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Kimmo Tiilikainen
Minister of the Environment, Energy and Housing of Finland

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Foreword

According to Carbon Brief, the UK's CO_2 emissions have dropped to levels last seen in 1890. In that year, the political career of Otto von Bismarck came to an end when Kaiser Wilhelm II forced him to resign the Chancellorship of Germany. Meanwhile, Italy established a colony in Eritrea: Europe was a complicated place in 1890. It is no less complicated today.

And so in this issue, we wrestle with the decarbonisation of transport: Emmanuel Desplechin uses the debate over biofuels to illustrate the wider need to embrace every sustainable option in the fight against climate change. Even with the vast potential growth of RE in transport, he says, it might still only account for 3% of energy consumption within the sector. Since this might lead to a possible tripling of the use of liquid biofuels, he argues it is that imperative to avoid labels like "conventional" and "advanced". On that theme, we are delighted to feature another excellent article by Seán Kelly MEP, who explores the role of biofuels within the context of the RE Directive. He points out that the contentious nature of the subject – and in particular how uncertainties over the now-infamous indirect land use change (ILUC) – have hindered investment. While arguing that not all biofuels have the same environmental impact, he seeks a pragmatic, negotiated way forward – perhaps with the input of the Bulgarian Presidency.

Away from that controversy, we feature a well-researched article by Dr. Jäger-Waldau and the team from the Joint Research Centre. They remind us that 68% of global greenhouse gas emissions come from fossil fuels, making decarbonisation of energy the single most important factor in achieving the Paris targets. Pointing out the gap between current levels of PV installation and those required to meet current 2030 targets, they evaluate the potential of rooftop solar PV.

Finland demonstrates an excellent example of energy decarbonisation, as Henna Virkkunen MEP explains. Collaboration with other Nordic countries and building a diverse energy portfolio have enabled it to reduce fossil fuel-based energy consumption below 40%. Put another way, more than 60% of Finnish energy is renewable. This remarkable progress is set to continue because Finland's future energy production will rely even more heavily on renewables. Echoing this theme, Kimmo Tiilikainen, Minister of the Environment, Energy and Housing explains that technology development and renewable energy production are driving change, while the energy sector also will increasingly become a service business.

As we are frequently told, "the sun doesn't always shine and the wind doesn't always blow," putting energy storage at the heart of decoupling energy consumption from generation. Brittney Elzarei reviews the role of EASE, proposing a roadmap overviewing energy storage technologies with a view to aligning R&D effort. From this, she suggests that we can identify priorities; and proposes a strategic energy storage plan.

Among the reasons for Bismarck's downfall in 1890, there appears to have been disagreement with the Kaiser over Germany's foreign policies. Today, apparent uncertainty over the position of the present German Chancellor has been resolved, only to be replaced with new uncertainty over the Italian leadership, where migration of people from the Horn of Africa appears to provoke strong feelings. UK emissions seems not to be the only story today with echoes of 1890.

And there's a lot more for you to read inside…

Michael Edmund
Editor

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Every year, the European Commission (Directorate-General for Energy and Executive Agency for SMEs) organises the **EU Sustainable Energy Week** (EUSEW) – the biggest event dedicated to renewables and efficient energy use in Europe. The 13th edition will take place from **4 to 8 June 2018 in Brussels** at the European Commission's Charlemagne building and at the Residence Palace. This year's tagline is **'Lead the Clean Energy Transition'**, and it will cover a series of activities with an EU-wide scope.

Policy Conference

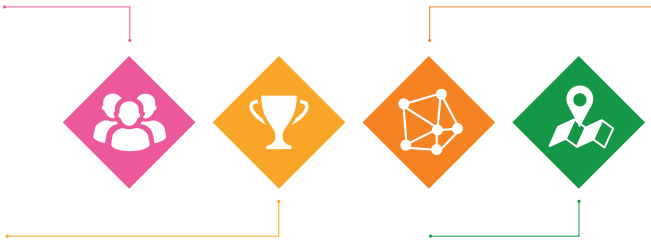
05.06 to 07.06

One of the most important European conferences dedicated to sustainable energy policy issues.

Networking Village

06.06 to 07.06

A space for the EUSEW community to exchange ideas and to foster information-sharing and new connections to promote sustainable energy innovation.



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05.06

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- → Organising or attending an Energy Day
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- → Presenting at or attending the Networking Village
- → Organising a session at the Policy Conference
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Help make the EU Sustainable Energy Week a success!

About EUSEW

Since 2006, the EU Sustainable Energy Week has become the European information hub for all aspects of sustainable energy policy in Europe and has provided a platform for many new ideas to be formulated and debated. From the Policy Conference to the Sustainable Energy Awards and the Networking Village, EUSEW 2017 gave a great outlook on the work being done by ordinary people, entrepreneurs, local authorities, businesses, NGOs and the European institutions to fight climate change and boost the use of renewable energy. Last year's numbers speak for themselves: **2 290** participants, **422** speakers, organisers of **50** networking activities, **22 749** Award voters and over **12 000** social media mentions – and trending for three consecutive days.

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Biofuels and the Renewable Energy Directive

BySeán Kelly, MEP

In February, inter-institutional negotiations between Council and Parliament on three key elements of the Clean Energy Package - the Governance Regulation, the Energy Efficiency Directive, and the Renewable Energy Directive - got underway. The Renewable Energy Directive in particular sees the institutions head into negotiations with quite differing positions. Parliament has been more ambitious generally in its approach to the file, opting for the higher overall target of 35%, while also increasing ambition on articles dealing with issues such as heating and cooling, distributed generation, and planning.

Perhaps the issue that causes the most contentious debates in Brussels policy circles is that of renewable energy in transport, and specifically the use of biofuels to meet the targets. This is an issue that has been ongoing for a number of years now, with the original Renewable Energy Directive including an obligation to review the impact of indirect land use change (ILUC) on greenhouse gas emissions associated with biofuels, leading to the introduction in 2015 of the so-called ILUC amendments which capped the share of conventional biofuels that can be counted towards the 2020 renewable energy target to 7%. At the end of 2016, the Commission came forward with its proposal for the recast of the Renewable Energy

Directive for the period to 2030, which brought the proposed phase-down of the cap from 7% in 2020 to 3.8% by 2030. With all of these changes in recent years, it is clear that the biofuels sector has had to put up with quite a lot of uncertainty, which has hindered investment.

So how is the situation looking on biofuels as negotiations get going? Firstly, I think that both Parliament and Council have both adopted quite sensible, albeit different, approaches and I think it gives us something to build on. Council has rejected the proposed phase-down of the cap, and has looked to maintain it at 7%, as agreed in 2015, up to 2030.

In Parliament we agreed upon a different approach whereby Member States would each be capped at their current levels, and the level of this cap would be maintained to 2030, with some flexibility for Member States with shares below 2%. I think the position Parliament has adopted sends two important political messages: firstly that we reject the Commission proposal for a gradual phase out of conventional biofuels, and secondly that we want to protect the investments that have already been made, avoiding any retroactivity in this regard. I think with the two positions that are now on the negotiating table, there is scope for us to work towards a pragmatic outcome.

There are of course real sustainability concerns on conventional biofuels, and the challenge for us as negotiators is clear: find a pragmatic solution on biofuels that avoids burning investors, but also ensures that the biofuels we use are sustainable. In the Parliament's position we have included a text that would consider Palm Oil to be unsustainable and therefore not eligible to be counted towards the achievement of targets from 2021 onwards. Concerns about this text have been put forward in recent weeks, particularly from representatives of Indonesia and Malaysia - two large Palm Oil producers that would stand to be greatly impacted by this. The arguments against the ban is that it would not be in line with WTO rules. This may be the case, but the inclusion of the text, from a political perspective, means that we will at least need to try to find a solution that does not incentivise the biofuels, such as palm oil, with the highest environmental impact.

I have long argued that a workable solution needs to be found to ensure that we do not paint all conventional biofuels with the same brush; some are clearly better than others. The reputation of biofuels has been tarnished due to the unsustainable production of certain feedstocks and their environmental impact; palm oil is the obvious example. Biofuels grown by European farmers which achieve high greenhouse gas savings, and which produce high-protein animal feed as a by-product, are not the same as imported palm oil. In the Committee stage of Parliamentary discussions, I proposed drawing a distinction between good and bad biofuels along these lines, but unfortunately the emotive nature of this topic meant it was very difficult to get agreement.

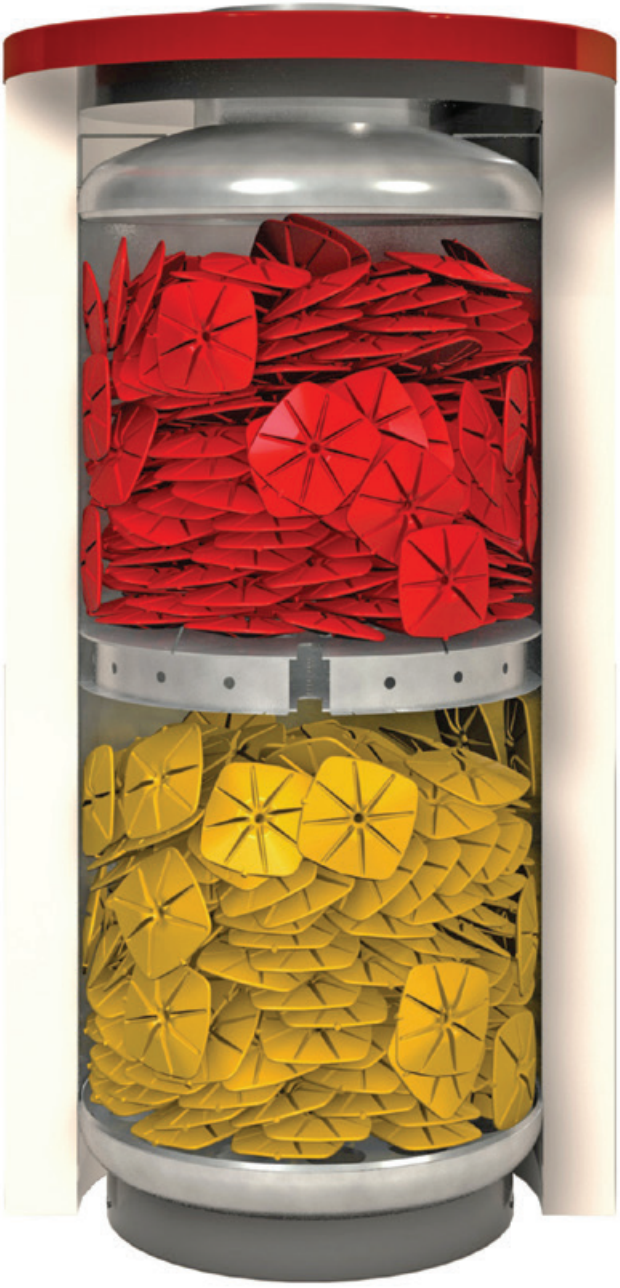
It is clear to me that we should promote the better performing biofuels, and end support for the worst ones; the way in which we achieve this is less clear. The proposed phase-out of conventional biofuels is difficult for many Member States and political groups for a number of reasons, most of which I have outlined already. Additionally, the uncertainty and disagreement around the methods used to determine ILUC factors for different feedstocks means that using these to determine sustainability is extremely unlikely to get agreement.

Am I therefore pessimistic about finding a solution? I genuinely am not. As a team of rapporteurs in the European Parliament, we have built up a strong understanding and a very effective working method over the last year. While we have differing ideological perspectives on most issues, there is always a will to find a compromise. This is the attitude that we will bring into negotiations with Council, and I hope that the Bulgarian Presidency will join us in this approach. Vice President Sefcovic has set us a target of October 2018 to conclude negotiations on the Clean Energy Package.

Although there are a number of issues of contention within the Renewable Energy Directive, which extend far beyond biofuels, I am confident that with the right cooperation, flexibility and political will, we will be able to reach a strong and ambitious agreement which allows us conclude well in advance of this target and which puts us on track to meet our 2030 Climate and Energy targets.

Among the most innovative ideas in Europe: The Heatsel® storage capsule increases the capacity of heat and cold storages

Heatsel® is lens-shaped, plate-sized and a real break-through in the area of heat and cold storage as it increases the storage capacity of heat and cold storages by up to three or four times. By macro-encapsulation of phase change materials (PCM) the German company ESDA developed with its subsidiary Axiotherm a high-performance, high-capacity but cost-efficient user-friendly solution that can be introduced into the storage subsequently as well. The European commission recognised the Heatsel®'s innovation and market potential and is supporting its implementation with the SME instrument. The project application of ESDA received the highest points out of the total 135 submitted applications in the "energy" category, making the first place among Europe's most innovative ideas.



THE TECHNOLOGY

For decades, there have been attempts to transfer PCM such as paraffins or salt hydrates into a user-friendly form. Before now, it was assumed that micro and macro encapsulation of PCM would be unsuitable for a broad application, both technically and economically. But Heatsel® proves the precise opposite.

Latent storage systems can only achieve sensible integration into complex systems such as technical building equipment if not only their capacity, but also the discharge and charging power can be controlled in a wide range, and in a temperature range that is as precisely defined as possible. Therefore, the Heatsels® are surrounded by a heat carrier medium (e.g. water), to optimise heat transfer from the heat carrier to the PCM.

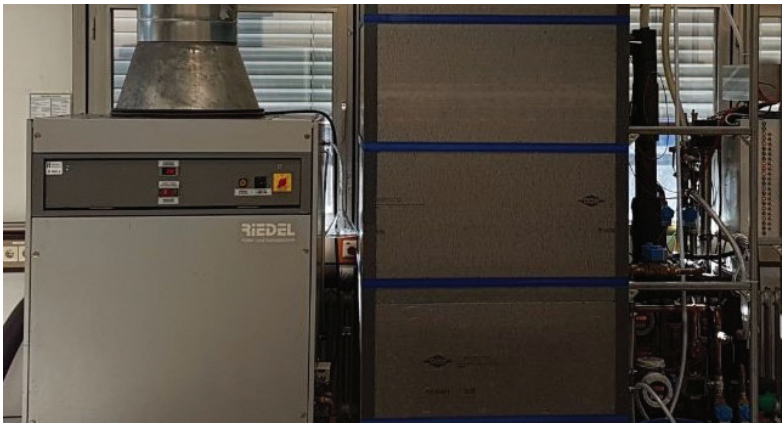
In the Futurium – the so called "house of the future" in the neighbourhood of the Federal Ministry of Education and Research in Berlin – such a PCM storage forms a central part of the innovative cooling concept. The production of cold with a delay and its demand will be bridged by five storages holding more than 9,000 litres and equipped with 9,500 Heatsels®. At the same time, the current output can be controlled by the variable mass flow on the primary and

secondary sides: It is possible to temporarily take a higher output from the storage than was fed in on the primary side. The internal heat transfer processes are of the utmost importance for this.

The project is therefore supported from the beginning by the department of energy/building/environmental technology of the University of Applied Sciences in Münster under management of Professor Bernd Boiting, who built the corresponding test benches and developed empirical approaches in order to permit performance examinations of latent storages and development of calculation approaches. The Figure below shows the hydraulic module that can be used to charge and discharge any storage elements in a defined manner and to change framework conditions and flow directions, in order to develop a simple planning tool for system planners and constructors in the end.

THE ADVANTAGES OF PCM

Thermal storages based on PCM are comparatively space-saving and permit efficient charging and discharging. Thermal energy can be saved and emitted on the temperature level at which the upstream energy converters work efficiently and connected systems are optimised. At the same time, they can relieve the mains when they reduce energy consumption in buildings and balance it out over time. Energy converter runtimes can be delayed or extended, which increases system efficiency and reduces the size of the energy converters. Thermal storages are



therefore also of interest in connection with the "Smart Grid", in order to use the option of larger "virtual" storage units. Regeneratively generated power can be easily converted into heat via resistance heating – or more efficiently into heat or cold as required via compression chillers.

ACHIEVING MORE TOGETHER

The innovation consultancy EurA AG has essentially contributed to successfully applying for subsidies. The company has seven offices in Europe and, among others, manages the "Energy Innovation Europe" network, bundling other innovative companies in Europe in addition to ESDA in order to establish sustainable international cooperation for the development of new technologies in the entire energy area. The network is open to new members.

Phase Change Materials

Phase Change Materials – PCM www.pcm-ral.de – are materials that can reverbly change their state of aggregation based on exteernal, usual thermal, energy input/discharge. When they change from solid to liquid, they take up a great amount of thermal energy at a constast temperature. they will discharge this "latent" stored energy again on crystallisation at the same temperature level. This way, a lot of thermal energy can be stored in small spaces and at a consistent temperature.

PCM storages are therefore a more efficient technology than conventional water storages. At the same time, their small working temperature differences increase the efficiencies of thermal heating and cooling processes.

Information:

www.technologie.esda.de
www.axiotherm.de
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The Rooftop Potential for PV Systems In the European Union to deliver the Paris Agreement

By Thomas Huld, Katalin Bodis, Irene Pinedo Pascua, Ewan Dunlop, Nigel Taylor, Arnulf Jäger-Waldau,
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On 4th November 2016 the Paris Agreement, which aims to limit the maximum global average temperature rise as close as possible to 1.5°C, came into force. However, the Nationally Determined Contributions (NDC's) proposed by each country are so far not sufficient to reach this goal. The current policies in place to limit global greenhouse gas (GHG) emission are not sufficient to keep the temperature rise below 2°C [1].

As 68% of the world's current greenhouse gas emissions are due to burning fossil fuels, the decarbonisation of our energy supply is the single most important component to achieve the targets [2, 3]. In 2015, electricity represented only 18.5% of the final energy consumption but was responsible for 38 % of the fossil fuel related and 31% of the total CO_2 emissions. It is interesting to note that the emissions related to the generation of electricity have increased by 45% compared to the 40% total increase of CO_2 emissions between 2000 and 2015 [3].

Global average of CO_2 emissions per kWh of electricity was about 506 g in 2015 [3]. Under the World Energy Outlook 2017 New Policy Scenario, these emissions would fall to 325 g CO_2/kWh by 2040. For Europe the situation looks somewhat better, i.e. 344 g CO_2/kWh in 2016 and a forecast of about 150 g CO_2/kWh in 2040, but this is still not sufficient for the necessary reduction of CO_2 emissions to 65 g CO_2/kWh in order to meet the Paris Agreement [4]. Such a development is only possible under the Sustainable development Scenario, where electricity emissions in Europe should decrease to 45 g CO_2/kWh.

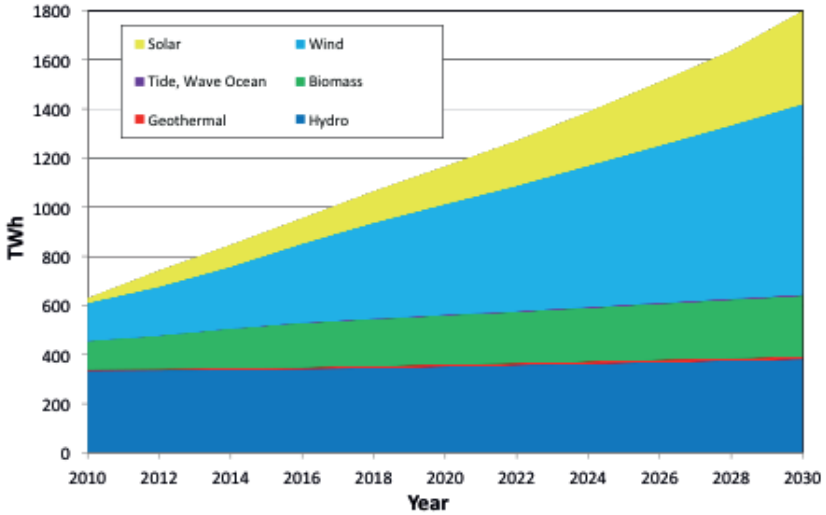

Fig. 1: European electricity production until 2030 to meet the 35% RES target (extrapolation based on the impact assessment of the 2016 Market Design Directive proposal [5]).

So far the European Union has proposed a binding target of at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990, and a 27% target for renewable energy consumed in the EU in 2030. In January 2018, the European Parliament voted for a binding target of 35% of energy generation from renewable energies by 2030. EU Member States must now decide on their position and whether or not they support this target. The consequences for renewable electricity would be that around 1 200 to 1 250TWh require to be generated from solar and wind power to reach this goal (Figure 1). Of this roughly 400 TWh would come from solar power, about 20 TWh Solar Thermal Power Generation and 380 TWh PV, which would require close to 350 GW PV capacity to be installed by 2030.

However, with a total installed capacity of about 108 GW at the end of 2017 and annual installations between 5.1 and 7.5 GW in the last four years (Figure 2), it will be difficult to reach

this target [6]. New policies are needed to enable a three times larger annual market over the next 13 years, which is needed to reach the target [7].

What options are available to install the required capacity?

a) large-scale or utility plants, with arrays of free-standing modules, connected to the transmission grid, and

b) PV located on roofs or facades of buildings.

Both have different economic rationales: utility PV plants can take advantage of economies of scale to reduce investment and operational costs, and the electricity generated can be traded in wholesale markets.

Rooftop installations have higher capital costs, but the electricity can be consumed either wholly or in part on site, so the value is related to the relevant industrial or residential retail prices. Rooftop PV also brings a better geographical match between supply and demand, a factor of increasing importance as we progressively electrify the heating and cooling and the transport sectors.

Indeed, several studies suggest that roof space is not an issue, even for the most ambitious scenarios. For instance the IEA 2016 Energy Technology Perspectives reports an estimate potential in EU urban areas for over 500 GW of PV [8]. This like many other EU-wide studies relies entirely on population density data as a proxy. A more direct approach is to map actual buildings right across Europe using earth observation data. This is what the JRC is currently working on, exploiting data from the Global Human Settlement Layer (GHSL) initiative. With this we can estimate available rooftop area in blocks of 10 m x 10 m across the entire EU in both urban and rural areas. With ths data layer combined with exsiting geographic information

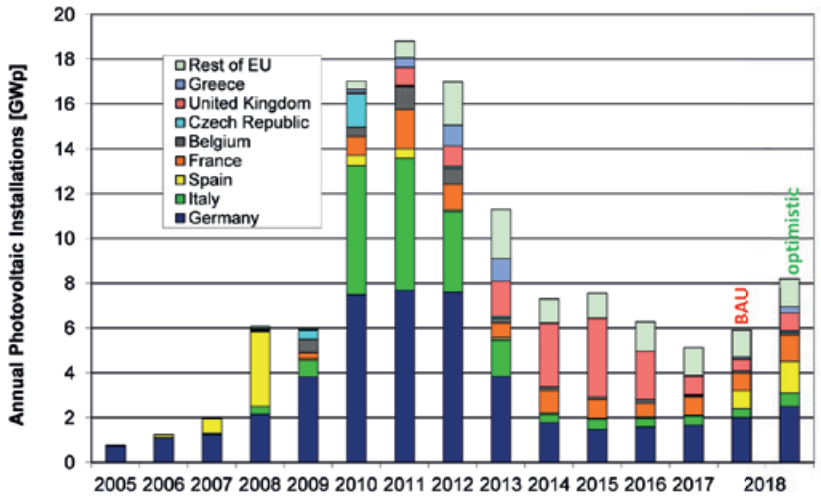

Fig. 2: The annual photovoltaic installations in the European Union

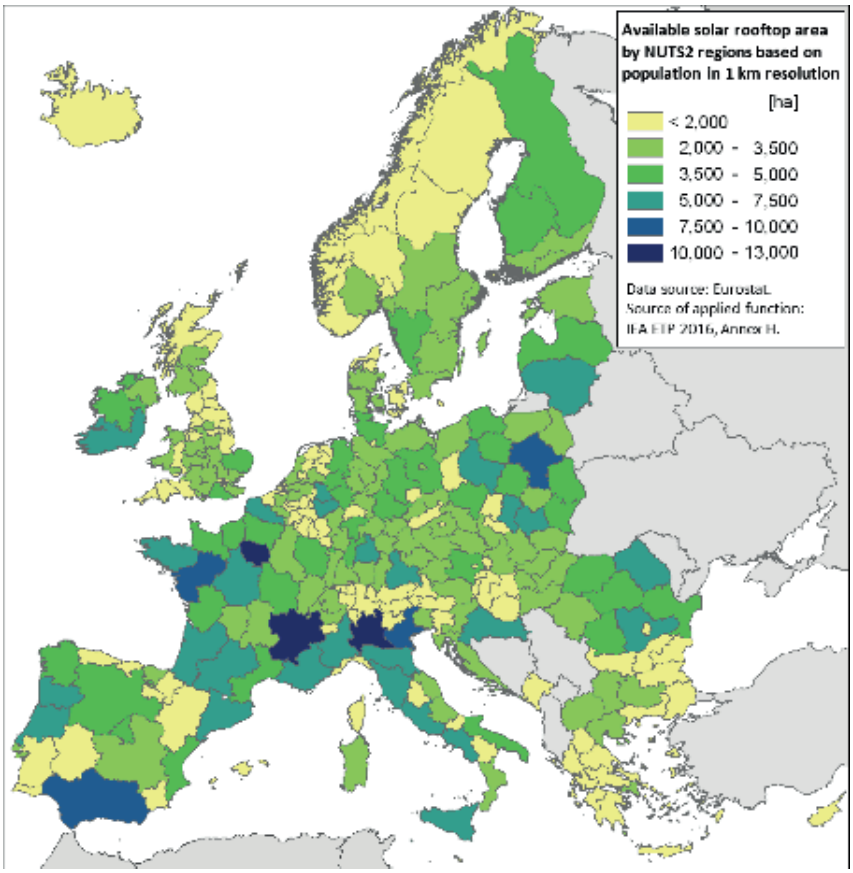

Fig. 3: Distribution of available rooftop area for solar PV, aggregated at NUTS 2 region level as a function of population density and total population applied in 1 km resolution [10]

systems already available in the JRC we can study a range of potential scenarios relevant to EU policy implementation:

- at Member state level, for medium-term planning e.g. in the proposed Energy and Climate Action Plans for 2030;
- at regional level, to support use of structural funds;
- at urban/city level, to promote

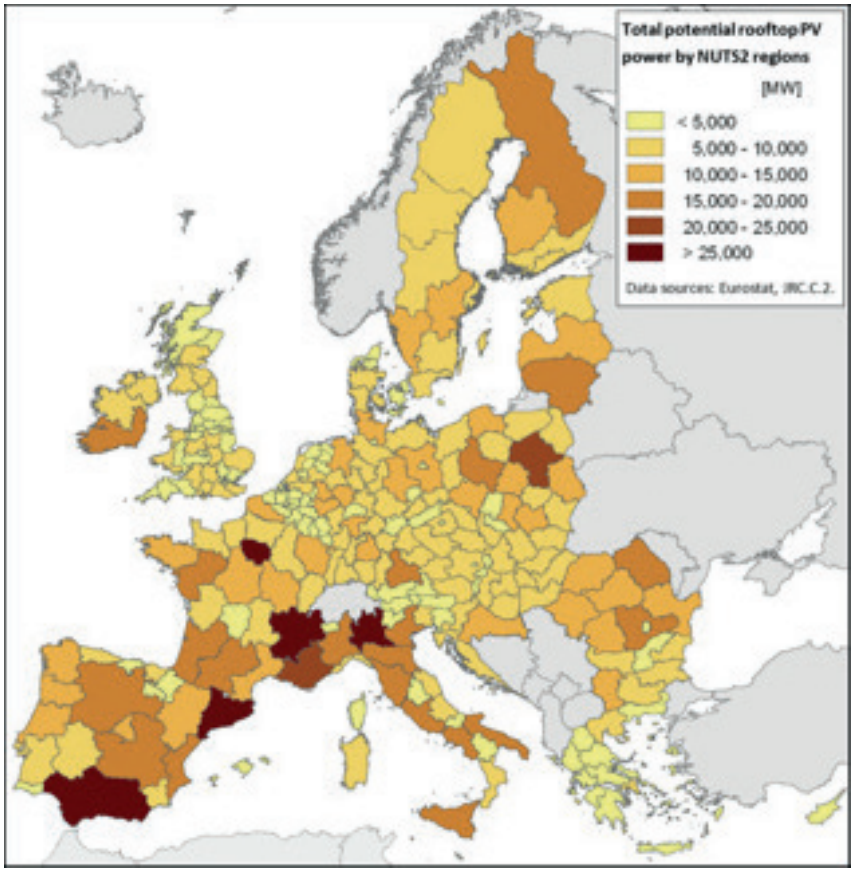

Fig. 4: Potential PV capacity per NUTS2 region

local decarbonisation and clean air programmes, for instance under the Covenant of Mayors initiative [9].

The next step is to determine the relationship between the total roof-area and that suitable one for solar PV installations. For this we use very high resolution Digital Elevation Model data for a number of cities, where the resolution is high enough to detect buildings and trees. In this way we can calculate details like surface slope and orientation as well as shadows from trees and neighbouring buildings.

We then combine these data with Open Street Maps (OSM) layers to get the exact location of buildings. In this way we may calculate the PV energy output for each roof including an estimate of how much things like shadows and non-ideal installations will influence the energy production. More details can be found in a recent technical JRC report [10].

The rooftop area available for PV systems in the different NUTS2 regions was calculated using the gridded population statistics of Eurostat, which are available in 1 km resolution, as the input variable in the model [8]. This dataset permits a more detailed overview on spatial pattern of population, delineates different degrees of urbanization (cities - densely populated areas, towns and suburbs – intermediate density areas, rural areas – thinly populated areas).

The available solar rooftop area per capita was then calculated in a 1 km^2 resolution as a function of the population density. The results show that the available area per capita varies between 4 m^2 in the most densely populated cities to 175 m^2 in scattered settlements. The total available rooftop area for PV installations per NUTS2 region is shown in Figure 3.

To calculate the energy production of PV systems the PVGIS PV assessment tool was used [11], giving an estimate of the energy produced by PV systems at any location in Europe. These results where then corrected for the lower productivity on typical roof-top PV systems (compared to free standing systems).

The capacity was calculated under the assumption that 1 kW capacity would require 7 m^2 to accommodate the PV system including all the necessary access paths for servicing and maintenance, this results in a conservative estimate for the possible capacity.

Using these assumptions the total PV capacity was calculated that could be installed on roofs in each NUTS region. The results are shown in Figure 4.

Looking further into the future, these calculations show that if all suitable rooftop area could be used for PV generation this would result in more than 1500 TWh of electricity generation. This represents a contribution of just over 35% of energy from PV in a possible 100% Renewable Energy supply scenario [12]. This scenario, produced by the Lappeenranta University of Technology with an open source model, gives a breakdown of the percentage of electricity produced by different renewable technologies and electricity demand in the different Member States.

Compared to the available potential, the 380 TWh electricity needed from PV systems to reach 35% renewable energy use by 2030 requires only a quarter of the total area. The percentage of the total available rooftop area in each country for the 2030 scenario was calculated and is presented in Figure 5.

With the exception of Belgium, Luxembourg and the Netherlands, where more than 60% of the suitable rooftop area is required all other Member States have an area demand

below 50% of the available rooftop areas (Fig. 5).

How can we realise this great potential and help ourselves deliver on the Paris agreement?

Hardware costs should no longer be a barrier. Already 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. In efficient markets the costs of systems is around €1300/kW, with potential to close the gap further on large-scale ground mounted systems, but economies of scale put limits on this ultimately. A lot however needs to be done to bring prices in all EU regions to the benchmark levels in major markets. Soft costs are another area where huge improvement can be made. Community initiatives and de-risking instruments can also play a key role.

Last but not least, the Energy Performance Building Directive and the increasing requirements for net zero energy buildings is another driver. JRC estimates that approximately 1.5 million new residential buildings are constructed per year, and 2.5 million undergo substantial renovation. Adding 10 m^2 PV to each project would potentially add 5.7 GW per year. With commercial buildings even more dynamic and the addition of retrofitting existing buildings the potential for PV to contribute significantly to the Paris Goals are clearly viable. ●

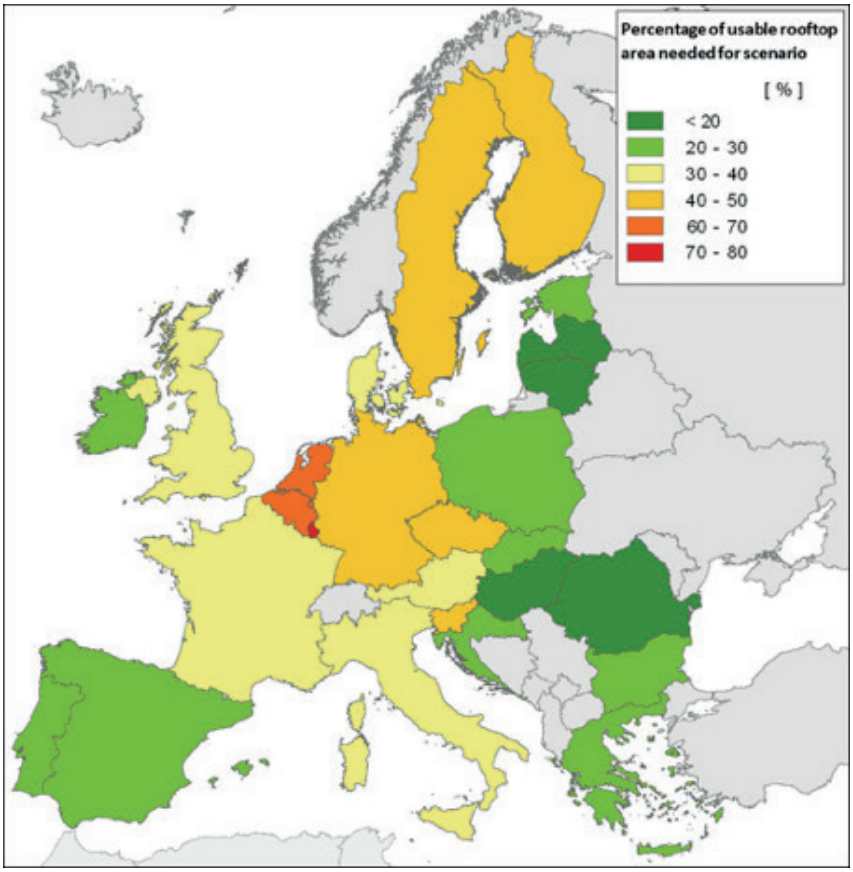

Fig. 5: Percentage of available rooftop area that would be necessary for the 2030 scenario, provided all PV installations would be on roofs.

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Advanced biofuels to promote decarbonisation of transportation

With CO_2 emissions continuing to grow in the transport sector, EU institutions are looking at renewables such as biofuels to decarbonise the mobility sector. Currently, a number of directives regulate the use of biofuels in the EU, among them the "Renewable Energy Directive" (RED) and the "Fuel Quality Directive" (FQD). In November 2016, the European Commission proposed - as part of its energy and climate goals strategy - a revised Renewable Energy Directive (commonly referred to as "REDII"). REDII stipulates that, by 2030, at least 27 % of all the energy used in the EU have to be produced from renewable sources. In January 2018, the EU Parliament recognized the need for advanced biofuels produced from agricultural residues in order to reduce greenhouse gas emissions in transportation. A vote was taken calling for a specific 12 % target for renewables in the transport sector by 2030, 10 % of which should come from advanced biofuels and other low-carbon fuels. This proposal of the EU Parliament sets the right direction for creating a stable and predictable business environment in order to trigger investments in advanced biofuel production within the EU. If the proposal prevails in the negotiations with the Council of Ministers and the European Commission, it will bring many benefits: significant greenhouse gas savings, the creation of thousands of new green jobs and a sustainable and competitive source of domestic renewable energy for the EU.

SUNLIQUID® – COMPETITIVE AND SUSTAINABLE CELLULOSIC ETHANOL

Advanced biofuels such as cellulosic ethanol can be used in today's car fleet within the current energy infrastructure. The technology for the production of cellulosic ethanol is mature. One example for such an innovative technology is Clariant's sunliquid® process. Sunliquid®-based cellulosic ethanol achieves CO_2 emission savings of up to 95 % compared with fossil fuels. The co-product lignin from the process is used for renewable energy production and the vinasse for soil fertilization, which makes the process energy self-sufficient and highly sustainable and provides a tangible example of a circular economy.

In October 2017, Clariant announced its plans to invest in a new full-scale commercial flagship production plant for cellulosic ethanol made from agricultural residues based on the sunliquid® technology. The new plant with an annual production capacity of 50,000 tons cellulosic ethanol will be built in a rural area in the southwest of Romania. At full capacity, it will process 250,000 tons of agricultural residues like straw annually, which will be sourced from local farmers. Tapping into the full potential of plants, the sunliquid® process makes use of currently underutilized inedible biomass and thus contributes to optimizing the efficiency and sustainability of biofuels. The use of agricultural residues in the immediate vicinity promotes local fuel production. Furthermore, it creates green jobs and economic growth in predominantly rural areas that might be struggling with underemployment and economic downturn.

Clariant's flagship plant shows that the production of advanced biofuels provides many benefits. In the upcoming negotiations on REDII, it is essential that the EU institutions agree

on a binding target for advanced biofuels for 2030, to make headway in decarbonising transportation and reach global climate protection goals. This will also create a strong framework for investments in sustainable, innovative technologies and production facilities in the EU. ●

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The way to promote innovation in biofuels

By Emmanuel Desplechin

The European Union is finalizing a new renewable energy policy for the 2020-2030 period, and – as is typical with all difficult policy processes – nearly everyone involved is having to make some compromises.

Each of the EU institutions has offered a different vision for Europe's transport energy mix, varying from approximately the status quo to a near-total phase-out of crop-based biofuels. Each proclaims to want to shift from so-called "conventional" to "advanced" biofuels, as if one somehow comes at the expense of the other.

In fact, Europe needs both.

That is because under almost any scenario for the coming decades a massive scale-up of biofuels in transport will be needed to meet climate targets. Europe will need to mobilize the best of today's solutions at the same time it encourages the kind of innovation that fosters tomorrow's technologies.

A couple of new studies from international agencies have highlighted the importance of using all sustainable options to reduce greenhouse-gas emissions in transport.

The International Energy Agency's latest Technology Roadmap states very clearly that greatly increasing consumption of biofuels is essential to success. According to the IEA, if there is any hope at all for meeting global climate ambitions, governments need to do more to encourage the development of renewable fuels such as ethanol, which when blended with petrol delivers significant greenhouse-gas emission reduction over fossil fuel.

The report's authors say the transport sector's biofuels consumption must triple by 2030 in order for the world to meet the "2-degree scenario" in the fight against climate change. Two-thirds of that increase, they write, should come from advanced biofuels and notably from cellulosic ethanol.

They also point out that "conventional" or first-generation biofuels will continue to have an important contribution to make while the massive scale-up of advanced technology is under way. For example, today's ethanol consumption – mainly first-generation – is a key enabler for cellulosic ethanol market access.

In its new "REmap" report analysing renewable energy prospects for the European Union, the International Renewable Energy Agency (IRENA) also calls for more biofuels – both conventional and advanced – in achieving EU energy and climate goals.

"All renewable transport options are needed to realise long-term EU decarbonisation objectives," the report states.

IRENA also takes a realistic look at the growth prospects for renewable electricity in transport. "By 2030 most passenger vehicles sold could be fully electric or hybrids, and electric vehicles could potentially account for 16% of the overall car stock in Europe," the report says. "However, even with such quick adoption of electric vehicles, renewable power would only account for about 3% of the energy consumption in the sector by 2030."

According to the report, that means biofuels are vital. "Liquid biofuels – both advanced and conventional – will still be needed for the existing stock of vehicles with internal combustion engines and for transport modes where electrification is still not an option. The use of liquid biofuels could triple by 2030 compared to 2010 levels to reach ~66 billion litres."

Advanced biofuels won't just happen by themselves because the EU says they should. They need time to develop and they need a stable policy framework that promotes existing investments – made in many cases by the same people who have invested

in conventional biofuels as a response to a call by policymakers. The same investors will be essential in the growth of advanced technology like cellulosic ethanol.

In Europe, the industry continues to mature along with the EU policy framework – in other words, with some bumps in the road. Many member states have or will implement specific advanced biofuels mandates such as Finland, Italy, Denmark, France, Germany and Slovakia.

That's why the current debate on EU renewable energy policy is so important. Instead of creating further uncertainty by threatening to turn back on biofuels, the EU should set policies that expand deployment of existing technologies, commercialise new technologies, and develop sustainable supply chains and appropriate sustainability governance systems.

More generally, Europe also needs to send a clear signal that in the fight against climate change it is willing to embrace all sustainable options that work and get past labels like "conventional" and "advanced".

Innovation for tomorrow depends on making the right choices today. The coming months will be crucial in determining whether Europe can live up to its energy and climate commitments.

Emmanuel Desplechin is Secretary General of ePURE, the European renewable ethanol association.

Green methane: speeding up a cost-efficient energy transition

In order for the European Union (EU) to meet the assigned target of reducing CO_2 emissions by at least 40 per cent by 2030 compared to 1990 and by 80–95 per cent by the year 2050, the majority of fossil and nuclear energy must be replaced with renewable energy. As renewable sources tend to be volatile and generate energy intermittently, long-term storage is required.

An EU Horizon 2020 Research and Innovation programme project coordinated by the DVGW Research Center at Engler-Bunte-Institute, Germany, is striving to integrate power-to-gas (PtG) technology into Europe's future energy system. The project, 'Innovative Large Scale Energy STORagE Technologies & Power-to-Gas Concepts after Optimisation' (STORE&GO), involves the demonstration of three different PtG concepts in: Falkenhagen, Germany; Solothurn, Switzerland; and Troia, Italy. The work builds on previous research that has demonstrated the technical feasibility of PtG technologies, and seeks to further enhance the technology's ability in order that it can be integrated into the daily operation of European energy grids.

The project is led by Dr Frank Graf and involves the participation of 27 partner organisations and companies from across Europe, specifically Austria, France, Germany, Italy, the Netherlands and Switzerland. Project activities are spread over nine work packages. To ensure smooth coordination and collaboration between the project partners, the STORE&GO consortium utilises an online project management platform, which enables the researchers to continuously exchange their progress and findings with each other.

The team feels this level of collaboration is required due to the extent of the expertise required for such an undertaking. 'We are convinced that it is not sufficient to simply serve the public a powerful new technology,' Graf highlights. 'Instead, we need to analyse the strengths of PtG so that we can give precise recommendations regarding how and where to roll out this technology. Policy makers and investors need to be told how, when and where they can apply this technology to generate a business case, or to safeguard the security of supply, or to protect the environment.' For this reason, the STORE&GO consortium benefits from the involvement of large industrial players, innovative small companies, and research institutes with a focus on reactor concepts, electricity grids, techno-economical studies, business development and law. These partners provide the experience and knowledge necessary to ensure that STORE&GO's activities result in real-world change.


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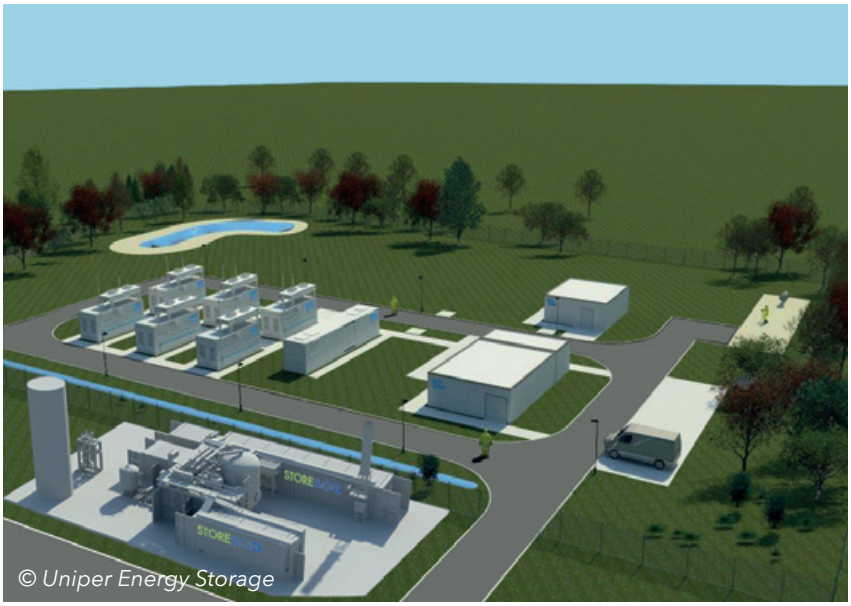
The researchers are working to reduce the energy losses and costs associated with existing methods of converting energy. In addition, the team has identified that there is currently no place for PtG in the legislative framework. At present, regulations exist for either electricity or for gas, but not both, meaning that interfaces between the two networks are not accounted for. This state of affairs presents a range of problems, as it creates uncertainty regarding who may operate a PtG plant (i.e. a system operator or a gas producer), there are no clear approval procedures, and plants run the risk of being liable for double fees. This is something that the STORE&GO consortium wishes to change. 'We dearly hope that PtG will be considered in the ongoing revision of the EU's energy legislation,' Graf explains.

Each of the three concepts being demonstrated in STORE&GO involves

novel methanation technologies, and each has been adapted for the respective demonstration site. These PtG plants will be integrated into the power, heat and gas grids for further transport and integration. The idea is that this will enable the researchers to feed renewable methane into the existing natural gas grid in a climate-neutral way without any restrictions, which means it can be made available for a wide range of customer applications. 'The demo sites provide highly diverse testbeds: different climates; grid types and topologies, like transmission or distribution; different combination of solar, wind and hydro energy; and different CO_2 sources, including bioethanol, waste water and directly from air,' Graf elaborates. 'This way, we can analyse and compare the advantages of PtG in various environments.'

Two of the sites use thermo-catalytic methanation, with reactors designed specifically to improve the heat management of the exothermic methanation reaction that is needed to ensure high conversion rates of hydrogen and CO_2 to methane. In addition, the researchers expect that these reactors will have constructive advantages that will result in cost reductions. At the third site, a biological methanation reactor is used. This involves microorganisms called Archaea breathing in hydrogen and exhaling methane. 'This concept seems to be feasible, especially in context with biogas plants in rural areas,' underlines Graf.

In addition, the team is analysing the existing regulatory and legislative framework, in order to identify where PtG fits in. As such, the researchers are involved in the BRIDGE initiative – a cooperation group involving to date 32 low carbon energy (LCE) smart-grid and energy storage projects funded under Horizon 2020. The researchers are also conducting a multi-country survey in order to identify acceptance or resistance in relation to PtG.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The team hopes to accelerate market uptake by identifying business models; creating a European PtG map displaying the most promising locations to install facilities; and developing a European PtG roadmap that contains recommendations regarding which applications PtG may serve in the short-, mid- and long-term. 'This European PtG roadmap will be a central outcome of the project,' reveals Graf. The team hopes that the STORE&GO project will benefit end users across Europe by ensuring a sustainable supply of energy and therefore guaranteeing security. 'Furthermore, the gas generated by PtG can replace fossil gas in any application, like heating and transport,' states Graf. 'It thus helps to free the heating and transport sector from fossil CO_2 emissions.' The team is pleased with the progress STORE&GO has made to date and is confident it is on target to achieve project objectives and, ultimately, enhance the future of energy storage and provision, benefitting humankind. ●

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Energy Storage: Many Technologies for a Competitive European Storage Industry

By Brittney Elzarei, EASE Policy Officer

Energy storage technologies are essential for the transition to a decarbonised energy system. Energy storage technologies allow us to decouple energy generation and consumption, both geographically and over time. They can provide flexibility at various time-scales, from seconds and hours to weeks and months.

Storage capacity will be vitally important once electricity systems are dominated by variable renewables, meaning that generation cannot be dispatched to match (predicted) demand. Even now, as we integrate more and more renewables into the system, energy storage can help the system function more securely and efficiently while extending the life of existing assets (for example grid infrastructure). Energy storage can also support decarbonising the heating, cooling, and transport sectors. Finally, storage can empower consumers to participate actively in the electricity market by generating, storing, and selling electricity.

In order for energy storage to fulfil its vast potential, we need a range of cost-effective, efficient energy storage technologies. No single technology will be able to meet the challenge of providing system flexibility at different time-scales. This is why there are many different storage technologies on the market or in development today: pumped hydro storage, flywheels, batteries, supercapacitors, power-to-gas, smart electric thermal storage, molten salt storage – the list goes on. Each technology has different advantages, making it suited to a particular set of applications.

A ROADMAP BACKED BY INDUSTRY AND R&D

Given the vast array of different energy storage technologies and the diverse players working on them, there is a need to gain a clear overview of each technology's current status and R&D challenges. Then, we can work to align research, development, and deployment (RD&D) efforts and issue concrete recommendations for policymakers.

This is the idea behind the EASE-EERA Energy Storage Technology Development Roadmap, which was first published in 2013. Given the rapid advances in storage R&D, a comprehensive update to this roadmap was issued in October 2017. The roadmap is a joint effort of the European Association for Storage of Energy (EASE) and the Joint Programme on Energy Storage under the European Energy Research Alliance (EERA). It includes contributions from over 80 experts.

The roadmap's aim is to strengthen Europe's research and industrial competitiveness in the energy storage sector and to ensure the availability of cost-effective storage technologies for the energy transition.

PRIORITIES FOR STORAGE TECHNOLOGY DEVELOPMENT

The roadmap has a dedicated section for each group of storage technologies, which identifies the challenges, opportunities, and R&D priorities of each technology. Covering all of these technologies in one roadmap allowed us to identify cross-cutting R&D priorities. Cost reduction is the highest R&D priority across all energy storage technologies. This can be achieved through an increased focus on materials research, manufacturing processes, and efforts to improve integration with other system components. Another overarching theme is the need to research energy storage business cases and to clarify the technical requirements and economics of aggregating different storage services. Additionally, the roadmap identified hybrid energy storage systems (combining two or more technologies into one storage system) as a top research priority.

Finally, a key priority is to remove the regulatory barriers that are currently holding back the deployment of storage in Europe, as this will open the door for large-scale deployment

and commercialisation of storage technologies, which in turn will result in economies of scale and cost reductions.

RECOMMENDATIONS FOR R&D

Finally, EASE and EERA identify **recommendations for R&D policies and regulatory developments to support the development and large-scale deployment of cost-effective energy storage technologies.** These could feed into the post-Horizon 2020 research framework and be considered for initiatives such as the recently launched European Battery Alliance.

Our short-term policy recommendations are to:

- develop a strategic energy storage plan for Europe
- set up demonstration and pilot programmes focused on grid integration of relatively mature technologies
- demonstrate the ways in which storage can provide energy services and monetise the added value to the system,
- support materials and equipment research, and
- investigate new designs for hybrid energy storage systems.

Another important consideration that is underlined by the roadmap is that **we cannot and should not identify winners and losers among the different storage technologies.** Each technology has unique benefits and applications, and we will need both fast-reacting, short-duration storage as well as longer-term (weekly, monthly, seasonal) storage in a decarbonised energy system. Being able to choose from a diverse array of cost-effective storage technologies will benefit the entire system. This should be the central tenet of the EU's R&D efforts as well as policymaking in the storage sector more broadly.

About EASE:
The European Association for Storage of Energy (EASE) is the voice of the energy storage community, actively promoting the use of energy storage in Europe and worldwide. It supports the deployment of energy storage as an indispensable instrument within the framework of the European energy and climate policy to deliver services to, and improve the flexibility of, the European energy system. EASE seeks to build a European platform for sharing and disseminating energy storage-related information and supports the transition towards a sustainable, flexible and stable energy system in Europe.

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The EASE/EERA Energy Storage Technology Development Roadmap can be downloaded at:
http://ease-storage.eu/ease-eera-storage-technology-development-roadmap-2017-hr/

Towards active participation in the grid

While smart metering, smart home and CLS systems are gaining acceptance throughout Europe, they are mostly confined to the single household, and are not designed to allow or encourage users to become active participants in the energy economy.

AnyPLACE began in 2014 with a comprehensive review of the many factors, technological, cultural and legislative, that affect smart metering, home automation and controllable local systems in the different countries of the EU. For instance, Germany the Netherlands have mandated specially developed smart meter gateways, so that appropriate data is securely transmitted into the home, and to external actors such as the retailers and network operators. Elsewhere, in Portugal a mandatory smart meter interface for the home is required, while in Belgium there is still no specific legislation about the introduction of smart energy meters, though they are widely recognised as an important vector in the modernisation of energy grids and the interaction with the end-users.

The aim of AnyPLACE was not to define any new standards, rather to propose an architecture that could be applied in any country in Europe, to actively connect smart homes to the grid. The increase in the uptake of e-mobility, home generation and domestic energy storage had to be factored into the design.

Using the findings, the team, including participants from Germany, Portugal, The Netherlands and Austria, set out to develop an energy management system capable monitoring and controlling local devices according to the preferences of end-users, and take advantage of changing opportunities such as variable tariffs and micro-generation.

AnyPLACE set out to define an architecture to actively connect smart homes to the grid, that could be applied in any country in Europe.

The solution had to provide excellent data security, but at the same time an adaptable interface, which could incorporate local languages, conditions and a wide variety of home systems, appliances, applications and devices. The project also had an ambitious target to create a prototype which could eventually be mass-produced for less than €100.

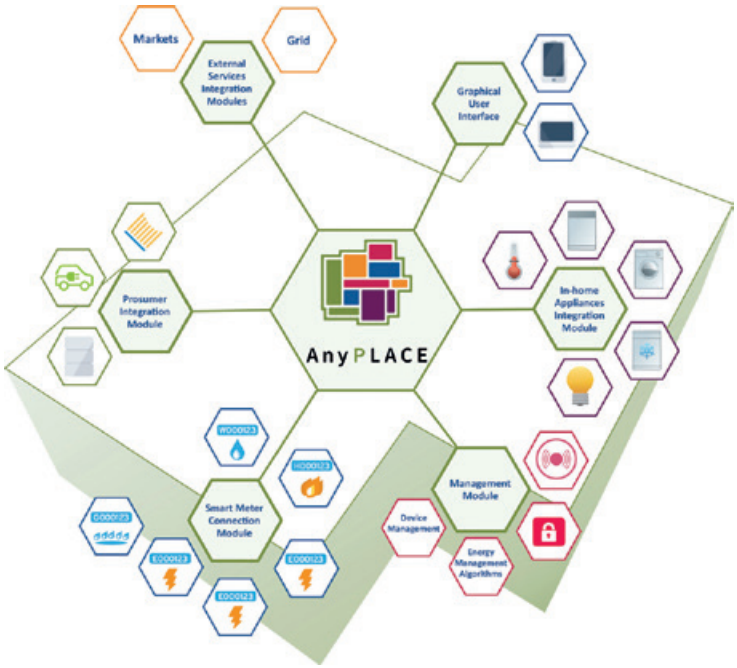
The vision of AnyPLACE goes far beyond commercial home automation systems, and proposes that users should be able to take part in new energy services and take advantage of whatever opportunities are presented by the changing energy market, not only to minimise their own costs but also to impact overall energy consumption and efficiency of demand and supply.

AnyPLACE2020 concludes in June of this year, and a Public Event will be held in Dörentrup, Germany, where the majority of the field trials are installed, in May 2018. If you would like to attend this event, view an online demonstration, or get an information pack, please visit http://www.anyplace2020.org/final-event

Participants: Instituto de Engenharia de Sistemas e Computadores do Porto (INESCP), EFACEC, and Bosch Thermotechnology in Portugal, The Automation Systems Group of the Technical University of Vienna (TU Wien) Austria, Institute Industrial IT (inIT), Kreis Lippe and Power Plus Communications, Germany and the European Commission Joint Research Centre (JRC) located in The Netherlands.

The AnyPlace project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 646580.

Website www.anyplace2020.org



As well as smart home technologies, the increase in the uptake of e-mobility, home generation and domestic energy storage had to be factored into the AnyPLACE design.

AnyPlace project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 646580

Solar and Storage – a match made in clean energy heaven

By Thomas Döring (pictured), Senior Policy Analyst, SolarPower Europe

Like bread and butter, like coffee and cream – solar and storage make the perfect pair. Storage extends solar's power beyond the time the sun is in the sky, allowing energy producers to use solar 24 hours a day, 365 days a year, no matter if the sun is shining or not. This opens up a whole new world of opportunities for solar, allowing solar technologies to be used to their full potential.

Although storage has been developing for decades, solar-plus-storage solutions are now becoming the new standard for clean energy production. Whether it be large-scale utilities, or small-scale home installations – solar and storage will be at the core of the new energy system.

Storage has been emerging in recent years primarily because it has experienced a steep decline in price, similar to the dramatic price drops that solar has witnessed in the past decade. In some EU countries, the price of storage has fallen over 60% since late 2014 – and these prices are expected to drop another 50-60% by 2030, according to IRENA. This, combined with solar's falling costs, means that solar-plus-storage systems are becoming economically more and more attractive for European consumers. Today, Germany is one of the fastest growing markets for residential battery storage, close to 100,000 solar storage systems are forecasted to be installed by 2018.

These price decreases are largely due to better, more efficient technologies as well as an increase in production and commersialisation of battery technologies. Chemistry advancements have allowed for better batteries that are smaller and lighter while storing more energy. It is projected that battery storage in stationary applications will skyrocket from a mere 2 GW worldwide in 2017 to over 235 GW by 2030.

With the dropping prices of solar-plus-storage solutions, more European citizens will have access to the clean energy power of these technologies. We will undoubtedly see an important increase of energy prosumers – citizens that both produce and consume their own energy – as solar and storage offer opportunities to decrease European citizen's energy bill while increasing predictability of their energy supply. With solar panels on your roof and batteries in your home or electric vehicle, you can have an uninterruptible supply of clean energy, therefore reducing reliance on a fluctuating energy market.

As more and more energy consumers become energy prosumers, more and more clean energy can be integrated into the energy system. New business models, made possible by solar and storage, will catalyse the decentralisation and smartening of the energy system, bringing important system benefits by unlocking the flexibility potential at consumer level by offering services to grid operators. With storage in the mix, European energy prosumers can make smarter use of their clean energy by facilitating demand response, ensuring that the energy generated from your solar panels is saved as back-up and only used when and where you need it the most.

This is especially important in the era

Caserne de Bonne Shopping Centre, Grenoble

of climate change, where extreme weather events are becoming increasingly common. With solar-plus-storage solutions, energy prosumers will always have an emergency supply of energy even if the grid is down. When the devastating Hurricane Maria hit Puerto Rico in 2017, it completely destroyed the power grid, yet businesses, hospitals, and homes were able to keep their lights on thanks to their solar panels and batteries donated by Tesla and Sonnen after the hurricane hit. Solar and storage were a critical element to get Puerto Rico back on its feet after the natural disaster, and a much cheaper and cleaner solution than the traditional diesel generators.

Despite a growing recognition that solar-plus-storage represents the future of the energy system, Europe's storage industry is currently behind on the rest of the world. According to the 2014 figures of the EU's Joint Research Centre, 51% of the global battery manufacturing capacity is in China – this rises to 88% when South Korea and Japan are included. The EU makes up a mere 2% of the global battery industry, meaning that Europeans rely on imported batteries and cells to help power the energy transition.

The recent launch of the Battery Alliance by Energy Union President Maroš Šefčovič, an industry-led initiative uniting carmakers, banks, and governments, aims to supercharge the European battery industry by forging links between sectors and boosting R&D. This initiative will help to increase production and investment in the storage industry, providing important local jobs and economic growth in Europe. This will be an important initiative as it is estimated that the European battery market will be worth 250 billion euros annually from 2020.

Yet, increasing battery manufacturing won't be enough if Europe wants to become a world solar and storage leader. The EU must create an energy market that embraces solar-plus-storage solutions instead of creating obstacles for deployment. A dedicated policy framework for prosumers of renewable energy within the revised Renewable Energy Directive should be developed, supporting the rights of prosumers and simplifying administrative procedures, and supporting small-scale renewable installations to encourage the emergence of new business and finance models. This will go hand in hand with the Energy Union's promise of a consumer-driven energy transition.

A 'prosumer friendly' approach should also be reflected in the way distribution tariffs are set by national regulators, with the quantified and real impact of prosumers on the grid being considered at the time the tariffs are set. In addition, proper remuneration of services to the grid provided by energy prosumers will empower Europeans to participate in the clean energy transition and increase investment in both solar and storage. These two elements will facilitate the market integration of solar-plus-storage solutions and pave the way towards the clean energy transition.

In order to become the world leader in renewable energy, Europe must also become a world leader in batteries as the two sectors will be inseparable on the path towards an efficient and stable energy transition. Solar and storage will be the new standard - Europe must ramp up support for the development of this market to power its clean energy future!


Photo: © Olivier Morin, GEG ENeR

Thomas Döring is Senior Policy Analyst at SolarPower Europe. Döring is responsible for SolarPower Europe's Market Intelligence & Research, Global Market Outlook for Solar Power and Task Force on solar & storage. Prior to joining SolarPower Europe he gained experience in leading organisations such as Innogy and GIZ. Thomas holds a Master's degree in Energy Science from the University of Utrecht.

European PV Storage Insights – how do European PV installers rate storage subsidy schemes?

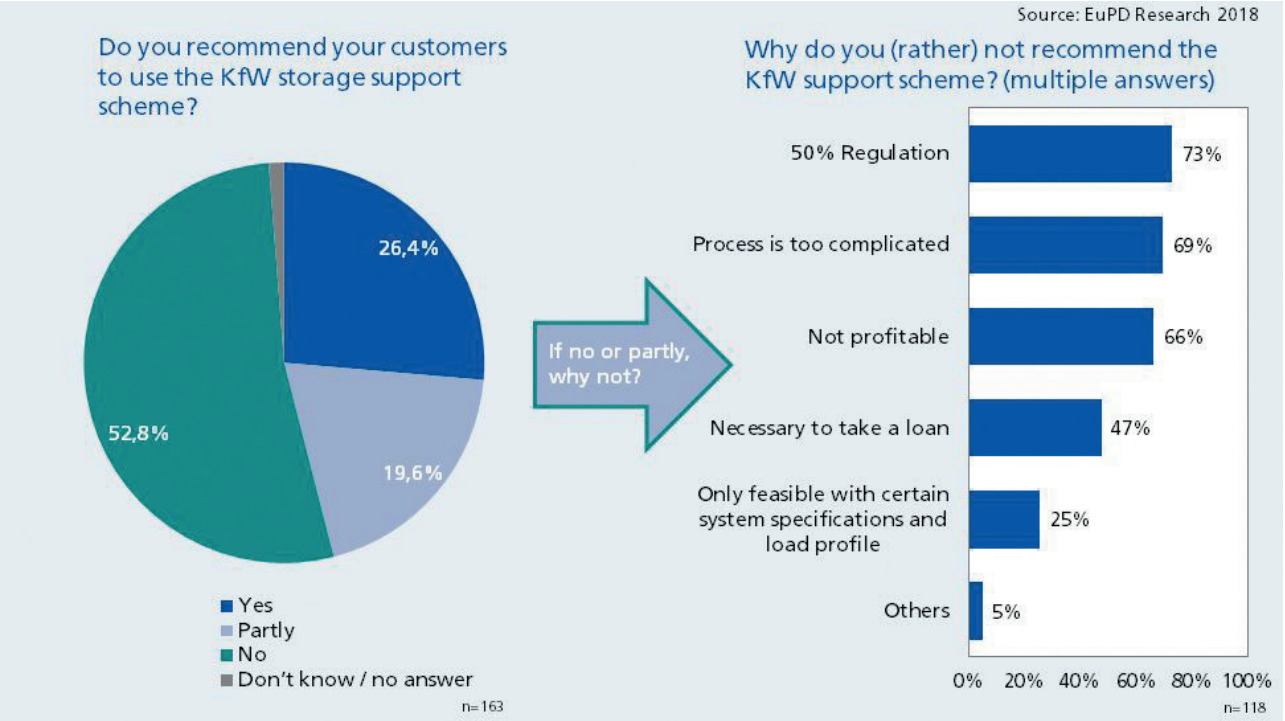
By Saif Islam, EuPD Research

Over the last few years various subsidy schemes have ignited the interest for residential PV energy storage in Europe. In Germany the „Kreditanstalt für Wiederaufbau" (KfW) ("Reconstruction Credit Institute") initiated one of the first support programs for home-owners in 2013. Last year nearly 7.000 system installations were financed, which was about a fifth of all residential storage installations in Germany. In a recent survey, market and economic research institute EuPD Research surveyed European PV installers and, amongst others, asked about their opinion on storage subsidy schemes.

For the tenth year in a row EuPD Research surveyed European PV installers in regards to procurement, brand awareness, market penetration, satisfaction and energy storage solutions. EuPD Research values the installers as the most important market intermediaries, as they are key in regards to the choice of technologies and brands. The tenth edition of the "Global PV InstallerMonitor" was recently published and features the results of the surveys in Germany, France, the Netherlands, Austria, Switzerland, Italy and the UK.

In the first subsidy period from 2013 onwards, 30% of the investment costs for a storage system were funded. Due to the very high system prices at the time, the majority of storage customers made use of the support scheme. Towards the end of the second subsidy period, the support sum decreased to merely 10% of the investment costs.

German installer may have the longest experience with storage subsidies, and one would think the KfW support program 275 for energy storage systems would offer a good opportunity to sell more storage systems; however, merely a little bit more than a quarter of the surveyed installers said that they actually recommended said storage subsidy to their customers. On the other hand, more than half of the survey



participants said that they would not recommend the subsidy program. When asked for the reason, most of the installers said that the fact, that storage users have to feed in 50% of the generated energy into the grid, was not beneficial for the use of a storage system. Furthermore, they describe the application form as too complicated (all in all nine steps are necessary to receive the funding).

Amongst the other mentioned reasons, German installers today largely believe that the storage subsidy program is not profitable for their customers. And the fact that customers need to take out a loan from the KfW in order to benefit from the support scheme (even if they have the necessary money) is deemed as a further barrier, as this means that despite having the necessary assets, home-owners would have to pay the repayment instalments over a period of possibly 10 years.

It is therefore not surprising that, when asked how satisfied the installers are with the KfW on a scale from 1 (very satisfied) to 5 (not satisfied at all), only three per cent of the survey participants answer that they were very satisfied. More than 50% of the installers rated their satisfaction with the subsidy scheme with either a 4 or, even worse, a 5. In total the satisfaction received an average rating of 3.64.

The picture in Italy is significantly different. As there is no federal subsidy program like in Germany, Italian installers may offer their customers a number of storage support schemes, for instance like the program in the region of Lombardy. The administrative region in Northwest Italy launched a € 4 million incentive program for solar storage. The program provide rebates that cover up to 50% of the cost for purchasing and installing a storage system coupled with a PV system. Only storage projects combined with PV installations with a capacity of up to 20 kW are entitled to have access to the program.

The feedback from the installers surveyed in Italy was nearly the complete opposite as compared to the German installers. 92 percent of the survey participants answered that they recommend the regional support schemes to their customers. Only 4% would not recommend any programs, whereas the rest is unaware of any subsidy schemes or has no programs available to recommend.

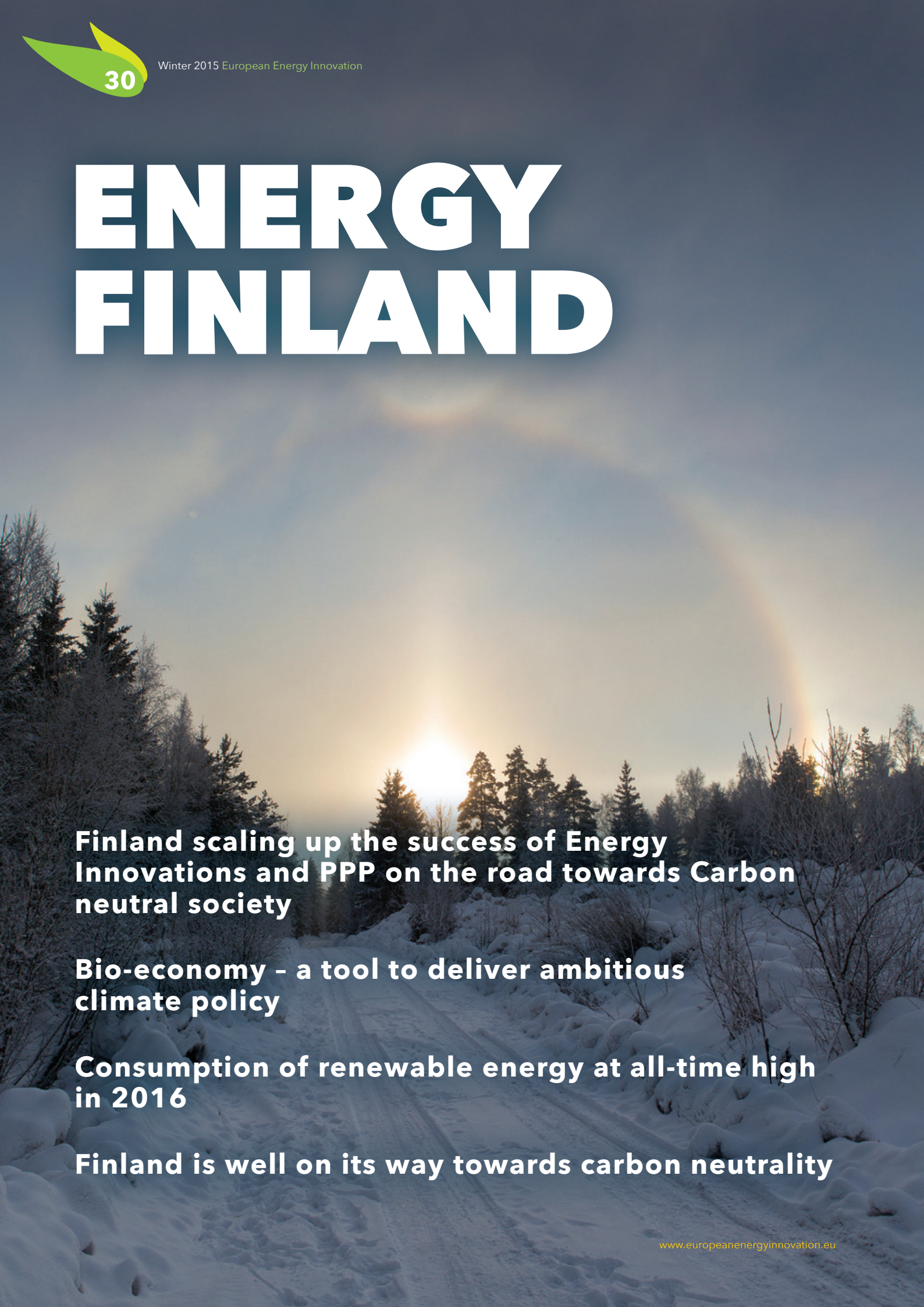
A further sign that the regional support schemes in Italy offer a possible incentive for energy storage is the comparably higher satisfaction of the Italian installers with the offered programs. In total the satisfaction rating with the programs only reached 3.15, however, a higher share of installers rated the schemes favorable as compared to their German counter parts. Around 30% of the surveyed Italian installers are satisfied with the available energy storage support programs.

These insights into two of the leading sales markets for residential storage solutions in Europe shows that support schemes can, depending on market developments, be assessed both positively and even negatively amongst the important target group of installers. Whereas a market can benefit from any kind of stimulation caused by a support scheme in the early stages, the number of sceptics may increase in established markets. Subsidies generally have a positive impact for any kind of market entry; however, it needs to be ensured that self-supporting structures are established in order to prepare for the phase once the support scheme has expired. ●

About EuPD Research Sustainable Management GmbH:

EuPD Research Sustainable Management GmbH is an international service provider focusing on B2B market research with a highly specialized multilingual interview center. We provide our clients in Europe, Asia and the US with the entire range of qualitative and quantitative research services. With the help of in-depth market knowledge combined with methodological professionalism, we provide practical, future-oriented business solutions and ensure that our clients receive a return on their research investment. Our continuous research has enabled us to develop particular skills in the field of renewable energy sources, particularly in the field of solar energy.

ENERGY FINLAND



Finland scaling up the success of Energy Innovations and PPP on the road towards Carbon neutral society

Bio-economy – a tool to deliver ambitious climate policy

Consumption of renewable energy at all-time high in 2016

Finland is well on its way towards carbon neutrality

LIVELY BIOENERGY SCENE

Finland is number two in Europe in utilization of renewable energy. The binding goal for 2020 (38% of gross final energy consumption) was exceeded already in 2014, and the 2017 figure is likely to be the highest ever. Finland's success with renewable energy largely relies on its extensive use of bioenergy.

Finnish bioenergy is based on utilization of sidestreams of forest management, such as harvest residues and thinnings, and sidestreams of forest industry, such as black liquor, chips, sawdust and bark. The amount of energy wood taken directly out of the forest is only around 11-12% of the total harvest, while the rest flows to industrial use. The use of bioenergy increased by 125% between 1990 and 2016, while the carbon sink almost doubled. This has contributed to a strong decline in GHG emissions of 45% when all sectors of the economy are taken into account. The respective average figure in EU-28 is below 30%.

Plans to continue further expansion of renewable energy and bioenergy have been laid out as part of an effort to achieve carbon neutrality by 2045. The private sector is strongly committed to efforts towards this goal. During the last few months, several new bioenergy plants have started operation. Metsägroup's new Äänekoski bioproduct mill increases Finland's renewable energy use by 2% alone. In Naantali, a new CHP plant was inaugurated in December 2017 utilizing up to 70% bioenergy and reducing CO_2 emissions by 0.42 Mt. In October 2017, Fortum replaced light fuel oil in one of its heat plants in Espoo with biobased pyrolysis oil. In December 2017, the local energy utility in Tampere informed it will apply for an environmental permit for a 200-240 MWth CHP plant retrofit utilising bioenergy up to 100%. In January 2018, the local energy utility in Oulu announced a plan to modernise its CHP plant (new capacity: 215 MWth) to use up to 70% bioenergy (currently: 40%). In February 2018, the energy utility in Helsinki (Helen) opened a 92 MWth heat-only pellet plant, which replaces coal in energy supply. Only a few kilometers north, the local energy company of Vantaa is retrofitting a CHP plant in Martinlaakso to use more bioenergy and cut fossil fuel use by 34% (0.15 $MtCO_2$).

Several investments into production of transport biofuels are also in the pipeline. Sunshine Kaidi has been considering a large investment in production of renewable diesel and biogasoline in Kemi since 2016. The new REDII Directive will play a significant role in the final investment decision. In eastern Finland, in Lieksa, a plan to produce bio-oils is progressing. In Haapavesi, Kanteleen Voima Oy is preparing a new biorefinery producing ethanol that is going to be integrated in an existing, but mothballed condensing power plant. In February 2018, the forest industry giant UPM announced a new plan – even larger than Sunshine Kaidi's – to expand its biofuel production by 0.5 million tonnes in Kotka.

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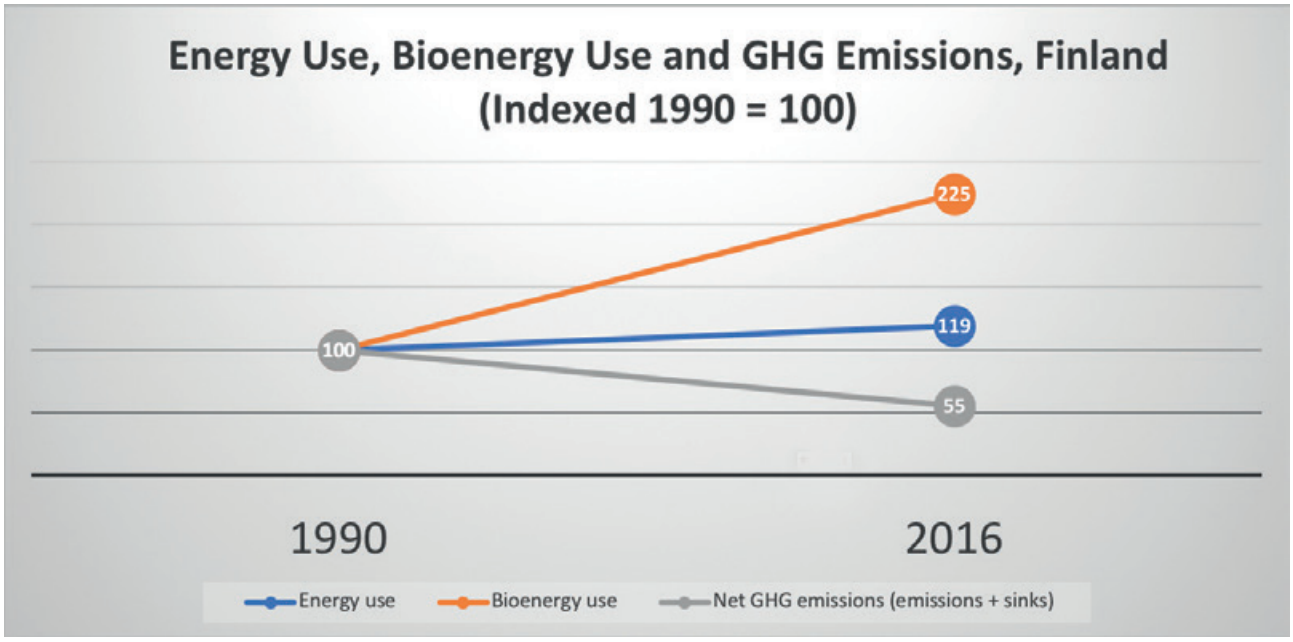

Finland scaling up the success of Energy Innovations and PPP on the road towards Carbon neutral society

By Kimmo Tiilikainen, Minister of the Environment, Energy and Housing of Finland

Finland's long term goal is a carbon-neutral society and we are working hard to reach that goal in 2045. The Government approved the National Energy and Climate Strategy to 2030 on November 2016. The strategy sets out concrete actions and targets through which Finland will achieve international and the EU energy and climate objectives. Our national goal is to cut the use of fossil oil by half, raise our share of renewable energy in total energy to 50 per cent by 2030 and to stop using coal by 2030. A survey of actions needed and costs rising will be completed by the end of March. It also looks at the option of ending the use of coal by 2025.

Diverse actions are needed including the potential of biogas. Forest growth is utilized in reaching the climate targets in a way that ensures sufficient carbon sinks, also in the future. Climate targets can well be reconciled with the protection of biodiversity,

Key drivers of change are associated with technology development, decentralized and renewable energy production, digitalization, urbanization and the consumer's more important role. Energy production alone will no longer be the most significant business area in the future, as the energy sector also will increasingly turn into a service business.

One of our common challenges is the global urgency to move towards sustainable, low carbon economic growth and to address climate change while meeting the increasing demand for energy. In this transition, the role of international cooperation is crucial.

But it is not only the Governmental actions needed. Business life and companies as well as individual citizens have to do their share for better climate and environment. There are many signs, that climate is changing rapidly and to avoid harmful effects, we have to implement cleaner and better energy infrastructure all around the world.

The future energy system will be flexible and intelligent. In addition to directing energy production, energy consumption may also be managed and coordinated as indicated by the current production situation. Hybrid systems that combine different forms

of production will become more widespread.

Flexibility of demand will change the role of the consumer. An active consumer will simultaneously consume, produce and store energy. Digitalization and the Industrial Internet will help improve the efficiency of energy use everywhere. Energy efficiency is a cost-effective way of reducing greenhouse gas emissions, and the circular economy mentality will further increase the efficiency of resources use.

OUTLOOK FOR TECHNOLOGY DEVELOPMENT

The markets are increasingly showing interest in solutions that reduce the use of non-renewable and fossil raw materials. Solutions are sought in bioeconomy and new, biomass-based products and services. Bioeconomy comprises a lot more than just bioenergy and biofuels. Wood-based fibre can be processed into high-value chemicals, for example for the needs of the pharmaceutical and chemical industries. Nutrient cycling is another example of the business opportunities offered by the bioeconomy.

It is estimated that the share of sustainable bioenergy will be about one half of all renewable energy supply in 2030. Carbon-neutral transport will initially be achieved by using the potential of all carbon neutral sources, including biofuels. When investing in EVs and Hydrogen, also promoting the deployment of biofuels in heavy goods vehicles will be important. Sustainability will be a key factor, and international trade will grow. The raw material base of bioenergy will expand and increasingly rely on wastes, which will also encourage biogas use.

Wave energy is an example of a field where Finnish technology and companies are on the global leading edge without a domestic market. Wave energy is expected to be commercialised after 2020. The first more extensive sites will be off-shore wind farms, where wave energy production may benefit from shared network connections.

Finland is one of the most energy intensive per capita countries in the word. Improving energy efficiency is a very cost-effective way of reducing CO_2 emissions. We have a lot of experience and know-how for efficient industrial processes and buildings as well as improving energy efficiency at the system level. In the future, the energy system of an intelligent home can be used by the market driven consumer to control the electric devices, energy production and storage, and electricity trade of the household.

Intelligent transport will also increase service business, and the MaaS (Mobility as a Service) model will promote more efficient energy use. Intelligent transport is now looking to the new Transport Code that strives to renew and develop the entire transport sector as digitalization advances.

BUSINESS OPPORTUNITIES AND STRONG PUBLIC-PRIVATE PARTNERSHIPS

Finland's success is based on strong public-private partnerships, world-class technical expertise and innovations. We are very pleased to promote and implement Clean Energy Solutions together with other partners. And we really need cooperation and help from our partners even in Finland.

Power electronics represents top expertise from Finland. Distribution networks will feature power electronics and intelligent properties. Finland could also offer expertise for turnkey system deliveries, but a large operator would be required to ensure competitiveness in the global market.

Virtualization, on the other hand, is associated with technology that enables the simulation of reality. In the flexible energy system of the future, virtual power plants may have a key role in controlling such aspects as decentralized energy production, storage and consumption.

The flexible energy system of the future, in which the consumer plays an essential and significant role, will also create a need for different security technologies. The importance of cybersecurity will be highlighted, bringing new business opportunities.

The greatest growth is expected in the fields of wind power, solar energy, biomass boilers and small-scale CHP technology. In these, Finland's areas of strength are wind power components, biofuels and biotechnologies as well as gas-fueled engines and power plants. Potential export sectors also include turbine generators for small-scale and mini hydroelectricity installations and technological and system expertise in solar energy and fuels cells.

To reach Finland's ambitious energy and climate targets and long-term goal to become carbon neutral society needs also investments in research, development and innovations.

Innovation Funding Agency Business Finland started last year a Smart Energy Innovation Program which target is to create new global business for Finnish companies, investments in Finland, create top research in energy sector and support Finland to achieve its' international targets. The Smart Energy Program aims to build different kind of test platforms to promote these targets.

Pilot platforms have a crucial role in bringing different actors together, networking them for new kind of co-operations and boosting joint competences. Platforms link research actors, big companies and SMEs in dynamic and flexible manners. As a term, platform can have multiple meaning ranging from dedicated pilot setups to wide co-operation environments. Commonly, platforms apply open principles for instance for sharing data, co-innovating and memberships.

Bio-economy – a tool to deliver ambitious climate policy

By Miapetra Kumpula-Natri MEP

Tackling climate change is nowadays an all familiar part of the agenda of governments, companies, NGOs and increasingly a guiding principle in our day-to-day decisions of grocery shopping and travel arrangements. But what does it mean to really put climate efforts first? To actually deliver a carbon-free economy? That is something policy-makers around the world still try to grasp.

The European Union has had climate change at the centre of its policy targets for a long time. Longer than most countries and policy-making bodies. But even for the EU, new challenges were presented by the adoption of the Paris Climate Agreement in 2015. The Union's response has been to beef up set targets for energy efficiency, renewables and overall emissions reductions. This was put in to practice by the presentation of the so called Clean Energy Package by the European Commission late 2016.

In the European Parliament, we have tried to improve, preserve and slightly steer the Commissions ambitious agenda. On energy efficiency the Parliament has already agreed with Council to tackle the energy performance of buildings (a Directive I had the privilege to follow as a shadow rapporteur for my group, the Socialists & Democrats).But more battles will be fought on the levels of renewable targets (Parliament's 35% vs Council's 27%) and the target for energy efficiency (where again Parliament has set its sights higher with a 35% binding target).

I have been sad to see that the European Council is not sharing Parliament's appetite for increased ambition. This is all the more perplexing as many Member States have already declared their willingness to go further than what is required by the EU. I am afraid that the Council's position is more influenced by a fear of Brussels dictating the rules rather than any sort of denial of climate action.

That, however, is a dangerous road to go down. We need a more united approach to climate change, not only because of the border-transgressing nature of the phenomenon, but also to safeguard the interests of citizens, consumers and businesses operating in the Single Market. Deciding on the Clean Energy Package is an important test of the European political system. I hope in the end we can find that the EU is a strong, predictable and reliable partner in global climate action.

Although the debate has in recent year revolved around energy, I would argue that energy forms only a part of our solution and that we are still far away from actually transforming our economic system to a sustainable one. Europeans still consume about 2.5 times the sustainable level of natural resources.

Bio-economy is in its essence a concept of the next shift in our economic structure, in fact the third evolution of it. First was the agrarian model, mostly based on production and use of natural resources. For the last 200 years we have been living the industrial model, which has produced unforeseen levels of economic prosperity and well-being - but with the cost of driving our ecosystem towards its barriers. Therefore a third evolution is needed - one which decouples the accumulation of well-being from the limits of our natural resources. Bio-economy is part of this new phase along with digitalisation and increasing efficiency of our industrial operations.

All of this might sound a bit too high flying for the needs of present day solutions. What does bio-economy offer in practice? Too often bio-economy is referenced only as bio-energy, with ensuing battles over the role of carbon sinks etc. It is much more.

One of the most concrete areas is the replacement of one-use fossil-based materials with reusable and recyclable bio-based ones. The EU's newly proposed plastics strategy aims (in line with the waste hierarchy principle) at reducing the amount of plastics. But it should also aim at replacing as much as we can with bio-based alternatives or bio-plastics composites. Building materials are another example. We should get rid of building rules stemming out of outdated research and concrete industry lobby that prevent the extensive use of wooden structures in buildings, both low and high rise buildings.

In policy terms the EU can do two things in the coming years to facilitate this change. The first step is to agree on a continued and enhanced role for bio-economy research in the EU's next Framework Programme on research. In the heart of the efforts is the Bio-Based Industries Joint Undertaking, which has proved a success so far. Despite pressures to limit budgets all around, concrete actions such as the BBI-JU which offer real EU value add should remain intact.

The second is the review of the Bio-Economy Strategy, originally drawn up in 2012. The revised strategy should show us a way of bridging market failures and gaps for bio-based products and show where existing EU regulation can be streamlined to open up more possibilities for bio-economy and other circular economy initiatives.

There is no time to lose. The countries of the EU need to present to the rest of the world our willingness to stop climate warming to 1.5 Celsius. Bio-economy is just one part of the package. We are not without tools to stop the worst, if we are just willing to look beyond short-term losses and gains and invest. Without vision and courage we will, however, fail.

Miapetra Kumpula-Natri
Miapetra Kumpula-Natri (born 1972 in Vaasa, Finland) is a Member of the European Parliament representing Finland, S&D Group and The Social Democratic Party of Finland.

Kumpula-Natri is a member of the ITRE Committee on Industry, Research and Energy, where she has focused on energy and digitalization.

She's also a member of Delegation to the Euronest Parliamentary Assembly and Delegation to the EU-Moldova Parliamentary Association Committee and a substitute of the EMPL Committee on Employment and Social Affairs. In addition, Kumpula-Natri is the chair of the Parliament's Bioeconomy Working Group, member of the Internet Forum and member of the board of European Energy Forum.

For 11 years, Mrs. Kumpula-Natri was a member of the Finnish parliament. She was, among other things, chairperson of the parliament's Grand Committee. She's been a member of municipal council of Vaasa for 20 years and she's currently the chairperson of the Assembly of the Ostrobothnia Regional Council.

By education Mrs. Kumpula-Natri in an engineer. She's also studied economics. Mrs. Kumpula-Natri speaks Finnish, Swedish, English, French and Russian. She is married and a mother of two.

Turku aspires to be carbon neutral faster

When the climate objectives of cities were globally compared in 2015, Turku came up to sixth. Now the city hopes to become carbon neutral even more rapidly than before.

Turku, located on the southwest shore of Finland, is an active centre of an urban area of approximately 350 thousand residents. Once the capital of Finland, Turku is famous for its universities and knowledge-based economy. The Mayor of Turku Minna Arve (pictured below) does not find it impossible for Turku to be carbon neutral already in 2029, at the time of its 800th anniversary. So far, the objective has been the year 2040.

"We are currently in the process of renewing our climate and energy strategy. For instance, we invest into sustainable energy and smart mobility."

The biggest single climate investment already carried out in Turku is the new multifuel power plant for electricity, district heating and process steam. This plant replaced the old coal-fired power plant.

"The power plant can operate solely with biofuel. At the same time, we are developing smart decentralised energy production and storing, and improving energy efficiency comprehensively."

CLIMATE WORK AS PART OF THE CITY'S IDENTITY

Arve reminds that the best way to reach the goal is that all residents, businesses and communities commit themselves to ambitious climate action. She continues by saying that cities and their residents have a key role in battling climate change.

"Turku is, for instance, an agile city of just the right size and can take new technologies into use rapidly. We can function as a testing platform for international cleantech businesses, for instance."

"The fact that we are committed to climate work is a key part of our identity. It also creates an image of Turku, acts as an attraction and creates vitality and wealth."

TOGETHER WITH OTHERS

According to Arve, one of the issues currently under consideration is how to

Mayor Minna Arve says ambitious Climate action is part of Turku's identity.

Cool people of Turku bike all year round – and the city makes this possible.

CITY OF TURKU

take climate objectives into account in all city purchases.

"Turku is striving for its objectives together with others. We have taken actively part in Paris and Bonn climate conferences. We operate in the Union of Baltic Cities, in ICLEI and in the Climate Leadership Coalition that promotes the readiness of businesses to react to climate change.

Turku is also taking part in the Civitas Eccentric project that promotes smart and carbon neutral mobility.

"For instance, a renovated route for winter cycling has been opened and e-buses operate the central bus line. Digitality offers many new means to turn transport smarter.


Timo Honkanen


Jussi Vira

SMART ENERGY

According to the CEO of Turku Energia Timo Honkanen, the company has already for a long time developed its energy production towards carbon neutrality. Turku Energia is a company owned by the city of Turku.

"The new power plant is of course important. However, we have also increased wind and hydropower. Our customers can also buy solar panels from us or rent shares of a solar power station."

In Turku, the district Skanssi functions as a testing area for new energy. A unique two-way heating network is being built there, making it possible to transmit surplus heat from the customer towards the network and store heat in the area.

"We also capture heat from waste water and use it for district heating and cooling."

The energy system is being decentralised in new ways. In the future, households will be more actively involved.

"Demand response, energy efficiency and different smart digital solutions will gain a more central role."

Turku Energia is already offering smartboxes for households to manage their energy consumption, such as by warming up the water heater automatically when the price of electricity is at its lowest.

"If we think solely about energy, Turku has the chance to become carbon neutral already in the next few years", Honkanen states.

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Consumption of renewable energy at all-time high in 2016

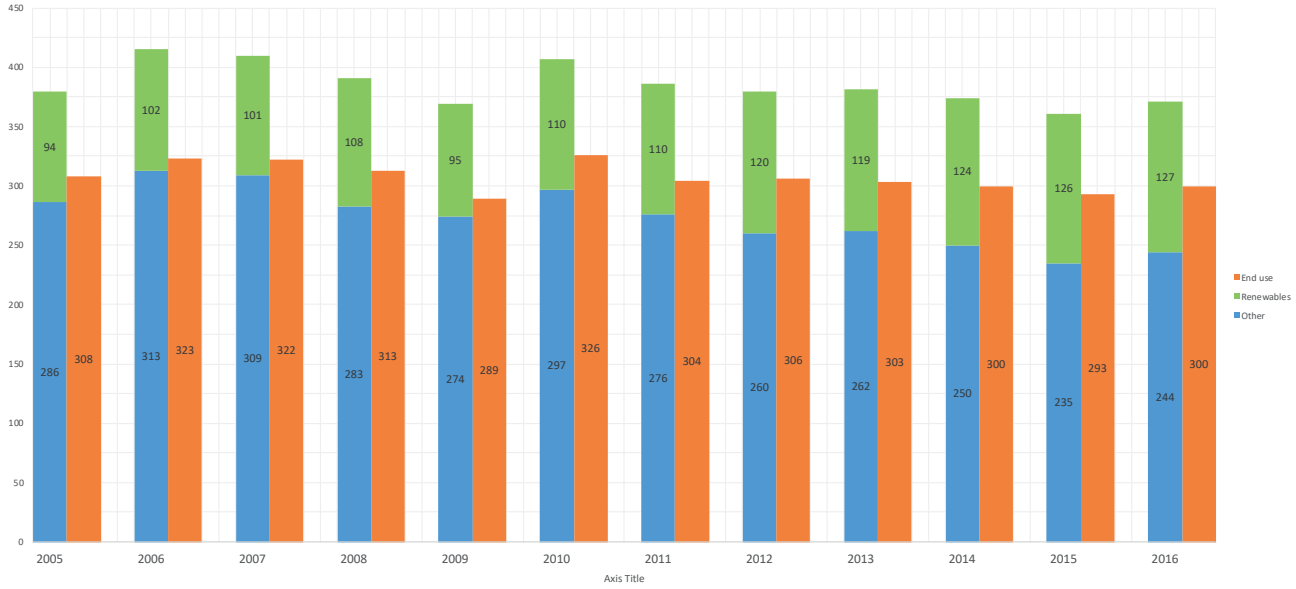
By Pekka Ripatti (pictured), Director, Energy Authority, Finland

In 2016, 127 TWh of renewable energy was consumed. This is 34% of the total use and approximately 40% of the final consumption. 96 TWh was produced from wood fuels, which constitutes 76% of renewable energy. Most of the energy produced from wood was used in heat generation. Hydropower amounted to 13% and wind power to 2% of renewable energy. The amount of electricity produced from renewable energy sources was 30 TWh, which constitutes 35% of year's electricity consumption.

According to preliminary data from Statistics Finland, Finland's energy consumption in 2016 was 371 TWh, of which final consumption constituted 81% or 300 TWh (Figures 1 and 2). The difference between total consumption and final consumption is caused by the loss of energy during conversion and transmission of energy. Compared to 2015, consumption increased by 2%, which was mainly caused by the increase in industrial production. Following the development of the gross domestic product, however, energy consumption decreased for five consecutive years in 2010–2015. On the other hand, the traditional connection between the gross domestic product and energy consumption is weakening due to the structural changes in the Finnish economy. When looking at individual energy sources, the most significant changes in comparison with 2015 were the decrease in the use of natural gas and peat and the increase in the use of coal and the net imports of electricity. In relation to earlier energy production, the production of wind energy increased the most, but it's share of the total energy consumption was only around one per cent.

A record amount of electricity, approximately 19 TWh, was imported in Finland even though the use of

Total use and end use of energy 2015-2016, TWh



electricity remained at the level of 2015. Due to the mild winter, electricity production in CHP facilities remained at the previous year's level, whereas production in condensation electric power plants that only produce electricity increased by 8%. At 2016, the value of energy imports was approximately EUR seven billion, whereas exports amounted to EUR four billion. Compared to 2015, carbon dioxide emissions of electricity production increased by 7%, which was caused largely by the 16% increase in the use of coal.

CONSUMPTION OF RENEWABLE ENERGY AT ALL-TIME HIGH

In 2016, 127 TWh of renewable energy was consumed, which is more than ever before. It is over 34% of the overall consumption and approximately 40% of the final consumption of energy. A more accurate estimate of the proportion of final consumption will be included in the report on the consumption of renewable energy in Finland, required by the European Commission. Overall, the use of renewable energy sources has increased 33 TWh (35%) since 2005.

Although the consumption of renewable energy increased in comparison to 2015, its share of the total consumption and final consumption decreased. This was due to the fact that the consumption of renewable energy increased less than the consumption of energy from other sources in relation to the total consumption and final consumption of energy. If industrial production continues active, also energy consumption will increase. If we want to achieve the renewable energy consumption targets set by the Government in the new energy and climate strategy, growth should become more rapid.

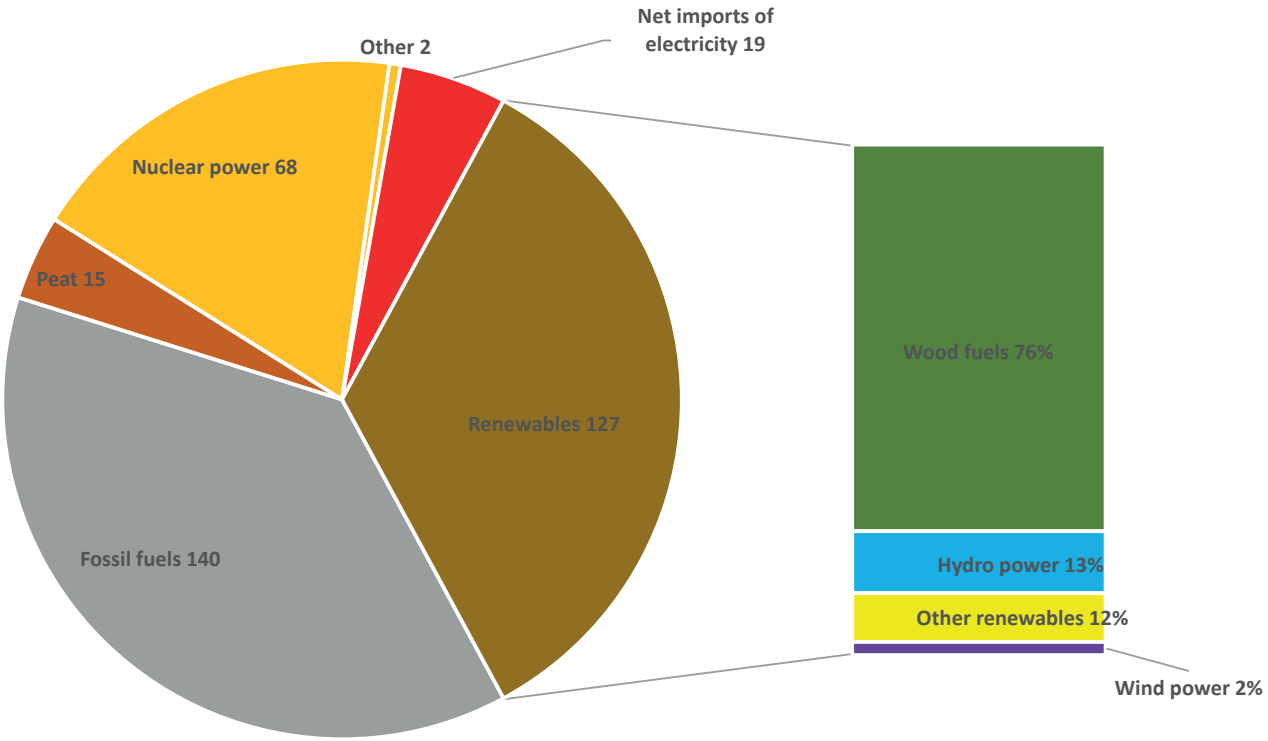
WOOD IS NUMBER ONE

Of all renewable energy sources, wood was the most significant, and for the fifth consecutive year more important than oil products. In 2016, 96 TWh of energy was produced from wood fuels, which accounts for 76% of renewable energy. Hydropower was the second most significant source of renewable energy with 16 TWh or energy produced. It constituted approximately 13% of renewable energy. However, compared to 2015, the amount of energy produced from hydropower decreased due to the rainfall being smaller than in the previous year. Wind power was used to produce approximately 3 TWh of energy, which was 30% more than in 2015. Other renewable energy sources produced slightly over 12 TWh. The most significant were bioenergy, recovered fuel and heat pumps. Solar energy, which has gained much attention in public debate, constituted less than one per mille of renewable energy.

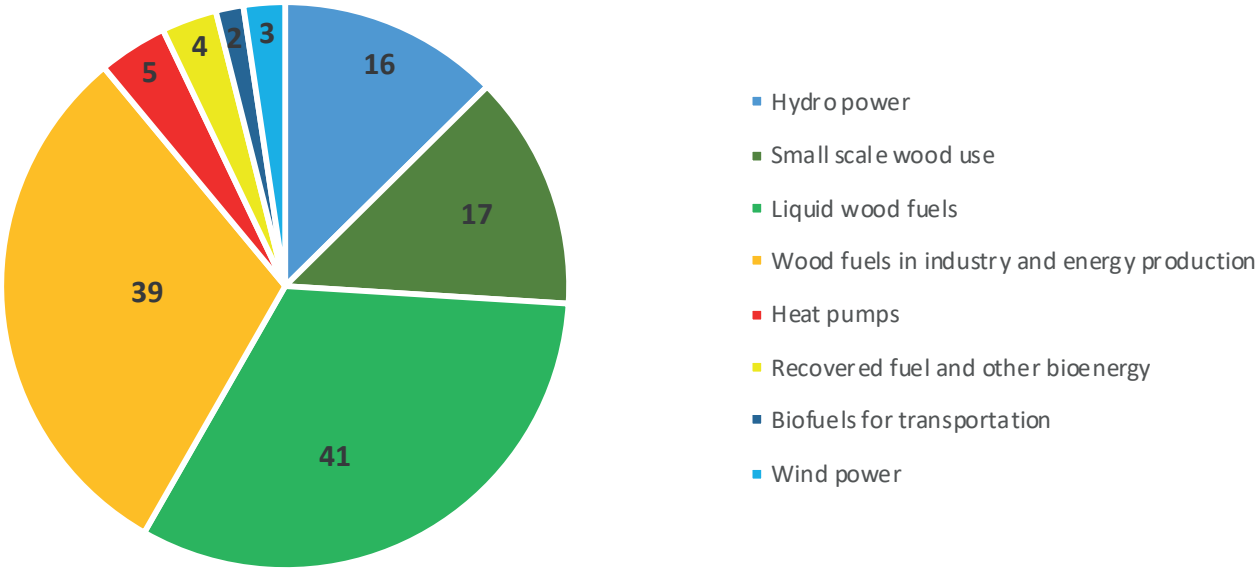
TIMBER CHIP WILL FALL SHORT OF THE TARGET

The biggest challenge for reaching Finland's renewable energy target is the use of timber chip fuel. The target set in the renewable energy programme for timber chip is to produce 25 TWh of energy in 2020.

Total consumption of energy in energy source 2016 (371 TWh)



Production of renewable energy 2016 (127 TWh)



That is approximately fifth of the total target of the programme. In 2016, approximately 15 TWh of energy was produced from timber chip, which is equal to the level of 2015. It seems, therefore, that this target will not be achieved. The reason for this is not, however, the availability of timber chip, but the fact that the profitability of electricity production has declined as a result of falling electricity prices.

INVESTMENTS WITHIN THE FOREST INDUSTRY INCREASE THE PRODUCTION OF RENEWABLE ENERGY

On the other hand, we have already exceeded the target of the second cornerstone of our renewable energy programme – liquid wood fuels generated as a by-product of pulp mills. The target was to achieve consumption of 38 TWh by 2020. In 2016, the consumption of liquid wood fuel was 41 TWh, which is approximately 1% more than a year earlier. This was due to the increase in the utilisation rate of the capacity of pulp mills, which resulted from the increased demand of market pulp. If the recent large investment decisions will be realised, the use of liquid wood fuels and the production of renewable energy will increase significantly.

CONSUMPTION OF TRANSPORT BIOFUELS PLUMMETED

Where is renewable energy used? Most of the energy produced from wood is used for heat generation and only just over 10% is used for electricity production. Even though the share of renewable energy is only a little over 10%, it equals to approximately 10 TWh. Hydropower and wind power, on the other hand, are only used for producing electricity. Transport used less than 2% of renewable energy, which is 65% less than in 2015. However, domestic production of biofuels has not decreased. So far biofuels have been mostly manufactured from vegetable oils and various wastes and residues. UPM-Kymmene has renewed the process of manufacturing biofuels when it started to manufacture renewable diesel from crude tall oil classified as processing residue. In addition, Fortum has started to manufacture pyrolysis oil from timber chip to replace heavy fuel oil.

Over half of renewable electricity produced from hydropower

The share of renewable energy sources in electricity production is roughly the same as in the total consumption of energy. In 2016, 85 TWh of electricity was consumed in Finland and approximately 30 TWh or 35% of this was produced from renewable energy sources. The share of electricity produced from domestic renewable energy sources was even larger in Finland because in 2016 Finland imported 19 TWh of electricity. It is noteworthy that even though it cannot be guaranteed that imported electricity comes from a certain source, a significant portion of it was wind and water power from Sweden. Compared to 2015, the share of renewable energy sources in Finnish electricity production remained at approximately 45%.

The amount of electricity produced from hydropower was almost 16 TWh, which is over half of all electricity produced from renewable energy. The share of wood fuels in electricity production was approximately 11 TWh and the share of wind power was over 3 TWh. Compared to 2015, the amount of electricity produced from water and wind power decreased slightly, whereas the amount of electricity produced from wood remained on the same level. Industrial CHP facilities used the most wood fuel to produce electricity.

Finland is well on its way towards carbon neutrality

By Henna Virkkunen, MEP, Finland


Photo: Mikko Mäntyniemi

Negotiations regarding the EU's clean energy package are at their final stages. The package sets goals for the year 2030 to meet the demands of the Paris climate agreement. These demands include increased self-sufficiency and share of renewable energy, considerable reduction of emissions and increased efficiency, transparency and marked-basedness in the energy market.

For my country Finland, these goals are a good fit. Finland has long been building a joint energy market and interconnectors together with other Nordic countries, and we have been purposefully increasing the share of low-emission energy sources.

In fact, the strength of Finland's energy policy lies in its relatively versatile energy palette. The country is not dependent on any single energy source or supplier. Furthermore, the share of fossil energy sources: coal, oil and natural gas has already been squeezed down to under 40 percent.

Finland is the most forested nation in Europe. This gives Finland one of the highest shares of renewable energy among European countries. Over 39 percent of our energy is already renewable and wood is our most significant energy source. This is made possible by the Finnish forestry industry, which has made sure that its side streams, scraps and waste can be cleverly turned into energy.

Even though Finnish industries are very energy-intensive, thanks to modern technology, the energy efficiency of factories has increased tremendously. Recently, Europe's largest forestry investment came to fruition near my home when a new kind of bio product plant became operational. The plant produces 2.5 times as much energy as it spends and the plant alone raises Finland's share of renewably energy by a whopping 2 percentage points.

Currently the discussion on the EU level focuses on whether the goal for the share of renewable energy should be 27 or 35 percent by 2030. Finland has already exceeded these numbers and we have decided to strive towards a 50 percent share of renewable energy by 2030.

While emissions have been reduced from their 1990 levels in all other sectors across the EU, they have increased in traffic. Finland is one of only a few EU countries that now produces less road traffic emissions than in the year 1990. This is primarily achieved with large-scale investments into renewable fuels.

In Finland the share of biofuels is already at 22 percent, which is three times the European average. Finland has set a national goal of increasing the share of renewable fuels in road traffic to 30 percent and adding significantly to the number of electric cars.

Even though progress towards all other European energy goals seems to be underway, the dependence on energy imports is one challenge Europe has been unable to tackle. This also applies to Finland. As is true for the entire EU region, Finland still maintains a share of imported energy that exceeds half of its total energy consumption. Electricity produced using nuclear power has been an important energy source for Finland's energy-intensive industries, and it is classified as imported energy. In Finland, 18 percent of energy is produced via nuclear means. This share is unlikely to be reduced as Finland aims to replace imported electricity with domestic nuclear power. One new nuclear power plant is currently under construction and another one is in the planning stages.

In the future, Finland's energy production will rely even more heavily on low-emission energy sources, where renewable biomass, nuclear power and hydro, solar and wind energy are the most important elements.

Carbon Farming – a powerful tool to combat climate change

REACHING THE 1,5-DEGREE TARGET?

The conclusion of the Paris Climate Agreement was an ecstatic moment for people working against climate change. The agreement was greeted with superlatives and described as a historical breakthrough. Enthusiastic work was begun to produce concrete proposals for achieving the goals of the agreement. However, many of the measures are uncertain and their net impact is debatable and/or materializes too late to enable the world to stay at the 1,5-degree target. For example, the penetration rate of electrified transport is very slow, and the net GHG savings are marginal when measured on well-to-wheel basis. Also, the ramp up of significant advanced biofuels production capacity will take place during the next decade, assuming the right policy framework is in place. There are also sectors with no sufficient CO_2 abatement methods as yet available. For example, ICAO has agreed upon a carbon neutral growth of global aviation from 2020 onwards. However, the practical tools seem insufficient if not non-existent, only a couple of years prior to the agreement becoming effective. Additional tools are imperative to mitigate the risk of delays and failures in the already selected decarbonization measures. Also, the cost of decarbonization needs to be considered. Today, the CO_2 abatement cost of using biofuels in road transport is ca. 150 €/t CO_2 in the Nordics. And with electric vehicles the cost is significantly higher. In light of the above and numerous other examples the Paris agreement target seems to be escaping us.

CARBON DEBT IS ALREADY 100 BILLION TONS

Assuming the totally hypothetical scenario where the whole world would suddenly stop emitting any greenhouse gases into the atmosphere, the climate change would continue. The simple reason is the paralyzing amount of 100 billion tons (100.000.000.000 tons) of excessive carbon in the atmosphere today. To put it in perspective, to biologically sequestrate the entire amount equals a forest the size of the Sahara. Whatever the world or the EU decides to do with the continuously growing GHG emissions, we need to start sequestrating the atmospheric CO_2, immediately and at unprecedented speed. We must start paying the global Carbon Debt, now. The good news is that we already have a well-functioning tool that is globally recognized and cost effective. It's about planting trees and forests, ie. afforestation or reforestation. It's even included in every international climate agreement.

Afforested area in Khemisset, Morocco

The bad news is that we are extremely poor and slow at deploying it. For the big part it has to do with the fact that the increasing population needs more and more resources and agricultural land which, instead, causes deforestation. Globally, we are moving in the wrong direction, even though in some regions, like the Nordics, the forests are in fact growing.

CARBON FARMING

What can we do to get the global afforestation pace at the level required? The question is about money. Carbon needs to be monetized, and in this case the biologically sequestrated carbon. When the carbon has a price, the growing biomass has a value. With value a company can have a business case to invest in. We have named it Carbon Farming. If the CO_2 abatement cost of 150 €/t is taken as a reference, there is a lucrative business case to invest in Carbon Farming. The measurement of sequestrated carbon needs to be done according to the IPCC guidelines. Naturally, a robust and fully transparent management system should be put in place as well as being audited and verified on a regular basis. It has to be emphasized that the idea is to incentivize the afforestation as a supplementary tool to sectoral and national activities. It's not intended to be a substitutive method. Actions need to be taken simultaneously and on all fronts.

LOW TECH SOLUTION

In deserted or semi-deserted areas, a well-functioning irrigation system is a prerequisite for success. Ideally, treated waste water, or, if not available, even with the help of solar power, desalinated sea water can be used to irrigate the plantation. There are plentiful successful case examples to demonstrate that this is doable. In addition, globally, there are large areas where Carbon Farming could be fully deployed with or without a limited amount of artificial irrigation requirement. Carbon Farming is an overlooked and underrated low-tech solution, just waiting to be deployed on a large scale.

REGULATION AS ENABLER

In the EU we must create a regulative framework that enables a cross sectoral and geographically cross border flexibilities to mitigate climate change by also enabling Carbon Farming. Practically, this means a structure where a part of the sectoral and national GHG reduction target could be fulfilled with biological carbon sequestration in the EU as well as in other parts of the world. Climate change is a global problem, and the measures need to be taken globally, regardless of where we live, or where companies happen to be headquartered or where they operate. This is well recognized in the Paris Agreement. Unfortunately, the envisaged EU 2030 Effort Sharing regulation would specifically prevent a cross sectoral and cross border approach to the extend needed to make Carbon Farming a reality. We are moving in the wrong direction. We must do a U-turn.

CONCEPT THAT COMBATS CLIMATE CHANGE AND BENEFITS LOCAL PEOPLE AND SOCIETY

There is a long history of afforestation and reforestation activities worldwide, from where good and bad lessons learned should be drawn. One of the main goals is to ensure that the afforested area remains and flourishes for years and decades to come. The fundamental key success factor is to create a concept that benefits local people and society. Firstly, land ownership should be undisputable and societal conditions should be stable enough to enable long term investment. Concepts, where the growing biomass offers a monetary value for local people, have proven to be most successful in the history of afforestation. Perhaps, the most appealing approach is the so called Agro-forest concept. The idea is simply to combine large tree plantations with crop farming. This is especially effective in arid areas, where an Agro-forest offers an array of environmental and societal benefits, such as prevention of desertification, increased food production and even decreased pressure on international migration. For example, if the Agro-forest concept could be successfully implemented in the Sahel area, it would at best create decent living conditions which are so desperately needed in this region.

Carbon Farming should not be seen as a substitution to sectoral decarbonization measures. It is a supplementary, and paramount tool to fight climate change. It's not about either or – it's about both and more.

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Research needs to tackle road transport decarbonisation

By Josef Affenzeller, EGVIA Secretary General

The EU is facing various important challenges to be tackled in the decades to come, in particular the decarbonisation of the European economy. The transport sector represents today almost a quarter of the total Europe's greenhouse gas emissions and road transport accounts for about 80% of all GHG emissions related to transport.

To tackle this challenge, ambitious goals have been defined by the White Paper for transport published in 2011, calling for a CO_2 reduction from the transport sector by 60% in the year 2050 compared to 1990 levels. This was complemented with the signature of the COP21 Agreement in Paris on clean air quality in cities.

To identify the research needed to tackle the decarbonisation challenge, with the assumption of CO_2 neutral electricity production, the European Green Vehicles Initiative Association (EGVIA), with the support of the three European Technology Platforms ERTRAC[1], EPoSS[2] and SmartGrids updated its roadmap "Electrification of road transport" extending the outlook until 2030. The task of the roadmap is to set the scene, give clear objectives, and list the milestones that require funding or policy actions at European level. It provides research, development and innovation roadmaps for the electrification of the different vehicle categories (passenger cars, 2-wheelers, buses and coaches, trucks).

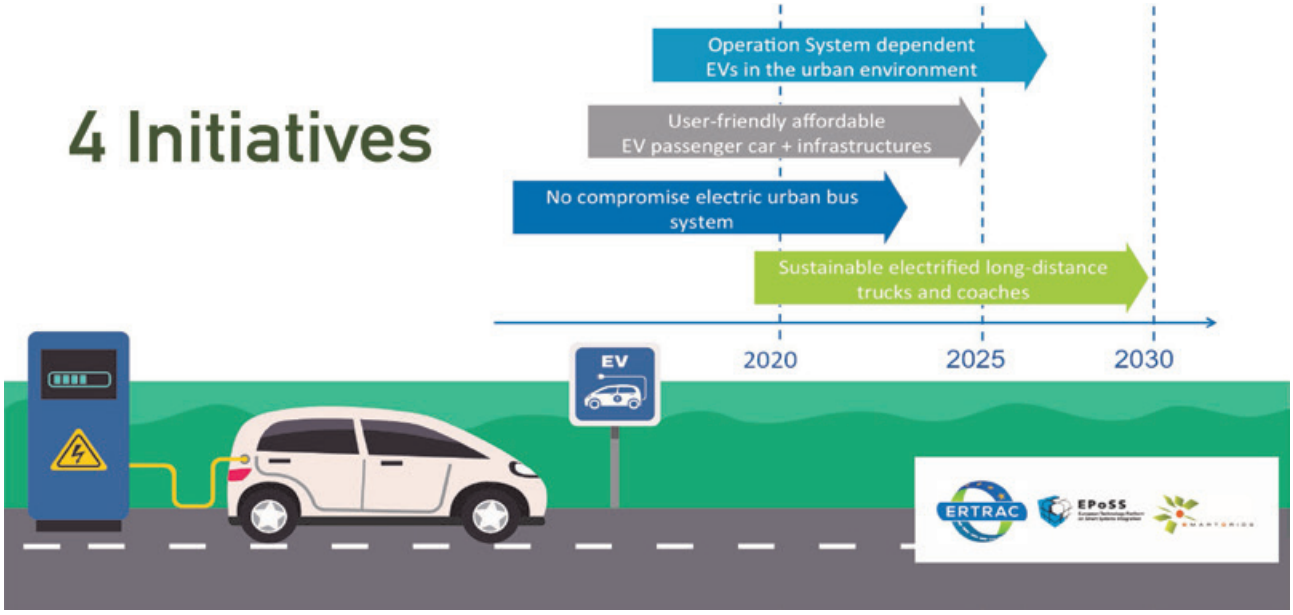
The task force defined four big initiatives that should drive research and innovation in the upcoming years:

- Operation system dependent EVs in the urban environment
- User-friendly affordable LEV/EC passenger car + infrastructures
- No compromise electric urban bus system
- Sustainable electrified long-distance trucks and coaches

For each of these big initiative, the updated version of the document aims at providing recommendations for research and innovation activities, under Horizon 2020 but beyond – also in view of the activities to be undertaken under the FP9.

All future research needs have been defined following a user-centric approach, with the objective of extending vehicles' range, reducing the cost while improving the charging procedures of vehicles (both in terms of time and charging convenience) in order to increase the attractiveness of these vehicles for the end users.

The full version of the roadmap is



1 European Road Transport Advisory Council
2 European Technology Platform on Smart Systems Integration

available on EGVI website: http://egvi.eu/mediaroom/63/22/New-Joint-Electrification-of-Road-Transport-Roadmap-published.

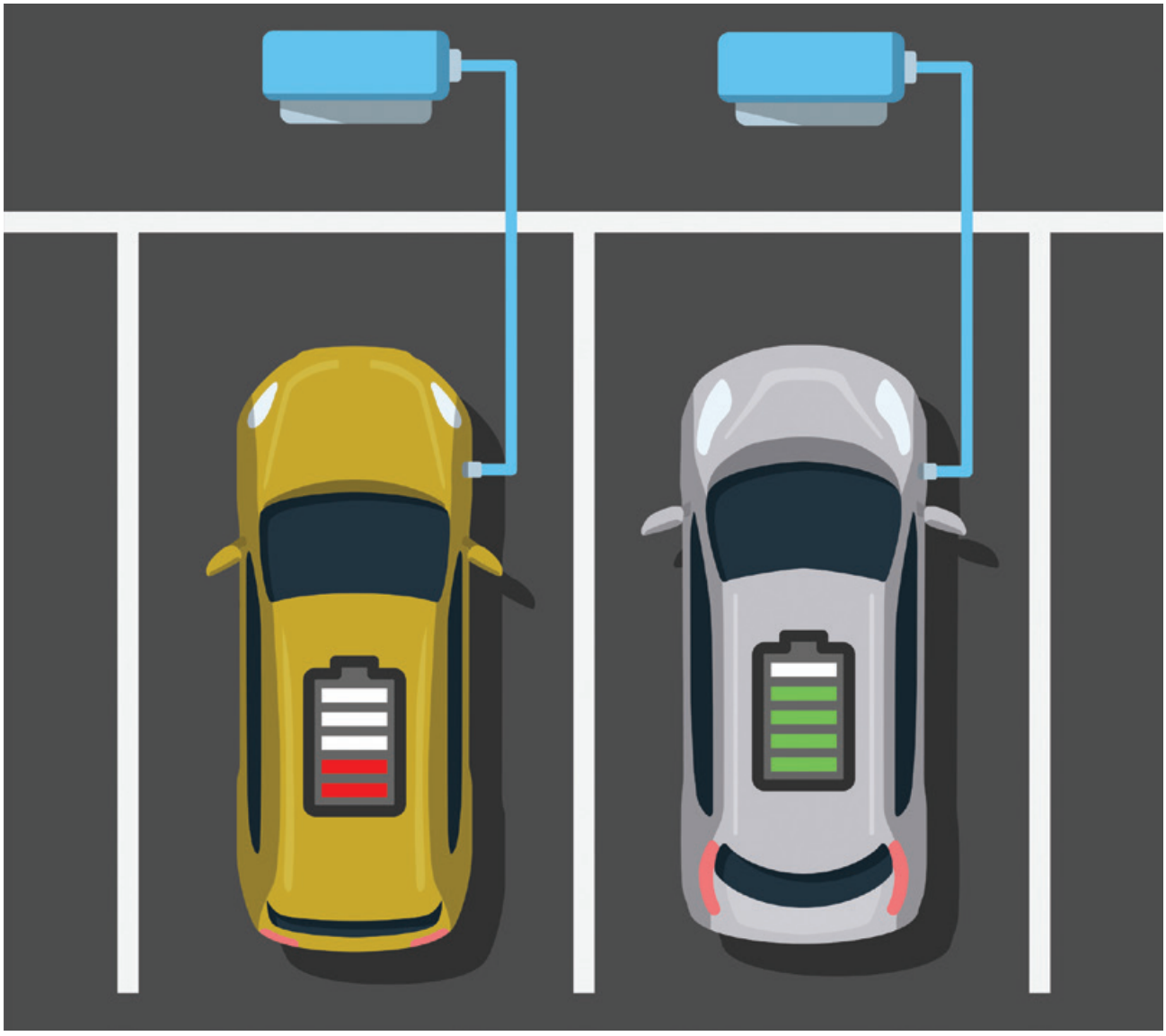
EGVIA is fully committed to achieve the White Paper objectives as well as to improve the air quality in cities, while also considering the continuous increase of passenger and freight transport.

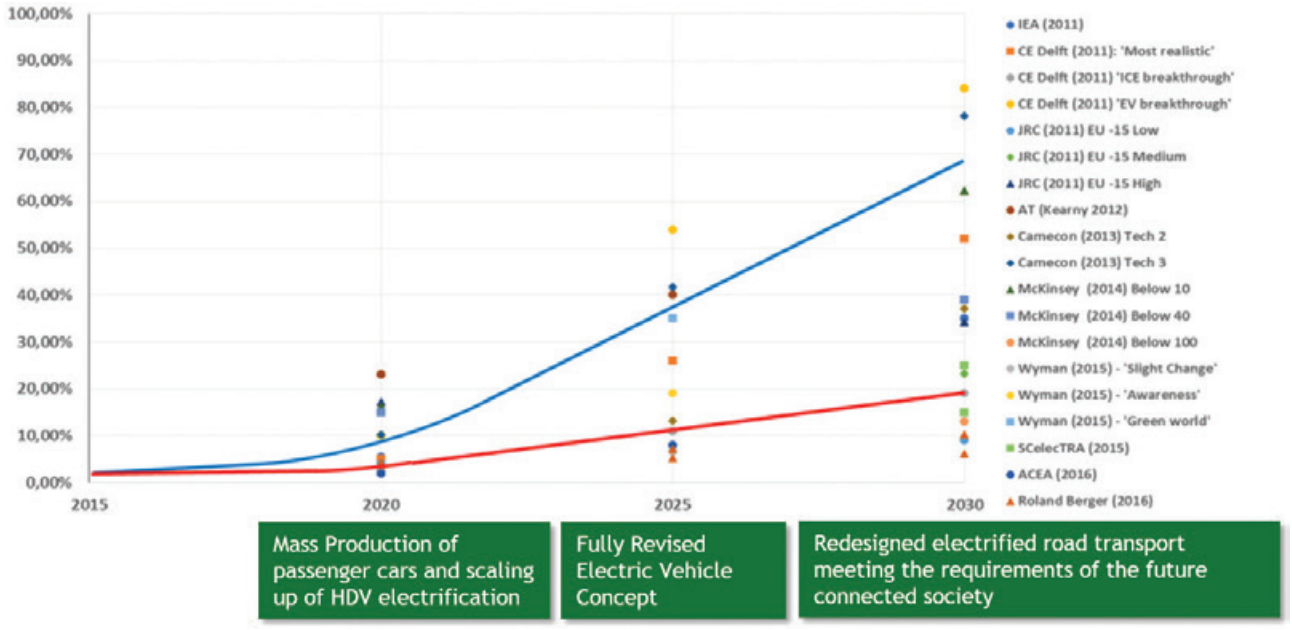
Keeping in mind that there will be no single solution fitting all applications and types of vehicles, electrification will bring a significant contribution to the decarbonisation of road transport and improvement of air quality, particularly in urban areas.

The improvements in batteries technologies will be one of the key area to accelerate the deployment of electric vehicles in the market. While the currently available batteries are mainly based on Li Ion chemistry and will remain the most commonly used solutions in the years to come, new generation of batteries will arise in the next 5 to 10 years onwards, providing even better performance and driving the transition towards electric mobility.

Research activities are still needed to improve the energy and power density of batteries, while ensuring a longer life-time and the possibilities of second life reuse for other applications (i.e. stationary applications). More still has to be done to reduce the cost of batteries up to 75€/kWh by 2030, in line with the Action 7 of the SET-Plan in order to make electromobility more affordable for the end users.

To achieve the targets, all sectors which contribute to the electrification of road transport will have to work hand in hand in order to bring into the market the necessary innovations to reach this goal. This will require of course a stronger collaboration between the automotive industry and the energy sector, as much as developing a system approach allowing to take into account all parameters impacting the largest deployment of electromobility.





The future market penetration of EVs and PHEVs depends on a multitude of factors including technological developments, policy support, deployment of charging infrastructure, production capacity, economic parameters, energy prices … Based on the interplay of these factors, several forecasting exercises have been carried out during the last years. The incertitude in quantifying the abovementioned factors results in a wide range of options as can be seen in the figure above.

EGVI
European Green Vehicles Initiative

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Supporting cities in energy planning – capacity building of local authorities in six European regions

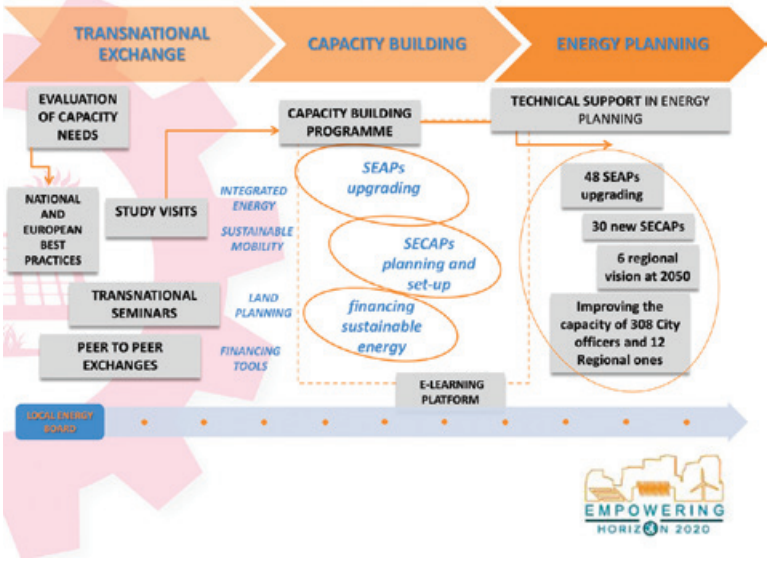
Cities play a key role in fighting against climate change. Local authorities have the power to influence climate issues, however often lack the capacity to recognise challenges, opportunities and deliver solution. This is particularly true for small- and medium sized local authorities which face several challenges when it comes to energy planning and implementation. In their case the coordination and support is definitely needed.

Three years ago different authorities – regional development agencies, regions, research institutes – from 6 EU regions (from Italy, Spain, Romania, Croatia, Hungary and Greece) decided to empower local and regional authorities (policy makers and public officers) of each region involved to shape sustainable energy plans coherent with the European climate and energy policies. The initiative received funding from the HORIZON 2020 Programme, which is the most important financial instrument to support research and innovation in the European Union.

THE CONCEPT

The main idea was to involve local municipalities and regional authorities in a sound transnational exchange and learning activities. The capacity building measures supposed to target organisational development and human resources as well.

The transnational exchange programme is designed to enable policy makers and public officers involved to learn from each other's experiences and adapt effective responses to the major energy challenges with the thematic focus on integrated energy, sustainable urban mobility, land use planning and innovative financial solution. Based on the transnational exchange a capacity building programme is elaborated. As the result of a successfully implemented capacity building program, the improved knowledge and competences of local authorities are put into practice during the adaption of new Sustainable Energy Action Plans and upgrading of the existing ones, while regional authorities are supported in shaping regional energy vision to 2050.



CAPACITY BUILDING NEEDS ANALYSIS

To find the right pathway for the most suitable capacity building program, a survey was conducted in all the six participating regions. The involved local authorities were smaller and therefore have potentially limited capacity, although have motivation to plan and influence energy consumption. The data was collected from 61 local authorities using a structured questionnaire. It was also followed by personal meetings where targeted questions were asked from the participants. Although the results were analysed in all regions separately, similarities within the participating regions could be discovered.

CONCLUSIONS

Available funding influences the implemented measures.

Most local authorities realize exemplary practices in areas related to land use planning where internal structures and institutional settings (procedures) coherently exist. This could be a consequence of the fact that these structures are related to urban planning as an overall concept, however in most cases these structures do not have a focus on sustainable energy. Still, among the topics to be the subject of capacity building activities, "land use planning" scored the lowest preference (46%).

Regarding innovative financing solutions, most respondents scored the lowest level of structural approach – there are gaps on most aspects envisaged (projects, structure, settings, training, resources) and this is confirmed by their preference (of 81%) to be trained on the topic of financial innovative solutions.

More information and related materials are available on the website: http://www.empowering-project.eu/en/

Five trends for the power sector in 2018

By Kristian Ruby, Secretary General, eurelectric

2017 was a landmark year for the power sector. 2018 will be no less significant. Here is a roundup of five energy trends to keep an eye on in 2018.

RENEWABLES: UNEVEN DEPLOYMENT, CONTINUED COST REDUCTIONS

Deployment of renewables will continue in Europe, but with an increasingly asymmetrical pattern. Some markets - especially in Western Europe - will see strong deployment. Others, especially in Eastern Europe, will come to a grinding halt.

The cost-reductions of variable renewables will continue and consolidate. This will be reflected in new subsidy-free deployment models from Dutch-style zero-bid auctions to corporate power purchase agreements and purely merchant projects. Yet, paradoxically, the decisive factor in renewables expansion will be politics, not economics.

As Member States reach their EU mandated targets, some drop the necessary enabling frameworks in order to slow expansion. In some countries, we have seen retroactive changes and even de facto bans on specific renewable technologies.

In parallel to the EU-level targets debate, we need to increase focus on investment barriers in Member States. Consistent, predictable frameworks are needed and targeted measures to tackle public acceptance and permitting barriers will be crucial for continued renewables deployment.

BATTERIES ON THE RISE, BUT HYDRO STAYS KING OF STORAGE

The strategic importance of storage will crystallise further in 2018 and we will see a number of significant developments in the storage space.

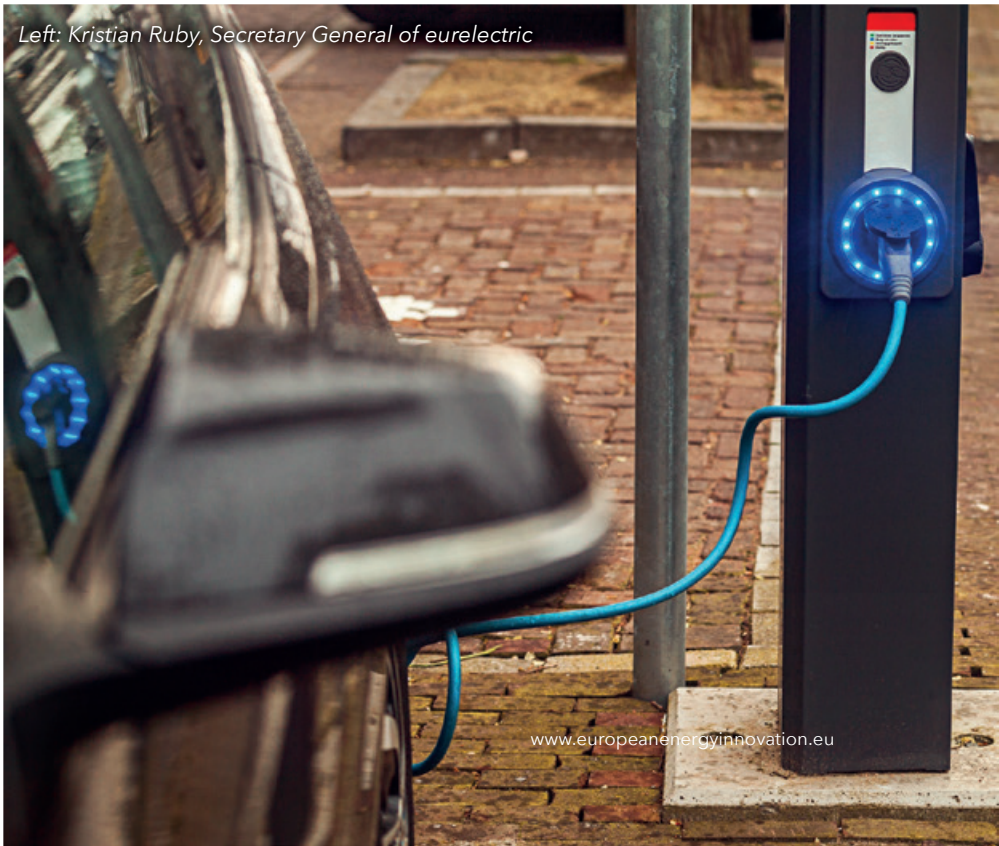
The drop in battery costs will continue. Ion-lithium batteries will outpace the forecasts again and we will hear more of new battery technologies. We will also see other technology strands mature further - thermal storage and power-to-X will become a more established part of the discussion.

Nevertheless, hydro will stay king of storage. In terms of installed capacity, flexibility specs and bulk potential. In several European markets, there is an untapped potential both technically and economically, for increasing hydro capacity, through repowering and new projects, that deserves more attention. The additional feasible hydropower potential in EU-28 exceeds 650 TWh. That is equivalent to the gross electricity production of Germany.

DEEPENING DIGITIZATION

The changes caused by digital technologies will bring benefits to all parts of the value chain from generation, to distribution and retail and will deepen to a point where

Left: Kristian Ruby, Secretary General of eurelectric



they alter the DNA of utilities. Some companies are already redefining their identity from utility to tech company, revamping their strategy, products and business models fundamentally.

Customers will see direct benefits from the digital revolution. More choice and tailored products. New services in mobility, smart home control and decentralized energy system management. Improved customer journey. The list continues.

But action will be required to remove regulatory barriers and unleash the full potential of digitization. A hypothetical, but realistic example: A Dutch utility has a large customer base in Germany, but wants to centralise data operations and run their cloud from a datacentre in Denmark. Technically, moving digital customer profiles between two servers will require just a few clicks. But differences in data protection rules could complicate such an operation immensely and hinder companies from exploiting economies of scale.

SUPPLY-DEMAND IMBALANCES WILL INCREASE

Whereas aggregate overcapacity will persist, regional bottlenecks and adequacy issues will get increased attention. Real urgency is two-three years away in most cases, but warnings from TSOs and generators will amplify in 2018.

There are several aspects to this. Economic growth is picking up across Europe. This means more power consumption by customers who buy new gadgets and services, and industries who rush to serve the increased demand for their products.

At the same time, an increasing amount of dispatchable capacity will decommission in the coming years. Platts expects that 60-70 GW of controllable plants will leave the market by 2025.

Finally, grid constraints and continued restrictions to cross border flows will add to the urgency around regional bottlenecks as demand for power increases.

NEW FRONTIERS OF ELECTRIFICATION

2017 was the point of no return for electrification of passenger cars. In 2018, electricity will prove its potential in areas we had not thought possible even a few years back.

Two-wheelers: A quiet electric revolution has already begun in Asia where millions of scooters are shifting to electric. In 2018, this will reach the big brand name motorcycles. Harley Davidson just announced an all-electric motor cycle in January.

Buses: Another obvious segment for electrification due to predictable routes. Several cities in Europe will accelerate their shift to electric buses.

Maritime: Short-haul maritime is already seeing the beginning of a shift to electric. But electrification will move beyond small ferries. Hybrid solutions with electric elements will find way into long-haul maritime transport as well.

Aviation: The wave of electric flight start-ups and pilot projects from 2017 will continue and trigger concrete business plans and strategy announcements in 2018. The first one already came in January from Norwegian Avinor, which announced all short-haul flights to go 100% electric by 2040.

Industry: Expect to see new application of electric power for heavy industrial processes. Vattenfall just announced a pilot project for green steel fuelled by hydrogen from fossil-free electricity. Others will follow.

Hydrogen, and Renewables do it!

By Michael Weber and Thomas Kattenstein, EnergieAgentur.NRW, North Rhine-Westphalia, Germany

The reduction of greenhouse gas emissions and local pollutants is far from being solved. Substantial progress requires the predominant use of renewable energy in all sectors and the widespread use of electric drives in cars and locally operating vehicles[1] – drives using both technologies, batteries OR hydrogen, depending on users' needs.

The provision of all sectors with renewable energy will be based mainly on electricity from wind and sun throughout Europe, and this requires flexibility in space AND time. Electricity transport is just one side of the medal. Flexible electricity use, storage and especially its conversion to storable energy carriers is the other, and this side needs fair consideration in energy regulation.

If Europe sticks to "efficiency" as a quasi-dogmatic super target, although it is just one pillar of the building, and if Europe takes the strongly promoted path to "all-electric", discriminating green fuel based alternatives just because of their seemingly lower efficiency, and if Europe keeps confusing "uniform electricity price" and "common market" and forces ever larger transmission grid extensions burdening the loads on unprivileged consumers, instead of financing electricity transport via horizontal market price differences and thereby motivating proximity of production and consumption, …it will throttle the growth of renewable electricity generation, it will increase transition cost, and it will see increasing portions of gratis producible renewable electricity unproduced – like the 4.5 TWh in northern Germany in 2015. This is "zero efficiency", and the amounts will grow as long as flexible Power-to-X converters are missing and regulation does not distinguish them from consumers requiring security of supply.

Electrolytic production of hydrogen together with all its subsequent use cases is one key flexibility element for renewable energy systems, because it stores large amounts of energy at high density; water is abundantly available in most places, pure hydrogen can be stored in salt caverns or pipes, and most of todays' gas storages are suited for the future blend gas containing limited fractions of hydrogen next to synthetic methane, biogas, and natural gas.". Even easily storable liquid fuels can be made from hydrogen and CO_2.

European countries, institutions and industry drive the development by programs and regulations, studies and projects. The Fuel Cells and Hydrogen Joint Undertaking (FCH JU), a PPP formed by the EU-Commission, the Industry Group "Hydrogen Europe" and an Academia Group, is the dedicated European research fund. Its flagship projects are JIVE for city buses and Hydrogen Mobility Europe for other vehicles and stations; power to hydrogen projects are funded, too. Other EU-programs like Mehrlin(TEN-T) for refueling stations, as well as national programs like the German National Innovation Program on Hydrogen and Fuel Cells (NIP) and sub-national programs like in NRW (EFRE-based) complement its capabilities.

Regulation: the Alternative Fuels Infrastructure Directive (AFID) supports hydrogen use. The Fuels Quality Directive (FQD) does consider hydrogen, but requirements on "green" hydrogen are too strict and green hydrogen use in refineries is not supported neither, which obstructs a number of paths to increase renewable energy use. The same applies to the Renewable Energy Directive (RED). In addition, for its new issue under preparation, the council proposed to impute the use of renewable electricity in battery electric vehicles with a factor of 5, whereas the efficiency benefit of fuel cells over combustion engines is not considered at all. But p rogress

needs a level playing field for ALL use paths of renewable energy.

Studies: Recent FCH JU-supported studies on European level are "HyUnder..." on underground storage and the "Study on early business cases in energy storage…". "Hydrogen Scaling Up" of Hydrogen Council looks on the industrial impact. Recent German studies are "Klimaschutz durch Sektorenkopplung" by Enervis, „Der Wert der Gas-Infrastruktur für die Energiewende" by Frontier and „Comparative Analysis of Infrastructures: Hydrogen Fueling and Electric Charging of Vehicles" by Research Center Jülich. Regional roadmap studies are "Green Hydrogen Economy in the Northern Netherlands" with GW numbers, "Akzeptanz durch Wertschöpfung" by GP-Joule on hydrogen mobility based on local wind power, and "h21 Leeds City Gate" with detailed plans to switch the whole gas supply of the city to hydrogen made by steam reforming with CCS and to support hydrogen mobility. This is not power-to-gas, but it will boost sustainable hydrogen use technologies.

Technology: for electric splitting of water there are 3 options: alkaline electrolysis with proven long lifetimes, the potentially more efficient PEM electrolysis based on Proton Exchange Membranes with much higher power densities, and the high temperature Solid Oxide Electrolysis (SOEC) using oxygen ion-conducting membranes. When using externally generated steam the latter has the highest efficiency (92%), but its stack size is limited to few kW. Due to reversibility it is well suited for energy storage at small scale or other applications that strongly value efficiency. The other two technologies reach stack sizes of few MW and in most projects efficiencies of ~71%[2]. At lower current density (higher cost) PEM can easily reach higher values. Development focuses on cheaper catalysts, new membrane types and efficient design. Cost ranges from 1000 to 1500 €/kW for large plants excluding compression or injection. Reduction potential ranges down to below 500 €/kW.

In Europe there are 31 **projects** with a total power of 25.4 MWel in operation and another 14 totaling 29.3 MW under erection. The latter includes 1.2 MW in Hobro, Denmark, that is close to commissioning. Nineteen respectively 8 of these projects are located in Germany with a total power of 22/18 MW. Some projects are for multi-purpose like hydrogen for mobility and industry as well as gas grid injection, in others the latter is combined with methane synthesis. Liquids are produced at small scale in Dresden with German funding, and a 1 MWel Methanol production is being erected in Niederaußem, NRW (MefCO_2, FCH JU). Energy storage is demonstrated in projects MYRTE (Corsica, FCH JU) and H2Herten (NRW, EFRE).

Important non-German plants in operation are located in Aberdeen for mobility (1 MW) and in Troia, Italy, for methane (1 MW). In Germany there is Werlte for methane (6 MW), Energiepark Mainz for multiple hydrogen use (6 MW), and Ibbenbüren in NRW (150 kW), that reaches a record efficiency of 86%, to which heat use attributes 15%. Erections include Wesseling refinery in NRW (10 MW), Südermarsch Wind (2.4 MW) and Leuna (2 MW) in Germany, Linz in Austria (6 MW, steel), BIG HIT on Orkney (1.5 MW, H_2) and Jupiter in Fos-sur-Mer (1 MW, methane). More multi-MW projects are being planned, but we also see non-operation of plants due to unfavorable regulatory boundary conditions.

The development of power to gas depends largely on its fair consideration in Renewable Energy Directive, which is hardly visible in current drafts. Use of renewable hydrogen in fuel cell vehicles should be imputed with a factor being half as much as that for battery vehicles – but at least 2, and PtG-electricity has to be imputed as renewable in more cases:

- 100%, if it is supplied by the grid operator in order to avoid throttling of renewable energy-producers
- 100%, if it is supplied synchronously from any specific RE-producer
- in case of purchase at an energy exchange: to the instantaneous regional (national or bidding zone related) percentage of RE, which is to be certified officially for each region and hour of the year.

In any of these cases electricity consumed by power-to-gas plants must of course not be imputed on the renewable energy target for the electricity sector. But this is enough to avoid double counting. The RED drafts' limitation to new off-grid plants is far too strict.

EnergieAgentur.NRW, funded by the state and EFRE, supports SMEs in their development of innovative energy technologies. Its Fuel Cells and Hydrogen, Electromobility Network founded in y2000 has 430 members.

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1) Gas-engines do also reduce emissions, but their GHG-reduction potential per unit of renewable electricity is not sufficient to let them serve as standard solution for such vehicles – combustion engines and green hydrocarbon fuels are advantageous for long-distance transport.
2) based on the higher heating value

Pineapples, standards and monkeys – where do we stand with electric vehicles and where are we heading?

By Thomas Willson, Policy Officer at ECOS

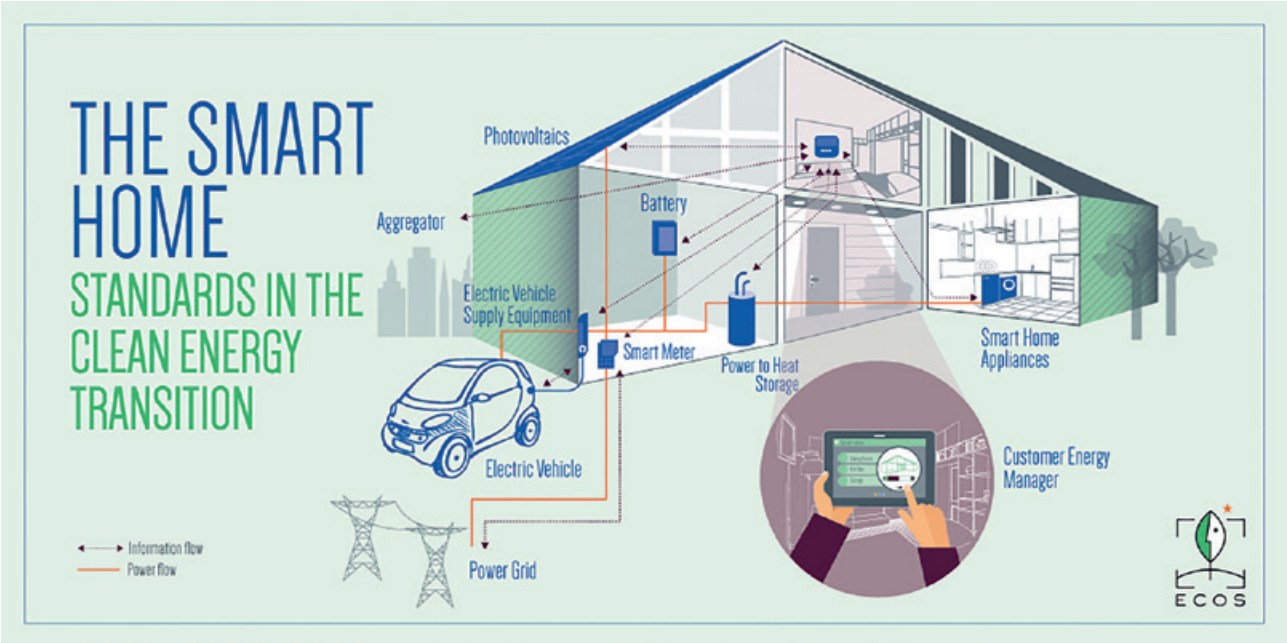
Transport is responsible for a quarter of all greenhouse gas emissions in the European Union and stands as the largest source of emissions ahead of the power sector. Road vehicles account for most of these emissions and disproportionately impact local air quality and noise pollution.

The link between road vehicles and pollution was not known until many years after their introduction on western roads. The relationship was eventually discovered by the chemist Dr. Arie Haagen-Smit, a professor at Caltech who had achieved recognition for his work on plant hormones and studies into the flavours of wine and garlic. Harnessing a technique that also helped to determine the flavour of pineapples, he was able to end a debate that had been raging in Los Angeles in the 1940s – whether it was industrial pollution, backyard incinerators or road vehicles that were responsible for the choking smog that had engulfed the city.

Today, the relationship between road vehicles and pollution is well understood. The Volkswagen emissions scandal 'Diesel-gate' has further improved our knowledge, with revelations on how manufacturers circumvent emissions tests with 'defeat devices' installed to reduce exhaust pollutants when under test conditions. These defeat devices recently made headlines again, after the extraordinary disclosure that they had been used in experiments on Java monkeys, which were placed in airtight boxes to inhale Volkswagen Beetle exhaust fumes while distracted by cartoons, in a bid to prove the environmental performance of diesel cars.

Diesel-gate and the work of Dr. Haagen have since become important milestones for the transport sector and helped to inadvertently drive the most promising means to decarbonise road transport: electromobility. Electric vehicles (EVs) offer several advantages over conventional combustion engines, which include lower emissions, improved local air quality, reduced dependency on fossil fuel imports and strengthened security of power systems. Studies have shown that even when electric vehicles (EVs) are charged with the dirtiest EU electricity mix, their environmental performance still exceeds traditional internal combustion engines.

The question of how to ensure the rapid market uptake of EVs has often been likened to the 'chicken or the egg' paradox – how can EVs numbers grow without charging infrastructure and how can charging infrastructure be deployed without EVs? The European Union attempted to crack the egg with the Alternative Fuel Infrastructure Directive, which aims to support the availability charging infrastructure and ensure their interoperability with standardisation.



The reason why was restated in the Communication on Union strategy for low-emission mobility: 'standardisation and interoperability are crucial to make the most of the scale of the internal market, especially for electro-mobility and barriers to charging of electric vehicles across the EU need to be eliminated'.

So where do we stand today in the ever-evolving landscape of electromobility standardisation? Historically, the standardisation of electromobility has focused traditional electrotechnical issues, such as plugs, outlets and electrical safety. ICT aspects, such as communication interfaces and data models needed to ensure integration with energy markets, have been primarily developed as research and pilot projects outside of the standardisation system. This has led to a series of proprietary and fragmented solutions, which reflects the current state of the market to a certain extent.

Initial efforts to resolve the ICT dimension did not get off to a great start. The first edition of the international standard that defines communication between the electric vehicle and the charge point (ISO 15118) is still being tested by manufacturers, largely due to a series of technical teething issues. However, standardisation progress has since increased over the last few years to match the intensity of charging infrastructure deployment and sales of EVs.

A second, improved version of ISO 15118 is under development to address these issues and incorporate two new aspects that could dominate future EV charging processes: bidirectional power transfer and wireless charging. The standard will join other efforts, such as CHAdeMO, and enable smart charging with the Type 2 and Combined Charging System (CCS) plugs. ECOS has supported this process to develop requirements for bidirectional power transfer and power islanding, improve time synchronisation and raise the need for 'grid codes' to manage the behaviour of EVs in a grid-friendly way. Taken together, these requirements should enable EVs to become active participants in energy markets and support the uptake of wind and solar power. Vehicle manufacturers expect to implement the second version in production lines from 2020 onwards.

To cover the remainder of charging infrastructure, a new standard was launched in 2017 to cover the management of charging station equipment beyond the charge point (IEC 63110). ECOS has contributed to define the overall technical shape of the standard and ensure interoperability with building energy management systems. The European Commission has since urged Member States to apply both ISO 15118 and IEC 63110 to support smart charging in their recent Communication on the Alternative Fuels Infrastructure Directive Action Plan.

These are positive steps as we roll towards the creation of an internal market for Electric Vehicles, and a giant leap from the smog filled streets of 1940s Los Angeles. Progress from here depends on our collective efforts to realise the opportunities that these common solutions can bring and solve one of our greatest challenges in the fight against climate change.

MariGreen: Testing of LNG Methane Catalyst

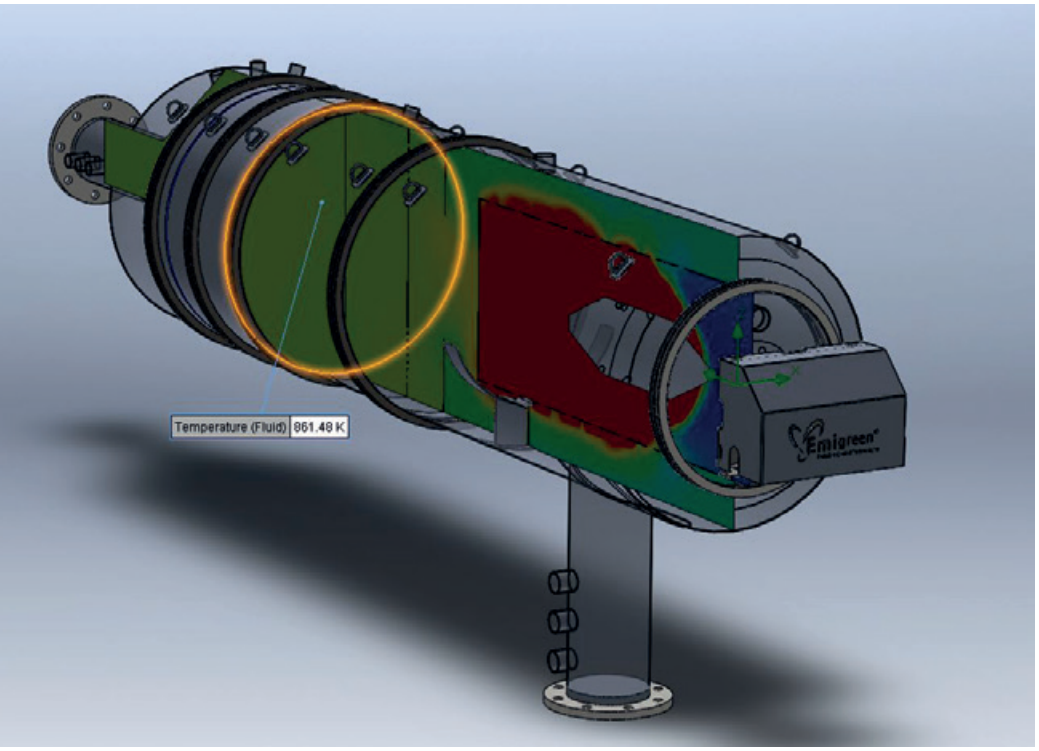
The MariGreen project is focused on the development of innovations for greener and low-emission shipping that will ultimately reduce the ecological footprint of the shipping industry. This collaborative project between Germany and the Netherlands brings together shared goals to push international standards of excellence even further whilst promoting the profile of the region as a model in Green Shipping. Through a consortium of fifty-nine German and Dutch maritime companies and research institutions, a total of twelve innovation projects will be realized as part of the broader MariGreen Project.

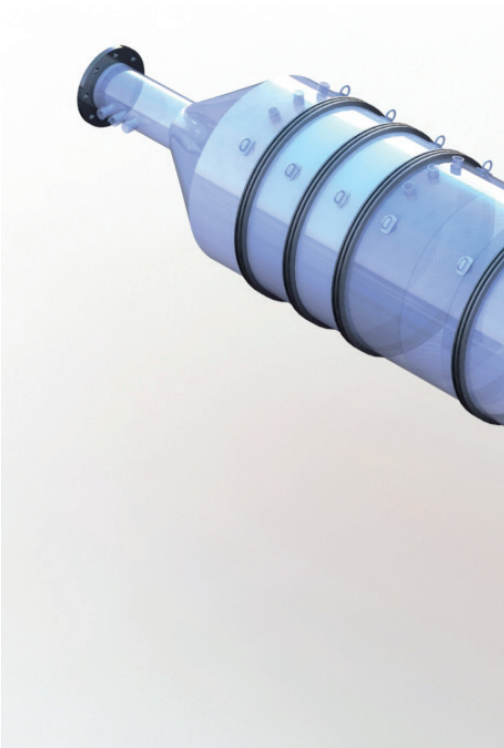
This broad-reaching project encompasses a total of twelve sub-projects focused on Liquefied Natural Gas (LNG) and wind-powered drive systems as well as green logistics alternatives – all with the common focus on resource efficiency and safety in coastal and maritime transport.

LNG offers a low-emission and environmentally friendly alternative to conventional fuels in shipping. However, climate-relevant emissions can occur in the LNG chain from the terminal to combustion in the engine. In particular, the escape of methane (the main component of LNG) plays a special role This phenomenon is known as 'methane slip' Engine manufacturers are continuously developing design upgrades to reduce methane slip. Today limits below 4gr/ kWh, are achieved. However considering the global need to reduce CO_2 emissions ("Paris Climate Agreements"), further reduction is desired. To this end, one MariGreen sub-project is dedicated to developing and testing a viable market-ready solution for marine gas engines to eliminate methane slip.

Euro Stage V includes methane emissions under hydrocarbon emissions (HC). These HC-limits for gas engines remain quite lenient compared to diesel engines (0.19 g/kWh for diesel engines vs. 1.10 g/kWh for gas engine (56kW≤P≤560kW) and 6.00 g/kWh for gas engines with P>560kW). Nevertheless, methane emission abatement techniques for lean-burn gas engines will gain more ground as LNG market uptake continues.

The catalyst being developed and tested in the project MariGreen will have the task of converting the residual methane in the exhaust gas into carbon dioxide and water, thus resulting in a significantly cleaner engine system. The design and



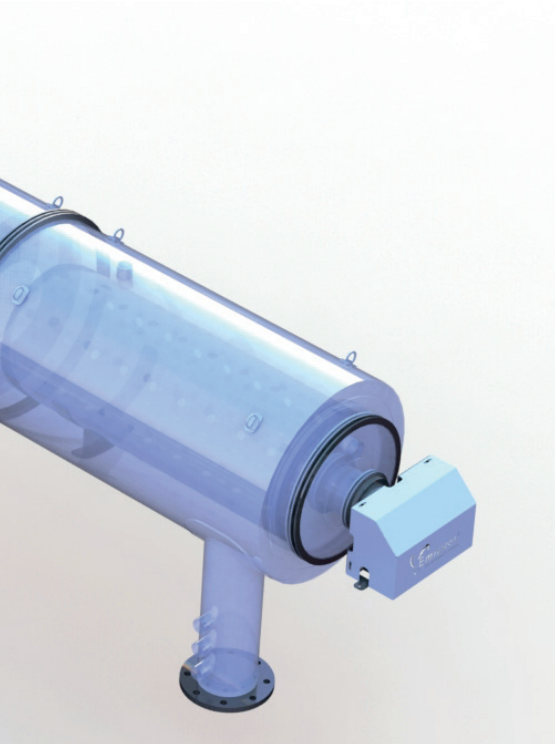


development of the catalyst is in its final stages, with three of the most promising catalyst formulations ready for testing. Meanwhile, a design sketch for the prototype is being finalized together with a list of components that will be required for construction (see images below). After all the components have been delivered, construction of the prototype is currently being carried out by Emigreen B.V., Wärtsilä B.V., Koedood Diesel Service and the Emden-Leer University of Applied Sciences.

Like most catalyst with oxidative capacity, methane oxidation catalysts (MOC) are based on rare earth metals. Beside these elements the MOCs under consideration consist of a more exotic cocktail of elements. An impregnation process is used to bind the powdered carrier material to the base metal substrate. This carrier is calcinated at elevated temperatures for several hours, nitrates solutions are used to subsequently impregnate the carrier. Later drying and calcination is done to finish the catalyst.

A suitable testing facility for the catalyst has recently been found at Intertech B.V. Located in Groot-Ammers. They offer the required expertise and testing space equipped with a cooling system, exhaust and gas control systems in place to carry out controlled tests with valid outcomes. Testing is planned to begin in April 2018.

The MariGreen project (www.marigreen.eu) is supported in the framework of the Interreg V-A program Deutschland-Nederland with funds from the European Regional Development Fund (ERDF) and national co-financing from Germany and the Netherlands. The MariGreen project is coordinated by lead partner MARIKO GmbH in Leer, together with Co-Partner FME, the entrepreneurial organization for the technology industry.



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Shipping as responsible sector contributing to a sustainable society

By Martin Dorsman, Secretary General of ECSA, European Community Shipowners' Associations

Shipping is the backbone of global trade, enabling import and export of affordable goods on a scale that is not possible for any other transport mode. Maritime transport has been a catalyst for economic development and prosperity throughout the history. Around 90% of world trade is carried by the international shipping industry. It is the most efficient transport mode when large amounts of manufactured items or bulk transport of raw material need to be transported, within Europe and between continents. There are over 50 000 merchant ships trading internationally, transporting every kind of cargo. Shipping contributes around 3% to the total global emissions of CO_2. The shipping industry recognizes the need to have an ambitious global CO_2 reduction policy in place, to contribute to the limitation of the increase of the global temperature. In this way shipping is taking its responsibility and is part of the answer in the fight against global warming.

REDUCTION OF EMISSIONS TO THE WATER

The reduction of emissions by the world fleet is already for many decades on the agenda of the regulatory bodies governing the shipping industry. Impressive results are already realized when we talk about emissions to the sea. The amount of oil spills was greatly reduced due to for example the requirement that oil tankers have a double hull. Toxic anti fouling was forbidden and replaced by bio friendly solutions. Emissions to the air are now also being lowered, with global

regulations that already entered into force or that will become effective the next years.

REDUCTION OF CO_2 EMISSIONS

Improving the fuel efficiency of the fleet

Shipping is the world's first sector where global regulations apply for the energy efficiency of newbuild vessels, regulations that become stricter over time. In this way the CO_2 emissions of newbuild vessels are lowered. Discussion is now ongoing to make the regulation more stringent, as the improvement of the energy efficiency is going faster than expected. Continued innovation is the driver of this. Companies have done major investments on new technological innovations such as upgrading engines, propellers and underwater hull to improve fuel efficiency. Companies also have adopted strategies to continuously monitor fuel efficiency on board to reduce the overall fuel consumption. Total CO_2 emissions are estimated to be well below 2008 levels.

Measuring the CO2 emission of the global fleet

As of 2019, the total yearly CO_2 emission of every vessel trading internationally will have to be monitored on basis of the IMO[1] global Data Collection System (DCS), which will become obligatory to use for all shipowners with ships above a certain size. With this system the total CO_2 emission of the world fleet can be calculated.

This is an important figure to use when formulating the global CO_2 reduction strategy.

Setting the CO_2 reduction strategy

In line with the spirit of Paris declaration COP21, the International Maritime Organisation IMO is now discussing the CO_2 reduction strategy. October 2016 IMO decided to set an initial strategy in April this year, to be finalized in 2023. This schedule is in conformity with the time schedule of COP21.

Industry position on CO_2 reduction

The shipping industry through its international shipowners association ICS calls upon governments to set an ambitious strategy that makes shipping a part of the solution in the fight against global warming, while at the same time safeguarding the role of shipping as we know today in the world economy. The industry itself formulated a number of ambitious goals and submitted that to the IMO to steer the discussion.

The first goals is to keep CO_2 emissions below the 2008 level, a much more ambitious goal than COP21 allows. COP21 allows for an increase of CO_2 emissions until 2023.

The second goal is an improvement of the relative CO_2 emissions per tonne-km as an average across the world fleet by at least 50% in 2050 relative to 2008 levels.

The absolute CO_2-emissions of international shipping have to be reduced by a convincing percentage, to be agreed upon by IMO in its April meeting of its environmental committee.

Reducing other emissions

Also for other emissions shipping is delivering. In Europe and in the North America region and the US Caribbean Sea the maximum sulphur content of the bunker fuels is already reduced to 0,1%. The global cap was reduced to 3,5% and will be reduced further to 0,5% in 2020. The shipping industry is calling upon governments worldwide to ensure that an effective enforcement policy is in place, to guarantee a level playing field for shipowners. Non compliance should not prove to be a rewarding policy to follow, on the contrary any benefits realized by being non-compliant should be taken away by effective sanctions.

Also the emission of nitrogen is regulated by the IMO and recently the countries around the North Sea and the Baltic Sea decided to introduce the most stringent regulation on NOx, the so called Tier III, in those sea areas for newbuilds from the 1st of January, 2021 onwards. This will reduce the emission of NOx by 80% compared to current levels. In the North America region and the US Caribbean Sea the Tier III requirement is already in force.

Recently new on the agenda of IMO to regulate is the emission of black carbon.

1) The UN body for the safety and environmental regulation of the internationally trading fleet

Reducing Shipping's Emissions

By Simon Bennett (pictured), Deputy Secretary General, International Chamber of Shipping

As the global trade association for ship operators, the International Chamber of Shipping (ICS) is immersed in complex negotiations with it global regulator, the UN International Maritime Organization (IMO), to further reduce the industry's atmospheric emissions. These involve the successful implementation of a global sulphur cap in 2020, and the development of an ambitious strategy to further reduce the sector's CO_2 emissions.

One of the most pressing challenges facing ship operators is the impact of the IMO global cap on the sulphur content of marine fuel, which will come into full effect on 1 January 2020.

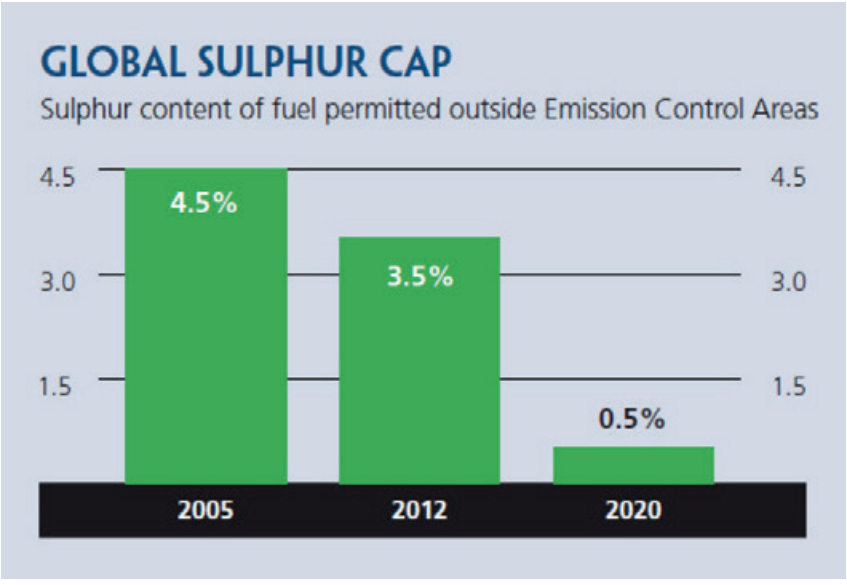
The 2020 global sulphur cap is the requirement under the IMO MARPOL Convention for all ships trading outside of sulphur Emission Control Areas to use fuel with a sulphur content not exceeding 0.5%, reduced from the current permitted maximum of 3.5%.

This improvement in fuel quality should bring about serious benefits to human health in coastal areas.
This new IMO regime is fully supported by the global industry. But the economic impacts of the resultant additional fuels costs are likely to be significant.

The cost of low sulphur fuels is currently about 50% more than the cost of residual fuel, which is that most commonly used by most ships today. In response to the greatly increased demand for low sulphur fuels that will arise in 2020, the cost compared to the current price of residual fuels is likely to increase considerably.

ICS has no reason to think that there will be anything other than full compliance by the vast majority of shipping companies. But in view of the huge sums of money involved, this has generated speculation about the potential for non-compliance and the possibility of unfair competition and market distortion.

In November 2017, the industry therefore proposed that IMO adopt a ban on the carriage of non-compliant fuels when the global cap is implemented in January 2020, providing governments with an additional tool to verify full compliance.



Now that the 2020 date is fast approaching, ship operators and oil refiners must urgently prepare for implementation. The oil refining industry in particular will need to take important decisions to ensure that sufficient quantities of compliant fuel will indeed be produced.

With regard to CO_2, the vision of the industry is to achieve zero emissions as soon as the development of new fuels and propulsion systems will allow. ICS is confident that new technology will eventually deliver, whether using fuel cells or batteries powered by renewable energy, new fuels such as hydrogen, or some other solution that cannot yet be anticipated.

In the meantime, the industry has set an objective of holding the sector's total CO_2 emissions below 2008 levels regardless of projected increases in demand for maritime trade due to population growth and economic development. The industry has also requested IMO to agree a mid-century objective for cutting the sector's total CO_2 emissions on a future trajectory towards zero emissions.

In April 2018, as requested by the industry, IMO Member States will adopt a comprehensive initial strategy for the further reduction of the international shipping sector's total CO_2 emissions, as a response to the Paris Agreement on climate change.

CO_2 emissions from international

shipping were about 8% lower in 2015 than in 2008, despite a 30% increase in maritime trade. Delivered with a combination of technical and operational measures, this is an impressive level of reduction, especially as shipping has no control over the ever increasing demand for its services.

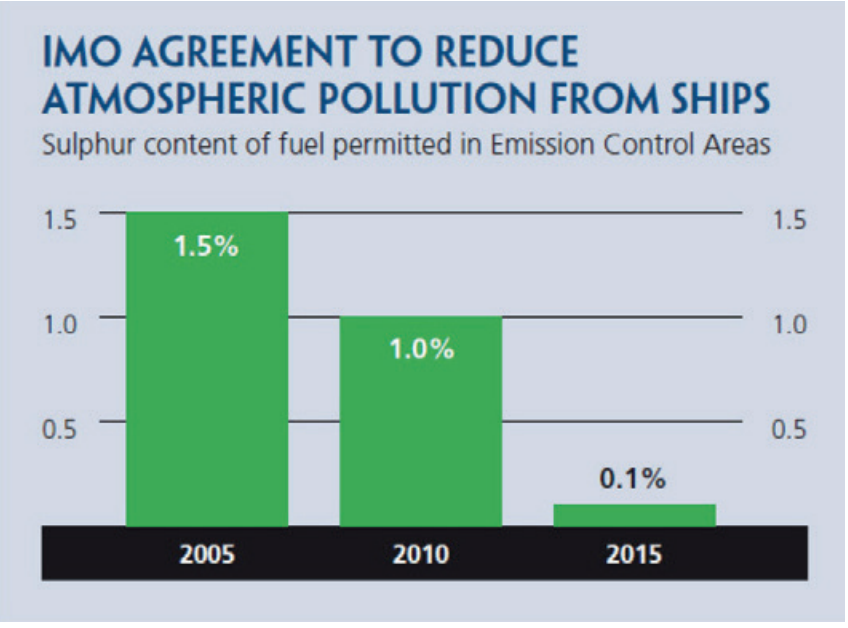
Moreover, as a result of amendments to the MARPOL Convention adopted by IMO in 2011 – the first such global agreement to apply to an entire industrial sector – new ships delivered from 2025 must be at least 30% more CO_2 efficient than ships constructed before 2013.

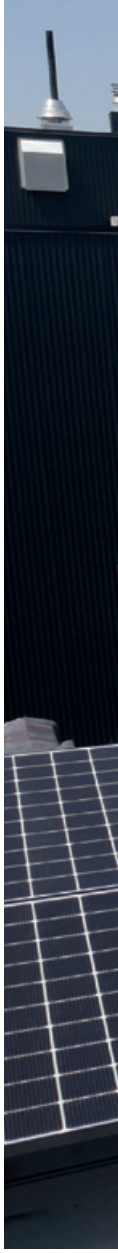
In addition to agreeing some high levels of ambition for the further the reduction of the sector's total CO_2 emissions, IMO is also expected to agree a comprehensive list of potential candidate measures for achieving these objectives.

Most controversial is applying some kind of Market Based Measure (MBM) to international shipping. The industry remains deeply sceptical about MBMs as a means of further incentivising CO_2 reduction. Fuel is already by far the largest cost for shipowners, and this is expected to increase dramatically as a result of the 2020 sulphur cap. But in the event that IMO decides to develop an MBM, the clear preference of the industry would be for a fuel levy payable to come kind of IMO climate fund, being a mechanism least likely cause market distortion, rather than an Emissions Trading System to which the industry is completely opposed.

The adoption this April by IMO of an ambitious CO_2 reduction strategy will be a significant achievement as it will need to take account of the legitimate concerns of emerging economies, such as China and Brazil, about the potential impacts on their economic development, consistent with the UN's Sustainable Development Goals.

Hopefully, the high level of ambition that will be established by IMO will be sufficient to discourage regional action by the likes of the EU. Unilateral responses would have disastrous consequences for the global maritime regulatory regime that is vital to ensure the provision of efficient maritime services. But most importantly, the dramatic reduction of CO_2 from shipping on a global basis can only be achieved through measures adopted for global application by IMO.





Why Blockchain is a high potential Game Changer in Utility

By Mirko Ross

Blockchain is more than Bitcoin. This concept of distributed ledger is an early stage technology which establishes new opportunities for decentralized systems and business processes. This fits perfectly to the future challenges of utility industries and has the potential to be a game changer.

While I am writing this article the Bitcoin crypto currency price has fallen to $6.000 from its peak of $20.000 end of 2017. When this article is published the price chart can be completely turned up or down. Talking about the charts of digital currencies as Bitcoin, Ripple or Etherium is gambling. But furthermore, this gambling is distracting from the ongoing revolution beyond this digital currency hype.

All in common the technology blueprint of this crypto currencies coins is designed to enable trusted transactions in decentralized networks, where all transactions are stored in distributed ledgers. It's an early stage technology and you can compare the maturity of its role out with the state of the Internet in early 90s. But the current success of Bitcoin as a trusted network reveals the huge potential of the underlined decentralized ledger technology. There are several connections of blockchain to energy sector. Good and bad ones. Let's start with the shady side and then turn to the bright outlook.

First Bitcoin and other digital currencies are a mess for mankind's goal to reduce carbon footprint. Today most transactions in blockchains are based on a proof of work principle, where new transaction blocks are needed to be calculated first by computing efforts or miners. Bitcoin creation is a result of a computing competition, where miners can raise their chances by adding computing power to create new blocks for the blockchain. This process is called "proof of work" and it is exclusive performed by miners.

The majority of Bitcoin mining is happening in China and its electricity hunger is appeased mostly by coal plant sources. Early January of this year the Bitcoin Network annual power consumption was 39 Terrawatt hours. A single transaction in the Network, for example to move a Bitcoin from a wallet to another, requires 335 Kilowatt hours. In other words: one single Bitcoin transaction power consumption is equal to the daily power consumption of 11 US households.

This bitcoin proof of work principle has become a significant negative factor for climate change. Even Chinese government considers a restriction of mining to embank the power consumption in mainland China. That's one important reason why alternative distributed concepts are required to validate transactions in Blockchain world. Promising alternative solutions are using a proof-of-stake principle where the validation is done by digital currency owners or by participants using mathematical models like "tangle" or "hashgraph". All in common the transactions in these networks do not require a massive power consumption of Bitcoin anymore.

Let's face the bright side of Blockchain and what value it can add to utility industries and have a look on applications domains and how the technology is already used to improve processes and to create new business models.

BLOCKCHAIN IN MICROGRIDS FOR COMMUNITY BASED ENERGY MANAGEMENT AND TRADING

In November 2016, the US based startup LO3 announced a pilot in Brooklyn for blockchain based energy management and trading. The Brooklyn microgrid connects all stakeholders on a local level. Local electricity generators such as renewable sources, energy storage providers and consumers will be connected on a dynamic marketplace.

In this microgrid the electric loads are still connected to the centralized power grids. But when the microgrid systems detects an outage, it can use its own power generation and storage capabilities to serve the local electrical load. As a result the blockchain based peer-to-peer architecture makes renewable energy more accessible and keeps the community resilient to outages. "We're focused on trans active energy. LO3 empowers communities to take control of their

Victoria Milne, Brooklyn microgrid prosumer, on her rooftop with her solar PV system (Photo LO3)

energy choices by facilitating the buying, selling and consuming of community energy" says Melanie Adamson of lo3Energy. And further, "This means the ability for distributed energy resources, such as batteries, smart devices, or generators, to participate in a marketplace where it is the user's preferences that make decisions, not any central entity". LO3 is no longer limiting its activities on US market.

The startup has gained remarkable worldwide support and partnerships with industrial enterprises. In November 2016 Siemens digital grid unit announced to support LO3. Siemens has early identified blockchain as one future core technology. "Blockchain is a new topic. I see a high potential for distributed ledger and smart contract technologies to solve future challenges in decentralized power grids and to enable transactive energy systems" says Stefan Jessenberger, Innovation & Partner Manager, Microgrids & Renewable Integration at Siemens. "That's why we at Siemens are investing own R&D capacities into blockchain technology and we are cooperating with start-ups worldwide to find the best benefits in energy sector."

BLOCKCHAIN BASED SMART CONTRACTING FOR ELECTRO MOBILITY

Electro mobility is facing two big challenges. First to provide reliable charging infrastructure and second to establish low costs payment for all stakeholder's transaction, starting from energy supplier, mobility provider towards customer. Innogy the subsidiary of RWE and the startup Slock.it announced to establish a blockchain based transaction platform for smart chargers.

The "Share & Charge" platform is targeting private charging providers. Owners of provide charging stations can share their infrastructure with other electronic vehicle users. Their power consumption will be charged by the platform and rewarded to the private charging provider. The payment transaction is processed by its own Etherium Blockchain based crypto currency. Consumers can load the coins on mobile Wallet App and charged energy is billed from the charging unit. As a service provider, the "Share & Charge" platform retains 15% service fees. The service has started in May 2017 with 1.100 charging station provided by Innogy but the joint venture is targeting more than 45.000 private charging station operators. The solution is now also

prepared for US market by a trail roll out in California together with the San Carlos based company Electric Motor Werks.

DISTRIBUTED LEDGER FOR SMART DATA MARKETPLACES

Transactions in the blockchain are usually stored in a transaction book called "distributed ledger". Adding a new record to this ledger is secured by complex algorithms calculation to confirm a transaction. On most common blockchain solutions as Bitcoin and Etherium this process is done by miners. As written in the first part of this article the mining process itself is heavily power consuming.

The developers of the IOTA have created a distributed ledger algorithm called "tangle", with no need of mining and zero transaction fees. Several projects in energy and utility sector are running on IOTA technology. In the applications range from smart micro grid management of households in the Dutch city of Groningen towards data management of electro vehicle charging networks. This year January the US smart mobility testbed company International Transportation Innovation Center (ITIC) announced a partnership to use IOTA's data market platform in helping technology companies develop smart mobility, energy and supply chain management related applications.

SUM UP WHY BLOCKCHAIN IS A POTENTIAL GAME CHANGER IN UTILITY AND ENERGY INDUSTRY

Blockchain is still in an early stage. But the development is rapid and the technology has disruptive potential in utility and energy sector. It allows to enable flexible peer to peer business models, where prosumers interact independent from monolith market players. This will force traditional suppliers into new roles, where they have to transform traditional business as energy supplier and billing towards new services oriented business with new revenue streams.

By that the challenge is not only technical. It's more a challenge to turn current organization culture towards innovation for service oriented business.

RWE with their innovation incubator Innogy and Siemens are currently pushing towards such new culture and business models. Both have identified blockchain as promising technology. Siemens Board Member Cedrik Neike claims blockchain to be one of the 14 core enterprise technologies. This is a strong strategic commitment of a traditional and powerful enterprise in energy and utility sector. But beside the new opportunities for traditional enterprises the blockchain creates a vibrant and powerful start up ecosystem with hundreds of new market players.

A significant amount of them is well financed by new instruments of Initial Coin Offerings, selling own Crypto Currencies to investors filling their war chest. So the Australian Startup PowerLedger targets the smart Power Grid market and has raised over $34 Million by offering tokens to investors. This capitalization allows them to develop and expand new business models with high speed and independent from traditional stock based shareholder legacy. In Germany the IOTA foundation has placed one of the top ten worldwide Crypto Currencies with a market capitalization of $6.8 Billion USD. Recently BOSCH and Volkswagen have taken seats in the IOTA Foundation board to support the technology development. And in the United States the Siemens grouphas invested in LO3 to develop blockchain based energy trading platforms. Markets are moving rapidly. The enterprises mentioned have decided to push transformation instead being transformed by new blockchain competitors.

Note: the author is invested in crypto currencies. Not enough to change life, but enough to understand their impact.

An interview with Cedrik Neike, Member of the Managing Board of Siemens AG

Q World economic forum predicts 2025 that 10% of world GDP will be processed over blockchain. How is Siemens Energy preparing toward such scenario?

Blockchain is one of the 14 company core technologies, Siemens is focusing on. We are already gaining a lot of experience with the use of Blockchain in particular in the energy field. Late in 2016, we announced the collaboration with the US startup LO3 Energy on Blockchain microgrids.

LO3 Energy realized a microgrid project in Brooklyn mainly enabling peer to peer energy trading among small prosumers. It is now being further developed with the aid of Siemens Digital Grid in the US into a full Microgrid integrating Siemens Microgrid control technologies.

This solution will not only enable Blockchain-based local energy trading between producers and consumers in parts of Brooklyn but also balance out local production and consumption and make local grids more resilient.

Blockchain technology is an innovative method of storing and validating data that permits direct transactions between energy producers and consumers. Transactions are trackable and tamper-proof on distributed systems without the need for centralized monitoring. The combination of a microgrid control solution and Blockchain technology will make it possible for

a provider of photovoltaic systems on the roofs of buildings in Brooklyn to feed its excess electricity back into the existing local grid and receive payments from the purchasers.

Q What impact do you see espacially on renewable enery market using blockchain technology?

We see more and more small producers in the market in particular with distributed photovoltaic installations, which can serve both as producer or consumer, depending on their current needs and production of energy. Blockchain, in combination with smart grid technologies, has a huge potential to further drive and enable new business models and co-operations in the energy market by utilizing market mechanisms to optimize not only their individual situation but also the grid itself.

Q Currently bitcoin mining consumes more energy a year than ireland. Is siemens energy investing in better energy saving blockchain solutions than proof of work algorithme. If yes, on what kind of alternative blockchain technologies (e.g. prood of stage, tangle) do you invest?

Of course, Siemens is also exploring other technologies for secure, automated transactions. A major challenge is the adaptation of transaction technologies to the special requirements of the industrial environment. For example, in the energy sector, Blockchain technology can in principle be applied to the entire energy market, but it requires appropriate regulatory action to open up the market and create a mechanism for energy trading.

5G – the new era for mobile communications

By Nina Kajander, JRC Press Officer

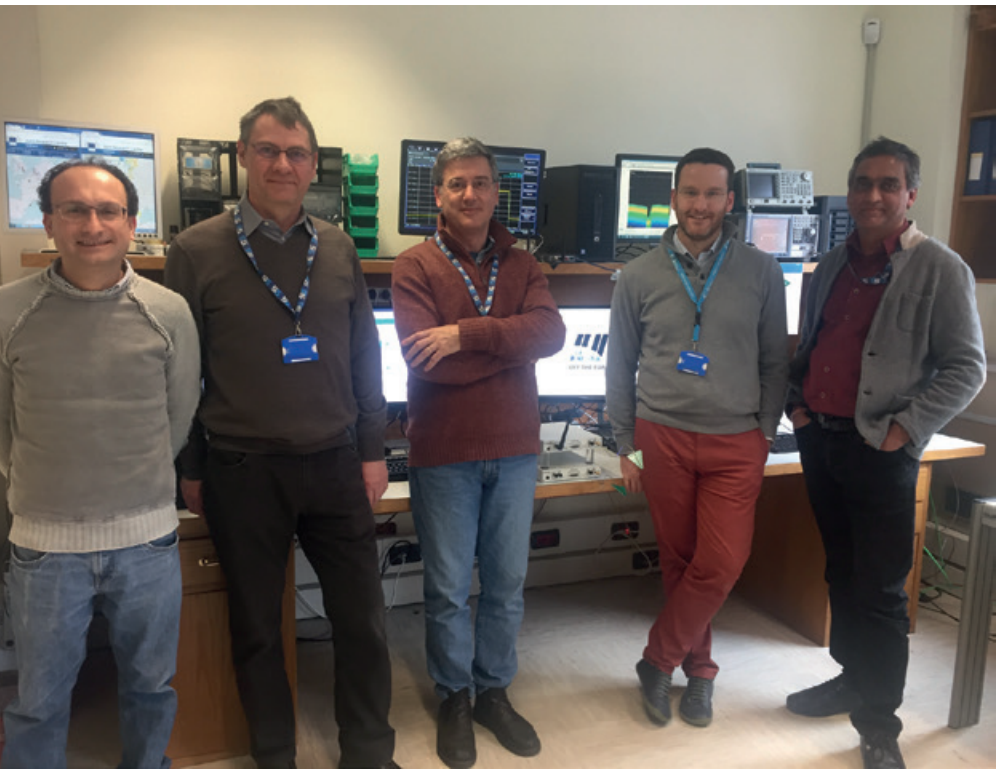
About every 10 years, the technology that connects your mobile phone to the network changes. 5G is the 5th generation mobile network, a step up from the 4G technology currently in use. The 5G network will be faster and more reliable. It will have more capacity to cope with high demand – for instance in crowded places such as concerts and stadiums, where many users want to use the network at the same time – and allow data to be streamed much faster.

This is good news for all those who are frustrated with slow Internet connections, but there is much more to 5G than faster wireless networks. Researchers at the European Commission's Joint Research Centre (JRC) are busy studying new 5G frequency bands in Europe, prototyping waveforms and testing 5G enabling technologies which will pave the way for a whole new world of digital communications and services.

BRINGING THE INTERNET OF THINGS TO LIFE

The 5G technology will enable the industry to take a leap forward in the provision of services based on machine-to-machine communication. It will allow an enormous amount of devices to be connected to the network to exchange data.

This is predominantly driven by the Internet of Things: a combination of the physical and the virtual worlds into a new smart environment, which senses, analyses and adapts, and which can make our lives easier and safer.



"This is not only about browsing the Internet. The 5G technologies inaugurate a whole new era of connectivity and intelligence in which products, services and people can connect. In the Internet of Things, any physical or virtual object can connect to other objects, and people can interact with them", said JRC Spectrum Expert James Bishop.

The Internet of Things (IoT) will force business transformation and bring fundamental changes to our perspectives on how technologies and applications work in the world. Currently, less than 1% of objects are connected to the Internet, but the number of IoT connections within the EU is estimated to increase from approximately 1.8 million in 2013 to almost 6 billion in 2020, leading to the EU IoT market being worth over one trillion euros by 2020.

DIGITISING THE ENERGY SECTOR

The Internet of Things and 5G also represent a new reality for the energy sector. They facilitate the development and implementation of smart grids – intelligent energy networks that combine smart appliances and energy efficient resources with intelligent computing systems to optimise energy production and reduce energy consumption.

New internet-connected devices such as smart meters and end-to-

end solutions that optimise energy production can be used for smart energy monitoring and for the creation of new services that integrate renewable energy sources and allow better management of available resources.

The rise of IoT platforms leads to new data-driven business models that allow building comprehensive solutions across multiple services ranging from home comfort, heating and automation, car charging and smart appliances. The user will benefit from enhanced customer services and flexible energy prices and will assume an active role in the energy market.

The 5G technology will improve the connectivity of smart grids through easy transfer of high volumes of data and reliable communication with low latency.

FROM REMOTE SURGERIES TO AUTOMATED DRIVING

The 5G technology will enable the industry to accelerate intelligent automation – sometimes referred to as Industry 4.0 – through smart production processes based on robots, sensors and machine-to-machine communication.

5G is also expected to give rise to new dynamic processes that rely on an ultra-reliable communication network that is optimised to process a high volume of data with a minimal delay. Automated driving and remote surgery are examples of such processes. They rely on time critical operations and ultra-reliable machine communication that can process fast critical requests.

"In order for self-driving cars, for instance, to be a reliable transport option in the future, the car needs to respond very quickly to various situations on the road. It needs to detect pedestrians and other cars immediately, and there can be no margin of error. The computer system managing the driving cannot crash

Photo: tanaonte – Adobe Stock.com

and it has to rely on a communication system which is flawless", Bishop explains.

To understand the implications on future policies, the European Commission is studying various aspects linked to autonomous driving, from cybersecurity to interoperability aspects. Cybersecurity – secure exchange of data via wireless networks – is one of the key aspects to be guaranteed before any large scale 5G implementation is initiated.

TESTING, TESTING...

Scientists at the JRC consider technology readiness to be one of the key enabling aspects – but also one of the biggest challenges – for moving the 5G mobile networks "from hype to ripe". And in order to be able to demonstrate the readiness of these technologies, more testing, research and 5G pilots are still needed.

In the Ispra-based radio spectrum laboratory, researchers have created experiments which simulate 5G signals to analyse options for the optimisation of bandwidth, the coexistence of different types of wireless networks and interferences to the network caused by various disturbances.

In the anechoic chamber of the spectrum lab, a device transmits a video to a computer screen sitting on the other side of the room via an ad hoc 5G wireless connection. Spectrum monitors track various parameters linked to the quality of the transmitted data.

"Before we were able to start testing the behaviour of 5G connections, we had to create the conditions that are identical to a 5G network, so we created this testbed which imitates a wireless 5G network. It allows us to run different kinds of experiments and to test, for instance, the impact of available bandwidth to the quality of the transmitted data", said Jaime Ferragut, JRC expert on wireless communications.

The scientists are also looking at spectrum efficiency and spectrum sharing techniques, which would allow different players to share the available spectrum and bandwidth of 5G networks. Spectrum availability has a central role in the EU's 5G strategy. Sharing spectrum among various users will not only allow the finite spectrum bands to be used more efficiently, but it can also create business opportunities for smaller telecom businesses that cannot afford massive investments in spectrum licences, thus leading to more competitiveness and better telecom services for users.

LOOKING AHEAD

As the race to 5G is accelerating worldwide, the Commission's

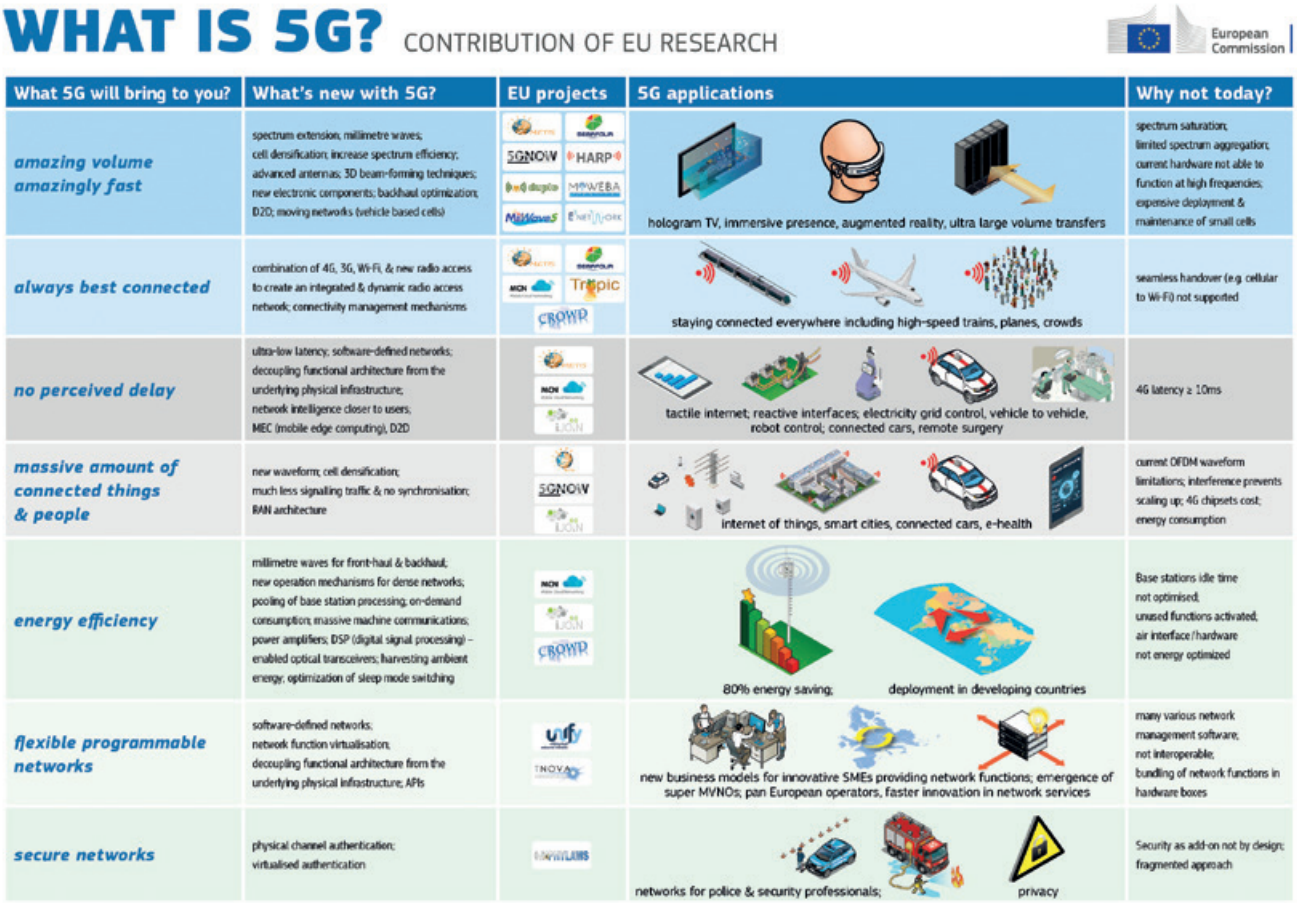


Image: European Commission DG CNECT

research centre wants to keep up with technological developments and anticipate future research needs. And scientists at the JRC are not short of ideas about how to advance research in this area. One idea is to establish at JRC Ispra a large-scale 5G testing facility, where researchers will be able to carry out tests of smart technologies for automated driving, smart cities, smart energy production and distribution in totally independent and real, city-like conditions. The JRC's research campus in Ispra, which spreads over 170 hectares of land and has over 36 kilometres of internal roads, would provide very good conditions for this.

"There are already many 5G testbeds in Europe, and the aim is that by the end of 2020 each EU Member State will have at least one major 5G-enabled city. We would like to create at the JRC in Ispra a research facility that will allow several JRC research teams to work on various aspects of 5G, from testing of self-driving vehicles to cybersecurity and connectivity. On the JRC's research campus we could have full control of the road infrastructure, the energy infrastructure and the communications network. This would provide optimal conditions for testing", said Ferragut.

Future research plans include also looking at user acceptance as well as health and social implications of future 5G networks. The European Commission strategy for the Digital Single Market underlines the importance of very high capacity networks like 5G as a key asset for Europe to compete in the global market. In 2013, the Commission launched a Public-Private Partnership (5G-PPP) backed by 700 million euros of public funding with the aim of making sure that 5G technology is available in Europe by 2020.

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