which have had ambitious low-emission legislation for several years, are now leading, but I see positive signals that some European manufactures have started to take this seriously and catch up. They do have the potential "to be at the table rather than on the menu", but it is fully up to them to realise it. Part of it will be building winning partnerships with players from "adjacent sectors" such as power and ICT, a process that is already taking place as we speak.

Our sector calls for open and competitive markets for the electricity industry and I believe this should apply for the automotive industry as well. However, a robust market framework and investment security is necessary and this is why we call for strong and stable CO_2 emission standards for new cars and light duty vehicles for the post-2020 period. If car manufactures can rely on such a framework, these standards will be progressively tightened and they can be sure that investments in electric vehicle production will pay off.

1) Assuming a consumption of 15kWh/100km, and a CO_2 intensity of power generation in Europe of 331g CO_2/kWh. Power intensity based on EURELECTRIC Power Statistics, December 2016.

2) European Environmental Agency (EEA): Fuel efficiency improvements of new cars in Europe slowed in 2016, April 2017.

3) European Commission Staff Working Document (2013), Impact Assessment – Accompanying the Clean Air Programme.

4) EURELECTRIC Power Statistics, December 2016.

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In 12 learning modules – 5-7min each – the players can gain knowledge in areas such as:

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The outstanding success and positive feedback of German speaking industrial and teaching stakeholders all over Europe motivated us to grow this towards an European learning and qualification platform. We would like to:

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The global megatrend of urbanization is creating metropolitan areas that pose an enormous challenge to supply logistics.

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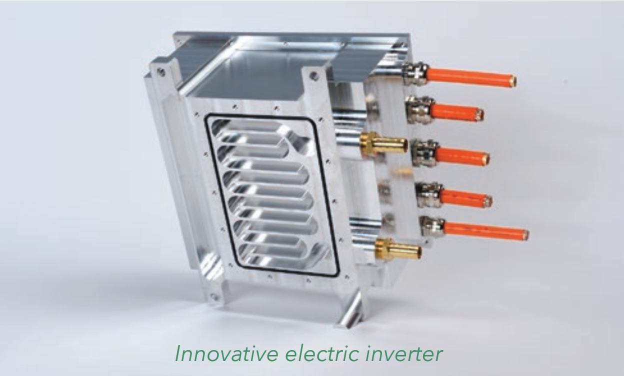
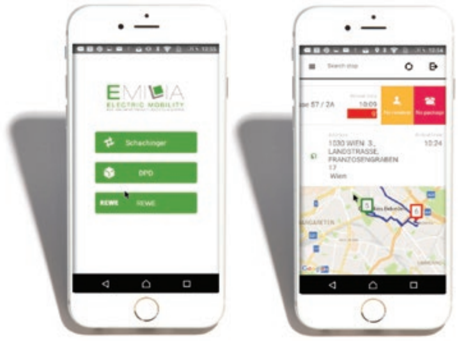
- Innovative components for light utility transport vehicles distinguished by avoiding the use of rare earth metals in the production
- Smart routing algorithms for the best possible and most eco-friendly use of electric vehicles in urban logistics
- Electric cargo tricycles with innovative tilting & springing technology for a better driving dynamic, more driver safety and lower dropping costs for the use in food delivery and parcel distribution.


Innovative electric inverter


Smart routing application

Electric cargo tricycle

powered by klima+energie fonds

Electric vehicles: sparking your interest

While climate change sparks interest in electric vehicles, it raises questions as well. Professor Joeri Van Mierlo (pictured) from the MOBI research group at Vrije Universiteit Brussel tackles them one by one.

Climate change, local air pollution and the economic dependency on imported oil requires solutions to these severe issues. The transportation sector is responsible for more than 20% of the global warming emission, more than 50% of the NOx emissions in Europe and 25% of the PM emission, harming our human health. Another striking figure is the billon a day Europe is exporting out of its economy to import crude oil. Without no doubt, we must find alternatives in the transportation sector.

Modal shift from passenger cars towards walking, biking and public transportation is needed. But as the use of private cars is a dominant transport mode, one needs to find technical solutions for environmental friendly vehicles too.

ARE ELECTRIC VEHICLES REALLY THE BEST SOLUTION FOR THE ENVIRONMENT?

The short answer is yes. When discussing environmental impact, it is important to take into account the full life cycle of a vehicle. We have developed at the Vrije Universiteit Brussels reliable scientific models for this purpose. This allows looking beyond emissions from the vehicle itself to the environmental impact of batteries, the production of electricity and beyond.

In a full life cycle, electric vehicles emit **two times less** carbon dioxide (CO_2) in comparison to diesel engines if we take the European electricity mix. This can be even 4 times less is we take for example the Belgian electricity mix. If cars were driving on sustainable electricity, carbon dioxide emissions could be further reduced by a factor of 15. And this is the way to go.

If we look at vehicles from a "well-to-wheel" perspective, electric vehicles produce four times less particulates and **20 times less nitrogen oxides** (NO_x) (Belgian example) compared to conventional vehicles. However, we need to stress that the exploitation and mining of raw materials in South America and China leaves much room for improvement. **Recycling** can further reduce the environmental impact. Car manufacturers have already made considerable efforts to reduce emissions of conventional cars in general however; reducing NO_x remains a challenge, in particular for diesel vehicles.

As far as CO_2 goes, diesel engines exhaust 20% less in comparison to petrol. Yet the difference between both fuels is annually decreasing. Also **biofuels** produce 40 to 60% less greenhouse gasses, but they do not significantly improve air quality. Moreover, we need surfaces as large as 2 football fields to power one car per year. We do not have the space in Europe and would therefore move this

supply problem to other countries with many undesired side effects.

There are other fuels such as natural gas or liquefied petroleum gas (LPG). They have a less negative impact on air quality and are thus better for our health. On the other hand, however, they do not offer a real solution for climate change. In order to counter climate change we need to switch our entire transport and energy sectors to non-fossil fuels. Electric vehicles have the potential to drive on solar and wind power.

It is not so easy to compare all the alternatives. But fortunately we have scientific methods to do this for us, namely life cycle analysis models (LCA) to compare all these factors in an unbiased way. If we take into account both climate change and air quality, the difference between petrol, diesel, LPG and natural gas driven cars is minimal. Hybrid and plug-in hybrid vehicles can improve scores with a factor two. The overall environmental impact of battery-electric vehicles can be up to **five times smaller** than conventional fuels, in case we consider for example the Belgian electricity mix.

Sometimes we hear that **hydrogen** is the true and only zero emission solution. Yet, also hydrogen needs to be produced. If we produce hydrogen with natural gas there is no advantage as far as greenhouse gases go. So you need to produce hydrogen from sustainable energy sources such as wind, sun or water. But the problem is that you need **three times more wind turbines** to drive a hydrogen-powered car in comparison to a battery-electric vehicle.

HOW DO ELECTRIC VEHICLES AFFECT OUR ECONOMY?

Research indicates that the electrification of our transport system would generate one million additional jobs in Europe in 2030 and double in 2050. These jobs relate to the production of components for electric vehicles. But they also relate to new services, such as charging infrastructure for example. Electrification is also positive to reduce our oil dependency. The import of oil costs the European economy one billion euro per day. Investing this in our own economies could mean a vast improvement on employment rates. Families could increase their purchasing power when they no longer need to depend on imported oil products.

"ELECTRIFICATION OF TRANSPORT GENERATES EMPLOYMENT AND REDUCES OIL DEPENDENCY"

It is suggested however that loss of income from duties and taxes on diesel and petrol will negatively impact government budgets. But this does not take into account improved air quality. Improved air quality will have a positive effect on the health budget. Less expenses for health care, but also cleaning of monuments and historical buildings for example. These are not wild guesses. MOBI developed an 'External Cost Calculator', which can provide well-founded data. Policy makers can use these to make better-informed decisions.

WHAT WILL OUR VEHICLE FLEET LOOK LIKE IN 2050?

Apart from electric cars, self-driving or autonomous vehicles will have made their appearance by 2050. Even though both technologies are not dependent on each other, electric cars are better candidates to become self-driving cars. Autonomous cars depend on electronics for their control. It therefore makes sense to equip them with an electric motor. The autonomous vehicles, which we can expect on the market the coming decades, need different charging infrastructure then the electric vehicles which are coming onto the market now. The self-driving car from 2050 will seek its own charging point when it needs to and charging points will therefore be organised differently and in other locations, allowing smart grid operations. It will be no longer necessary to own a car but define your needs. In your smartphone you plan your car, like you plan other items in your agenda. At 7am a fully charged vehicle will be waiting on your door step. When you return, the car will return to its automated charging station.

WILL ELECTRIC DRIVING CAUSE POWER SHORTAGES?

Suppose that 10% of our fleet would

be electric, this would only mean an additional **demand for electricity** of 1,4%. We should not forget that the introduction of renewable energy sources is gearing up. Their share in the production of energy will only increase. It does create other issues though. What if there is no wind and sun? At these moments we either need to rely on other sources or we need to invest more in energy storage. The battery of an electric vehicle can play an important role in energy storage.

When too much electricity is produced, it can be stored in the batteries of cars. When there is not sufficient electricity, they give it back to the grid. This is what has been called **V2G** or 'vehicle to grid'. Furthermore second life batteries will makes electric vehicles more economically attractive. Will there be enough electric cars to envisage this? We do indeed need a large fleet of electric vehicles to realise this and those are entering the market rather slowly. In anticipation of this gradual introduction, we need to rethink our electric supply system drastically if we want to increase the share of renewable energy sources.

In other words, our grid will need to be remodelled, even independent from the introduction of electric vehicles, purely because of the need to increase the share of **renewable energy** sources.

V2G applications have an impact on the life expectancy of the battery of an electric car. It is therefore important to research how we can give batteries a 'second life' and how they can be recycled. If the capacity of a vehicle battery declines to 80%, we assume it is no longer serviceable. Yet it still has 80% storage capacity. So it could be used for other applications, such as to support the grid, for micro-grids or home storage, etc.

HOW FAR CAN YOU GET IN AN ELECTRIC CAR?

Driving range is an important issue and depends on many factors, first of which of course the battery. In a Tesla you can cover 400km today, but the typical autonomy of electric cars is more in the range of 150km. However, things are changing fast. More and more car manufactures are bring electric cars on the market with a driving distance of around 400km and this at acceptable prices ranges. Driving range is also dependent on driving style, weather conditions and the desired comfort. If you would like a temperature of 22 degrees in your car in the middle of winter, this demands a lot of energy from your battery. Yet manufacturers are looking into to tackling these issues too.

For the average consumer driving range is a key factor when considering a car. We call this '**range anxiety'**. Yet more than 95% of our daily trips are less than 100km. 30% of all our vehicles never drive more than 100km per day. We could make a start replacing these 30% with electric vehicles. Yet consumers have a tendency to upscale their car for the occasional longer trip. Most of the cars on our roads are oversized, with a large trunk for the annual summer holiday.

The need for public charging infrastructure is dependent upon families owning a garage. In cities this is a problem. Less then 11% of families in Brussels for example have a private garage. Apart from standard charging points, fast chargers will find their place on motorways, in cities and in suburban areas. These fast chargers can fully charge a battery in 15 to 25 minutes.

The development of batteries is taking fast leaps forward. MOBI's Battery Innovation Centre performs ground-breaking research in collaboration with key European players.

WILL EVERYONE DRIVE ELECTRIC VEHICLES IN THE NEAR FUTURE?

No more combustion engines. Breathing clean air in our cities, hearing birds instead of traffic. Is it an unrealistic vision for the future? The reality is that we cannot change an entire fleet overnight. The average lifetime of a car is 14 years. In other words, if you buy a diesel car today, it will still be on the road in 2030.

Nevertheless we are at a turning point. It is not just diesel gate that drives the market. Tesla has opened the market by offering models that go way beyond the small city car. A whole new type of consumers is now interested in electric cars. All manufacturers are working on electric models. So things are moving.

On the basis of MOBI's consumer behaviour models, we predict that by 2020 about 5 to 10% of new cars sold in Belgium will be electric. We also depend on policy makers and the incentives they offer. As a result of fiscal policy, in Norway for example the best selling car is not petrol or diesel but an electric car.

But we still have not answered the question about the number of electric cars in 2050. Or should we look at the issue from a different perspective? How many electric cars do we need by 2050 to generate additional employment, improve our health and quality of life and slow down climate change?

Professor Joeri Van Mierlo is Director of MOBI: Mobility, Logistics and Automotive Technology Research Centre. He lectures at the Vrije Universiteit Brussel and is an internationally recognised expert in the field of electric vehicles.

He is the Vice president of the European Electric vehicle association (www.avere.org) and the scientific chairman of the International Electric Vehicle Symposium EVS30 (www.evs30.org).

OPTIRESOURCE

The final software tool to master Well-to-Wheel analyses

OPTIRESOURCE is a powerful and interactive software package for Well-to-Wheel analyses as well as for evaluation and visualization of car-related energy chains and energy scenarios. It provides information about the primary energy demand and greenhouse gas (GHG) emission rate associated with energy chains or energy scenarios. The results also include an evaluation of primary energy supply and land and water use for the chains where this information is relevant.

OPTIRESOURCE is an essential tool for politicians, vehicle manufacturers, planners, users and buyers of vehicles to make plans and to take actions about future transport solutions. Its database allows the creation of more than 800 chains, combining several primary energy carriers, processes, fuels and power trains, giving a comprehensive overview of today's and future mobility concepts.

OPTIRESOURCE uses data from the study "Well-to-Wheel Analisys of Future Automotive Fuels and Powertrains in the European Context", conducted by the JEC consortium. The JEC is a cooperation between the european Joint Research Center, EUCAR and Concawe which provides neutral and validated simulation results concerning energy consumption and green- house-gas emissions that allows a fair comparison across drive systems. The database is complemented with supplementary input from the LBST consultancy firm.

Before OPTIRESOURCE was established, it was difficult to show, compare, add or sort this large spectrum of mobility concepts. For this reason, Daimler, aided by Protoscar, has developed OPTIRESOURCE: an intuitive and interactive software family for the Well-to-Wheel assessment of passenger cars.

OPTIRESOURCE IS AVAILABLE IN THREE VERSIONS

OPTIRESOURCE Lite: Web based and free of charge, this program is the optimal solution to quickly compare energy chains.

OPTIRESOURCE App: Take OPTIRESOURCE everywhere you go. Use your fingertips to create robust Well-to-Wheel analysis anytime, anywhere on your tablet or mobile phone.

Chain construction

Results

OPTIRESOURCE Professional: This online application only requires an Internet connection and a standard web browser. In matter of seconds you can create complete Well-to-Wheel analysis in any of its two operation modes:

OPTIRESOURCE Query

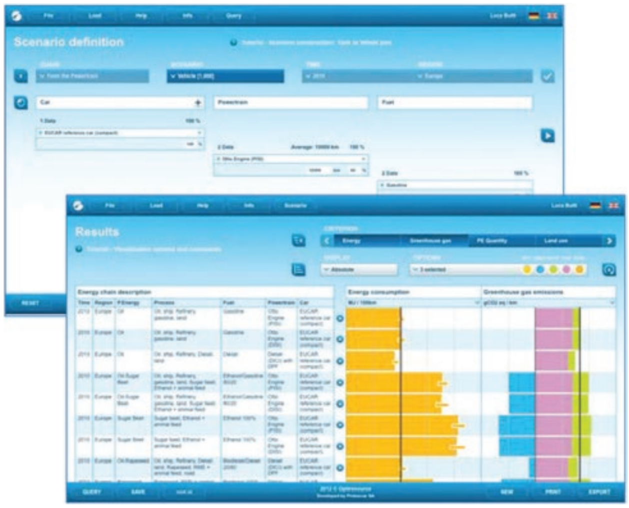
Query construction

Query results

With OPTIRESOURCE Query, you can retrieve, compare and graphically evaluate any number of energy chains. The selection of the chains is done in a highly interactive way: select one or more primary energies, transformation and transport processes, fuels and powertrains. OPTIRESOURCE will assess all possible combinations for you. The results are graphically presented in a comprehensive way and can be arranged and displayed according to your needs.

OPTIRESOURCE Scenario

Scenario construction



Query results

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Licenses for the professional version of OPTIRESOURCE are available.

Please send a request to to obtain a test account: optiresource.org/account

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Flexibility management with Flex4Grid

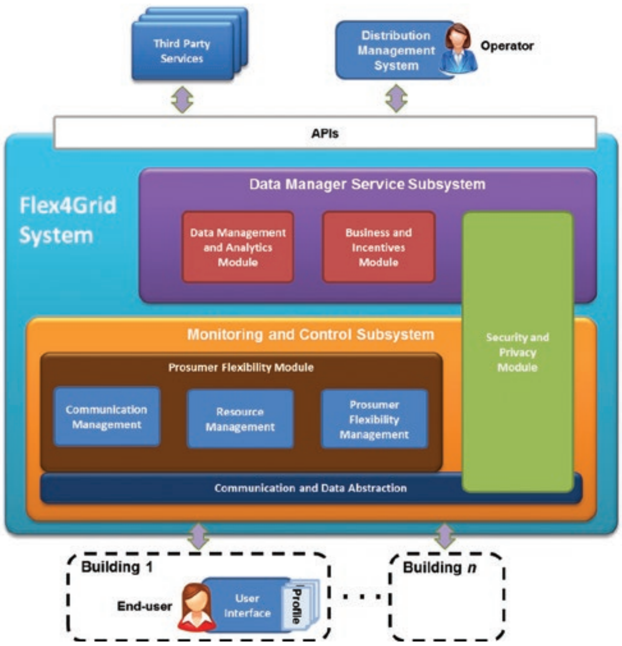
The consumption of electricity is increasing with the adoption of electric cars. At the same time, the production-side is also experiencing big changes in Europe, as we are moving towards distributed and renewable energy sources. In this evolution the so-called energy prosumers, i.e. private customers that consume and produce electricity, become key players in the energy value chain. However, this shift towards greener energy comes at a price. The volatile energy demand and generation by prosumers challenges the stability of the distribution grid, because the Distribution System Operators (DSO) have limited means for controlling the flexibility assets possessed by prosumers.

Flex4Grid is an EU H2020 funded research project that develops and evaluates novel solutions for managing prosumer flexibility within the distribution grid. Prosumer flexibility management is investigated both at operational and business level with the aim to improve power grid management and expand the smart grid market for new stakeholders.

The main outcome of the project is the Flex4Grid system that enables prosumer and flexibility operators to better utilize the distributed flexibilities for balancing energy production and consumption within the distribution grid. The system comprises: Flexibility Operator Interface, Prosumer Cloud Services, and Prosumer Flexibility Management Kit. The Prosumer Flexibility kit consists of smart plugs, a home gateway and a flexibility management app (available for iOS and Android). The kit enables users to monitor and control their appliances in real-time, monitor their daily household consumption and production, receive flexibility management requests from the DSO, and automate the flexibility management processes within their home. The Prosumer Cloud Services provide the main business logic of the Flex4Grid system. They include services for data management, aggregation and analytics, security and privacy provisioning, and flexibility aggregation and management. The Flexibility Operator Interface tools provides DSOs and other flexibility operators with means to access and manage the flexibilities of their customers. The system provides DSOs with the following incentive models for flexibility management: Critical Peak Pricing, Peak Time Rebate, and Demand Bidding.

The Flex4Grid system is currently being evaluated in three large-scale pilots deployed at three distribution networks in Celje, Bonn and Bocholt. The test users are classified in two groups: a group with smart plugs for controlling energy consumption and a group without smart plugs. Moreover, in Celje existing smart meters infrastructure (AMI) is used. In Germany this was already planned at the start of the Flex4Grid-project in the beginning of 2015, but the smart metering implementation is delayed because of uncertainties in the regulatory framework.

The main benefits of Flex4Grid is that it enables DSOs to cope with increasing amount of distributed local energy sources and volatile energy consumption. Moreover, Flex4Grid supports new market opportunities for third parties via cloud-based services, going beyond smart meters, and bringing end-users and other potential stakeholders into the value creation process.



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GasON project: future CNG engines as smart integration of innovative technologies

Transport at present consumes one third of all energy used within the EU and generates one quarter of the greenhouse gas (GHG) emissions. Also the demand to reduce air pollution due to transportation vehicles in urban areas becomes stronger, especially taking into account that the GHG emissions from transport are expected to constitute a larger share of the overall EU GHG emissions, up to over 40% in 2050, thereby also becoming the dominant sector in terms of GHG emissions. In this context, a strong de-carbonisation process has been launched to drive the European transport sector to the 2050 target and the use of Low Carbon Alternative fuels, like Natural Gas, will play a fundamental role to accelerate this process. Today, for customers, Natural Gas (NG) vehicles are attractive mainly because of the low fuel costs. On the other hand, the high acquisition costs, reduced driving range, and the insufficient filling station infrastructure are regarded as obstacles. In this context, the "GasOn" project, funded by the Horizon 2020 EU Research and Innovation programme, aims to develop advanced CNG only, mono-fuel engines able to comply with the 2025-2030 CO_2 emission targets, claiming the 20% CO_2 emission reduction with regard to current best in class CNG vehicle segment by segment, and to guarantee a low fuel consumption even in real driving conditions.

Focusing on the engine, in order to exploit the main environmental benefits of CNG and biomethane (Natural Gas from renewable sources) enabled by low carbon content and the high knocking resistance enabled by high octane number, the way has to go over Gas-Only powered engines through the following steps, carried out in the GasOn project:

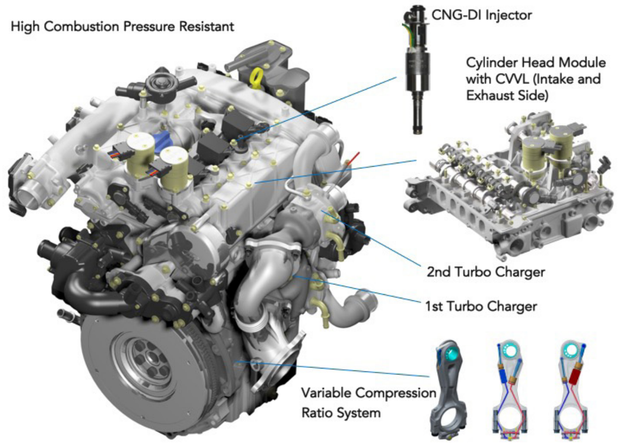
1) The implementation of CNG Direct Injection (DI) as first important step to much more efficient gas vehicles. The Direct Injection is a key step to CNG performance equivalent to gasoline, moving to a full integration of advanced technologies.

2) The development of a new lean burn concept, a new step to producing highly efficient gas-only engines. Non-DI CNG Lean Burn combustion process, based on a Diesel engine, will fundamentally gain additional benefits related to the further development of DI CNG engines.

3) The development of Advanced Boosting system to optimize the engine combustion.

4) The development of a sensor to detect gas quality and composition, a helpful tool for all gas vehicles to improve

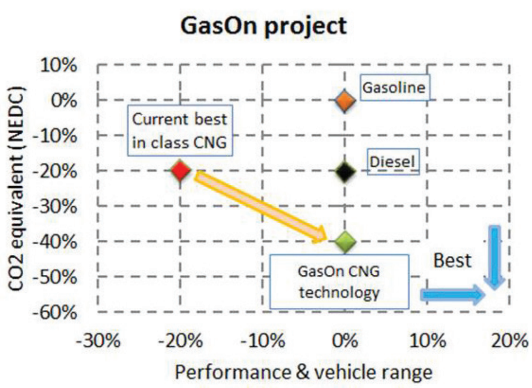
GasOn – Dedicated CNG Direct Injection Engine



efficiency. The measurement of the methane number and the caloric value allow adjusting the ignition timing to operate the engine close to the knock line and to optimise injection strategy and boost pressure.

5) The driving range of at least 600 km achievable thanks to the development of advanced solution for the compressed gas storage system.

The consortium of the EU GasOn project strongly believes that Natural Gas / BioMethane has the potential to play a major role as an automotive transportation fuel for future passenger cars, trucks and buses, since methane is an environmentally friendly energy carrier which can easily be produced by different sustainable pathways.



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Reimagining the energy system – smart buildings and electric vehicles

How smart buildings and electric vehicles can successfully work together

By Cosmina Marian, Buildings Performance Institute Europe

Buildings, transport and power sectors are the three biggest CO_2 polluters in Europe. But emerging new trends - such as digitalisation, mass customisation, servitisation, greater circularity and resource efficiency – are leaving their mark by transforming how these sectors work. These external factors, together with the EU's decarbonisation goals, must lead to an energy efficient, more decentralised, renewable-energy-based and interdependent energy system.

While in the past, these three sectors might have been separated, they are now linked by innovative technologies and business models, a sign of the energy system's changing needs. Buildings, currently often viewed as inflexible, are evolving, becoming micro energy-hubs. These are buildings flexibly connected and synchronised with the energy system, able to produce, store and/or consume energy efficiently. They can adapt to citizen's needs and simultaneously strengthen the energy system. Micro energy-hubs are smart buildings.

Almost in parallel, electric vehicles have entered the market, being championed by companies like Tesla, but now hailed by most car manufacturers. A greener car fleet will reduce air pollution and greenhouse gas emissions. In Norway, for example, almost one quarter of the new vehicles sold today run on electricity and politicians from all sides have agreed to have 100% of the newly

BPIE

registered cars fully electric by 2025.

In the UK, up to 60% of new car sales in 2030 should be electric vehicles. And recently Britain banned the sale of all diesel and petrol cars and vans from 2040, due to rising concerns that high levels of nitrogen oxide present a major risk to public health, especially in cities. The commitment follows a similar pledge made by France this year.

Many cities are leading the way. Iserlohn, in Germany, is implementing an innovative pilot project to create smarter charging and easier billing procedures for electric vehicle owners. While early-adopters of electric vehicles have dealt with a fragmented market, a smarter payment method is required to further boost uptake. Through smart contracts it could be possible for a building owner to sell stored, or excess, green electricity produced by the building to cars passing by.

Industry is also looking for ways to tap into this revolution of the mobility market. A German company, Ubitricity, is undertaking a project to build charging sockets for electric vehicles into street lamps. Volvo has announced that it will launch electric and hybrid cars from 2019. And Toyota is working on an electric car to be powered by an advanced type of battery that has the potential to increase driving range and reduces charging time.

But if electric vehicle charging goes unchecked, the grid may not be able to sustain it. The problem is not the surge in the total energy production, but the management of peaks stemming from a widespread switchover to electric cars. Buildings can be the solution.

Operating as micro energy-hubs, buildings can act as a balancing force for the energy system and foster a smooth transition from fossil fuelled cars to electric vehicles. While buildings are becoming smarter, so are cars and their charging infrastructure. And as electric vehicles are mostly charged at home and at the workplace, buildings are slowly being transformed into docking stations – modern gas stations – providing renewable electricity instead of fossil fuels.

FOR A SPEEDY EVOLUTION

The building, transport and power sectors are connected by these innovative developments, but also by a growing need to facilitate their market uptake to avoid costly spikes in power demand. This is where forward-looking and progressive legislation comes in. New policies are needed to foster not only uptake, but also decarbonisation of the energy system. Electric vehicles and buildings are crucial for Europe to meet its climate and energy goals.

Policy-makers should support innovative business models encouraging more electric vehicles, smarter buildings, and greener electricity, providing at local community level the necessary charging systems, interconnected with micro energy-hubs.

However, given that the technology related to electric vehicles and charging is developing rapidly, any lock-in to existing technologies must be avoided. Pre-equipping buildings (with conduits for pre-cabling, for example) and access to a sufficient power supply, to enable the installation of recharging points later, is more appropriate than a specification of charging infrastructure that may be outdated, unnecessary, insufficient or oversized once the building is used. Plus, the cost of equipping buildings with conduits is expected to be considerably cheaper, so this could easily be put in place in all new or renovated buildings.

Policy-makers should encourage and foster production and self-consumption

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of renewable electricity by electric car owners. This could very well lessen the pressure put on the grid in case of demand peaks.

And electricity suppliers, (local) governments and companies that own parking spaces could foresee charging points for electric cars, fed with renewable electricity. Increasing the visibility of charging points, in workplaces and shopping centres can stimulate their uptake by making consumers more aware of the potential to charge electric vehicles. This is something being tested by the EU-funded project CommON*Energy*, which focuses on transforming shopping centres into energy efficient environments. Charging stations were installed in Grosseto, Italy, to allow visitors to charge while shopping and showcase the technology to other shoppers.

Heavy amounts of paperwork are another real burden. So, countries like France, Spain and Portugal have eased permitting and approval procedures for installing charging points in existing multi-family buildings. An initiative that can only be welcomed.

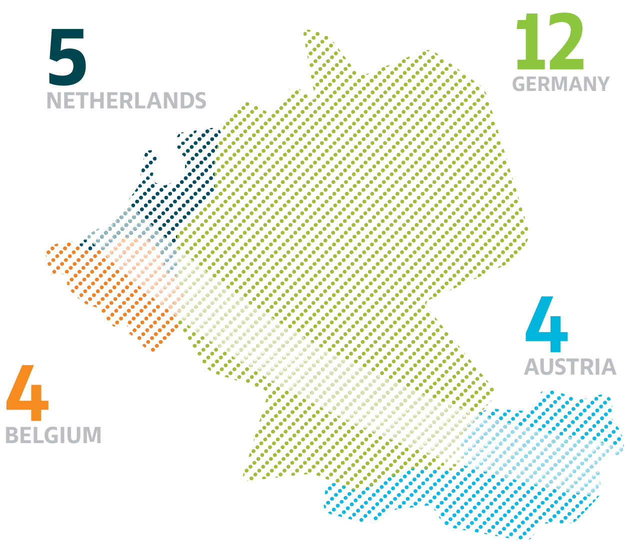
The challenges ahead of decarbonising the building, transport and power sectors pale in comparison with the benefits to be reaped from an economic, social and environmental point of view. More and more players are realising this and entering the market place with innovative green technologies. Smart buildings and electric vehicles can successfully work together while sound policies pave the way.

For more information on BPIE's work visit **www.bpie.eu**

Electric long distance driving in Europe

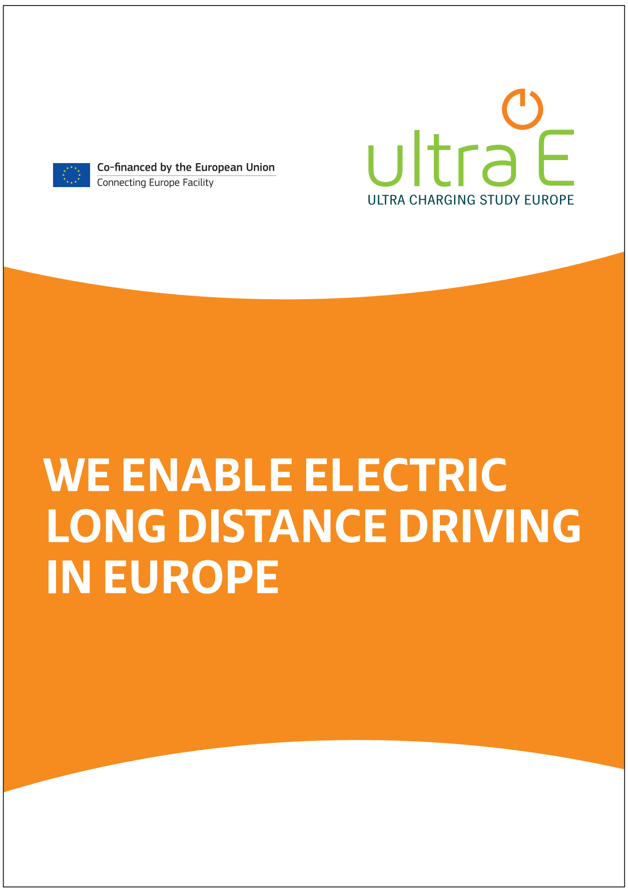
ultra E
ULTRA CHARGING STUDY EUROPE

ultra-E is laying the foundation stone for the construction of a full-scale, Trans-European, ultra-rapid charging network for long-range electric cars.



Between now and the end of 2018, a network of 25 ultra-rapid charging stations, each with a charging capacity of up to 350 kW, will be built along a stretch of more than 1,100 km in Europe. This network of charging stations, located around 120 to 150 km apart, will connect Germany, Belgium, the Netherlands and Austria along trans-European transport corridors (as part of the TEN-T program). The stations will be equipped with CCS Combo2 plugs and offer a charging capacity of 350 kW, ideally supplementing the existing 50-kW fast-charging network. This ultra-rapid charging technology cuts the charging time for a range of 300 km to 20 minutes. This technology is also set to be tested for electric buses and trucks.

Super-fast charging is of enormous importance not only with respect to the setting-up of a charging infrastructure tailored to the needs of the mass market, but also for future developments. For instance, the project-related "Market and Business Models for Ultra Charging" study is dealing with a range of aspects of ultra-rapid charging technology. Starting with technological developments, trends and new markets, this study also delivers important findings about consumer behavior and informs us about regulations and recommendations. As such, it serves as a solid foundation and guideline for the pilot project and unites the standards and needs of existing electric vehicles with the requirements of the latest generation of long-range electric cars.



The ultra-E project has been running since September 2016 and is being co-financed by the European Commission to the tune of €6.5m as part of the "Connecting Europe Facility" program.

The international project consortium is headed up by Allego BV, and in addition to Bayern Innovativ (the State of Bavaria's organization for innovation, technology and knowledge transfer), involves the automakers Audi, BMW and Renault as well as Magna, Hubject GmbH and VERBUND AG/SMATRICS.

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A future driven by standards

By Thomas Willson, Policy Officer at ECOS (pictured)

The European transport sector is on the cusp of a revolution. Emissions from transport in Europe have stubbornly refused to conform to emission reduction trends seen in other sectors, accounting for a quarter of all emissions and much of the air pollution in cities, yet signs are emerging of an approaching inflexion point. In the past few months, both government and industry have presented a series of strong signals that the end of the internal combustion engine is approaching. France will ban the sale of all petrol and diesel vehicles by 2040, and vehicle manufacturers have unveiled production line after production line that centres on one technology: electromobility.

Electromobility offers an unequalled solution to address European climate and energy goals. A modal shift from internal combustion engines to electric vehicles would reduce oil imports and carbon emissions, while improving energy efficiency, local air quality and noise pollution. These environmental benefits are not without an economic dimension, with large numbers of additional new jobs expected to be created over the next few decades alongside a shift towards domestically produced goods and services. Electric vehicles also offer the potential to support the rapid changes underway in the power sector.

In recent years, power generation has become progressively cleaner, more distributed and renewable. Wind power and solar photovoltaics have formed the greatest part of this trend and will continue to dominate in the future. As these sources increase in market share, so too will the variability of the supply-side of the power system. In parallel, power systems have become increasingly digitalised and interconnected with other sectors, such as the transport sector. This interconnection has been made possible by advances in information and communication technology and data, which have opened new possibilities in the active management of power systems to strengthen the ability of the demand-side to react to variability of supply.

Demand-side flexibility is expected to provide substantial benefits to European power systems. As a resource, demand-side flexibility can improve environmental performance, cost-effectiveness and reliability of networks. Demand-side flexibility can enable larger shares of variable renewable energy sources to be integrated in the generational mix; for instance, by managing periods of solar photovoltaic over-supply by increasing demand and storing energy in electric vehicles. In addition, demand-side flexibility can displace carbon-intensive 'peak' power generation and avoid the construction of additional network capacity to cope with demand to reduce overall system costs.

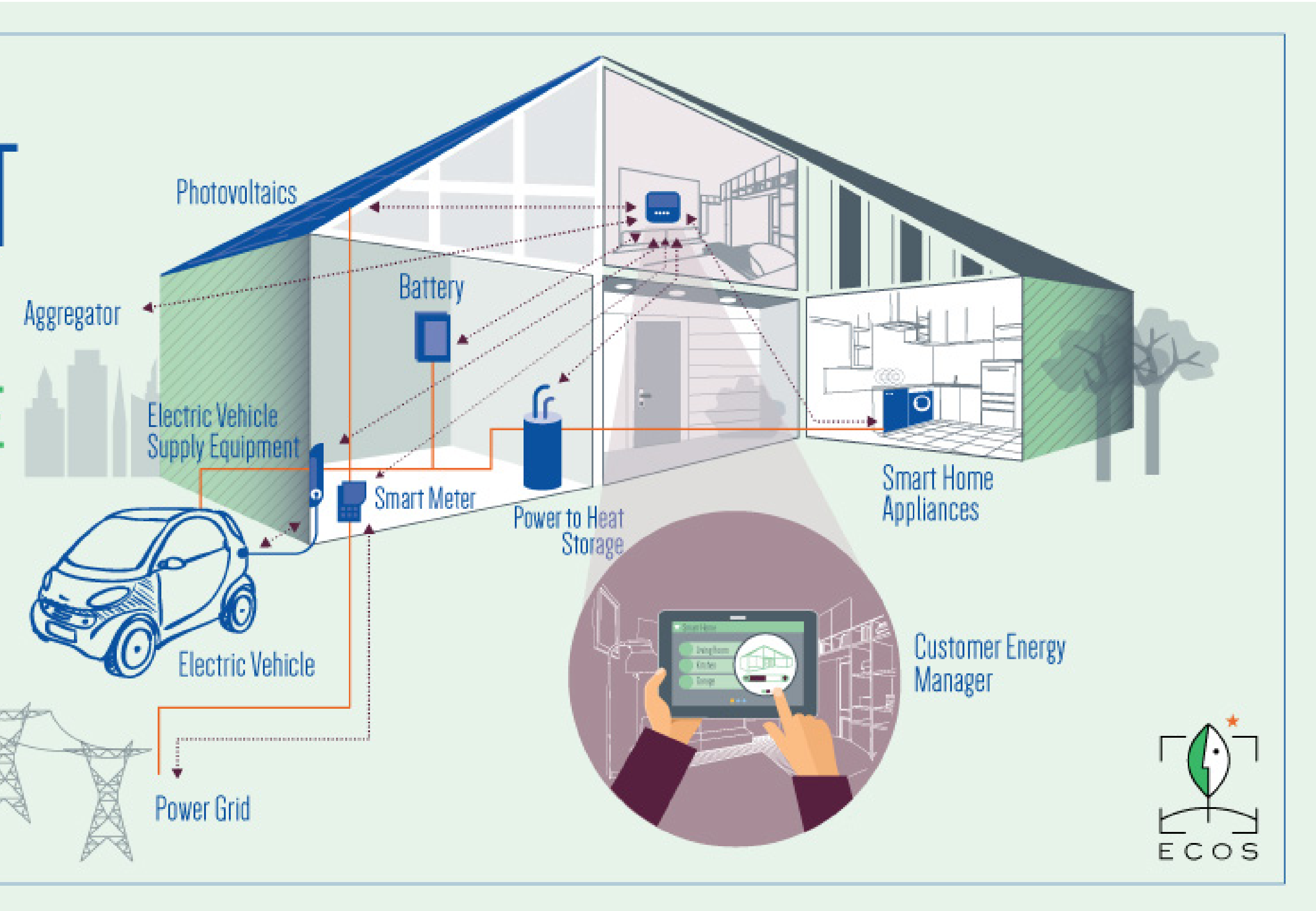
EU legislative proposals are poised to take this a step closer. The implementation of the Alternative Fuels Infrastructure Directive and the Clean Energy for all Europeans Package will drive progress towards establishing recharging infrastructure and the integration of electric vehicles in European power systems. These proposals could support a

transformation in the flexibility of the demand-side and how owners of electric vehicles can benefit from their participation in the management of power systems.

Standards offer the technical foundation for this transition. They act as powerful tools within the Single Market to strengthen interoperability for millions of devices, reduce the risk of stranded assets, avoid market fragmentation and guarantee minimum functionality. Standards define how technologies function and interoperate, which can influence their favourability among consumers, environmental performance of the sectors and ultimately, the evolution of markets.

Standardisation of electric vehicles has historically focused on plugs, outlets and electrical safety. Back-end aspects, such as communication interfaces and electric vehicle power system integration have been primarily developed as research and pilot projects, which has led to proprietary solutions that reflect, to some extent, the current state of the market. More recently, attention has shifted towards the development requirements for smart charging. For instance, the standard that governs the communication between the electric vehicle and the electric vehicle supply equipment (ISO/IEC 15118) is currently being revised to ensure the inclusion of advanced smart charging options, such as bidirectional power transfer and wireless power transfer. This will be supported by the launch of new international projects, such as a standard to manage back-end electric vehicle charging infrastructure (IEC 63110) and a standard to govern communication between charging service operators and third-party service management platforms to enable electric vehicle roaming services.

ECOS has been deeply involved in the development of these standards and others, to support a vision of sustainable power and transport systems working together to provide the services we need. This includes contributions to standards that govern not only electric vehicles, but also customer energy managers, smart appliances and smart meters to strengthen their ability to interoperate among themselves and support variable renewable energy sources. While significant challenges are yet to be overcome, a sustainable future supported by standards is within our grasp. ●



Modern battery engineering

By Prof. Dr.-Ing. Kai Peter Birke and Christoph Bolsinger, Electrical Energy Storage Systems, University of Stuttgart

Battery development for electromobility is driven by continuous energy density enhancement (Wh/kg, Wh/l). This applies for weight and volume as well as for the costs of batteries in €/kWh. If more energy can be stored by using the same raw materials, batteries become more cost effective.

Lately the focus has been more and more on volumetric energy density. Here Li-Ion cells show a unique property since volumetric energy density is double that of gravimetric energy density. This is why Li-sulfur cannot be a competitive technology any more for applications in electric vehicles. Even Li-air (on realistic cell level, not by theoretical calculation) may not be able to compete any more in this field.

Generally, the focus of energy density improvement is still extremely targeted on cell level. The latest potential advancement can be seen in the renaissance of Li-metal solid state cells. The level of standardization is also developing and there are standards such as 18650 and 21700 for cylindrical cells, and for prismatic ones that standardization committees are at last accepting.

Figure 1

However, the situation on battery level (assembled cells) is surprisingly lacking in focus. As a rule of thumb, only half of the energy density remains on battery level for most of the batteries which are actually installed in electric vehicles. This means that, from 200 Wh/kg on cell level only, 100 Wh/kg are available on battery level. For volumetric energy density it is often less than one third. Additionally, those batteries are not easily recyclable.

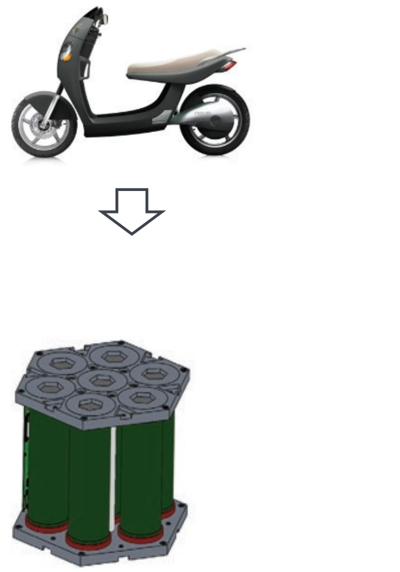
The reasons may be seen in battery constructions which satisfy firstly the safety and lifetime. First generation Li-Ion batteries for hybrid vehicle application show a very rigid housing which withstands harsh deformation from outside, and thus satisfies safety demands. For the lifetime of the battery, usually welded connections of the cells are employed. All this makes recycling very difficult.

However, looking at the tremendous potential of energy density enhancement by avoiding senseless losses from cell to battery level, new construction methods are necessary. It is important to consider that energy density enhancement of Li-based cells will be more and more exhausted within the next decade.

Here the project "LIBELLE", founded by the "VECTOR-Stiftung" shows new directions. The project has been undertaken by the Electrochemical Energy Storage Systems team at the University of Stuttgart in Germany, under the supervision of Professor Kai Peter Birke. The basic idea is to use the cell as a self-supporting part. One cylindrical cell may fail under static load tests. However, a multiple array easily sustains the automotive standard deformation test conditions from different directions (x, y, z) for traction batteries. This is an important result which has already been achieved in this project. Such a cell array is depicted in Figure 1. On module level 180 Wh/kg can still be preserved and this shows the power of the concept of self-supporting cell arrays. The final battery housing has thus no tasks to prevent against deformation and can be constructed with very lightweight materials. The cooling board will be made out of modern plastics. The final target of the project is to reduce the loss of energy density from a factor 2 (if gravimetric energy density from cell is divided through energy density of the battery) to at least 1.5, preferably 1.3. The level from cell to module (as shown in Figure 1) is actually in the regime of 1.2.

Additionally, a recycling concept on cell level is successfully employed. The modules can be completely disassembled since the cells are screwed on and clamped. Here, experimental results show that this way of cell connection is fully competitive with the conventional cell welding methods. However, these results still have to be verified over lifetime. The recycling concept is supported by a pure optical based communication concept to the Battery Management System.

Generally, battery production concepts still show a huge lack of industrialisation which, surprisingly, lacks the focus applied to standardisation efforts on cell level. A Giga-Factory usually means a cell factory. Looking at the cost structure, the ratio between cell and battery



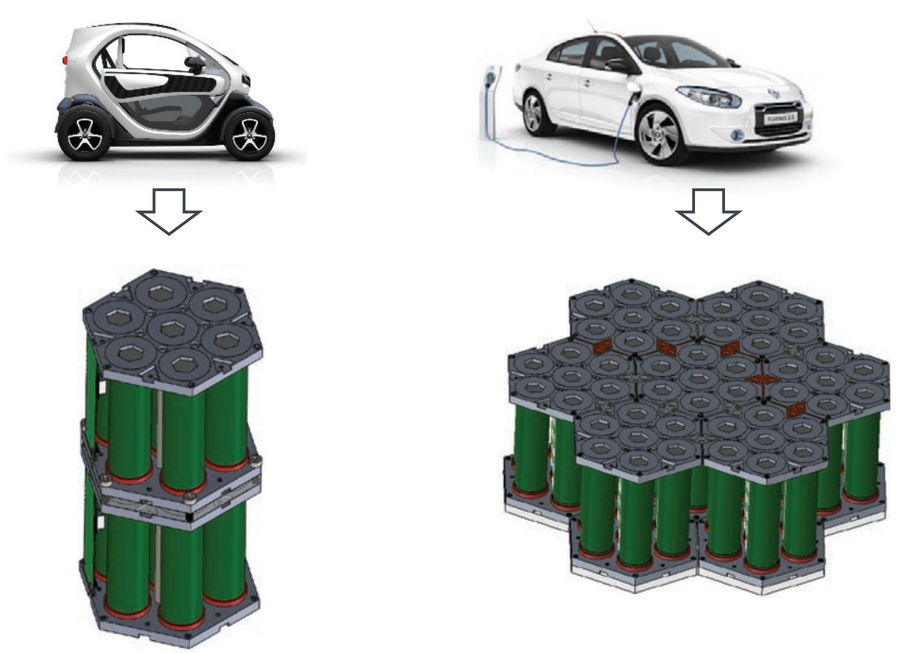


Figure 2: Proposal 1

(without cells) costs should be about 80:20 or even more for the cell. In reality, we find 40:60 and even less than 40, which is consequently one of the cost drivers of actual batteries. Again, the reason is not the cell but the battery. If such issues are consequently addressed, cost friendly mass-production on battery level and system costs of less than 100 €/kWh seem to be feasible. This becomes competitive if efforts for combustion engines to pass emission rules increase continuously. Also quite simple assembly concepts can apply and the cell becomes a central construction element – as presented in the LIBELLE-project. This may help to achieve the cost targets. Therefore, the assembly concepts for the cell are hugely important. In addition a modular block building concept to address many applications, from light-mobility over HEV, PHEV and EV to heavy duty applications (Figures 2 and 3), is equally essential. This is just tuned by employing higher power or high energy tuned cells (which have the same size). The heat conduction is carried over the common metal board where the cell poles are mounted (see Figure 1). These common boards are then connected to a slim cooling board (not depicted). Its dimension and the cooling media throughput finally determine the temperature of the battery and can thus be adjusted to the different above mentioned applications. ●

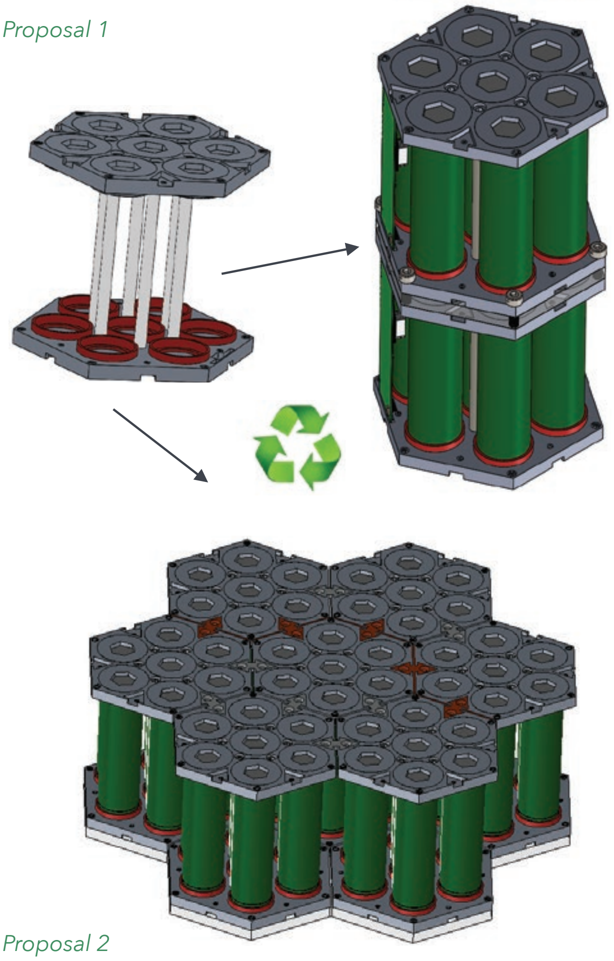


Figure 3: Proposal 2

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INTENSSS-PA

A Systematic Approach for Inspiring Training Energy-Spatial Socioeconomic Sustainability to Public Authorities

INTENSSS-PA is an HORIZON2020 project that aims to develop and implement a human and institutional capacity building approach related to integrated sustainable energy planning, addressed to public authorities and societal stakeholders in order to support them to enter in a new era of energy planning through a participatory, multi-level, interdisciplinary decision making process.

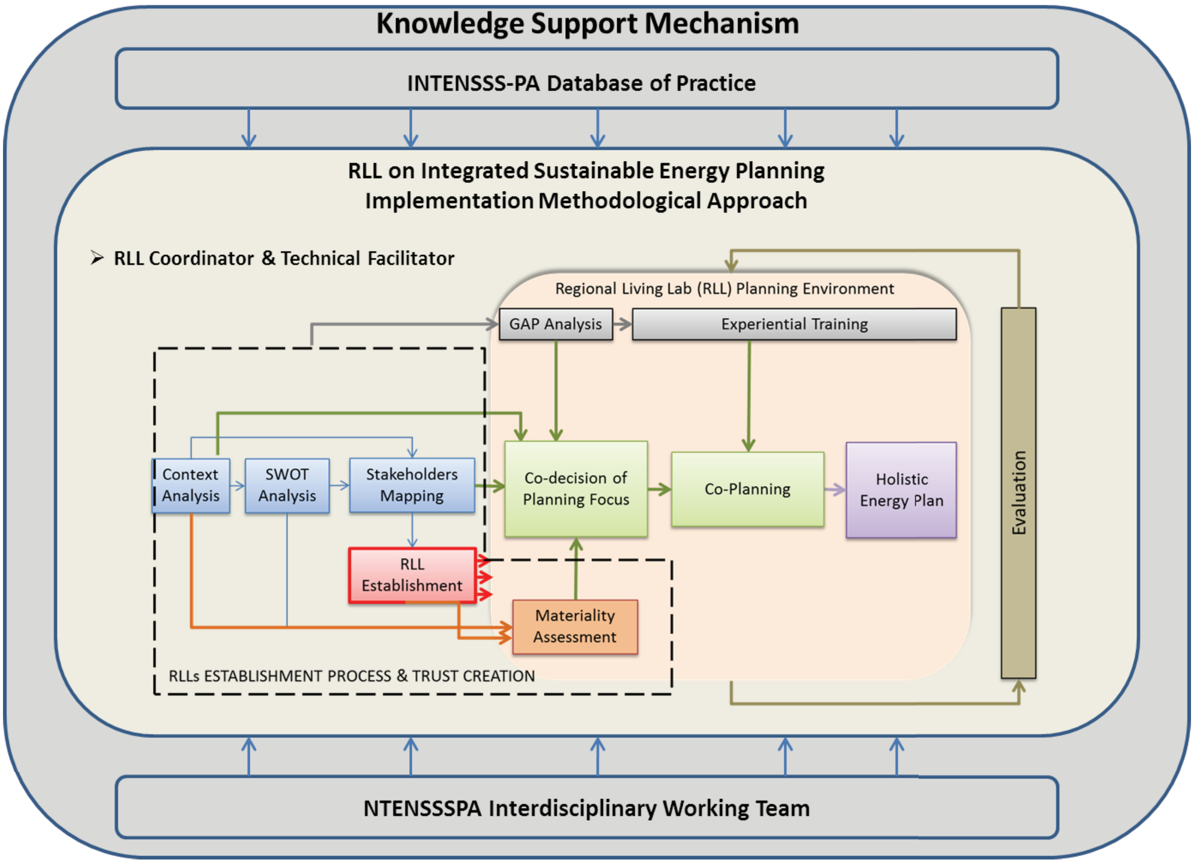
To implement this approach, the Living Lab (LL) concept has been adopted. Within INTENSSS-PA a Regional Living Lab (RLL) is defined as emerging citizens-public-private partnership, where all stakeholders work together to create, experiment and evaluate new innovative approaches and institutional innovation related to integrated sustainable energy planning.

INTENSSS-PA has established successfully a network of seven RLLs. These are at Junta Castilla y Leon, Calabria, Karditsa regional district, Pomurje statistical region, Zemgale statistical region, Groningen municipality and Middelfart municipality.

The seven RLLs proved to add value to energy planning in the regional areas by developing and implementing planning processes in relation to a more open and collaborative approach to governance.

At present the seven RLLs have entered the co-planning methodological phase and the completed integrated sustainable energy plans are expected to be delivered by February 2018.

Figure. INTENSSS-PA Holistic Energy Planning Environment and RLLs Implementation Approach



INTENSSS PA
Integrated Sustainable Energy Planning

INSPIRATION & APPROACH

The development of urban and rural landscapes constitutes a pioneering era with novel combinations between energy production and consumption and the upcoming changes in the urban and rural fabric including the associated socioeconomic uses. Moreover, the energy initiatives are more viable for development and less vulnerable to failure and societal resistance if they are well-integrated in the local and regional contexts. However, institutional questions remain regarding the required level of integration, while simultaneously the sustainable energy planning involves actors with diverse and conflicting objectives that must come to a consensus.

Inspired by these ascertainments INTENSSS-PA developed an holistic energy planning environment that provides structured expert support with the involvement of: (i) a technical facilitator within each RLL, (ii) an interdisciplinary expert group to provide methodological tools and guidelines and (iii) a Database of Practice that includes training materials and case-studies to support and inspire the RLLs. Overall, INTENSSS-PA's implementation approach aims to develop a transnational network of RLLs that within their ecosystems energy planning process is supported through a systematic and structured methodology, and to identify ways of integrating this planning environment/approach in the institutional framework for energy planning of the Member States/Regions.

PRELIMINARY CONCLUDING REMARKS

1. Multilevel Governance has a decisive role in the successful implementation of integrated sustainable energy planning.

2. Public authorities and societal actors have realized the capacity that participatory decision making provides for regional development and energy transition.

3. Viability of RLLs requires the development of appropriate business-models or their introduction to an institutional framework.

4. Societal actors have perceived the importance of energy initiatives on socio-economic and regional development; therefore there is an emerging need of introducing a good balance of top-down and bottom up measures, initiatives and regulations for expediting energy transition.

Partners:

ALESSCO – Agenzia per l'Energia e lo Sviluppo Sostenibile della Provincia di Cosenza
avka – ΑΝΑΠΤΥΞΙΑΚΗ ΚΑΡΔΙΤΣΑΣ ΑΝΑΠΤΥΞΙΑΚΗ ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ Ο.Τ.Α.
BEF – Baltic Environmental Forum LATVIA
bpm BUSINESS CONSULTING
CeNSU – Centro Nazionale Studi Urbanistici
EC Network
Gemeente Groningen
Grant Thornton – An instinct for growth™
LEA Pomurje – Lokalna energetska agencija za Pomurje – Local Energy Agency Pomurje
Junta de Castilla y León – Consejería de Fomento y Medio Ambiente
Middelfart Kommune
Regione Calabria
Skupnost občin Slovenije – Association of Municipalities and Towns of Slovenia
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Current waves of change require resilient European ports

By Isabelle Ryckbost (pictured), Secretary General, European Sea Ports Organisation

The world is changing rapidly. Disruption seems to become the buzzword of 2017. European ports are facing several changes and challenges: increasing vessel sizes, increasing market power through both vertical and horizontal alliances, adapting to climate change and the need for decarbonisation, greening of vessels, digitalisation, national budgetary austerity, increased security challenges, geopolitical developments, re-emerging economic nationalism, Brexit.

Faced with these challenges, ESPO is currently focusing on the following three priorities.

First, ports face a continual challenge to invest in long-lived port infrastructure. As it shows in the challenges identified, there are many more reasons (environment, security, safety, digitalisation, etc.) to build or adapt port infrastructure than increasing capacity. Even where such investments provide high societal added value and generate substantial economic returns, they often have low financial returns for the port authority. Many essential investments are impossible because of the nature of the project or because the port authority does not have the necessary financial scale to raise project finance.

It is in that respect, that we continue to make the case for continued and increased financial support in a variety of forms including grants and low cost long-term debt finance in the context of the review of the Connecting Europe Facility, the financial leg of Europe's Transport Infrastructure policy.

But there is also another reason for Europe to invest in efficient, sustainable and smart port infrastructure in Europe. Ports are strategic assets not only as transport node, but also as nodes of energy and in many cases also as important clusters of industry. European ports operate in intensely competitive environments both within the EU and with ports outside the EU.

Increasingly, there is investment in both ports and terminals within ports from international sources outside the EU. This is a relatively recent phenomenon and, while welcoming the availability of investment from all sources, we have to be careful not to cede control over essential and critical European port infrastructure of general interest. If foreign governments are looking at European ports as strategic assets, it is time for Europe to do the same.

Our second priority is facilitating maritime trade. European ports are very keen to see the administrative burden, which characterizes maritime transport still today, reduced. We are very much aware how alleviating this burden would take away one of the only disadvantages of EU maritime transport nowadays. Increasing the share of maritime transport in the transport of goods within Europe and increasing the efficiency of maritime operations and operators would be a big step towards a more sustainable supply chain.

The European Commission is currently preparing the ground for developing a European maritime single window environment. As ESPO, we can understand the rationale behind a single window environment if this interface is reliable and resilient, if it is more than a mere letter box. The single window should have the competences and responsibility to unfold the data set delivered by the shipping line and dispatch the information needed by and to the different authorities. If not the single window will not be a facilitator of maritime trade, but will just move the burden from ship to shore.

At the same time we believe that much can – and has to - be done in the field of harmonisation and simplification of formalities. Asking the same data elements in the same way should become the principle. We should also dare to question the need for certain formalities or the modalities for providing these formalities.

These efforts have to be made together with all authorities and all legislators, national, European and international. In this discussion we should not confuse the recipient of the information with the authorities using and needing the information. We should not overestimate the role of port authorities. We should address the users of the information and look at the policy requiring the data. Finally, we should also look ahead and understand that selling platforms like Alibaba might become the port clients of tomorrow.

Last but not least, ESPO and its members put a strong emphasis on their sustainable agenda. 90% of European ports are situated in or close to urban agglomerations. This implies that ports are very much part of their local communities and are part of their societal concerns and their engagement towards the environment and sustainability. Ports in Europe need to secure their "licence", ports must assure the people living around the port and society as a whole that their operations and investments are sustainable. But how far should this engagement go?

Be it on decarbonization, air quality or protection of our oceans, European ports are very keen on helping to address the issue and to engage and even invest in solutions. Within ESPO we support this engagement, whereby some ports are really punching above their weight. I believe however that this voluntarism should not be abused by turning it into a law. It should not come instead of policy options tackling the real causes of the problems and applying the polluter pay principle.

The last decades, European ports have already been faced with important economic swings. Despite the fact that political decisions, authorisations and often burdensome procedures prevent ports to move fast, they have proven to be resilient and dynamic. Let us hope that they can further build on this resilience to face new incoming waves of change.

CO_2 Capture and Storage for Inland and Shortsea Shipping

GENERAL INFORMATION

CO_2 is a greenhouse gas and is proven to play a major role in accelerating the damaging effects of climate change. International, European and national strategies for the reduction of CO_2-emissions are being developed to meet the requirements of the Paris 2015 Climate Agreement. According to the third IMO Greenhouse Gas Study from 2014, shipping is responsible for almost 3% of global CO_2-emissions.[1] CO_2 – emissions from shipping can be reduced to some extent through operational measures such as efficient steaming, or using alternative fuels such as for example LNG. Still, the impact of such measures on CO_2-emission reduction remains limited.

From 2017 onwards, seagoing ships that enter European seaports will be required to submit a CO_2-monitoring plan upon request and in 2019 the European Commission will make the CO_2-performance of ships publicly available. As soon as this emission data becomes publicly available, it is the expectation that some form of legal CO_2-emission monitoring and management system for the marine sector will sooner or later emerge.

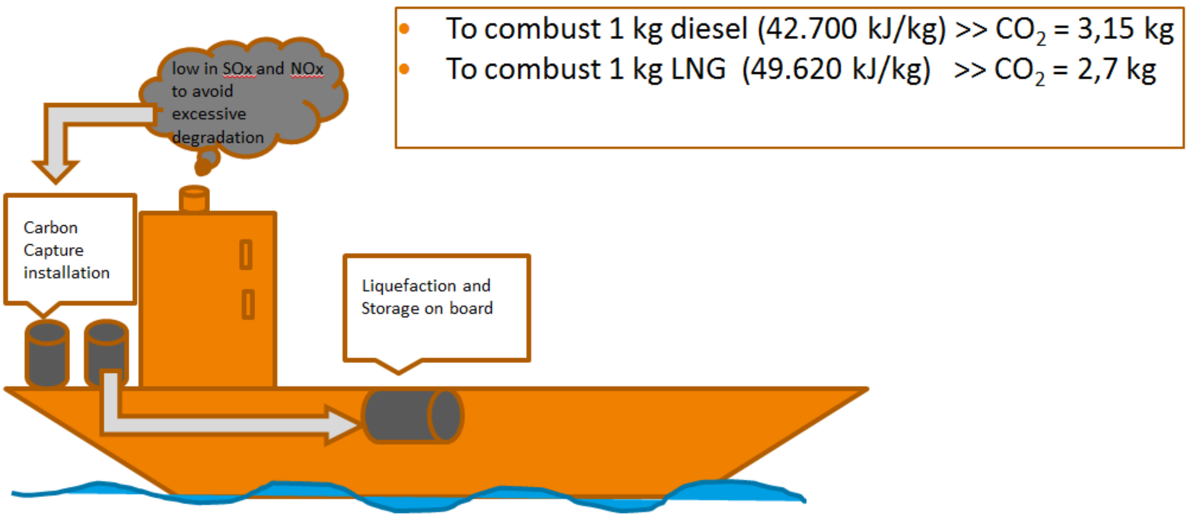
It has become evident that methods for capturing CO_2 capture following the burning of fossil fuels will need to be deployed in order to be able to meet future emission standards. Carbon capture techniques are already being successfully deployed in various land-based power plants, both as demonstrators as well as on a wider commercial scale.

Carbon capture technology is a well-known application that is suitable for large stationary power plants on land that use fossil fuels and it is technically feasible to scale down to the size required for ships.

However, the problem remains in meeting the high energy requirements of these power plant applications to capture CO_2 from flue gas. One possibility is to make use of the unused heat which is currently under-utilized as an energy source on board. Such energy losses stem from the hot exhaust-gases and under-utilisation of the cooling water system. When gaseous CO_2 has been captured on board, it can potentially be liquefied and stored in cryogenic pressure tanks. In the case of LNG fueled ships, the liquefaction of CO_2 can be done energy neutral.

CHALLENGES

The main innovative aspect is based upon understanding the feasibility of designing and demonstrating small scale, highly energy-integrated and fit-for-purpose carbon capture units that can be an economical addition to the range of measures to reduce marine CO_2-emissions. Further opportunities for reduction of capital costs and hence increasing the attractiveness of capturing and storing CO_2 on board of a ship are based on standardisation and large volume production.



The targeted users in the maritime sector currently have no experience with these kind of capture units and would therefore require a demonstration plant to understand the implications on ship operation, economic impact and scale.

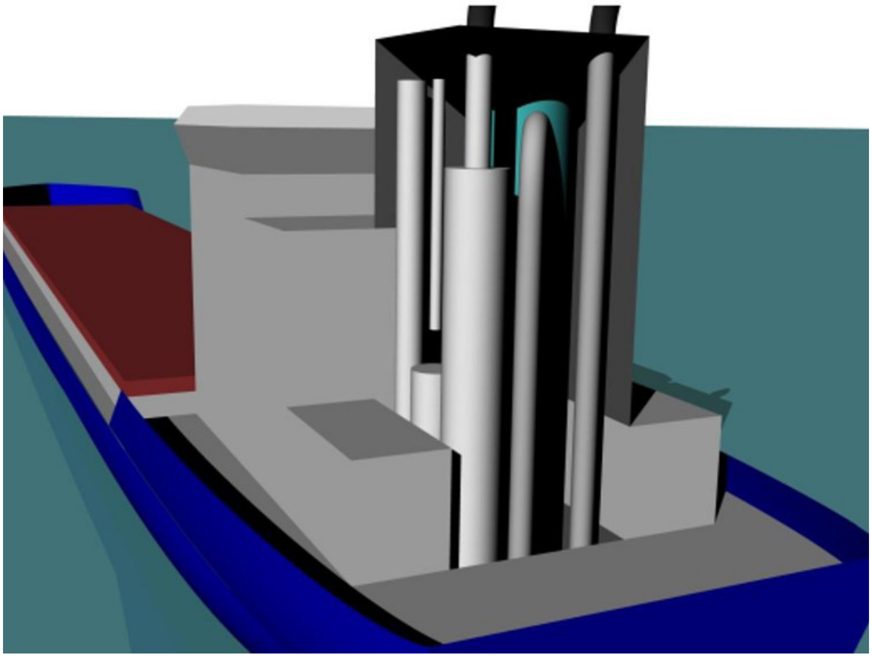
INNOVATION TARGET

The development and demonstration of a CO_2-capture and storage unit for ships will achieve:

- A high (energy-) efficiency of the unit on board
- A compact, economically feasible carbon capture unit
- An efficient and economically feasible storage (cryogenic, pressurized) of liquefied CO_2 on board of a ship
- Optimised integration with available excess heat and cold on board of a ship
- An adequate and well organised distribution chain for liquid CO_2 covering the storage on board of a ship, off-loading in a port or terminal and further distribution to end users
- Identification of alternative applications for liquid CO_2 originating from the maritime sector

BACKGROUND TO THIS INITIATIVE

The groundwork for this project is currently being laid in a parallel initiative, the Maritime Carbon Capture & Storage networking project, funded by the INTERREG V-A Program Deutschland-Nederland. Partners in this project are MARIKO GmbH, FME, ZEMprojects and TNO. A targeted outcome will be a technology roadmap and the establishment of a SME network concentrated on CO_2 capture in inland waterways and shortsea shipping. This will lay the groundwork for future cross-border initiatives leading to the development, testing and demonstration of innovative CO_2 capture and storage technologies for the maritime sector.



Impression of the concept design with the capture equipment located in the engine casing and funnel for a short sea vessel. Visible are the main components of the system, without piping.

1) http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Third%20Greenhouse%20Gas%20Study/GHG3%20Executive%20Summary%20and%20Report.pdf

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Motorways of the Sea and Connecting Europe Facility: towards greener ports and shipping industry

By Brian Simpson (pictured), European Coordinator for Motorways of the Sea.

Ports are vital for EU trade; they are important transport nodes, vital for short sea shipping in Europe and critical for ensuring the territorial cohesion of the EU.

Ports are also industrial clusters that generate growth and jobs and play a key role to promote sustainability and a smooth energy transition.

Motorways of the Sea (MoS) policy is part of the maritime dimension of the Trans-European Transport Network. It aims at supporting green, viable and efficient sea-based transport links that are well integrated in the entire EU transport chain.

The policy is supported by the Connecting Europe Facility (CEF), a financial instrument that enables to co-finance from the EU budget projects focused on short sea shipping in Europe, related investments in ports' infrastructure as well as various initiatives from the industry both at shore and sea side.

MoS are an integral part of the EU's TEN-T policy and it intends to connect better with the prioritised transport corridors in the EU (Core Network Corridors).

My work programme – Detailed Implementation Plan for Motorways of the Sea, identifies three key development priorities:

1. Environment
2. Integration of maritime transport in the logistics chains
3. Safety, Traffic Management and human element.

The work programme provides a set of recommendations on the profile of MoS projects financed from the Connecting Europe Facility.

As this autumn edition of the magazine is devoted to green ports and actions necessary to further reduce carbon emissions I would like to particularly focus on my first pillar: the environment.

The introduction of stricter emissions standards in general and the Sulphur Emission Control Areas (SECA) in particular, produced an immediate need for new ship technologies, operational processes, new ports' infrastructure and in general a need for new tools for financing environmental upgrades.

MoS supported by the CEF funding co-finances projects that are helping the industry to comply with applicable EU+IMO legislation and favours projects related to:

- Air quality and SECA (Sulphur Emission Control Area) benchmarks.
- Support further development of LNG or other alternative fuels.
- Continue to look into ways of lowering LNG storage and logistics costs.
- Tackle operational pollutions

So far CEF invested in MoS policy, all together, € 390 million, which contributed to 46 projects all over European ports and triggered investments of more than € 1 billion.

€ 204 million was allocated to 27 projects that are directly related to environment. Projects support various investments both in ports and operating vessels aimed at LNG propulsion installations, exhaust gas cleaning systems (to comply with SECA), number of projects in the Mediterranean to comply with the requirements of the Directive on Alternative Fuel Infrastructure. Other projects covered areas such as pilot testing of electric vessels, installation of on shore supply systems, waste water reception facilities, sludge port facilities, SECA compliance monitoring.

How can these funding be illustrated by concrete projects?

I have in mind three, which I think are a good illustration of cooperation between ports authorities, ship owners, private and public investors. All focus on environmental solutions that reduce emissions and make maritime operations cleaner and greener.

The BLUE BALTICS project involves partners from Lithuania, Estonia, Germany and Sweden. The project will deploy and upgrade the existing LNG infrastructure (refuelling stations and LNG small scale terminal with the aim to develop a network of LNG bunkering facilities in the Baltic Sea that would consolidate the use of LNG as marine fuel.

Another example that facilitates the deployment of alternative fuels is a project called **"Methanol: the marine fuel of the future"**.

The project tested the performance of methanol as a marine fuel by retrofitting RO-PAX vessel Stena Germanica to run on methanol and build dedicated bunkering facilities. To this day, the Stena Germanica is the only methanol powered ferry operating in Europe.

Lastly, The ZERO EMISSIONS FERRIES project test the electricity in two passenger vessels, including installation of an on-shore power supply with the aim to prove that maritime transportation without emissions is feasible. The results are expected to build up experience for a larger scale deployment of this type of vessels in the future.

Motorways of the Sea will continue to contribute to innovative projects in the field of environmentally friendly shipping and green port infrastructure helping the industry to comply with upcoming global sulphur restrictions and the entry into force of NECA limits in the Baltic and North Sea.

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Wind of Change in Ports with Problems Zero Emissions Terminals shall be no exception

By Malte Siegert (pictured), Head of Environmental Policy, NABU Hamburg

Air pollution in and from ports is a serious problem not only in the European Union. Still the impacts on air quality seem underestimated and little investigated. This is more of a problem where ports are located either close to or even in city centers such as in Antwerp, Amsterdam and Hamburg. Annually, air pollution causes over 420,000 premature deaths throughout the European Union. Of these, 50,000 premature deaths are attributed to shipping in European waters. Besides the negative consequences for human health, air pollution from nitrogen oxides (NOx), sulphur oxides (SOx), particulate matter (PM) and especially its component black carbon (BC) contributes to climate warming, diminishes biodiversity, harms nature and damages buildings and monuments.

Ports are hubs of air pollution. Various emitters operate in numerous kinds of transport and port machinery. Diesel engines are equipped with little exhaust treatment systems or even running on a comparatively dirty fuel. Some of these forms of transports and machinery, such as ocean-going vessels, do not fall under the strict(er) land-based regulations, but enjoy pollution privileges as allowed by international maritime laws. But even where - European or national - legal limits for air emissions exist, the limits are not strict enough and, moreover, some are breached without consequences for the emitters. Moreover, for some pollutants, such as black carbon (BC), there are no limits at all.

In contrast to the comparatively weak regulation for ports and especially ships (inland as well as ocean going vessels) road related regulation is quite strict in the European Union. The Euro-Norms oblige car and truck building companies to improve their efficiency performance and installing particulate filters and effective catalytic systems. In addition, diesel fuel used by the consumer has to be one hundred times cleaner than that what is demanded from ship owners or charterers, if they sail on MDO in the European Sulphur Emission Control Area (SECA). Why? Most obviously, impacts from road related traffic have been acknowledged as extremely harmful to health, nature and climate already decades ago. Ships mainly sail close to coastlines or enter major waterways like Loire, Scheldt, Humber, Weser or Elbe. These waters flow parallel to highways or streets. The big gap between both standards for streets and European waters does not make sense at all.

Politics and authorities are very well aware of this. Ports could agree on stricter rules without permission of the International Maritime Organization (IMO). But more ambitious standards for the waterside are waved away with the argument of competition and level playing field. If ports don't dare themselves to demand certain technical requirements such as abatement systems on board or mandatory use of onshore power supply (OPS), they could commit themselves either in certain regionsfor example the highly frequented "North Range" with all European major ports- or in the Mediterranean. Why no commitment from all European ports? A common approach? Not even the European Commission would have to be asked, if all ports agreed on some basics.

Nevertheless, there is light on the horizon as the picture onshore is a little different. Although expectations of local port authorities towards tenants are often low, their influence limited and national or EU regulation still insufficient, terminals themselves try to mitigate their burden on local communities. The interest in a good port-city-relation with little dispute is high, the awareness and sensitivity for the impacts of 24/7-port business in the public rising as urban development tends to spread towards the waterside.

That is why many terminals worldwide have started to electrify wherever possible. Good for the working conditions, the local air quality as well as in noise reduction. Whole car fleet operation like at HHLA-terminal Hamburg Altenwerder, craneoperation APM-terminal in Antwerp, electrified yard tractors, forklifts or top-handler at Pasha Omni Green Terminal in Los Angeles, electric automated guides vehicles (AGV) in Rotterdam or Hamburg, fuel cell drives for stack carriers, gas-to-liquid (GTL) from renewables, hydrogen injectionbest practice can be found all over the globe. An additional offer is onshore power supply (OPS) while ships are at berth. It keeps the emitter free from taking responsibility. Nevertheless OPS is better than not having any kind of exhaust treatment. Currently various systems are tested or already in daily operation. Hamburg for example offers "green" OPS from renewables for cruise ships, which can even choose between 50 and 60 Hertz.

The investment in renewable energies is not only for the sake of human beings and for the sake of environment. Fostering electrification is a business model and often pays out economically. Several terminals worldwide have invested in solar technology. Solar power contributes 10 megawatt to the demand of the Port of LA, the Port of West Sacramento already covers 100 percent of its demand from solar panels on 8400 square meter rooftops. In northern Europe wind is literally printing money. Eurogate and HHLA-terminals in Hamburg cover most of their demand from eight wind turbines- tendency increasing. The Port of Antwerp generates 45 megawatt from its wind turbines and plans to install further 15 turbines with a capacity of three megawatt each.

The future for ports has already arrived. If climate change shall be challenged and local impacts successfully mitigated, gaps in regulation have to be closed. Especially for ship operation. The dissemination of introduced best practice examples shall not be an exception, it must get a rule.

The EU port policy and green ports[1]

By Rémi Mayet (pictured), Deputy Head of the Port and Inland Navigation Unit, European Commission

SUMMARY
The ports of the trans-European network for transport are essential to Europe's growth and jobs. Both the amount of cargo handled in European ports and the size of ships are expected to continue to increase significantly. At the same time the Paris Agreement on climate sent a clear signal and shipping, although not formally covered by the agreement, must also contribute to the decarbonisation efforts. Moreover Europe has taken the lead to reduce the other pollutant emissions from maritime transport with the introduction of regional Emission Control Areas and a proactive stance in the International Maritime Organisation (IMO). The European ports are inevitably to be part of these changes, all the more that climate change and energy transition are full of challenges and opportunities for them: infrastructure must be made climate-proof, the oil and coal traffic declines and new business opportunities emerge with the development of off-shore marine renewable energies. The EU port policy contribute to address these challenges through the newly adopted Port Services Regulation, modern state aid control, support to multimodal and alternative fuel infrastructure and actions to accompany the digitalisation of transport. The Directorate General for Mobility and Transport also created a European Ports Forum in July 2017.

As 75 pct. of all goods to or from the EU are carried by ship, the ports of the trans-European network for transport are essential to Europe's growth. Every additional one million tonnes of cargo handled in a port create an average of 300 new jobs at local level. The amount of cargo handled in European ports and the size of ships are expected to continue to increase significantly as shown by the last series of order from large European companies to build container vessels of 22,000 Twenty-foot Equivalent Units – twice the maximum size of 10 year ago.

At the same time the Paris Agreement on climate sent a clear signal. All sectors including shipping, although not formally covered by the agreement, must contribute to the decarbonisation efforts. Europe has also taken the lead to reduce the other pollutant emissions from maritime transport with the introduction of regional Emission Control Areas and a proactive stance in the International Maritime Organisation (IMO). For the first time in October last year, IMO adopted a global cap of sulphur content of marine fuels and agreed to adopt an initial strategy for the reduction of greenhouse gas emissions from ships in 2018. The European ports are inevitably to be part of these changes, all the more that climate change and energy transition are full of challenges and opportunities for them: infrastructure must be made climate-proof and the oil and coal traffic will slowly decline while considerable new business opportunities emerge with the development of off-shore marine renewable energies and the circular economy.

The EU port policy seeks to address all these challenges and to turn in a win-win strategy the apparent trade-off between economy, jobs and environment by integrating ports in the internal market, tackling the bottlenecks in port hinterlands and pursuing ambitious EU decarbonisation and air quality goals, ports being often in close proximity to dense urban areas. Technologies that reduce the use of oil improve economic efficiency of ships, while reducing the sectors' environmental footprint. A strong focus on green innovation in the maritime/port sectors will address public health and citizens' concerns but also preserve and strengthen the European lead of the European industry and know-how at global level.

Examples of such innovation can be found in the ability of cranes to store the energy released when lowering a container, or in the use of engine heat in vessels to regulate the temperature on board. Smart port management can also combine measures to reduce emissions, energy consumption and costs by minimising ship idle time, optimising the land side operations of calls, using digital technologies, developing innovative mobility concepts, renewable energies and the interlinking of power plants and consumer plants to promote efficient use of resources.

The EU port policy contributes to such developments in particular through four initiatives:

1. **The Port Services Regulation:** The regulation was adopted in February 2017 after three years of debate in the EP and the Council. It introduces a transparent access to the market of port services and transparent rules on financing and charging. It promotes the charging of environmental costs by explicitly allowing it and asking the Commission to develop guidance to classify the vessels according to their environmental performance. Indeed, although 30 core European ports already apply green charges to use their infrastructure, the study which the Commission published in June indicates that more environmental benefits could be gained by a greater coordination and use of such schemes. The regulation also introduces port governance rules. The later ensures for instance the regular consultation of local stakeholders and communities on issues such as spatial planning and port environmental matters.

2. **Modern state aid control:** To facilitate investments in ports, in particular green port infrastructure, the Commission adopted a new General Block Exemption Regulation in May 2017. Member States will not be required any longer to notify to the Commission certain port investments for prior state aid control. The list of infrastructure includes the fixed, mobile or offshore port infrastructure allowing a port to supply vessels with energy sources such as electricity, hydrogen, or Liquefied Natural Gas (LNG) which contribute to the decarbonisation of transport and enhance its environmental performance.

3. **Multimodal and alternative fuel infrastructure:** The Connecting Europe Facility has awarded €1.1 billion since 2014 to projects to improve rail and inland waterways connexions to ports or to develop alternative fuel facilities in ports such as bunkering for vessels powered by LNG or on-shore power supply for moored vessels. In the latest so-called "Blending Call" closed on 14 July, we received additional proposals which are now being evaluated. The European Investment Banks and the European Fund for Strategic Investments (EFSI) also offer valuable opportunities to improve the bankability of projects, for instance the €750 million EFSI Green Shipping Guarantee Programme open for both retrofitting of existing shipping as well as for the construction of new vessels with a green innovation aspect. The various EU programmes are all the more important as they can help Member States to implement the Directive on alternative fuel infrastructure which requires LNG refuelling facilities to be accessible for all the core ports of the trans-European network by 2025. The lack of appropriate infrastructure indeed prevents viable alternative fuels and this chicken and egg problem is a typical market failure that adequate legislation and public funding can redress.

4. **Digitalisation:** By simplifying reporting and sharing data, maritime transport can become more energy efficient, attractive and easier to integrate in the logistic network. The creation of a genuine European Single Window Environment to digitally integrate all the reporting formalities is therefore high on the European agenda. Digital solutions and automation can also assist the captain navigating the vessel into the port, the terminal operations and more broadly the sharing of data between maritime, terminal, rail, river and intermodal operators using for instance block chain technologies. In Horizon 2020, a call dedicated to smart ports and the port of the future was launched last year. The call has generated proposals for €160 million (10 times the available budget!) which are currently being evaluated.

To facilitate the implementation of the new recently adopted rules on ports and promote good practices on all the above issues, the Directorate General for Mobility and Transport has created a European Ports Forum in July 2017. The forum will be composed of member States representatives and of organisations representing at European level the many stakeholders involved in port activities. We look forward to start working with the forum by the end of the year.

In short, the years to come hold great potential for the ports which are engaged to green their operations and promote more sustainable transport and the ports which are more broadly engaged in the energy transition. These ports will find at European level many opportunities to develop their strategies and disseminate their good practices. ●

1) The article only reflects the views of the author and not necessarily the ones of the European Commission.

Deployment of Liquefied & Compressed Natural Gas related initiatives in the Danube region

By Manfred Seitz and Ruxandra Florescu, Pro Danube International, Vienna

Home to over 80 million people, the Danube region aims at ensuring prosperous economies, healthy societies and dynamic ecosystems. With the Danube River as core transport axis, inland waterborne transport plays an important role for the transportation of goods in Europe, with demonstrated advantages in comparison to other modalities i.a. lower costs, lack of congestion, energy efficiency, all these turning it into an extremely attractive transport mode. The Danube is not only a vital source of water supply sustaining navigation, but is also great for facilitating power generation, industry development, biodiversity, agriculture, fishing, recreation, tourism, etc.

According to the European Commission, transport represents almost a quarter of Europe's greenhouse gas emissions and is the main cause of air pollution in cities. GHG emissions decreased in the majority of sectors between 1990 and 2015, with the notable exception of transport. Road transportation alone accounted for 24 % of CO_2 emission in 2015 (for EU-28 and Iceland).

In line with EU policies Danube countries have started to push towards achieving a low carbon economy. The usage of Liquefied Natural Gas (LNG) & Compressed Natural Gas (CNG) – including bio-methane – as an eco-friendly alternative fuel and as a new commodity is one key element for greening the transport system of the region. Moreover, LNG is capable of playing a vital role in the region in supporting innovation, sustainable development and the competitiveness of inland waterway transport, fact which was demonstrated already by the success stories in North-Western Europe.

The experiences gained in the LNG Masterplan for Rhine-Main-Danube flagship project (2013-2015) opened up the way for several other ambitious projects meant to close up the gap in the small-scale LNG supply chains in the Danube region. There are numerous challenges to be dealt with when promoting the use of natural gas (liquefied or compressed) as a fuel and as cargo, but Austria, Slovakia, Hungary and Romania are making important steps in this direction in line with the Directive 2014/94/EU on the deployment of alternative fuels infrastructure.

In Upper Austria, Rohöl-Aufsuchung AG (RAG) – the fourth-largest gas storage company in Europe is building a new LNG filling station in the port of Enns, adding from the end of September 2017 another important refuelling facility for Europe's logistics and heavy duty transportation, for both road and inland waterways. Ennshafen is located at the confluence of the rivers Enns and Danube and in close proximity to the Europe-wide E60 major traffic route, the second longest E-road in Europe. Due to its location, the station is ideally suited for transport companies that rely on LNG as an environmentally cleaner fuel. RAG successfully introduced one Iveco Stralis NP truck (the first LNG truck in Austria) in April this year. More Stralis NP trucks will be delivered to selected customers in September 2017. According to Iveco, there are more than 2.000 of such trucks on the road all over Europe.

In Slovakia two ambitious EU-funded

Photo: © RAG, Austria


Photo: © MGKKE, Hungary.


Photo: © SPP – Slovenský plynárenský priemysel, a.s.

projects are paving the way towards a wide-scale development of LNG and CNG infrastructure for the transport sector. Slovenský plynárenský priemysel or simply SPP is a major energy supplier in Slovakia that aims for a highly determined deployment summing up 14 L2CNG stations along the TEN-T core corridors on D1 and D2 highways, 3 large LNG stations, a small-scale LNG liquefaction plant, a fleet of more than 50 LNG-fuelled vehicles, a fueLCNG virtual pipeline with truck-to-ship and truck-to-truck filling. The construction of the first LNG liquefaction plant in Slovakia creates a local LNG source, hence sets up the prerequisites for supplying all transport segments including LNG river vessels. Pilot testing is scheduled for 2019, while the full use of the new infrastructure is expected by the end of 2020.

Slovak business association Danube LNG together with the public bus provider SAD Zvolen will supply as part of the EU-funded project LNGAFT 15 LNG-fuelled busses to the city of Zvolen. The project foresees also the deployment of one LNG fuelling station which shall become operational as of December 2019. In its sense, the project will contribute to the decarbonisation of public transport, making it more ecologic, hence mitigating the negative impact of transport on the environment.

Hungary is also progressing rapidly in ensuring new LNG/CNG infrastructure for both road and waterborne transport. With the help of EU funds PAN-LNG project will implement by the beginning of 2018 the first five road LCNG (Liquefied and Compressed Natural Gas) vehicle filling stations in Hungary. The five stations will be located along the Hungarian core transport corridors. PAN-LNG-4-Danube project will deploy by the end of 2019 a fixed LNG refuelling station at Csepel-Freeport in the southern part of Budapest, which is part of the inland waterway Core Network Corridor Rhine-Danube. This station will serve not only LNG propelled vessels, but also LNG trucks and possibly trains as well. Details on the PAN-LNG project may be found at: www.panlng.eu. More information about the PAN-LNG-4-Danube can be found here.

EU-funded CNG Clean Fuel Box project will be implemented in Hungary on three Core Network Corridors and will introduce a Clean Fuel Box – a LCNG self-service, compact compressor and refuelling station able to refill CNG vehicles independently of the gas distribution network. In order to reach a real-life trial by the end of 2018, a network of 39 stations will be built together with the purchase of LNG feeder and natural gas vehicles. For more details, please refer to the following website: www.lcng.hu

For Romania two important LNG related projects are planned for the cities of Constanta and Galati, comprising of small-scale LNG terminals with bunker station for maritime and inland vessels deployed in the area of the ports as well as LNG fuelling stations & LNG-fuelled busses and trucks for the cities. Pre-feasibility studies have already been concluded where possible locations and technical solutions have been investigated. Deployments are expected before 2025 in line with the timeline of the Directive 2014/94/EU on the deployment of alternative fuels infrastructure.

More information is available on the websites of RAG & Port of Enns as follows:
www.rag-erdgas-mobil.at/leistungen/erdgastankstelle-lng.html
www.ennshafen.at/mediencorner/presseberichte/06_07_2017_spatenstich_zur_ersten_lng_tankstelle_oesterreichs

More information about Danube LNG and SAD Zvolen may be found at:
http://danubelng.com
www.sadzv.sk

Power sector determined to lead the energy transition

By EURELECTRIC

Enel, Vattenfall, Ibedrola, SSE, Innogy, EDP, DONG Energy. Across the continent, the utilities are investing billions in new and clean energy. People today want clean energy and power companies are determined to deliver. Electricity will play a key role in solving some of the toughest challenges of our times. It will help decarbonise the economy, reduce pollution in cities and ensure that we use energy more efficiently in buildings and transport.

The electricity sector must seize this opportunity and prepare for the future. Led by Francesco Starace, CEO of the Enel Group, the Presidency team of EURELECTRIC, is determined to sharpen the industry's view of the future, and the role that utilities will play in creating win-win solutions for the energy system and to society as a whole.

As the power sector seeks to tackle technological disruption, decentralisation and carbon constraints, it will focus on three key approaches:

CHANGING THE MINDSET

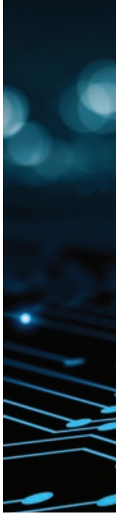
A new mindset is needed to maximise the environmental and social value that electricity brings to society. The sector will need to be proactive in its effort to stay at the forefront of the energy transition.

The sector will seek to engage openly with technology providers, customers, cities, communities and other industries involved in the energy transition. The transformation we are facing runs deep, Creating a more efficient energy system requires an unprecedented level of collaboration and coordination across industries and borders. The power sector will partner up as never before with non-energy industries such as automotive, construction and ICT to create value to society outside our traditional boundaries.

EMBRACING THE FUTURE

Creating long-term value for companies, stakeholders and overall society is a core task for utilities. The sector must therefore reinforce value-chain synergies and promote the establishment of market rules that enable medium to long term investment decisions.

In this context, the acceleration of electrification, especially in transport and heating & cooling sectors is extremely important. Electrification is key to building a low-carbon future and meeting the commitments pledged in the Paris Agreement on climate change. Electrification is also a key opportunity to address serious concerns to society such as improving air quality,



reinforcing and modernising value chains and strengthening Europe's competitiveness on a global scale.

The power sector will seek to innovate and build new cross-sector business models. Digitalisation, distributed generation and technological progress are changing the fundamentals of the power business, with unprecedented levels of interaction.

In order to facilitate new business models, the sector must partner with policy partners and societal organisations to lay down a solid framework for aggregation, demand response, peer-to-peer energy transactions and new cross-sector business models that enhance customers' participation in energy markets. These new building blocks, connected by smart distribution networks, will provide Europe with a resilient, flexible and highly efficient electricity system.

TRANSFORMING THE PRESENT

Achieving the energy transition means that we also have a past and present to contend with. Many high-carbon assets are still in operation in several European countries. At the same time, renewable energy assets developed over recent years have changed the dynamics of electricity markets, markets which were originally designed to cater for conventional technologies.

To solve this, we need to complete the integration of renewables and accelerate the restructuring of electricity markets across Europe. Customers expect competitive energy pricing, as well as more and better services. The new market design should not only value energy, but also flexibility and security of supply. This will give the right signals for efficient investments and further push integration of national markets.

The power sector is committed to finding sustainable solutions to transform our society into a carbon-free one, and to deal responsibly with the existing carbon-intensive asset-base.

Much has already been done, but the journey is far from over. The take-up of electrification, empowered customers through innovative solutions and smart market designs, are all necessary elements for a sustainable transformation. The power sector is determined to seize this unique opportunity to make a positive change and bring about a better future for Europe.

Why Europe needs to install more PV Systems to deliver the Paris Agreement

By Arnulf Jäger-Waldau (pictured), European Commission

The 21st session of the Conference of the Parties (COP 21) to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris, France ended in December 2015 with the landmark agreement to keep the maximum global average temperature rise as close as possible to 1.5°C. This agreement, now known as the Paris Agreement entered into force on 4 November 2016.

Despite this success, there is general consensus that the Nationally Determined Contributions (NDC's) proposed by each country are not sufficient to reach the goals of the Paris Agreement. With the current policies in place global green-house gas (GHG) emission are not projected to decrease fast enough to stay below 2°C [1].

The decarbonisation of our energy supply is an important component to achieve the targets, because 65 % of the world's current CO_2 emissions are due to burning fossil fuels. In 2014, 81 % of our total primary energy supply depended on burning fossil fuels, namely 29 % coal, 31 % oil and 21 % natural gas [2]. In terms of final energy consumption electricity only accounted for 18.1 %, but was responsible for 35.2 % of the total CO_2 emissions [2, 3].

According to the World Energy Outlook (WEO) 2016 of the International Energy Agency (IEA), the global average of CO_2 emissions per kWh of electricity was 515g in 2014 [4].

Under the New Policy Scenario, these emissions would fall to 335g CO_2/kWh by 2040. For the European Union the situation looks a little better, i.e. 358g CO_2/kWh in 2014 and a forecast of 156g CO_2/kWh in 2040, but this is still not sufficient for the necessary reduction of CO_2 emissions to 65g CO_2/kWh in order to meet the Paris Agreement [4].

In preparation of COP21 the European Council adopted the following Conclusions on 2030 Climate and Energy Policy Framework during its meeting on 23-24 October 2014:

- The European Council endorsed a binding EU target of at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990.
- An EU target of at least 27% was set for the share of renewable energy consumed in the EU in 2030. This target will be binding at EU level.
- An indicative target at the EU level of at least 27% was set for the improvement of energy efficiency in 2030 compared to the projections of future energy consumption under a current policy scenario.

The European Council confirmed that the target will be delivered collectively by the European Union. To achieve this in a cost-effective manner, the reductions in the Emission Trading System (ETS) – and non-ETS sectors were set to reach 43% and 30% respectively by 2030 compared to 2005 [10]. However, with the current implemented policies, GHG emissions are not expected to sufficiently decrease to reach the European Union's target of at least 40% reductions on 1990 by 2030. Therefore, modified national reduction targets and policies are required to realise the necessary additional reductions.

On 30 November 2016, the European Commission presented the Clean Energy for All Europeans legislative proposals to ensure the achievement of the European Union's 2030 targets. These proposals cover energy efficiency, renewable energy, the design of the electricity market, security of electricity supply and governance rules for the Energy Union. The package named the following three main goals:

- putting energy efficiency first,
- achieving global leadership in renewable energies
- and providing a fair deal for consumers.

A variety of policy options are presented in the new proposals to introduce new market models as a response to the fact that the current market arrangements in place do not adequately incentivize all market participants to adjust their portfolios (supply and demand) on short notice. These options will now be discussed in the European Parliament and the Member States.

The Commission Staff Document

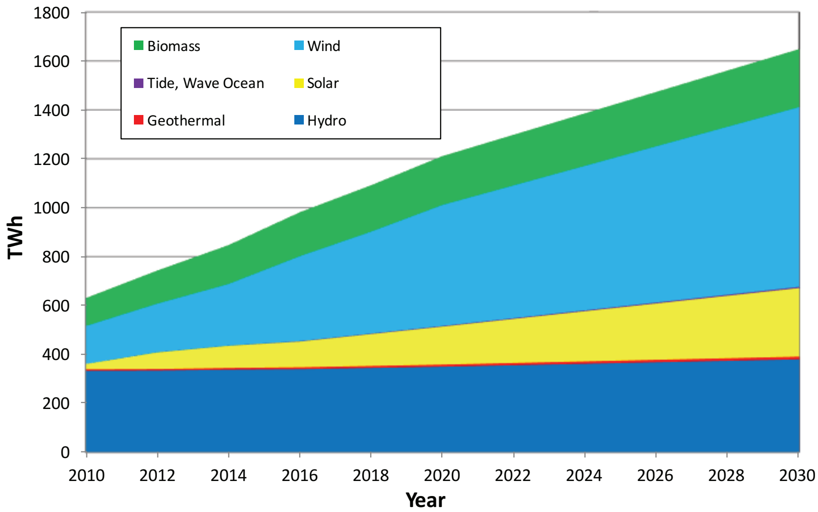


Fig. 1: European electricity production until 2030 to meet the 27% RES target

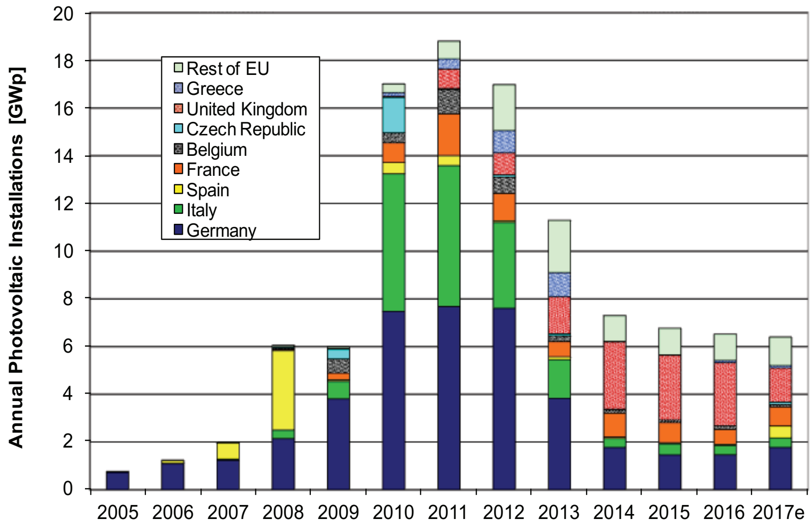


Fig. 2: Annual Photovoltaic installation in the European Union [6]

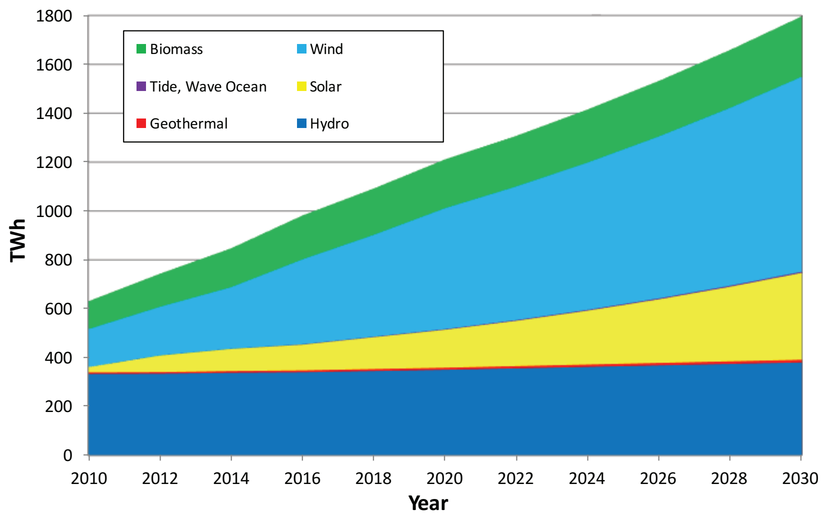


Fig. 3: European electricity production until 2030 to meet the 35% RES target

(Impact assessment) accompanying the proposal for the new Market Design Directive [5] forecasts a share of 49% of renewable electricity by 2030. 62% of this renewable electricity share or almost 1,000 TWh is expected to come from solar photovoltaics and wind.

To reach the 2030 targets, up to 50% of electricity has to be generated from renewable energy sources by 2030. It is estimated that the net electricity generation will be around 3,400 TWh in 2030. About 1,000 TWh of this should be provided by solar and wind. Fig. 1 shows the development of solar and wind power needed to meet the 27% RES target.

In order to generate the roughly 280 TWh from solar power and under the assumption that solar thermal electricity generation would contribute between 15 and 20 TWh, solar photovoltaic power capacity has to reach 235 to 240 GW by 2030. However, with a total installed capacity of about 102 GW at the end of 2016 and annual installations between 5.7 and 7.5 GW in the last three years, it will be difficult to reach this target. New policies are needed to allow for annual installation between 9 and 10 GW over the next 14 years, which are needed to reach the target.

The situation becomes even more pronounced if one takes into account the need to increase the renewable energy targets for 2030 in order to meet the goals of the Paris Agreement. At the moment the RES Directive recast is in the parliamentary process in the European Parliament and the committee for Industry, Transport, Research and Energy (ITRE) has already voiced it's point that at least 35% RES by 2030 are needed to stay

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Dr. Arnulf Jäger-Waldau is a Scientific Officer and Senior Scientist at the Energy Efficiency and Renewables Unit, Directorate C: Energy, Transport and Climate. He works for the European Commission's Joint Research Centre, since 2001. The assessment of renewable energy technologies, the effectiveness of their implementation, their integration into energy infrastructures and the role of renewable energy for climate change mitigation is part of his work portfolio.

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

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

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

Dr. Jäger-Waldau was a Lead Author for Solar Energy of the Special Report of the IPCC on Renewable Energy and Climate Change Mitigation. He served as a reviewer of the Global Energy Assessment Report (GEA) published in 2012 and as a reviewer of the 5th Assessment Report (AR5) of IPCC published 2014. Since 2013 he is a reviewer of the annual Medium-Term Renewable Energy Market Report of the International Energy Agency.

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

on the trajectory for the needed GHG reductions by 2050. The consequences for renewable electricity would be that an additional 200 to 250 TWh, mainly from solar and wind power are needed to reach this goal. Taking these developments into consideration, it is clear that Europe has a need for additional policies to increase solar photovoltaic power and especially rooftop installations to 350 to 400 GW by 2030. In order to achieve this goal, the annual market has to grow to over three times the European market volume in 2016 [6, 7].

Where could this capacity be installed? Besides the large potential of rooftops, where even the conservative IEA predictions in the Energy technology Perspectives 2016 show a technical potential of 470 GW of PV system capacity on rooftops in cities of the European Union by 2030 [8], the dual use of traffic or water infrastructure [9, 10] as well as closed landfills [11] and the re-naturalisation of mining sites offer potentials, often in the perimeter of existing electricity infrastructure.

For over 50 years, scientist, engineers and industry have worked hard to decrease the hardware costs of photovoltaic solar electricity generation systems. In 2017, the costs of direct current (DC) electricity in central Europe at the PV module level have dropped to less than 0.02 EUR/kWh and shows that it is the technology with the lowest cost for electricity generation. Even if the low DC generation cost is only a part of the total, as there is an additional cost component to provide the electricity to the customer where and when it is needed, photovoltaic solar electricity is one of the lowest cost options to de-carbonise our electricity supply.

If Europe wants to fill the Paris Agreement with life and make sure that our children and grandchildren will find a liveable planet, it has to embrace photovoltaics now with a massive increase of its own market volume and help less electrified countries to build up a sustainable electricity supply based on solar power.

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EERA: Championing EU transition to Low Carbon

By Adel El Gammal (pictured), Secretary General, The European Energy Research Alliance (EERA)

AN "INCONVENIENT REMINDER"

Except for those still believing in soothing political statements still hanging on to a 1,5°C warming target, it will be little surprise that humanity must get ready to accept the unknown consequences of temperatures rising well above 2°C by the end of the century.

Record concentration of carbon dioxide of 410 ppm (from the pre-industrial peak of 280 ppm in 1958) have been recorded in May 2017, hinting that the 450 ppm threshold needed for keeping warming below 2°C (with only a 50% probability) will irremediably soon be overshot.

A recent analysis by Carbon Action Tracker indicates that under full execution of the Paris Accord pledges, the world is likely to be on a 2,8°C warming trajectory, while under current policies, warming is expected to reach no less than 3,6°C.

In the race to fight climate change, decarbonizing the energy sector stands out as a key priority. But despite some remarkable achievements, the speed of transition to low carbon, in Europe and globally, fails to reflect the climate urgency and needs to be accelerated.

COMPETITIVE TECHNOLOGY READILY AVAILABLE

Under the combined effect of a deep economic crisis and a rapidly changing regulatory environment, the last decade has been in Europe the theatre of an intense turmoil in the energy sector. And the unprecedented lobbying activity that followed, resulting from the size of vested interests at stake, led to a blurred perception of the actual technological state of play.

While still in an early deployment phase a decade ago, many low carbon technologies have in fact delivered far beyond expectations, and constitute today highly competitive power generation technologies.

For instance, nobody would ever have thought a couple of years ago that – under a pure cost perspective – PV could now deliver electricity in Germany at a cost close to half the strike price of New Nuclear power (ref. Hinkley Point C, UK).

Nor that 75 GW of PV capacity could be built, installed and commissioned in a single year, representing about twice the historical installed capacity of a country such as Poland.

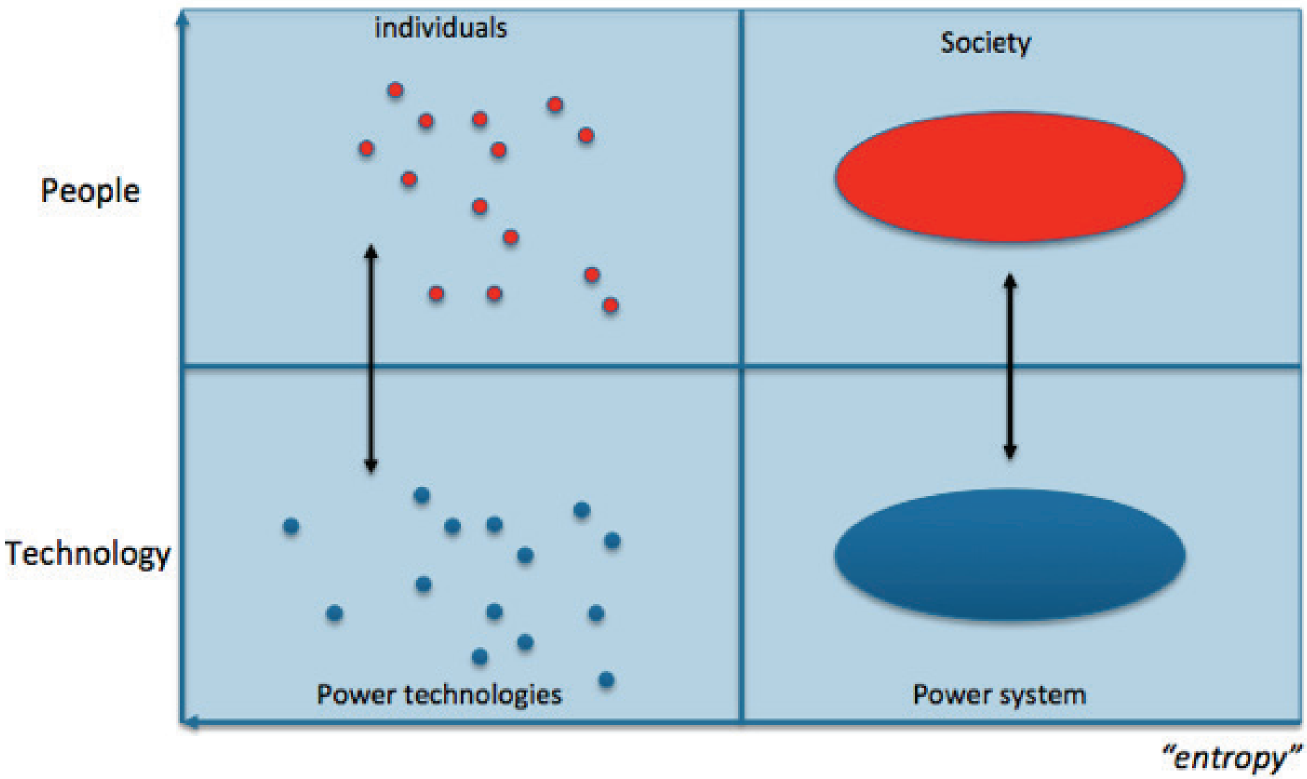
INCREASED RESEARCH AND INNOVATION IS CRUCIAL

Quoting Pascal Lamy (Report of the Independent High Level Group on maximizing the impact of EU Research & Innovation), "*Investing in Research & Innovation is increasingly crucial for shaping a better Europe future in a rapidly globalizing world where success depends even more on production and conversion of knowledge and innovation".*

Indeed, the fabulous progress achieved in low carbon technologies in the recent years is largely attributable to the early promotion of renewables in Europe and to the research impetus it has created within the union, that led to major advances in most low carbon technologies.

Focusing on PV, despite mass production now primarily taking place in Asia, EU still captures most of its added value. And thanks to sustained research efforts, it still holds scientific and technological leadership on advanced PV technologies and concepts.

In addition, due to the high penetration of PV in some EU member states, Europe is now also developing unique capabilities in addressing the complex



integration challenge resulting from the systemic implications of integrating high penetrations of distributed and variable power into the power system.

But transformation calls for more than technology only.

It is also about converting technological advances into products, services, and business models that, under the appropriate policies, actually deliver value to society.

For instance, resulting from its excellence in advanced PV concepts, the EU is also developing a distinctive leadership in designing PV for special applications such as integration of PV in the built environment. Such an application, if competitively developed, could actually become a game changer and substantially transform the energy model of cities. Furthermore, in a densely populated continent such as Europe, it could eventually unveil a huge market and develop a growing competitive product and service industry, firmly anchored in the local economy and not vulnerable to offshoring.

THE ESSENTIAL ROLE OF SOCIAL SCIENCE & HUMANITIES

In addition to the availability of affordable low carbon products and services, accelerating the energy transition also requires the active contribution of consumers.

It needs endorsement and acknowledgement by the citizens, who need to become full actors of the newly created ecosystem.

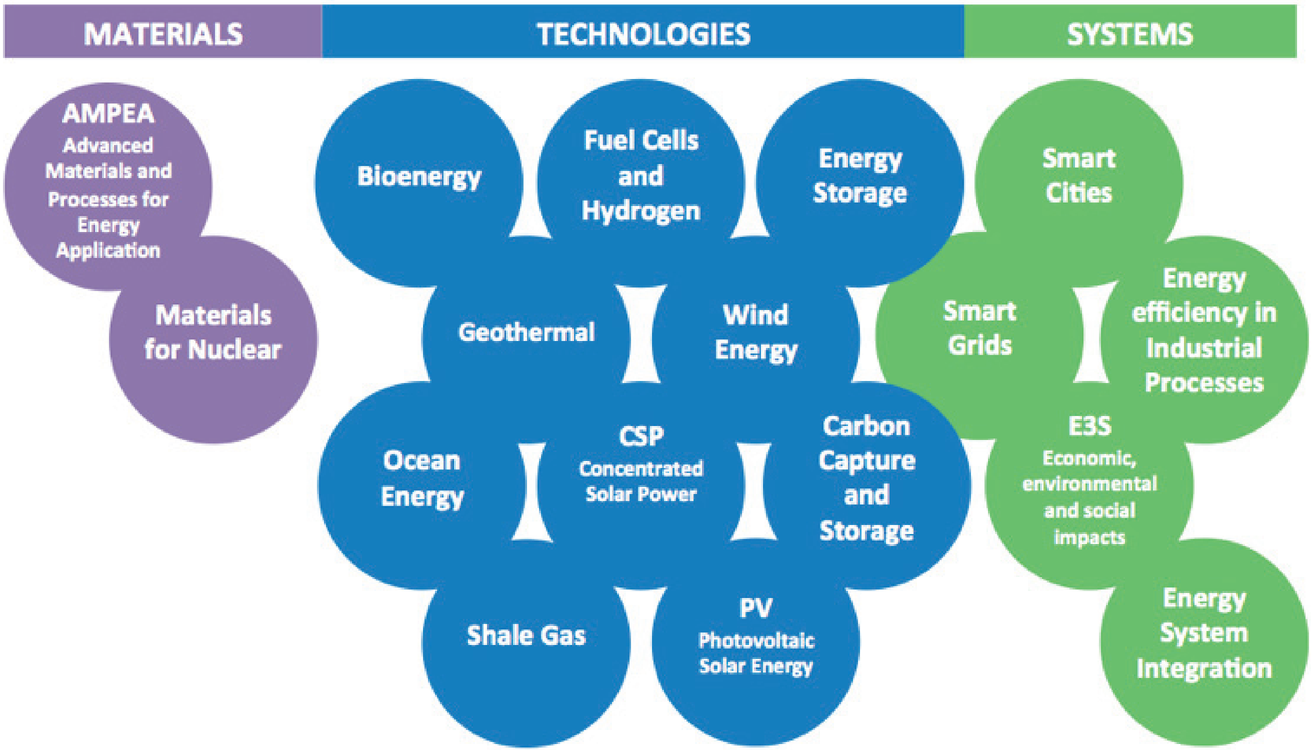
It entails understanding the human behavioral change dynamics that will help define the appropriate boundary conditions allowing technology appropriation by the citizen (i.e. how individuals interact with the power technology) and eventually inducing the desired lifestyle and societal transformation (i.e. how the community as a whole interacts with the power system).

It is therefore crucial to involve actors and communities in the innovation cycle in order to create "living innovation laboratories" able to pilot the new concepts of products, services and business models.

EERA, ADDRESSING THE GLOBAL TRANSFORMATIONAL CHALLENGE IN EUROPE

The European Energy Research Alliance probably embodies today the most relevant organisation in the EU dedicated to addressing the global challenge of transition to a decarbonized energy regime.

By connecting about 250 of the



most advanced universities and research centres active in low carbon technologies across the EU, EERA pools and coordinates the efforts of the best EU research resources across the range of low carbon energy technologies and disciplines through 17 "Joint Research Programmes" (see figure).

Adel El Gammal is a recognized expert and a senior EU Affairs professional in the fields of low carbon technologies, energy transition, and climate change.

Before joining EERA as Secretary General, Adel was active for the last 10 years in the EU climate energy debate, notably as Director of the Becquerel Institute, a consultancy providing advanced research and intelligence on the energy transition, and Secretary General of the EU PV Industry Association (EPIA, now SolarPower Europe), where he launched the SET-Plan Solar Europe Industry Initiative (SEII).

Adel is civil engineer from Ecole Polytechnique of Brussels, holds degrees in Business Administration from Solvay Business School (Belgium) and Insead (France) and later specialized in Environment Management (IGEAT, Belgium).

About EERA
The European Energy Research Alliance (EERA) is an alliance of European public research centres and universities.

It constitutes the strategic research pillar of the European Strategic Energy Technology Plan (SET-Plan).

EERA brings together about 250 research centres and universities. Actively working together on 17 joint research programmes, they build on national research initiatives. In a Joint Programme a research organization join institutions in other European countries to work on shared priorities and research projects. The EERA Joint Programmes are aligned with the priorities for low carbon technologies defined in the SET-Plan.

Capitalizing on its successful track record of EU research collaboration and scientific excellence, EERA will concentrate efforts on researching the conditions of a successful transformational transition of the EU society to a low carbon regime.

Acknowledging the recommendations of the "Report of the Independent High Level Group on maximizing impact of the EU Research and Innovation Programmes", EERA is therefore ideally positioned to contribute defining and to embrace "Mission Oriented and Impact-Driven" Research and Innovation programmes that will pave the way to a competitive, fair and prosperous low carbon energy regime in Europe.

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Society for Gas as a Marine Fuel SGMF – 4 years and counting

By SGMF London Secretariat, Mark Bell General Manager

A Global sulphur cap for marine heavy fuel oils will signify the end to a one fuel for all for shipping from 2020 onwards. Whilst apparently slow to change, maritime is grappling with a hunt for alternative and more environmentally friendly fuels. Natural gas is amongst the contenders to help bridge the gap and it offers significant advantages for the industry, but it is not the ultimate solution by any means.

Since the switch to oil for fuel as marine propulsion, maritime has developed sophisticated machinery to effectively utilise what is left at the bottom of a barrel of crude after all the goodies have been refined and taken out. Ultimately these oils include sulphur in various quantities and, from 2020, this cannot be more than 0.5% for shipping. Other industries such as automotive, utilities and power are also switching fuels, and gas is on the agenda for them too. However ships by their autonomous nature need portable fuels and natural gas is a very good fit. Other fuels, typically methanol and ethanol are also in the mix as are Nuclear and Hydrogen. However availability and cost lead to the choice of natural gas with a clear break in any link to the price of oil expected over the coming years. Nuclear remains a sound and understood source of power for ships but it is hard to imagine its widespread acceptance and use for what is a current world fleet of some 55,000 merchant ships over 500 [GRT]. Hydrogen is an ultimate solution having zero emissions upon combustion except for water. However its production, containment and are still at least a generation away, leaving natural gas as a sound intermediate fuel until those solutions are found.

There is the option of the industry burning refined oil fuels. However their price is uncertain and the environmental benefits not as great. In fact, the operator right now can continue to use heavy fuel oil so long as the exhaust is washed clean of sulphur. As we speak this acidic water wash may be pumped overboard, effectively cutting pollution to atmosphere and polluting the oceans, but it wont be long before this practice is banned. Regulatory uncertainty here sees an extremely low take up for this high investment for shipowners with current newbuildings.

Aside from the Scandinavian short sea area and back to back ferry operations, the significant sectors are cruise and container. Cruise sees almost all newbuildings with gas as fuel. It is container however the deep sea container sector that will set the dominoes falling in LNG fuelled newbuildings and the 2020 deadline might just be the catalyst for the switch to LNG.

Whilst there is a vast difference between carrying LNG in bulk on a ship and burning it for propulsive power, natural gas is liquefied to provide transportation efficiencies and in both cases these cryogenic technicalities are well known and understood. Nearly 50 years of operations in LNG transportation has proved the process of authoritative and careful development of industry guidelines and with sensible regulation as the right way to go.

SGMF has been is established as the Industry representative framework organisation that works to keep the use of LNG safe and efficient whilst advocating its use safely and correctly.

Publications to date have been numerous and their goal is to develop guidelines than can be used by appropriate authorities for standards that can be safe and more widely used, and at the same time, the multitude of benefits from its use are realised.

Since its instigation in the Autumn of 2013 SGMF, Society for Gas as a Marine Fuel has set up shop in the City of London as a wholly separate, but complementary NGO to the others that already exist. Much as the regulatory bible for LNG transportation has become the IGC code; the IGF code covers all matters pertaining to the use of LNG on ships as a fuel. Industry is recognising the significant difference in the issues between the two and it is no different when it comes to regulation and the need for the Industry body has never been greater. As of now 120 members from across the industry and growing, the pace of the maritime industry embracing the issues surrounding the use of LNG as a fuel is taking place.

In 2017 there has been a step change in LNG bunker delivery capacity worldwide from 1 vessel of just 150 [m3] capacity to seven vessels from SGMF member organisations with 27500 [m3] between them. These delivery vessels represent both a huge investment and significant commitment and I am confident we will see the same step change in the number of ships using gas as a fuel, placing LNG firmly in the mix for marine fuels for the foreseeable future. ●

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Removing technical barriers to biomethane injection in the natural gas grid

A GERG initiative to support the development of the biomethane industry in Europe

By Robert Judd (GERG), Mailys Pale, Helene Morin, Zacaria Reddad (Engie lab Crigen)

BIOMETHANE AND ITS INTRODUCTION INTO THE GAS NETWORK

Renewably derived gases, whether biomethane or hydrogen, have the potential to make an enormous contribution to the long-term development of a low carbon energy system in Europe and beyond. Although volumes injected into our gas networks are currently small, they are showing rapid growth in some European countries.

In the case of biomethane a pan European understanding of the steps needed to remove any technical barriers will greatly support the development of a viable and sustainable growth industry. To approach the removal of these barriers in a consistent and effective manner requires close cooperation with those developing the standards for use of biomethane.

Discussions on biomethane quality standard definition for network injection have been ongoing for several years now. However, a lack of scientific and tangible network data has held back a full understanding of the real impact of biomethane trace compounds on gas infrastructure as well as end-users.

Two European standards on biomethane have been published in 2016 / 2017:

- EN16723-1: Specifications for biomethane for injection in the natural gas network;
- EN16723-2: Automotive fuel specifications

Yet, they are only of voluntary application, and some thresholds values are either missing, or were set through stakeholder agreement but are not always based on real technical data, which has been lacking at a European level.

Therefore to ensure and secure the future of the whole biomethane industry, we need to define threshold values which ensure gas infrastructure integrity, and end-users' equipment integrity, without being unnecessarily stringent and therefore imposing unnecessary extra costs on producers. This will allow the gas industry and its vast existing infrastructure to play a major role in meeting Europe's climate goals.

THE GERG BIOMETHANE PROJECT

In 2016, a GERG project was set up and launched at the initiative of several European gas grid and gas storage operators. This project was led by Engie Lab CRIGEN (representing the French gas infrastructure operators GRTgaz, GRDF, STORENGY). Partners included the Danish Gas Technology Centre, DGC (representing Danish gas operators) , DNVGL UK (representing the four UK gas distribution companies, National Grid/Cadent, SGN, NGN and Wales and the West), Gasum, Gaz System, Innogy, Snam Rete Gaz, and TIGF. Kiwa and DNVGL Netherlands provided additional technical input and delivery based on existing Dutch industry knowledge and their known expertise in this area.

Since there is no precise knowledge about the choice of trace components to follow and the definition of threshold values, the aim of the GERG biomethane project is to gather robust technical information regarding the impacts of biomethane trace components on the gas infrastructures and on the end-users' equipment to propose revision of the standards using strong technical arguments.

The first step, completed this year, is a literature and operational data review to identify the gaps of knowledge. It focuses on two aspects:

- Corrosion: impact of the biomethane trace components in terms of corrosion: CO, HCN, H2S, NH3, HCl, HF, organo-halides, micro-organisms;
- Siloxanes: impact of silica compounds found in biogas sources both on the gas infrastructure (pipes, compressors, valves) and on end-users (boilers, engines).

A UNIQUE SET OF DATA REGARDING REAL BIOMETHANE QUALITY

The phase 1 of the GERG biomethane project has allowed us to collect a unique set of data regarding real biomethane quality. These data were collected by partners who need to perform biomethane analysis prior to its injection into their gas networks. As there is very little public documentation on trace compounds concentrations in biomethane, this set of data is highly valuable.

These data are very helpful to aid

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understanding of the real biomethane composition in the gas networks and in the end-users' appliances.

The data sets also give some clues on the ease with which biomethane producers can meet the current requirements of EN 16723-1 or the thresholds that may be suggested at the end of coming phases of the project.

The extensive review performed highlighted the gaps of knowledge regarding the impact of biomethane trace compounds on gas infrastructure and on gas users: in particular, the study shows that the impact of siloxanes on heavy duty engines and on some boilers needs further understanding, as well as the impact of biomethane on some materials, especially in the presence of water (which is the case in underground gas storage).

NEXT STEPS

Phase 1 of the GERG biomethane project has already helped to clearly identify the gaps of knowledge regarding:

- the impact of biomethane corrosive trace compounds;
- the impact of siloxanes on gas appliances, particularly on boilers and vehicles.

This project has set a unique baseline for real European operational data and will be followed by a second phase project funded under the H2020 framework through CEN. This new project will address the priorities given by CEN Technical Committees working on the standardisation programme:

- tests regarding the impact of siloxanes on heavy duty engines;
- tests regarding the impact of siloxanes on boilers and other stationary appliances;
- review on the impact of oxygen on underground gas storages;
- review on the impact of Sulphur on vehicles;
- Impact on health (which is to be studied through the expert group EG4 of CeN TC408).

The next phase will consist in performing tests to complete the existing knowledge.

This project will help to obtain threshold values in agreement with the interests of all the stakeholders needed to develop a successful biomethane industry in Europe:

- Biomethane producers: need to have limited treatment / upgrading costs to guarantee the economic viability of the projects, and thus the development of the biomethane sector;
- Grid operators: need to protect the grid infrastructure while including renewable gases in the grid;
- End-users: need to protect their equipment (boilers, engines, etc).

This next phase, which is to be launched in Autumn 2017, will gather as many stakeholders (biomethane producers, boilers manufacturers, engines manufacturers, gas grid or storage operators, etc.) as possible in its supervisory board in order to obtain a consensus on values that should be used as thresholds in the future European standards. This project is just one of the many ways that the European gas industry looks to support an increasingly low carbon and renewable energy based future.

ACKNOWLEDGMENTS

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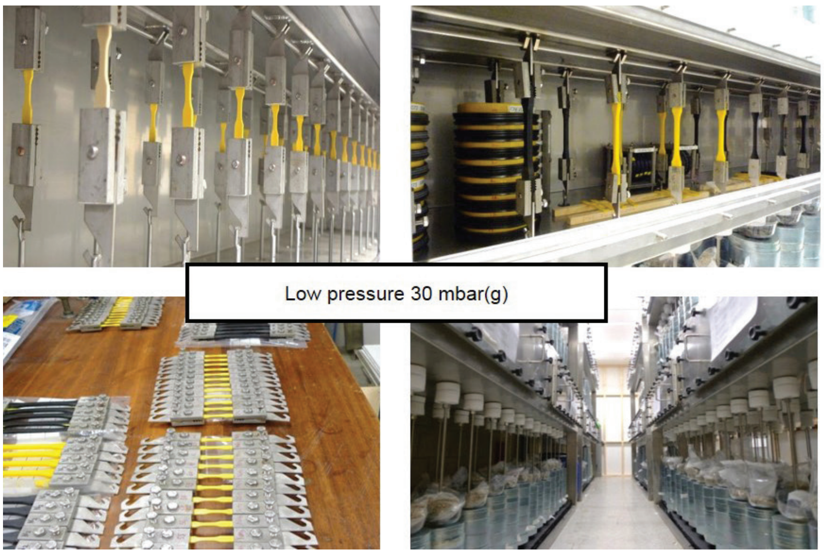

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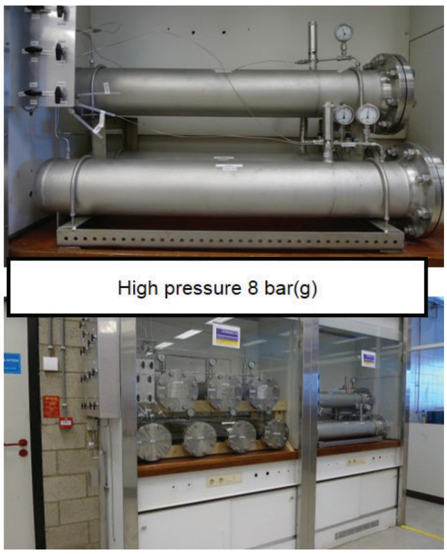

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