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Funding Low-carbon Technologies

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Editorial

By Wilhelm Molterer, Managing Director of the European Fund for Strategic Investments (EFSI)

EFSI significantly increases the risk bearing capacity of the EIB

Investing in clean energy makes economic sense as the accelerated deployment of efficient and low-carbon technologies can reduce energy import dependency and lower emissions. However, many low-carbon technologies are expensive. Therefore there is still a need for research, development and innovation (RDI) to reduce costs. Given the different development stages that these technologies are at (RDI, early market penetration and maturity), the European Investment Bank (EIB) has divided commercially proven technologies into mature and emerging categories, with a separate economic rationale for supporting each. The EU´s Strategic Energy Technology Plan (SET-Plan) is the core element of the EU policy for RDI in the energy sector, setting measures to coordinate RDI activities across national public funding initiatives. It focuses on low-carbon technologies that have the highest innovation potential for quickly delivering cost reductions and improvement of performance. It targets key common priorities such as renewable energy sources, an integrated and flexible EU energy system with consumers at the centre, energy efficiency and sustainable transport along with additional priorities such as CCS and safe nuclear power.

When you compare renewable energy generation to conventional generation you should take into account both the environmental benefits (in terms of reduced CO_2 emissions) as well as the additional costs that the electricity system needs to bear to connect and operate. Some energy generation technologies like hydro and onshore wind are already cost competitive today. Other energy generation technologies – like concentrated solar power (CSP) – are considered emerging technologies as they are not yet competitive compared to their fossil fuel alternatives. Nonetheless the Bank supports them as it believes they will become competitive in a reasonable time frame. The best example in this respect is solar photovoltaics – a technology that has been strongly supported by the Bank over the last years. Last year around 70GW of solar farms were installed globally making this technology the largest contributor to new capacity additions, surpassing wind for the first time. The costs of solar modules have decreased by 70 % over the last six years and this technology has now become cost competitive in many markets enjoying a good solar resource. Though we are still at an earlier stage of development we are beginning to see a similar trend in offshore wind where auctions in Denmark and the Netherlands last year have achieved unprecedented low prices. The Bank has been a pioneer in supporting offshore wind technology also at a time where costs were much higher as the industry was still developing and facing severe difficulties in implementing projects within initial budget and timelines. Things are looking much brighter for this industry nowadays and while we maintain a cautious approach, as there is still a way to go, we are also proud to say we played a role in taking it where it is today.

A major issue with funding projects is the considerable uncertainties that exist in energy markets – even in a sector like renewable energy that has been in the past highly regulated. RE projects are

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capital-intensive, and in today's market, project developers often run into difficulties in securing long-term financing. This partially reflects concerns around the future of renewable support schemes, but also the inherent project risks of construction and long term operation – particularly for relatively new technologies such as offshore wind being designed to operate for 20 years or longer in hugely challenging offshore conditions. This risky environment is where the Investment Plan for Europe and the European Fund for Strategic Investment (EFSI) comes in. EFSI significantly increases the risk bearing capacity of the Bank, and allows us to scale up existing risk sharing instruments and launch new products that are both more scalable and more flexible than we could provide before. It also enables us to significantly increase the overall investment volumes supported by the EIB. Out of the EFSI transactions approved by the EIB so far (until January 31 2017), 23 % are in the energy sector.

Another set of low-carbon technologies are at an even earlier stage of development and undergoing first technical or commercial demonstrations. These technologies include whole sectors like e.g. ocean energy technologies, including converting waves, tides, currents, etc., but can also be applied to certain specific applications like e.g. floating offshore wind turbines or enhanced geothermal technologies. Ad-hoc financial products are needed to support such technologies. The EIB has provided technical and financial assistance to the European Commission under the NER 300 initiative to fund innovative low-carbon technologies. More recently the EIB and the European Commission created a new facility under Horizon 2020 called Innovfin – Energy Demo Projects (Innovfin EDP) which was designed to address a financing bottleneck identified in the EU's SET-Plan. Innovfin EDP supports first-of-a-kind demonstration projects in the field of renewable energy and hydrogen/fuel cells by covering the higher risk faced by these technologies during the construction and initial operating stages. A first loan under this facility was signed last year with a pioneering start-up company that has developed an innovative wave energy device. More projects are in the pipeline in sectors such as floating offshore wind and tidal energy and discussions are ongoing at the moment with the EC to expand this facility, which is currently in a pilot phase.

These innovative energy technologies are extremely important because, while we may see their limited applications today, we are confident that many of them will become an integral part of the future decarbonised energy systems. It is only through a wide portfolio of renewable energy technologies that we can succeed in substantially reducing GHG emissions in the longer term. Therefore we need these new technologies to meet our longer term climate goals and we should not make the mistake of fully relying and concentrating our efforts on the most mature technologies (such as onshore wind or solar PV).

SET-Plan Update

The European Strategic Energy Technology Plan (SET-Plan) aims to transform the way we produce and use energy in the EU, with the goal of achieving global EU leadership in the development of technological solutions capable of delivering 2020 and 2030 energy and climate goals.

Low-carbon technologies are key ingredients for the energy system to meet the goals of the Energy Union. At the same time, investment in technological development is often expensive and entails commercial risks. Consequently, funding is a critical element of this endeavour. The following is a non-exhaustive overview of actions taken to support the funding of low-carbon technologies at EU-level, in addition to a more general look at recent actions in support of the SET-Plan.

Funding of Low-carbon Technologies

The European Investment Bank, set up in 1958 when the Treaty of Rome came into force, helps to finance energy projects by providing loans and other structured financing options. The bank and its partners have raised billions of euros for climate change investment through funds such as the Global Energy Efficiency and Renewable Energy Fund, the European Energy Efficiency Fund and vehicles such as the Marguerite Fund, the Crescent Clean Energy Fund, the Facility for Energy Sustainability and Security of Supply, the Green Initiative and the Climate Awareness Bond. The bank also supports energy efficiency via joint EIB/European Commission initiatives such as ELENA and JASPERS. Risk in the research, development & innovation (RDI) process is shared through the bank's InnovFin programme.

The EU's Cohesion Fund was set up in 1994 to provide funding for environmental and trans-European network projects. Since 2007 it has also been authorised to support projects in fields relating to sustainable development, such as energy efficiency and renewable energy. The EUR 63.4 billion fund aims to reduce economic and social disparity between EU countries and promote sustainable development. The Fund supports energy-related projects that benefit the environment by reducing greenhouse gas emissions, increasing the use of renewable energy or improving energy efficiency. Part of the Cohesion Fund will go into implementing the EU's plans for Energy Union with the help of the Energy and Managing Authorities Network. Another part of the Cohesion Fund also goes into supporting the Connecting Europe Facility.

The New Entrants Reserve fund, more commonly known as NER 300, was launched by the European Commission in 2008. NER 300 is one of the world's largest funding programmes for innovative low-carbon energy demonstration projects. Funded through the EU emissions trading system (ETS), it provides EUR 2.1 billion in co-funding to projects demonstrating environmentally-safe carbon capture and storage (CCS) and innovative renewable energy (RES) technologies on a commercial-scale within the European Union.

The EU also supports the uptake of low-carbon technology internationally, through the Global Energy Efficiency and Renewable Energy Fund (GEEREF), an innovative global risk capital fund that uses limited public money to mobilise private investment in small-scale energy efficiency and renewable energy projects in developing countries and economies in transition. GEEREF was launched in 2008 with EUR 112 million in funding from the European Union, Germany and Norway.

The European Energy Programme for Recovery (EEPR) was established in 2009 to address both Europe's economic crisis and European energy policy objectives. Almost EUR 4 billion were assigned to co-finance EU energy projects to boost economic recovery, increase the security of energy supply and contribute to the reduction of greenhouse gas emissions. The three sectors meeting these conditions were gas and electricity infrastructure, offshore wind energy and carbon capture and storage projects. In total 59 energy projects received funding: 44 gas and electricity infrastructure projects, nine offshore wind projects and six carbon capture and storage projects.

The EU's Research and Innovation Programme Horizon 2020 is providing EUR 5.931 billion in funding towards energy projects between 2014 and 2020. These projects aid in the creation and improvement of clean energy technologies such as smart energy networks, tidal power, and energy storage. Previously, energy projects were funded by the 7th Framework Programme for Research and Technological Development (FP7), which ran from 2007 to 2013.

The European Commission's Innovation and Networks Executive Agency (INEA) officially started its activities on 1 January 2014 in order to implement the Connecting Europe Facility (CEF) and parts of Horizon 2020 related to **smart, green and integrated transport and secure, clean and efficient energy**, in addition to other legacy programmes. INEA is the successor of the Trans-European Transport Network Executive Agency (TEN-T EA), which was created by the European Commission in 2006 to manage the technical and financial implementation of its TEN-T programme. INEA's main objective is to increase the efficiency of the technical and financial management of the programmes it manages.

Managed by INEA, the Connecting Europe Facility is the EU's EUR 30.4 billion plan for boosting energy, transport, and digital infrastructure between 2014 and 2020. Under the CEF, EUR 5.85 billion is available for trans-European energy infrastructure projects such as gas pipelines, transmission grids, LNG terminals, gas storage, and smart grids. The European Commission has drawn up a list of 248 EU projects of common interest (PCIs) which may apply for CEF funding. This list is updated every two years.

The JRC organised a workshop on "Funding innovative low-carbon energy demonstration projects in the context of the NER 300 programme" in the margins of the 9th SET-Plan Conference in Bratislava, Slovakia on 30 November 2016. The aim of the workshop was to provide an overview of the current state of the NER 300 programme. Funded projects shared their experience with the audience and a panel discussed challenges and opportunities.

A study on "European Energy Industry Investments" has been prepared at the request of the European Parliament's Committee on Industry, Research and Energy (ITRE). The study provides an overall assessment of European investments in the electricity sector. It concludes by providing policy recommendations to facilitate the investments in the electricity sector that are needed to enable a transition to a low-carbon energy supply, while realising a fully integrated and interconnected electricity system, enhancing competitiveness and ensuring security of electricity supply.

In March 2017, the International Energy Agency (IEA) published the report "Perspectives for the Energy Transition - Investment Needs for a Low-Carbon Energy System," prepared at the request of the German government to provide input for the G20 presidency. The analysis looks at what would be required from the energy sector to limit the global temperature rise to well below 2°C.

The European Energy Research Alliance (EERA), founded in 2008, brings together more than 175 research organisations from 27 SET-Plan countries that are involved in 17 joint programmes. It plays an important role in promoting coordination among energy researchers in line with SET-Plan objectives and in technology transfer to industry. In addition, it has been directly involved in the 2016 SET-Plan target-setting process. It also delivered a new strategy plan for the Alliance up to 2020, where its contribution to the SET-Plan is clarified and where cross-actions between the 17 joint programmes will be fostered, in an attempt to better address the challenges of an integrated energy system.

General SET-Plan related news and activities from JRC/SETIS

On February 1, 2017, the European Commission published its Second Report on the State of the Energy Union. This report shows the progress made since the Energy Union Framework Strategy was adopted to bring about the transition to a low-carbon, secure and competitive economy. The Commission has committed to presenting these reports annually in order to address the key issues and steer the policy debate.

On February 17, 2017, EU Member States agreed on the Commission's proposal to invest EUR 444 million in priority European energy infrastructure projects under the CEF. The selected smart power and gas grid projects will contribute to achieving the Energy Union's goals by connecting European energy networks, increasing security of energy supply, and contributing to the sustainable development by integrating renewable energy sources across the EU.

The Joint Research Centre organised a Workshop on Investment Vehicles and Financial Instruments supporting Technology Transfer and Innovation in Belgrade on 1-2 March 2017, with a focus on financial instruments as support to innovation and tech transfer projects in the Western Balkans countries and in the Danube region in general.

Within the context of Smart Specialisation (S3), the 2017 Conference on Synergies between European Structural and Investment Funds (ESIF) & Horizon 2020 Research and Innovation Funding: The Stairway to Excellence (S2E), held in Brussels on March 8, 2017, aimed to raise awareness among relevant stakeholders of: (1) progress in exploiting synergies between Horizon 2020 and ESIF and (2) practical bottlenecks emerging when implementing the available tools for synergies between funds.

In 2016, the SET-Plan community agreed on ambitious targets in terms of its 10 R&I actions through a wide participatory process involving national governments, industry and research actors representing 16,700 entities under 154 umbrella organisations. The important progress achieved so far was captured in an Integrated SET-Plan progress report, 2016 edition, called "Transforming the European Energy System through INNOVATION".

Maros Sefcovic, the European Commission's Vice President in charge of the Energy Union, in his article "Energy Union is about re-inventing our economy" published in January 2017 on the Euractiv portal, writes that the Winter Package of Energy Union laws will be a turning point for clean energy. He argues that the spirit of the package goes further than clean energy or tackling climate change and it is also about economic transformation.

In the first quarter of 2017, the Joint Research Centre published a report on Monitoring R&I in Low-Carbon Energy Technologies, the aim of which is to present the methodology that SETIS applies for the evaluation of selected key performance indicators (KPIs) included in the State of the Energy Union report to measure progress in research and innovation (R&I) in Europe.

Recently, the Joint Research Centre published the JRC Wind Energy Status Report and the JRC Ocean Energy Status Report – 2016 Edition. These reports present the market status and the technology developments on these specific technologies.

Other reports published since the last SET-Plan update include an Assessment of potential bottlenecks along the materials supply chain for the future deployment of low-carbon energy and transport technologies in the EU and a report on EMHIRES dataset Part I: Wind power generation, which provides an innovative methodology for capturing local geographical information to generate meteorologically derived wind power time series at a high temporal and spatial resolution.

EUROGIA2020, the EUREKA Cluster for low-carbon energy technologies, organised a brokerage event in Dusseldorf, Germany on March 13, 2017 as part of Energy Storage Europe 2017. This event, supported by the National Research Council Canada, aimed to bring the Canadian energy industry together with its European counterparts to generate transnational energy technology projects.

In the context of the process towards a SET-Plan Integrated Roadmap and Action Plan, organisations (universities, research institutes, companies, public institutions and associations) involved in research and innovation activities in the energy field are invited to register in the European energy R&I landscape database, which aims at facilitating partnerships and collaboration across Europe. Registration is open to stakeholders from the EU and H2020 associated countries. Organisations are able to indicate their area of activity according to the energy system challenges and themes, as identified in the SET-Plan process towards an Integrated Roadmap and Action Plan. The database is publicly available on the SETIS website.

The SET-Plan Steering Group met on December 1, 2016, under the umbrella of the 9th SET-Plan Conference in Bratislava, Slovakia.

The last SET-Plan Steering Group meeting took place on March 8, 2017 in Brussels. The main discussion points were the Winter Package, Energy Union Governance, in particular its fifth dimension on Research, Innovation and Competitiveness, the link between the SET-Plan and the 'Accelerating clean energy innovation' Communications, and progress on the implementation on the 10 SET-Plan Actions.

Rémi Gruet

CEO of Ocean Energy Europe (OEE), **TALKS TO SETIS**

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The core objective of Ocean Energy Europe is to promote the development of ocean energy in Europe on behalf of your members. What are the main actions that you undertake in support of this objective?

With ocean energy, Europe has the opportunity to create a new, large scale industry, including jobs in the supply-chain and services industry as well as significant export opportunities. The ocean energy industry must work in partnership with the public sector to realise this vision, and Ocean Energy Europe (OEE) is the vehicle it uses to do that.

For example, we have been working with the EC, industry, Member States and regions on the Ocean Energy Forum's Strategic Roadmap which was discussed on 27 February by Commissioners Vella and Cañete at the Council of Energy Ministers.

Our aim is to help ensure public support has the maximum desired impact by aligning the needs of the industry with support from research calls, financial instruments, and regulatory frameworks designed by the European institutions. OEE also does this through initiatives like ETIP Ocean – the Technology & Innovation Platform for Ocean Energy – and the Ocean Energy Roadmap.

On the business side, OEE also organises a number of events putting members in the same room to network and create business opportunities.

In the recent Ocean Energy Roadmap, you highlight a number financing challenges that need to be overcome for ocean energy technologies to reach their full potential. What, in your view, are the main challenges facing the sector?

The big one is risk. All energy projects bear investment risks – market, technological and regulatory risks – all of which have a direct impact on project revenue. The greater the risk is, the greater the cost of financing the project or insuring the risk.

Ocean energy technologies are innovative, and at early stage of development. The data required to assess, measure, and ultimately prevent, cover or insure risks is still lacking and will only be gathered progressively, as more devices are put in the water.

Additionally, these technologies, unlike their fossil fuel counterparts, are inherently CAPEX-intensive: once you've built and installed the machine, you have paid the large share of your cost. This means that capital is needed upfront, rather than when kilowatts are being generated.

Combining this upfront CAPEX requirement, the unknowns linked to innovation, and today's difficult investment climate, means access to finance is challenging.

But great are the rewards: we estimate that the sector could install 100GW in Europe, accounting for around 10 % of electricity consumption, and producing off-sync with other sources of renewable energies. This will help stabilise the grid and make the system more predictable.

Are there phases of development at which the need for financing is more critically felt? Why is this and what can be done to rectify the situation?

The pilot farm stage is the most critical – after successful testing of full-sale prototypes – known as the "valley of death" of financing.

The larger investments needed at this stage stretch R&D budgets to the limit, and other financing instruments are required. Risks are still yet not fully understood at this stage, leaving a return gap for the level of risk.

Public support is essential to get past this stage and bring the technology to market. It requires specific support schemes which address this particular stage of development. Those should include both upfront investment support to meet ocean energy's high CAPEX requirements, as well as a medium-term revenue support to encourage device efficiency and provide market visibility.

NER 300 and InnovFin EDP are the EU's only schemes so far to target the pilot farm stage, though some design elements made them more complex to use than necessary. The NER 300 level of award though was in the right ballpark, ranging from EUR 20 million to EUR 78 million for successful ocean energy projects.

The recommended actions in the Ocean Energy Roadmap include a call to set up an Insurance and Guarantee Fund and Investment Support Fund. Can you tell us a little about what this will involve and what the objectives of the funds are?

The objectives of both funds are clear: reduce financial risk for project developers and improve access to finance.

An insurance and guarantee fund would help bridge the current gap between risks that turbine manufacturers are willing to take – e.g. a successful installation – and risks that financiers are happy to support.

The investment fund aims to provide more flexible finance and fits the financing needs of project developers. This means possibly providing access to different forms of finance – equity, debt, repayable grants. It will also mean being able to cater for the different financial requirements that projects might have.

Both of these funds are currently being discussed with the Commission and Member States to see if, how and when they can be implemented.

Has funding of ocean energy technology in Europe been sufficient to ensure European leadership in this area, or does more need to be done?

The private sector invested an estimated EUR 1 billion to bring the first machines to full scale development. At the same time, strong support for ocean energy research has helped make these companies global technology leaders. EU support has been instrumental in getting some of these concepts out of the labs and into the sea.

The real prize however is not technology leadership, but capturing a large share of the global market as it emerges – a market estimated to reach EUR 53 billion annually by 2050, according to the Carbon Trust. While Europe is the leader today, other countries such as China, the US and Canada are starting to invest as well, recognising the economic opportunity and the energy benefits.

The EU must therefore continue to invest in ocean energy if it is to translate today's leadership into export market success. Taking our foot off the accelerator now that we have functioning machines and the first farms in the water in the UK, France, Canada – the latter with 100 % EU technology – would only open the door to EU intellectual property and knowledge for Chinese companies.

As in rugby – a sport dear to most ocean energy nations – we have scored the innovation try, now we need to make sure we get the commercial conversion!

Rémi Gruet

Rémi is the CEO of Ocean Energy Europe (OEE), the industry body for ocean renewable energy in Europe. He is a leading EU authority on renewable energy and climate policy and has authored several reports on wind and ocean energy. He has spent a decade working in Brussels – initially as a Political Advisor at the European Parliament, then as Senior Advisor on Climate and Environment at the European Wind Energy Association (Wind Europe). Prior to this, he worked in business development in the private sector for 6 years. He has a BA in Economics and a Master's Degree in Environmental Management.

Connecting a future low-carbon Europe

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Europe's research networks play a crucial part in developing low-carbon technologies. This is because they connect ideas, efforts and expertise from all over the continent. The European Cooperation in Science and Technology (COST) framework funds networking activities organised as part of science and technology networks spreading across Europe and beyond.

Such networks, also known as COST Actions, have played an important part in advancing research and advising on low-carbon policies for over 30 years. These communities connect and coordinate research efforts all over Europe and beyond, filling in the gaps between technology and policy and helping low-carbon technologies reach the market. They connect researchers, government authorities, industries, SMEs and citizens alike.

Looking at the whole EU funding landscape, COST Actions cover a wide variety of science and technology topics and are meant to help experts get together and collaborate on issues they consider relevant to their field. They do so by organising activities to share and compare results and experiences: workshops, conferences, scientific exchanges, training schools or communications efforts engaging different audiences.

The driving factors of every COST Action are the challenges it identifies and needs to address, which highlight the very need for pan-European collaboration. Highly interdisciplinary, COST networks focusing on solutions for low-carbon technologies take a look at the bigger picture and engage specialists from different fields. They try to find common ground and propose ways towards low-carbon, smart cities and regions.

Most challenges are naturally technological. Researchers in COST Action StableNextSol, a network of more than 470 leading European and international experts from 35 countries and 22 companies representing the photovoltaic industry, are trying to understand the degradation mechanisms behind state-of-the-art Organic and Perovskite Solar Cells. Finding the causes for lifetime decay would eventually help build more stable and predictable devices for building integrated and outdoor applications. Organic and Perovskite Solar Cells are set to become a real alternative for next generation photovoltaics. Their lightweight, colourful and flexible characteristics make them adaptable to a wide range of applications and designs. Their biggest upsides are low production costs and high-power conversion efficiency, already around 22 %.

"*Besides their solvable stability and minor safety issues, a future challenge is integrating the technology into tandem structures with*

Silicon, CIGS or similar solar cell technologies. Tandem configurations enable the Perovskite solar cell to capture the blue and green photons in the solar spectrum, while the Silicon solar cell captures reddish light. This results in power conversion efficiency that can easily surpass the 30% mark", says Dr Monica Lira-Cantu, the Action's leader.

Retrofitting is another challenge identified by Action *Smart Energy Regions (Smart-ER)*. In order to enhance the energy efficiency of apartment buildings, network members presented case studies of passive retrofitting that would reduce energy consumption and CO_2 emissions by 65%. In order to make these solutions more attractive for owners, the network also recommends introducing municipal incentives and bank loans with lower interest rates, all of which would ease the financial burden.

By addressing the bigger issue of reaching a low-carbon approach at regional level, Smart-ER presented a series of essential actions for a faster transition to low-carbon European regions. The network recommends industry to go for bottom-up, demand-driven solutions to reduce carbon emissions, since these projects often happen at community level. Another solution would be engaging organisations that can drive change by negotiating with top-down decision-makers and encouraging grassroots initiatives. Other recommendations include simplifying procurement procedures, and improving communication so that policy-makers and the public better understand the importance of low-carbon solutions and reduce the fear of risk taking.

Improving existing materials used in energy efficient applications is another challenge that COST Actions are facing. In the case of bio-based materials for sustainable construction, their competitiveness raises the issue of durability at minimal maintenance costs. The conditions that such materials need to meet refer to their mechanical resistance, stability, fire safety, hygiene, health, the environment, use safety, noise protection and energy consumption. COST Action *"Performance of bio-based building materials"* addressed the issue by running a round robin test that collected material performance data in different climatic conditions. Because wood degradation is the most common reason for structural failures, network members also published guidelines for preventing the decay of wood and plant fibre, as well as focusing on how the material behaves in service. The correct use of bio-based materials is essential to achieving the required service life and performance. The Action will lead to the publication of the book "*Performance of bio-based building materials*" in summer 2017.

Certainly, finding common ground is a crucial requirement to advance research, but it does not occur naturally. Networking activities in COST Action "*Hybrid Energy Storage Devices and Systems for Mobile and Stationary Applications*" helped achieve a common understanding of the requirements behind hybrid energy storage devices and systems used in transport and energy applications. The network developed a new type of hybrid energy storage device by combining Li-Ion and traditional batteries with supercapacitators. The Action also identified innovative materials, ways to improve existing materials used in building energy storage devices, and new approaches for developing hybrid intelligent energy storage devices.

Looking at the citizens' role in implementing evidence-based policies, network *WINERCOST* is focusing on social acceptance as a main hurdle. Researchers in the network started off by gathering existing expertise in offshore and onshore wind energy. Now they are developing ways to transfer that know-how and technology into the built environment. Their networking activities are intended to communicate and encourage policy-makers (mayors and other local authorities) and citizens to accept and invest in Built environment Wind energy Technologies (BWT). This dialogue involving the public, local decision-makers, industry and research will also help the network overcome the other issues – structural, noise levels, high costs, or unclear regulation. Network participants have also started evaluating government policies in various European countries, and the way these policies help strengthen citizens' acceptance of zero-carbon technologies.

"What the future holds is a mix of emerging and existing technologies – a hybrid solution, actually", says Dr Evangelos Efthymiou, member of WINERCOST. Understanding where we can use these technologies and their impact on our quality of life is key to a low-carbon Europe.

Andreas Boschen

Head of the Connecting Europe Facility (CEF) Department at the Innovation and Networks Executive Agency (INEA)

TALKS TO SETIS

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Energy is one of the three target sectors of the Connecting Europe Facility (CEF). What funding opportunities are available for energy projects under the CEF and what do projects need to do to access this funding?

The Connecting Europe Facility in the field of energy (CEF Energy) provides funding to infrastructure projects in electricity, natural gas and smart grids with the aim to better interconnect energy networks towards a single energy market in Europe. The programme supports the key objectives of the Energy Union by promoting further integration of the internal energy market, enhancing security of energy supply and integrating energy from renewable sources into the network. To support these objectives, the EU has made available a total budget of EUR 5.35 billion for energy projects for the period 2014-2020, of which EUR 4.7 billion is to be allocated through grants managed by the Innovation and Networks Executive Agency (INEA).

The CEF Energy programme co-funds actions that are either studies or works. The CEF funding cannot exceed 50 % of the total cost of the action. This funding rate may be increased up to 75 % in cases where the action provides a high degree of regional or Union-wide security of supply, strengthens the solidarity of the Union, or comprises highly innovative solutions.

To be eligible for financial support under CEF, actions must be identified as projects of common interest (PCIs). PCIs are key energy infrastructure projects that are essential for completing the European internal energy market and for reaching the EU's energy objectives

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of affordable, secure and sustainable energy. The first Union-wide list of PCIs in the energy sector was adopted in 2013, and since then it has been updated every two years.

Some examples of studies that can be funded through CEF include: feasibility studies, cost-benefit analysis related to a PCI, FEED (Front-End Engineering Design) of a project, onshore or offshore (subsea) routing surveys, environmental impact assessment (EIA), detailed engineering studies, preparation of documents necessary for the issuing of permits and other preparatory activities. On the other hand, works that can be funded by CEF are defined as all activities related to the physical construction of the PCI, e.g. laying of a gas pipeline or constructing of a substation.

How does CEF Energy funding differ from other funding mechanisms? Are there specific funding gaps that you aim to address?

Upgrading and developing energy transmission infrastructures in Europe requires investments of about EUR 140 billion in electricity and at least EUR 70 billion in gas. The vast majority of these investments are meant to be financed by the market, mainly through the regulated transmission tariffs. However, some energy projects are not commercially viable and would therefore not be implemented despite the fact that they provide important socio-economic benefits at regional level. This is typically the case for certain interconnectors. CEF is engineered to address the gap between the socio-economic value at regional/European level (including security supply) and the commercial viability for single promoters. The energy regulators play an important role in this calculation and in the apportionment of costs of cross-border projects.

What has been the focus of previous CEF Energy calls for proposals and how will these projects contribute to Europe's low-carbon objectives?

Previous calls supported projects focusing on the following objectives: security of supply, ending energy isolation, eliminating energy bottlenecks and completing the internal energy market.

In the electricity sector, actions funded through CEF also aim to better integrate renewables in the energy market. By supporting the development of major interconnectors, the CEF will contribute to

better dispatch and complementarity possibilities for the production and consumption of electricity produced from renewable intermittent sources. This is particularly important in the North-Sea region (interconnections Norway-UK, UK-France, Ireland-France…). The CEF also provided means to help EU Member States end their energy isolation, e.g. CEF co-funded electricity lines between Lithuania and Poland, Latvia and Estonia. Finally, CEF Energy is contributing to the completion of the internal energy market, e.g. the interconnection between Spain and France.

In the field of natural gas, the main focus was on projects relating to security of supply in the Baltic region and in Central and South-East Europe. The most important grants were awarded to the Poland-Lithuania gas interconnector (GIPL), to the Estonia-Finland gas interconnector and to the Romanian part of the Bulgaria-Romania-Hungary-Austria interconnection. Other CEF-funded actions contribute to projects that enhance the interconnections between EU Member States (e.g. Poland-Slovakia, Estonia-Latvia), open up new gas supply routes and sources (e.g. the Trans-Anatolian Natural Gas Pipeline (TANAP) and the Trans Adriatic Pipeline (TAP) or end the energy isolation of Member States and regions (e.g. Malta, Cyprus).

In addition, last year INEA launched a EUR 40 million call for proposals to support synergies between the transport and energy sectors. The selected synergy actions will contribute to the following specific objectives: increasing competitiveness by promoting further integration of the internal energy market and the interoperability of electricity and gas networks across borders, supporting projects promoting the interconnection of networks in the EU Member States; removing internal constraints; decreasing energy isolation; increasing the interconnectivity in electricity and achieving price convergence between the energy markets; and finally ensuring sustainable and efficient transport systems, by supporting a transition to innovative low-carbon and energy-efficient transport technologies and systems, while optimising safety.

What calls or funding opportunities related to low-carbon technologies are foreseen for the future?

It is expected that there will be at least one CEF Energy call for proposals every year during the rest of the financing period until 2020. The next one is expected to be published in April 2017 with deadline for submission in October this year. All information will be made available on INEA's website.

In addition to CEF funding, there have been a number of recent Horizon 2020 'Secure, Clean and Efficient Energy' calls related to 'Competitive Low-Carbon Energy'. How does the focus of these calls differ from the CEF and what type of projects may potentially be funded?

Horizon 2020 (H2020) is the European programme that supports research and innovation. In the energy field, the programme makes funding available to projects covering all the lifecycle of technology development except deployment. In practice, H2020 supports projects across basic research, applied research, prototyping, piloting and finally demonstration. Projects that can be funded under H2020 develop, for instance, improved renewable energy generation methods, smart electric grids or new technologies for CO_2 capture and storage.

An example of synergies between H2020 research actions and CEF deployment efforts can be found, for example, in the field of energy storage. Underground compressed air energy storage technology has been demonstrated (reaching TRL7) at Megawatt scale (MW) project under H2020. This technology is now being deployed in a much larger scale (several hundreds of MW) in Europe with the support of the CEF programme.

Further low-carbon energy calls can be anticipated under the Secure Clean and Efficient Energy calls in the Work Programme 2018 – 2020. Details will be given on the EC Participant Portal.

Andreas Boschen

Andreas has been leading the Department for the Connecting Europe Facility at the Innovation and Networks Executive Agency in Brussels since July 2014. His teams manage EU financial support to infrastructure projects in the areas of transport, energy and telecommunications. After beginning his professional career as a diplomat, he has been an official of the European Commission since 1998.

EUROGIA 2020 – labelling projects for funding success

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EUROGIA 2020 is a cluster of the EUREKA network, an intergovernmental network set up back in 1985 to facilitate innovation and to provide a platform for international cooperation in research and development. The network supports market-oriented international research, development and innovation projects and facilitates access to finance for companies. Since it was set up, EUREKA has mobilised a substantial amount of public and private funding in support of research and development in a wide range of areas, and has launched innovative products, processes and services onto the market, creating additional turnover and jobs for European companies, both small and large.

There are EUREKA clusters for a range of technological sectors, including IT and communications, water management, and manufacturing. EUROGIA 2020 is EUREKA's European-based industrial cluster that supports innovative, industry-driven, pre-competitive research and development (R&D) projects in the area of low-carbon energy technologies. The main objective of the cluster is to facilitate the deployment of existing technologies and support the development of highly innovative new technical solutions. To do this, it encourages cooperation and coordination among European companies.

EUROGIA 2020 does not fund projects directly - funding is granted via EUREKA countries' national programmes. A EUROGIA label, nevertheless, is a seal of quality that makes projects more attractive to public funding and venture capitalists. The EUROGIA label acts as a quality label for RD&D projects in the field of low-carbon energy technologies. The label is granted after a rigorous evaluation by a panel of world-class industrial and academic experts. It guarantees that the project is technically sound, innovative, well-planned and organised and is likely to lead to a commercial product or service that will positively impact the world energy system.

Helping ideas become reality

Although the label is very selective, the goal of EUROGIA 2020 is to help important project ideas become reality. This is helped by an interactive evaluation process - the Technical Committee and the EUROGIA 2020 office provide feedback to the projects to assist them in meeting the stringent criteria. However, despite the stringency of the evaluation, the label does not automatically guarantee public funding. The Eureka Member Countries have the final say on public funding in their territories, based on national policies, priorities

and constraints. However, the label facilitates access to this funding, particularly in the 20 countries that support EUROGIA 2020,[1] as these have made a commitment to view the national funding applications of labelled projects favourably. Successful funding is helped by the fact that representatives from the public authorities of supporting countries (E20PAC) liaise closely with EUROGIA 2020 throughout the evaluation process. Growing recognition of the EUROGIA label also facilitates access to regional public funding and to private funding, from venture capital to bank loans, in addition to acting as a link to interested customers.

Labelled projects cover a wide range of technological sectors, from cogeneration, fuel cells and solar power to energy storage, biofuels and wind energy. Energy efficiency is the most labelled technology segment, with projects in the Netherlands, Turkey and the United Kingdom. An example of one such project is BCP-HE in the UK. The main objective of this project is to develop an innovative boiler circulating pump and heat exchanger system, with improved performance and efficiency and reduced costs, to support the next generation of Ultra Super Critical Coal Power Plants. In addition, the technology being investigated as part of this project will open the door to new opportunities with the power generation sector, including the oil and gas market and the renewable markets.

Another labelled project, this time dealing with cogeneration, is the Biogaman project in Spain. The main objective of this project is the design, construction, operation and commercialisation of a technically and economically viable biogas plant for small agro-industries and farms. The project's focus is on microCHP plants, with power below 50 kWe. The innovation of the project is based on the use of alternative technologies for these small plants. Small biogas plants are an interesting solution for areas where electricity supply and transportation are limiting factors for the development of agro-industrial SMEs.

Dates for future applications

The next cut-off date for EUROGIA 2020 applications is May 26, 2017. To be eligible, the projects' participants must be organisations from a EUREKA Member Country. The applying consortium, which should comprise at least two large, small or medium-sized industrial enterprises from two different EUREKA member countries, submits a project proposal to EUROGIA 2020 for technical evaluation. EUROGIA 2020 projects must clearly show technical innovation in the future product/process or service (either through using new devices or in the utilisation of existing devices in a new application). The project must have a strong market and exploitation orientation. The contribution from any one country must not exceed 66 % of the total budget. Likewise, the contribution from any one partner (affiliated organisations count as one partner) must also not exceed 66 % of the total budget.

Even when not made mandatory, the active participation of research institutes or universities is strongly encouraged. Although EUROGIA 2020 does not exclude any consortia that meet the criteria for the quality label, experience has shown that the right combination of large enterprises, SMEs and research institutes often enhances the benefits of collaborative projects. Large enterprises bring their knowledge of international business requirements, a world-wide market base for the commercialisation of products resulting from collaborative RD&D projects, and a critical mass to support project management and administration. On the other side, SMEs bring their highly focused know-how and capacity in developing enabling technologies, their local market knowledge, and the required flexibility in terms of available resources and competences.

Eurostars

EUROGIA 2020 also benefits from the activities of its parent organisation. One such activity is the Eurostars programme, a joint programme dedicated to SMEs involved in R&D. The programme is co-funded from the national budgets of the 36 Eurostars countries and by the European Union through Horizon 2020, with a total public budget of EUR 1.14 billion for 2014-2020. Eurostars has been carefully developed to meet the specific needs of SMEs. It is an ideal first step in international cooperation, enabling small businesses to combine and share expertise and benefit from working beyond national borders. There are hundreds of international projects led by R&D-performing SMEs from Eurostars participating states and partner countries. Thanks to the programme, organisations of all types from across the globe are receiving government and European Commission support to improve their performance and focus on world-class, market-oriented research and development.

1 Austria, Canada, Croatia, Czech Republic, Estonia, France, Germany, Greece, Hungary, Iceland, Israel, Monaco, Netherlands, Norway, Poland, Portugal, Spain, South Africa, Turkey and the UK in collaboration with other EUREKA Member Countries.

Monitoring investment in Energy Union Research, Innovation and Competitiveness priorities

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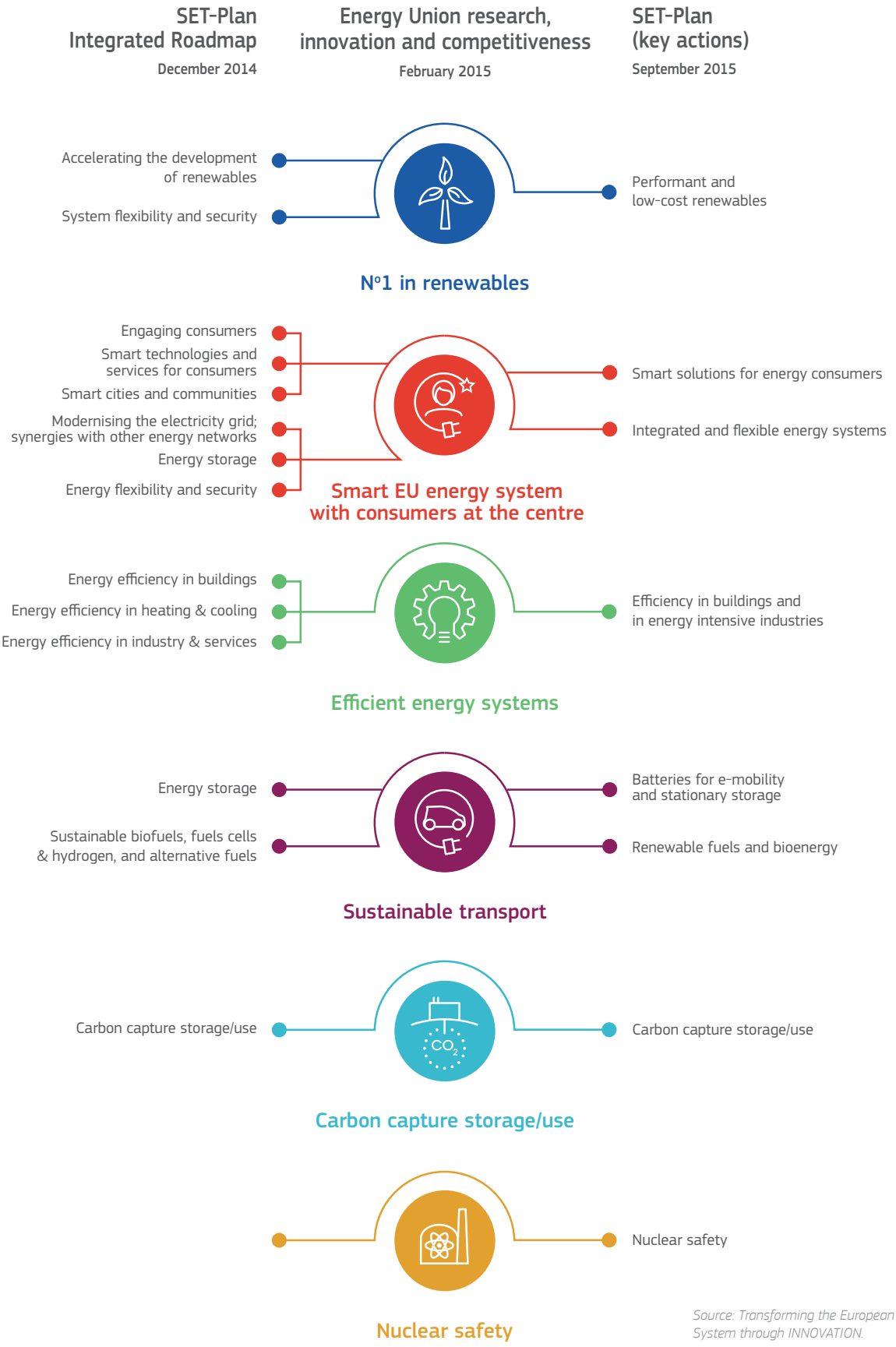
The Energy Union framework strategy, COM(2015)80, has called for an integrated governance and monitoring process to ensure that energy-related actions at all levels, from European to local, contribute to the Energy Union's objectives. This, inter alia, includes improved data collection, analysis and intelligence mechanisms that pool the relevant knowledge and make it easily accessible to all stakeholders; and an annual reporting on the state of the Energy Union to address key issues and steer the policy debate. Furthermore, in its Communication 'Towards an Integrated Strategic Energy technology (SET) Plan: Accelerating the European energy system transformation', COM(2015)6317, the European Commission proposed to develop a set of key performance indicators (KPIs) in order to measure progress in research and innovation (R&I) in Europe. This task was assigned to SETIS, the Strategic Energy Technologies Information System. SETIS manages and operates the monitoring and reporting scheme that supports the implementation and continuous development of the Strategic Energy Technology Plan (SET-Plan), through a more diligent and intelligent use of available information, data and reporting practices by stakeholders and Member States.

The JRC SETIS R&I team monitors and reports two relevant KPIs that have been identified in the Integrated SET-Plan Communication and have been included in the first, SWD(2015)243 and second, SWD(2017) 32, State of the Energy Union reports:

- the level of investment in Research and Innovation in terms of both private (expenditure by businesses and industry) and public (Member States' national programmes and instruments) investments;
- trends in patents in the relevant technologies.

These indicators are produced with various degrees of geographical and thematic aggregation. Figure 1 shows the links between the Energy Union R&I and Competitiveness priorities, the 10 SET-Plan actions and the SET-Plan Integrated Roadmap. These define the levels of reporting addressed by JRC SETIS. For example, figures can be computed at Member State, EU or global level and addressing the Energy Union priority of becoming Nº 1 in Renewables, the corresponding SET-Plan Action for performant, low-cost renewables, or a particular technology such as wind energy.



Source: Transforming the European Energy System through INNOVATION.

Figure 1: The Integrated SET-Plan Structure, representing the links between the Energy Union R&I and Competitiveness priorities, the SET-Plan Integrated Roadmap and the 10 SET-Plan Actions.

As already mentioned, the resulting indicators provide input to the Annual State of the Energy Union Report, the SET-Plan implementation, where SETIS reports as required in agreement and collaboration with the Member States, and briefings and working documents on EU Energy Research and Innovation.

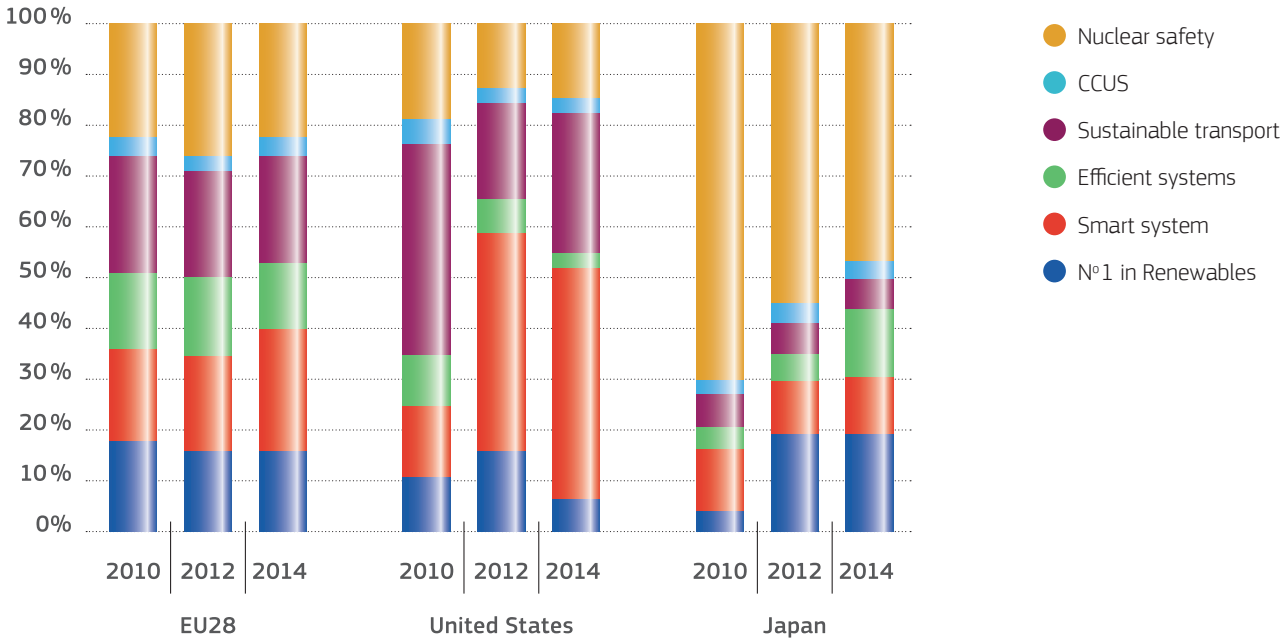
Monitoring of research and innovation efforts in the field of energy in general and low-carbon technologies in particular is made difficult by a lack of data. Relevant statistics tend to have a two to four year delay and may be differ in how they are thematically organised. This provides additional challenges and introduces an interesting debate about the use of best estimates for policy support.

In order to make the work of SETIS on these KPIs fully transparent, with regards to both data and methodology, JRC SETIS has recently published the JRC Science for Policy Report "Monitoring R&I in Low-Carbon Energy Technologies". The report provides the necessary theoretical background and addresses key conceptual and operational points that are important for the interpretation and use of these results in the policy debate, such as the timing of data availability, information sources, methodological caveats etc. This allows stakeholders to review both the methodology used and the outcome, and it is also meant to trigger feedback to the JRC that will lead to the further improvement of data collection, processing and evaluation mechanisms. The main sources of data, as further analysed in the report are:

- Public R&I investment data from the International Energy Agency RD&D statistics, supplemented by feedback from the Member States through the SET-Plan Steering Group and/or through targeted data mining by JRC SETIS.
- Private R&I investments that are calculated by JRC SETIS using patent statistics and published financial company statements, using a methodology developed by the JRC.
- Patent statistics that are also constructed by JRC SETIS using the Worldwide Patent Statistical Database created and maintained by the European Patent Office (EPO) as a source, and following the in-house methodology for data clean-up and processing.

A summary of first messages from the monitoring of the above indicators as well as some sample graphs (*Figure 3 - Figure 5*) are provided in this article. More extensive analysis covering the full spectrum of Energy Union R&I priorities, SET-Plan Actions and technological areas, as well as a summary of RIC indicators per Member State can be found in the forthcoming JRC Science for Policy Report "R&I financing and patenting trends in the EU".

Figure 3: Relative share of national R&I investments in Energy Union R&I priorities for the EU and major economies.

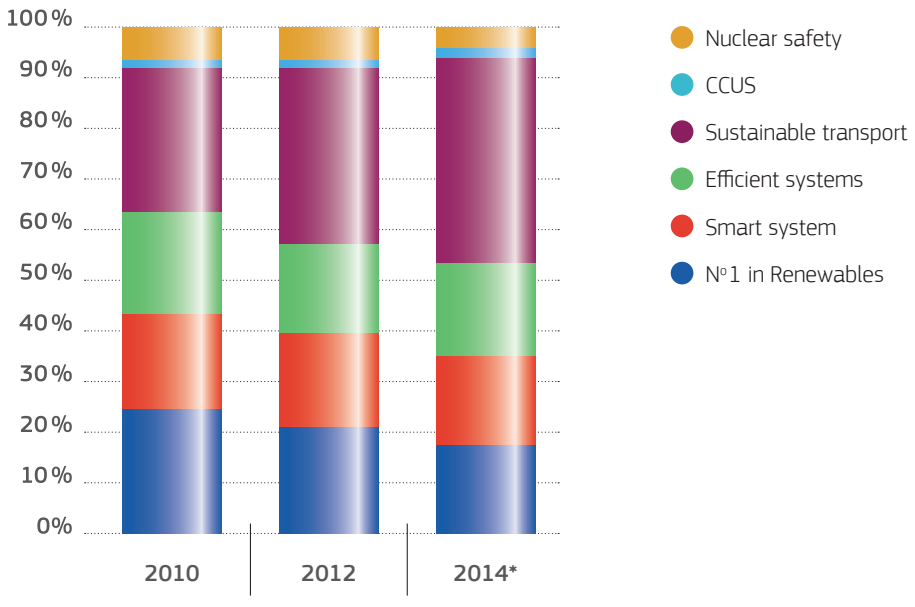


Data source: JRC SETIS, IEA

Messages for EU Energy Research and Innovation

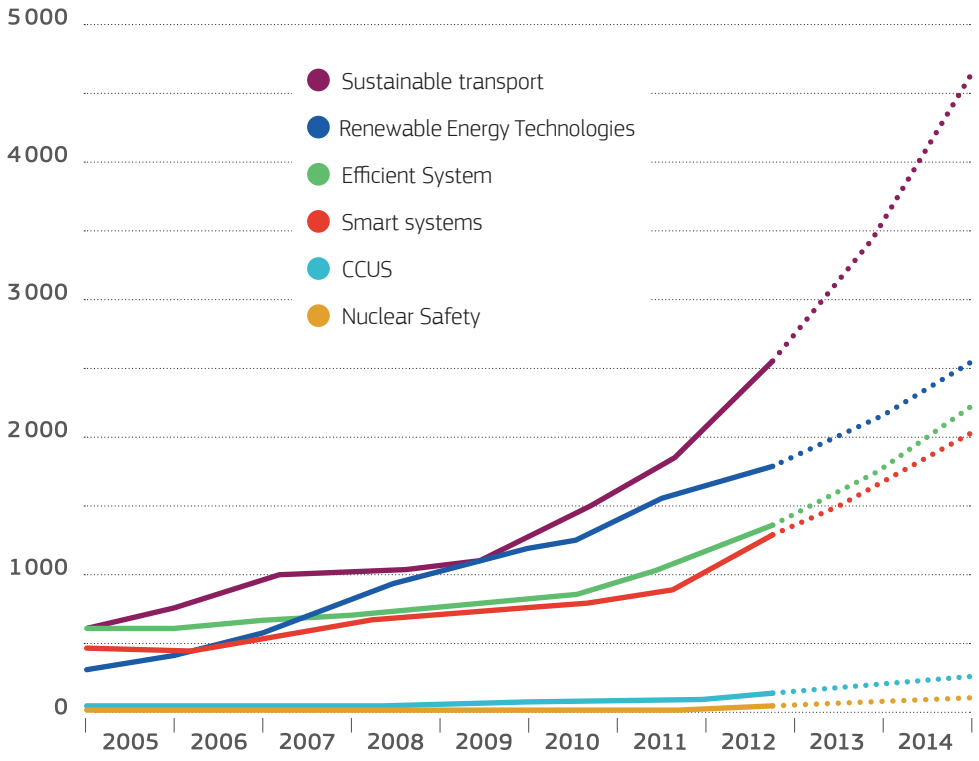
- In the EU, public R&I investment at national level has decreased slightly both in absolute terms and as a share of the GDP.
- Apart from an increase in the focus of national programmes towards a smart energy system (the only topic where national investment has increased), the allocation of national funds across the priorities has remained relatively stable in the EU relative to other developed economies. For example, in USA and Japan the shift in focus has been more pronounced.
- The share of national R&I investments in Energy (excluding European Union funding) in the total public R&D spending at EU level is half of that of the USA and Japan.
- Investments by the private sector have been increasing, and are the driving force behind research and innovation in most Energy topics. Private investment has provided over three quarters of the total R&I budget over the last few years, with a continuously increasing contribution.
- The sustainable transport sector draws the majority of the private investments in Energy Union R&I priorities – over 40 % in recent years. As private investment forms the majority of the total R&I budget, the same sector also receives the highest share of total funding. Renewables, smart system and efficient systems follow on a par.
- Renewables and nuclear safety are the two areas where private – and as a consequence total – R&I investments have decreased.
- There has been a significant increase in patenting activity worldwide. EU efforts have increased at the same rate as those of Japan, the USA and South Korea. However China has emerged as the global leader in patent applications.
- The EU had been leading in number of patents in certain areas of renewable energy but trends show that it is about to lose this advantage to China.
- Sustainable transport is the R&I priority with the highest number of patents filed per year and the Energy Union priority with the highest rate of increase in patenting activity.

Figure 4: Relative share EU total R&I investment in Energy Union R&I priorities.



Source: JRC SETIS

Figure 5: EU Patenting trends in the Energy Union R&I priorities.



Source: JRC SETIS

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SETIS
Information For Decision-making

Authors: The JRC SETIS R&I team is part of the Knowledge for Energy Union Unit of Directorate C – Energy Transport and Climate of the European Commission's Joint Research Centre.

Diego Pavia

CEO of InnoEnergy, **TALKS TO SETIS**

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Tell us about InnoEnergy, your vision and core objectives, and how you go about achieving these objectives?

At InnoEnergy, we have a big challenge, yet a simple goal – to achieve a sustainable energy future for Europe. I am convinced that innovation is the solution. We promote innovation by bringing together ideas, products and services that challenge the status quo, along with new businesses and new people who will deliver them to market.

What's unique about InnoEnergy is that we support and invest in innovation at every stage of the 'journey' – from classroom to end-customer. We do this by working with our network of partners across Europe – ultimately bringing together inventors and industry, graduates and employers, researchers and entrepreneurs, businesses and markets.

To summarise, we work in three areas:

- Our education offering creates an informed and ambitious workforce that understands the demands of sustainability and the needs of industry. Applications to our Master's School are open now, for any future game changers out there!
- Our Innovation Projects business line brings together ideas, inventors and industry. By unifying these players, we can fast-track commercially attractive technologies – many of which are now delivering results to customers.
- In Business Creation Services, we support entrepreneurs and start-ups who are expanding Europe's energy ecosystem with their innovations.

Bringing these disciplines together maximises the impact of each, accelerates the development of market-ready solutions, and creates a fertile environment in which we can sell the innovative results of our work.

What are the key thematic areas that you target with a view to securing a sustainable low-carbon energy future?

Developing a sustainable energy sector is one of the biggest challenges facing Europe today – we must reduce carbon dioxide (CO_2) emissions, reduce costs in the energy value chain and ensure guaranteed security and safety of energy supply.

There is no single solution that will enable us to overcome these issues, which is why at InnoEnergy we work with entrepreneurs, innovators, industry and universities across eight thematic fields:

Clean coal and gas technologies: Coal, gas and their chemical derivatives still have a major role to play in creating a stable, long-term energy supply. We encourage innovation that will:

- Help reduce emissions of CO_2, nitrogen oxide, sulphur oxide and particulate matter;
- Make best use of biomass, waste and unconventional gases as well as fossil fuels;
- Support CO_2 capture and storage.

Energy efficiency: Reducing consumption at home and work is still the most cost-effective way to reduce carbon emissions and improve energy security and competitiveness. We encourage innovation in two areas that together account for more than 50 % of the EU's energy consumption, and at least 33 % of its CO_2 emissions:

- Energy efficiency in buildings;
- Energy efficiency in industry.

Energy storage: The way we generate, transmit and distribute power is changing. Energy storage has a vital role to play in the development of the smart grid. We encourage innovation in large and small-scale storage that will:

- Help integrate renewable energy into the grid;
- Enable a more dispersed and responsive distribution system;
- Improve stability across the grid.

Energy from chemical fuels: Chemical energy carriers, derived from converting or processing fossil fuels or biomass resources, can play a significant role in addressing the energy challenge. We encourage innovative solutions that:

- Upgrade and standardise fuels from different feed stocks;
- Enable these fuels to be used in combustion systems, power plants, distribution and storage chains;
- Improve fuel conversion processes for greater efficiency.

Renewable energies: Renewable energy sources play an essential role in reducing dependence on fossil fuels and creating energy autonomy. We encourage innovation that:

- Improves the production, penetration and profitability of renewable energy;
- Continues to develop all forms of solar technology;
- Improves reliability, accuracy and integration of onshore and offshore wind;
- Increases performance, lifespan and scalability of wave power.

Smart electricity grid: The electricity grid is showing its age. Increased use, intermittent generation sources, and new regulations are threatening its ability to deliver low-cost, safe and secure power supply. We encourage new solutions that:

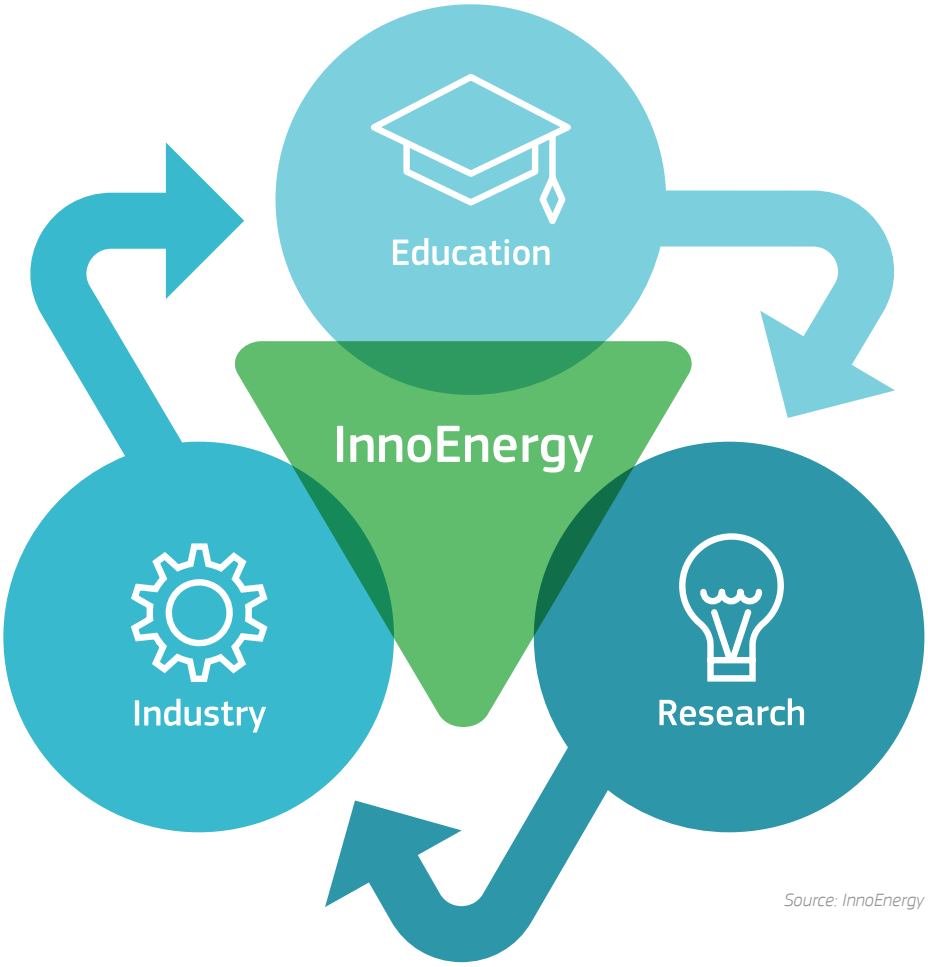
- Enable information, communication and analytics capabilities on a large scale;
- Support enhanced cyber-security and critical infrastructure protection;
- Increase control over intermittent sources of electricity.

Smart and efficient buildings and cities: 40 % of the world's energy is consumed in the built environment. Energy efficient buildings and cities are key to sustainable development. We foster innovation that:

- Enables energy positive homes and commercial buildings;
- Encourages energy saving behaviours at home and at work;
- Supports a smart and sustainable transport system.

Nuclear instrumentation: Nuclear power remains an important part of a sustainable energy mix, with 60 nuclear reactors under construction around the world. We support innovation in nuclear instrumentation that:

- Improves control and command systems, instrumentation and measurement to ensure reliability and performance;
- Enables materials, structures and radiation to be monitored under the most extreme conditions;
- Supports non-destructive testing and informs decision-making to prolong the life of reactors.



Source: InnoEnergy

How does the future look for low-carbon technologies in Europe? What are the main challenges that need to be overcome in order to mainstream these technologies?

In order to mainstream these technologies, we must consider a multidimensional approach.

- Regulation – we need to reduce the number of interventions in Europe, that will make us more competitive with the rest of the world. To achieve this, we are working closely with the EU by consulting and advising on the Winter Package.
- Societal appropriation – there is a lot of talk about energy targets, but as citizens, do we take our share of responsibility? Together with our partner network, we strive to educate consumers so that they can become an active, responsible, knowledgeable player within the energy value chain.
- Supply chain – currently Europe invests the majority of its funds into energy supply, but what about the demand side? It's the public administration that has the muscle when it comes to this challenge, namely public procurement. There are hundreds of ministries, hospitals and education centres that could be the first to adopt sustainable energy technology. So let's also encourage the public administration to adopt them.
- Value chain – by this I mean that the traditional top down approach to new business ideas, which has always been centralised by way of energy production, is gone. InnoEnergy is already working towards becoming a key enabler of this evolution through our Market Creator initiative where we build new business models for products or services that have previously failed on the market.
- Human capital – we need to feed the market with graduates that can change the game. This is what we strive for in our Master's School – and we are already seeing many of our graduates receive international acknowledgement for their contribution to the sustainable energy industry. For example, Allen Mohammadi, one of our ENTECH graduates, was recently listed on Forbes 30 under 30.

Lastly, it is fundamental that we coordinate all five dimensions with a systemic approach to low-carbon technologies – only then can we overcome the challenges that face the sector today.

You recently launched a sixth investment round for innovation projects. What opportunities are available under this round and what do applicants need to do to access these opportunities?

Taking a clean energy idea from a light bulb moment to a powering-the-light bulb moment takes money. But, for those of us who have tried, we know that financial investment alone won't get you there.

Our Investment Round, open until 7 April, is all about providing more than monetary support to help proven technology concepts change the future of the energy industry.

All projects supported by us have a solid business case and the consortium has at least one European partner. The uniqueness of this ecosystem provides projects with:

- Exclusive manpower to find complementary partners to develop their technology;
- Expertise in market analysis, business models, IP and industrialisation;
- A thriving supply side, for example our start-ups, and a thriving demand side (the early adopters and first customers of the product), many of whom are our partners;
- Reduced financial risk, an agreed ROI and ongoing actions to make sure their product is successful in the market.

It is a win, win, win situation – your success is our success, which contributes to a sustainable energy future for Europe.

For any businesses interested, I encourage them look at the application criteria and apply online at our dedicated website: https://investmentround.innoenergy.com/

What type of projects related to low-carbon technologies have you supported to date, and what has been the impact of these projects?

Since 2011, the Investment Round has successfully supported projects to raise EUR 1.3 billion, with InnoEnergy investing EUR 157 million and the remainder being funded by partner companies and investors. This has resulted in the creation of 299 partners across Europe, with 83 products now commercially viable and linked to EUR 3 billion in forecasted sales.

All of our projects fall within one of our thematic fields, some of which include: thermal chemical heat pumps from SolabCool; straw powered bio mass boilers from MetalERG; energy independent housing from evohaus; building-integrated photovoltaics from EnerBIM; proactive cyber-security management from foreseeti and wind turbine condition-monitoring systems from EC Systems – to name a few.

Diego Pavía

Diego graduated as electrical engineer, specialising in electronics and automation from the Polytechnical University of Madrid. His first professional experience, in 1988, was as co-founder and CEO of a start-up, Knowledge Engineering, dealing with industrial controls systems using artificial intelligence and neural networks. Three years later he joined SchlumbergerSema, where he headed multicultural working groups all over the world in the field of energy. Between 2002 and 2010, he was the CEO of Atos Origin, a leading international IT service provider. Diego has been CEO of InnoEnergy since 2010.

Solving the finance conundrum affecting innovative renewable energy technologies

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Ever lower renewable energy production costs are hitting the headlines on a regular basis. Technologies such as onshore wind and solar photovoltaics have gone through a lengthy path of gradual, but continuous, improvement and are today usually competitive against fossil-fuel based electricity sources, especially in areas where the resource conditions are optimal for the technologies.

But there are a myriad of other renewable energy technologies one or several steps behind on the commercialisation pathway, meaning they are much more costly or not yet even commercially available. If deployed at scale, these innovative technologies could also become cost-competitive in the future, potentially offering valuable services to the grid due to their dispatchability[2] capabilities (as is the case with concentrating solar power and geothermal energy), higher capacity factors (as happens with offshore wind energy[3] compared to onshore wind), or complementary generation profiles (an ocean energy farm, for example, will be more productive on a stormy day, whereas photovoltaic modules will produce considerably less due to the absence of direct sunshine).

Proving technologies at commercial scale leads to several other positive consequences: it greatly increases the potential for Europe to achieve its climate and energy targets, including energy security; it helps to unlock much needed private funding to deploy similar projects; and it supports the growth of a European industrial base that generates economic and social benefits. In addition, the diversification of energy production technologies allows countries to better exploit their indigenous sources and consequently to increase their share of renewables.

Despite their potential, innovative energy technologies covered by the Strategic Energy Technology Plan[4] face severe financing difficulties in progressing from innovation to successful demonstration and deployment – the so-called commercialisation "Valley of Death." A recent study commissioned by DG Research & Innovation of the European Commission shed light on the problem. The study, led by ICF in association with London Economics and completed during the autumn of 2016, concluded that current grant, debt and equity provision for these projects at EU and Member State level is around EUR 4 billion until 2020. The figure may seem high, but it is a far cry from the total estimated investment needs for such large-scale demonstrators, which could reach EUR 28.4 billion during the same period (see Table 1).

Data to underpin ICF's conclusions on the supply of funding was obtained through interviews with senior representatives from 29 market participants, including venture capital firms, asset managers, banks, sovereign wealth funds as well as energy utilities and engineering and industrial firms. Further consultations with 15 senior representatives from financial market participants were held to obtain additional insights and clarifications on some of the study's emerging conclusions and potential future support mechanisms.

Lack of funding is by far the main factor accounting for the inability of many innovative energy demonstration projects to reach a Final Investment Decision. However, other reasons conflate the challenge. For example, traditional investors in first-of-a-kind projects have either reduced their interest in this asset class for strategic reasons or else simply cannot afford to fund such projects off their balance sheet.

2 The power output of a *dispatchable* energy source can be increased or decreased (even turned off) at the request of power grid operators or of the plant owner.

3 Offshore wind has recently made great strides due to its record low cost of EUR 54.5/MWh in the Borssele auctions in the Netherlands.

4 Except nuclear energy, which is outside the scope of this article.

Moreover, the fact that several countries have dismantled support schemes guaranteeing electricity prices to producers (e.g. feed-in-tariffs, power purchase agreements) has introduced a significant commercial risk that makes banks much more reluctant to provide loans. Increasing regulatory and capital adequacy requirements imposed on banks and insurance companies have further reduced their willingness to take risk.

The study went on to detail the forecast financial structures[5] of 32 different energy projects in the low-carbon sectors identified above. The data gathered show that financing needs are complex and large variations in financing structures exist – even within sectors – due to different technologies, project scales, track record of sponsors, etc.:

- grants (i.e. public sector risk capital) play a very important role in many deal structures, with projects typically forecasting between 10-30 % of total funding or much higher amounts in some isolated cases;
- equity investment is forecast between 10-30 % of total funding in many projects, but is particularly high for several solar PV and ocean energy projects;
- debt requirements can be very large, varying from 10 % of total funding to more than 70 %. Mature sectors (e.g. fixed wind, solar PV) are typically able to raise higher debt levels, but the variation within the same sector and across sectors is considerable;
- bond finance and internal company financing is of limited relevance.

Despite the large funding gap affecting first-of-a-kind projects, there is currently an over-reliance on grant support across EU and Member State schemes – even though grants alone are clearly insufficient and projects typically require debt and equity as well. Most market participants consulted in the study felt that the European Commission should partially fill that gap by providing debt and/or equity support. Grant provision was still widely called for, however, both to support the feasibility and planning as well as construction phases of projects (when project risk is greatly elevated).

5 Projects in the ICF study were selected on the basis that they had yet to reach a Final Investment Decision and therefore could only provide a best estimate for the likely breakdown of their funding sources.

Table 1: Investment needs across selected innovative energy sectors covered by the SET-Plan

SET sector	Indicative project sizes (€ million)		EU FOAK project deployment needs to 2020		Indicative investment needs to 2020 (€ million)	Estimate of current unmet funding needs
	Min size of project	Max size of project	Min no of FOAK projects per sector	Max no of FOAK projects per sector		
Advanced energy networks	10	50	14	28	140 - 1 400	Medium
2nd generation biofuels	150	600	5	10	750 - 6 000	High
Bioenergy	8	100	10	20	80 - 2 000	High
Carbon capture and storage	500	1 400	1	2	500 - 2 800	High
Concentrating solar power	185	330	5	10	925 - 3 300	High
Geothermal energy	75	120	3	6	225 - 720	Low
Large-scale energy storage	15	350	5	10	75 - 3 500	Medium
Ocean energy	20	100	5	10	100 - 1 000	High
PV (generation)	35	50	5	10	175 - 500	Low
PV (manufacturing)	45	250	3	5	135 - 1 250	Low
Wind energy (fixed)	50	300	5	10	250 - 3 000	Low
Wind energy (floating array)	125	300	5	10	625 - 3 000	High
Total			**75**	**149**	**3 980 - 28 470**	

Source: ICF (2016), Innovative financial instruments for first-of-a-kind, commercial-scale demonstration projects in the field of energy. DG Research & Innovation. Available online on SETIS.

Aware of the "Valley of Death" finance gap, in June 2015 the European Commission and the European Investment Bank (EIB) launched the InnovFin Energy Demo Projects (EDP) facility. This financial instrument contributes to bridging that gap by supporting the commercial viability demonstration of first-of-a-kind innovative renewable energy projects. Support is provided through loans of between EUR 7.5 million and EUR 75 million. During a project's first four years, while it is not yet bankable (i.e. during the design, construction and early operation phase), the European Commission's Horizon 2020 R&I Framework Programme covers 95 % of any shortfalls. If this initial phase is successful, the project is deemed bankable, the Horizon 2020 guarantee is released (being recycled to fund new projects in the facility) and the project moves to the operational phase.

So far there have been 92 applications to InnovFin EDP with 59 projects identified as potentially suitable for support. Of these, one has been signed (see box), another approved by the EIB (signature will follow soon), and eight projects are currently being subjected to detailed technical and financial due diligence by the Bank. Nine applications have been rejected and seven put on hold, mainly on the grounds that the commercial risks of applicant projects is too high. After its initial warm up phase, InnovFin EDP seems now to be slowly entering cruise mode, with around half of the current funding envelope expected to have been disbursed by the end of 2017.

This success highlights the need to increase the current pilot allocation of EUR 150 million to InnovFin EDP. The European Commission is working towards at least doubling this amount by 2020, possibly by incorporating funds from other EU sources. Concurrently, based on the experience acquired so far, the Commission is working with the EIB to streamline the instrument and ensure that it is more agile and responsive to market needs – providing faster and more efficient support to high quality projects that unfortunately have found themselves trapped in the "Valley of Death."

First loan under InnovFin Energy Demo project provides EUR 10 million to harness wave energy

A first-of-a-kind 350 kW wave energy demonstration project has been the first recipient of a EUR 10 million loan provided in July 2016 by the InnovFin Energy Demo Project (EDP) facility. The total project cost is EUR 19 million. The Finnish company AW-Energy is expected to start assembling their WaveRoller device off the coast of Peniche (Portugal) this summer.

The project is a remarkable example of how continued efforts in R&I, whilst demanding both time and sheer ingenuity, can also bear fruit. The device consists of an underwater panel attached to the seabed on a hinge which moves back and forth as the waves surge past it. Hydraulic pumps attached to the panel drive a motor which, in turn, drives an electricity generator. The resulting power is taken ashore by an undersea cable.

The device story dates as far back as 1993, when the concept was first invented by a professional diver. It then took ten years for thorough tests to be performed with a grant from the Finnish Technology Fund. European Commission support started in 2012, when it funded an operational prototype of the technology as part the 'SURGE' project (under the 7th European Framework Programme for R&D, the predecessor of Horizon 2020).

If the WaveRoller demonstrator project under InnovFin EDP is successful, the global market potential for the WaveRoller technology is high – estimated at over 200 GW based on feasible sites. AW-Energy aims to sell over 50 units in the first four years of WaveRoller's operation.

Nuno Quental*

Nuno works as a policy officer in the field of energy for the Directorate-General Research & Innovation of the European Commission. His main duties are related to the Strategic Energy Technology Plan and to the risk finance instrument *InnovFin Energy Demo Projects*. Previously, he worked at the European Economic and Social Committee as Administrator of transport Opinions, in ICLEI – Local Governments for Sustainability as an EcoMobility Officer, and at the Porto Catholic University on projects dealing with sustainable urban development. Nuno holds a PhD in Territorial Engineering and a degree in Environmental Engineering.

* The author would like to thank the following for their input: Jonathan Lonsdale, Consulting Director of ICF, James Gardiner, Managing Consultant at the same company, Gwennaël Joliff-Botrel, Head-of-Unit "Energy Strategy" at the European Commission (DG RTD), and to Agustin Escardino Malva, Deputy Head of Unit "Renewable Energy Sources" at the same DG.

Horizon 2020 ERA-NETs in the SET-Plan: the experience to date

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The SET-Plan is a partnership at its heart: A continent-wide partnership between European governments, industry and research organisations in European countries and regions, and the European Commission. It is a partnership conceived to accelerate the energy transition by working together towards common goals. That is why public partnerships (P2Ps) and the concept of joint programming are crucial in trying to achieve the SET-Plan's objectives and, ultimately, in making the Energy Union a reality.

One of these objectives is to ensure that the various energy research and innovation funding programmes that exist in Europe are as coherent and complementary as possible, so that common interests and priorities are identified and duplicate efforts are avoided. To do this, it is necessary to build bridges and seek synergies between these programmes and to provide opportunities to collaborate for the people responsible for the programmes.

Horizon 2020 is one such programme. It is not only the main programme through which the European Commission supports the SET-Plan, but it also provides some opportunities to collaborate, through its joint programming instruments, such as ERA-NETs and European Joint Programmes.

Just over three years into the programme may be a good time to take stock of the experience so far with energy ERA-NETs in Horizon 2020.

Nine energy ERA-NET networks have been launched since the start of Horizon 2020, with another one under preparation. As a result, at least twenty joint calls for proposals have been, or will be, launched by participating countries, thereby extending the reach of EU and national research funding programmes. Creating ERA-NET networks is a complex and laborious process, so the fact that nine already exist after three years is an achievement in itself. More energy ERA-NET networks are likely during the second half of Horizon 2020, although the pace is expected to slow down in part due to saturation (considerable efforts were made to launch as many networks as early as possible to increase the chances of building long-term collaborations) and to additional conditions which will be introduced for networks launched from 2018 onwards.

The networks launched so far represent over EUR 311 million in public funding commitments for the period 2015-2021, including an EU contribution of over EUR 96 million. One of the difficulties experienced so far has been making the best and fullest use of these funds. This has not always been possible for a number of reasons. The main reason has been a consequence of a conscious policy choice to focus energy ERA-NETs in the first years of Horizon 2020 on funding demonstration projects. Although, according to feedback from some ERA-NET participants, this has resulted in projects going ahead that would not have seen the light of day otherwise. The higher financing volumes and risk levels have been a contributing factor in not having as many projects applying for funding through joint calls as was expected when the networks were being put together. For some technologies, sectorial circumstances have also played a part. And another cause, common to ERA-NETs across Horizon 2020 thematic areas, has been a limitation inherent in the design of the ERA-NET instrument itself when it comes to funds being used in the most efficient way. This limitation has led on occasion to gaps in evaluation ranking lists and to projects not being funded if participating countries had not put aside sufficient budget to support all

their national participants. All this has led to a shortfall in projects selected for funding and to some of the funds originally earmarked not being used. From 2017 onwards, however, the scope of energy ERA-NET topics has been widened beyond demonstration projects. From 2018, a budget reserve threshold will also be put in place to avoid ranking list gaps as much as possible. It is hoped that these measures will lead to a wider range and a higher number of quality projects being put forward.

On the other hand, this focus on demonstration activities has meant that ongoing ERA-NETs have been able to mobilise significant private funding for energy research and innovation: almost EUR 80 million for the joint calls concluded so far, which was 10 % higher than the public funding contribution. In other words, for every public euro spent funding projects through energy ERA-NET joint calls, the private sector has contributed €1.10. Encouraging private sector participation in SET-Plan activities is another fundamental principle of the SET-Plan. Considering that 85 % of energy research and innovation funding in Europe in 2014 (latest figures available) came from the private sector, the SET-Plan cannot succeed without substantial participation by private sector actors. Projects funded through ERA-NETs are showing success in this respect.

Beyond funding considerations, the main aim of the ERA-NET instrument in Horizon 2020, and of P2Ps in general, is to create a long-term collaborative environment for public funding organisations managing national and regional programmes in similar research areas, an environment which facilitates learning between funding agencies and capacity building. An evaluation of the ERA-NET instrument conducted last year highlighted that this has indeed been the main added value of the ERA-NET scheme so far. ERA-NET Cofund actions contribute to strengthening transnational cooperation and to creating a critical mass of resources to tackle EU societal challenges, including accelerating the energy transition. A particularly good example of this kind of cooperation specific to the Energy Challenge of Horizon 2020 has been the close involvement of the

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Joint Actions Working Group, a sub-group of the SET-Plan Steering Group led by SET-Plan countries, in developing and nurturing energy joint programming activities and ERA-NET networks.

It is too early, however, to assess whether these ERA-NETs have been successful or not in terms of effectiveness and impact, especially when it comes to increasing coherence between programmes. So far, only results from the first co-funded calls for the three ERA-NETs launched in 2015 are available, and the projects being funded as a result are only starting now. Last year's evaluation across all thematic areas concluded that ERA-NET Cofund actions are not yet sufficiently perceived as strategic instruments that can influence national strategies and lead to an alignment of national policies and EU R&D policies. This remains a priority objective of the Energy Union and the SET-Plan, so additional efforts will be needed to increase coherence and alignment between programmes by the end of Horizon 2020. The Implementation Plans being developed by 15 SET-Plan Temporary Working Groups will eventually contain a common set of priority actions shared by European governments, industry and research organisations and will therefore offer a great opportunity to achieve this objective. This should be an important consideration in moving forward with energy P2Ps and the SET-Plan.

Luis Valentin Miguel del Bosque

Luis is a policy officer at the European Commission's Research and Innovation Directorate General, working on matters related to energy research, strategic planning and joint programming. Before joining the Commission in 2007, he lived, studied and worked in the education sector in the UK for 12 years, after moving there from Spain as an Erasmus student. He holds a degree in History of Art and a foundation degree in IT.

Nicolas Merigo

CEO of Marguerite Adviser S.A

TALKS TO SETIS

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Tell us about Marguerite, its objectives and the motivation behind the setting up of the fund.

Marguerite, also called the 2020 European Fund for Energy, Climate Change and Infrastructure, was established in 2010 with the backing of six major European financial institutions, which committed EUR 100 million each. These are Caisse des Dépôts et Consignations (France), Cassa Depositi e Prestiti (Italy), Instituto de Crédito Oficial (Spain), Kreditanstalt für Wiederaufbau (Germany), PKO Bank Polski SA (Poland) and the EIB. Three further investors, including the European Commission, have added an incremental EUR 110 million to the Fund, bringing the total commitments to EUR 710 million.

Marguerite's mandate is to makes equity investments in new infrastructure projects in EU 28 countries. The Fund operates like a traditional infrastructure fund and seeks commercial returns, but pursues the following policy-driven objectives:

- Combat climate change and contribute to implementing the EU's 20-20-20 climate and energy targets: this covers investments in renewables energy projects like onshore and offshore wind, solar, biomass, geothermal, etc.
- Make a significant contribution in the development of transport Trans-European Networks (TEN-T): this covers infrastructure assets such as motorways, airports, seaports, etc.
- Enhance the security and independence of energy supply of EU Member States: electricity and gas interconnectors, storage, etc.
- Contribute to the deployment of the best possible internet connection by investing in telecommunication networks projects, mostly fibre optic networks.

So far, Marguerite has invested in twelve projects across nine countries, comprising over EUR 5 billion in project size.

How does Marguerite differ from other infrastructure funds – are there specific funding gaps that you aim to address?

The Fund's strategy is to take minority equity participations alongside strategic partners such as project developers and operators and to focus on situations with limited competition with traditional infrastructure funds, therefore filling an equity gap. This is done by targeting sectors, countries, or project stages that are outside the focus of mainstream funds. Our higher risk appetite is compensated by prudent forecasting and a structuring approach to restore an attractive risk return balance. In the renewables sector this largely involved entering the offshore wind market at a time when other investors were only looking at onshore wind.

Marguerite's role on Alsace's fibre optic FTTH network and Poznan's waste to energy projects was referred to by the market as a "pathfinder", and indeed we have opened new markets for financial investors. Thanks to its long term approach, Marguerite is also able to invest in countries judged to be riskier by most infrastructure investors at a certain point in time.

Finally, Marguerite can act on certain transactions as an anchor investor, such as the Butendiek project, for which Marguerite's role has been to help attract equity for the construction of the project.

Energy and renewables are among your core sectors – tell us about projects that you have funded in this area.

In the energy sector, Marguerite invested in 2016 in Latvijas Gāze the Latvian vertically integrated gas operator. Latvijas Gāze operates and maintains the Latvian gas transmission and gas distribution pipelines as well as the Inčukalns underground gas storage facility, the third largest storage facility in the EU and a strategic asset for the security of gas supply in the Baltics. The company has a significant ongoing capex program and sponsors projects that will improve the regional security of gas supply.

In the renewables sector, Marguerite is very active in the offshore wind sector with two investments to date in the financing of the construction of offshore parks in Belgium (C-Power, 326 MW, with Innogy, EDF, and DEME) and Germany (Butendiek, 288 MW, with WPD).

In solar, Marguerite invested in the construction of a portfolio of utility scale PV projects in France with the Toul and Massangis projects.

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At the time of its construction, Toul was Europe's largest PV project contributing significantly to the development of this sector in France. Marguerite's industrial partner on these projects is EDF Energies Nouvelles, which developed, built, and now operates the projects.

Marguerite is also present in the onshore wind sector in Eastern Europe, with 180 MW of projects built across Poland and Romania.

Finally, Marguerite invested, with Sita, in the first Energy from Waste Public Private Partnership (PPP) project in Poland. It covered the financing, design, construction and operation of a municipal waste incineration plant with a capacity of 210,000 tons per year. It allows the City of Poznań and the surrounding area to implement its waste management plan in local landfills, in accordance with the EU Landfill Directive and Poland's Waste Law.

What, in your view, are the main obstacles to the funding of low-carbon technologies and what needs to be done to overcome them?

One particularity of investments in low-carbon technology projects is the fact that, for most technologies, the business case relies on subsidies being paid over their economic life. Cost saving on equipment, construction and operation is therefore the main lever to ensure these technologies can be deployed to a level where it can have a significant impact on carbon reduction and offer a true alternative to carbon intensive production sources.

Another element, that we are starting to see on our assets, is the fact that the penetration rate of renewables projects on the energy mix is putting downwards pressure on market prices, due to the fact that these projects usually have a marginal cost that is nil. This in turn lowers the attractiveness of further investments in this sector: market design needs be updated to take into account this new generation mix.

Ensuring the adaptability of the grid to this intermittent supply will also allow for a greater growth of the renewables sector. This implies investments in further interconnections and storage which is part of Marguerite's strategy.

With respect to low-carbon technology, are there any areas where the need for funding is greater than others, or areas that should be prioritised for future funding?

The focus so far when it comes to low-carbon technologies has been on electricity. We believe renewable gas, or green gas (also called biomethane), offers great benefits, beyond its low-carbon feature. Biomethane projects produce methane from the fermentation of agricultural or industrial waste and inject it into the grid. We believe this technology deserves further support as it integrates the goals of security of supply, sustainability, waste management and local competitiveness.

Furthermore, E-mobility solutions (e.g. charging infrastructure) are at an early stage of development and will require funding support before being attractive to mainstream investors.

Nicolás Merigó

Nicolás has over 25 years' experience in private equity, M&A, and asset management. Prior to joining Marguerite in 2010, he spent 17 years with the Santander Group. He also worked at McKinsey (Madrid), Salomon Brothers (London), and Lazard Frères (Paris) before joining Santander. Mr. Merigó has a Physics degree from Imperial College of Science & Technology (London) and an MBA from UCLA.

PF4EE: supporting energy efficiency investments

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The Private Finance for Energy Efficiency (PF4EE) instrument, launched in 2014, is a joint agreement between the European Investment Bank and the European Commission that aims to address the limited access to adequate and affordable commercial financing for energy efficiency investments. The instrument targets projects that support the implementation of National Energy Efficiency Action Plans (NEEAPs) and other energy efficiency programmes in EU Member States.

The instrument is managed by the EIB, one of the largest lenders for investment in climate-related actions worldwide, and funded by the Programme for the Environment and Climate Action (LIFE Programme) under the Directorate General for Climate Action. Through the LIFE Programme, the Commission has committed EUR 80 million to fund the instrument's credit risk protection and expert support services in 2014-2017. The EIB will leverage this amount, to make a minimum of EUR 480 million available in long term financing.

The PF4EE will combine this EIB lending to financial intermediaries with protection against losses associated with energy efficiency loans. In so doing, it will help intermediary banks in Member States to develop and offer specific loan programmes targeted at energy efficiency projects. The financial instrument will also provide support and technical assistance aimed at effectively deploying the PF4EE Instrument by building the technical capacity of financial intermediaries.

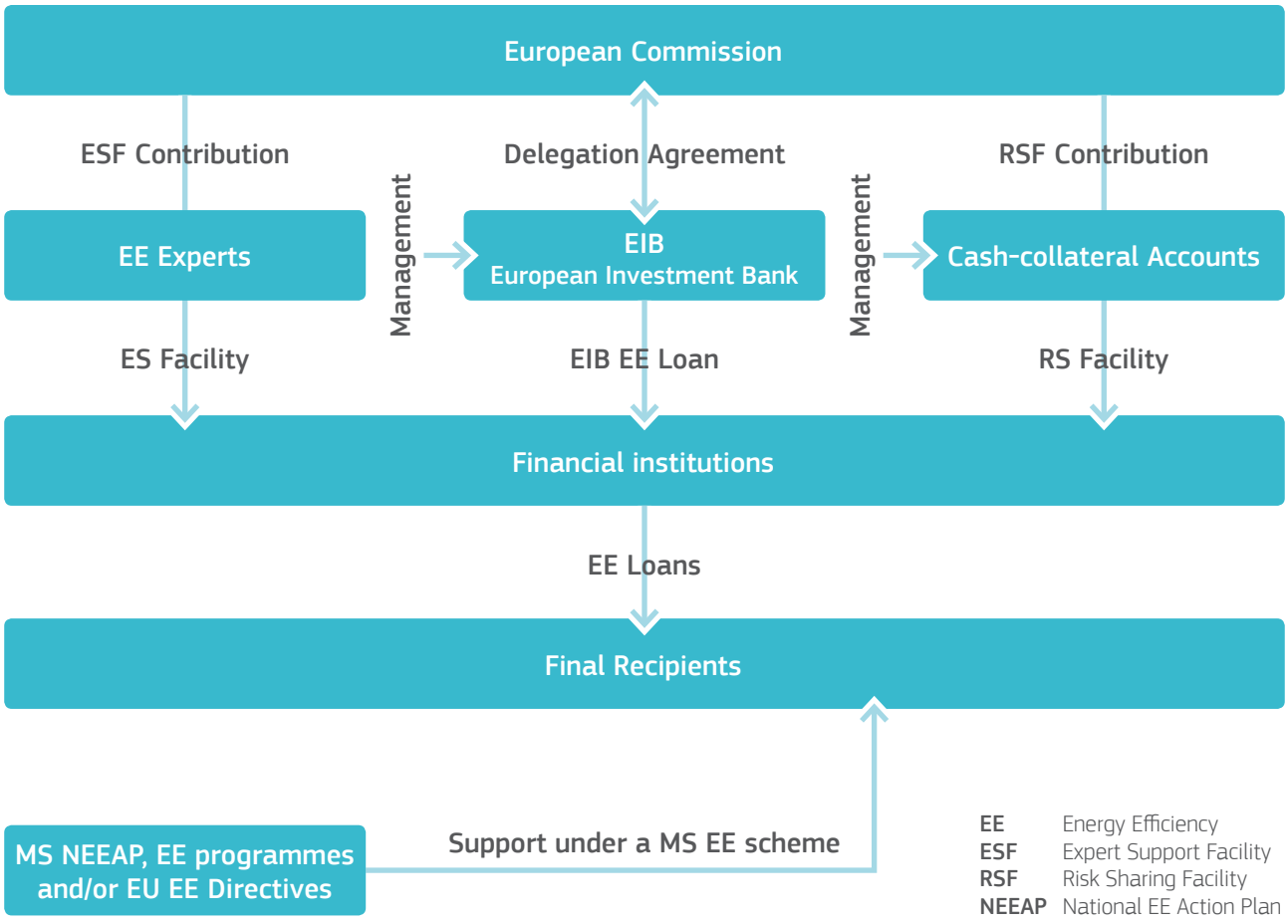
In this way, the PF4EE aims to make energy efficiency lending a more sustainable activity within European financial institutions, by looking at the energy efficiency sector as a distinct market segment. Another core objective of the instrument is to make debt financing more available to eligible energy efficiency investments. To achieve this, it will provide portfolio-based credit risk protection through a Risk Sharing Facility (RSF), in addition to long-term financing from the EIB (an EIB Loan for Energy Efficiency) and an Expert Support Facility.

The RSF is designed to mitigate the credit risk faced by financial intermediaries when lending to individuals or companies undertaking eligible energy efficiency investments. By using cash collateral deposited in a collateral account, the RSF will cover a set percentage of the losses incurring in loans included in an energy efficiency investment portfolio. The EIB Loan for Energy Efficiency may complement the RSF. These EIB loans will be provided at the EIB's own risk, at competitive rates and with long maturities, and will be on-lent to the final recipients to further improve their financing conditions. Finally, the Expert Support Facility will provide expert support services to financial intermediaries, to improve their understanding of energy efficiency investment and help them create suitable financial products tailored towards energy efficiency.

There are a number of criteria that financial intermediaries participating in PF4EE implementation will have to comply with. They will have to be a private sector financial institution or operate as such on the market, be authorised to carry out lending or leasing activities, and be established and operating in a Member State. They will also need to demonstrate that they have the operational capacity to manage the PF4EE instrument and to reach the final recipients targeted by the instrument. The financial intermediaries will also need to have a sound financial standing with a stable long-term outlook and robust credit risk assessment and rating policies, procedures and systems, among other requirements.

No more than one financial intermediary can be selected to distribute the PF4EE Instrument per Member State and priority will be given to intermediaries proposing to operate where energy efficiency investment needs are the greatest. Priority will also be given where the use of loan finance for energy efficiency is under-developed and the capacity to take up loans by final recipients is deemed low.

The target final recipients for the PF4EE instrument will be private investors in Member States investing in projects that enhance energy efficiency. These beneficiaries could include SMEs and private individuals (e.g. householders or hotel owners). Moreover, small municipalities or other public sector bodies undertaking small energy efficiency investments, capable of using energy savings to repay up-front borrowing, could benefit from loan programmes. The size



Source: EIB

of the energy efficiency loans to be provided to the final beneficiaries could range from EUR 40,000 up to EUR 5 million and higher in exceptional cases.

An example of a project financed under the PF4EE is a EUR 50 million agreement signed between the EIB and Banco Santander in Spain. This agreement is a typical PF4EE agreement and combines the instrument's three core elements: the first is a loan to improve the funding conditions of energy efficiency investments financed by Santander. The second component partially covers potential losses that Santander may incur, and the third will strengthen Santander's energy efficiency lending capacity by passing on technical and financial experience gained from similar schemes elsewhere in Europe.

The EUR 50 million EIB loan will finance energy efficiency improvements in hotels and, to a lesser extent, other tourist accommodations across Spain. The risk protection will cover 80 % of Santander's potential losses under these loans up to a maximum agreed amount. Santander will also benefit from the EIB's technical and financial expertise the start of the operation in planning marketing activities and in identifying and appraising energy efficiency investments.

The benefits of this agreement will extend beyond improvements to the energy efficiency and, consequently, the competitiveness of the Spanish hotel sector. By supporting national and European energy efficiency targets in this way, the PF4EE will help to underpin the EU's policy objectives of adapting to and mitigating the effects of climate change and will improve the security of energy supply on the European market.

For more information:
http://www.eib.org/products/blending/pf4ee/index.htm

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Bringing innovative low-carbon technologies to the market: the NER 300 programme

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Background

NER 300 is a large European funding programme for innovative low-carbon energy demonstration projects. As its name indicates, its funds do not come from the EU budget, but are generated by the sale of 300 million emission allowances of the new entrants' reserve (NER) set up for the third phase of the EU emissions trading system. The programme supports a wide range of innovative renewable energy sources (RES) and carbon capture and storage (CCS) technologies.

The NER 300 programme is one of the world's largest programmes for the support of innovative low-carbon technologies. It supports first-of-a-kind, commercial-scale projects of both renewable energy (RES) and carbon capture and storage (CCS).

NER 300 is an essential instrument in the EU climate and energy policy because it bridges the gap between R&D and commercialisation by funding first-of-a-kind projects. In total, it provides EUR 2.1 billion in funding but will leverage roughly EUR 2.7 billion in private investments. It aims at boosting the deployment of innovative low-carbon technologies, where the EU still enjoys a global technological leadership, and as a result will contribute to the creation of thousands of jobs.

Call for proposals and selected projects

NER 300 projects were awarded under two calls for proposals: the first one in December 2012 and the second in July 2014. As a result, 38 first-of-a-kind demonstration projects in renewable energy and carbon capture and storage covering 19 EU Member States were selected for funding. As shown in Figure 1, the majority of the projects belong to the technology categories bioenergy (13 projects) and wind energy (8 projects). Ocean energy and concentrated solar power (both 5 projects) are also important categories in the programme.

In terms of funding awarded, bioenergy is also the leading category with about EUR 910 million in awarded funding (Figure 2). Other categories with high amounts of funding awarded are wind energy (about EUR 340 million), carbon capture and storage (EUR 300 million), and concentrated solar power (about EUR 230 million).

Figure 3 shows the number of projects per Member State. Most Member States have one or two NER 300 projects being implemented on their territory. In total, 19 Member States host at least one NER 300 project. Three projects have been awarded funding in Cyprus, Germany, Italy, Portugal, Sweden, and the United Kingdom. Four NER 300 projects will take place in France as one of them is cross-boundary with Germany.

Figure 6: Number of ongoing projects according to technology category

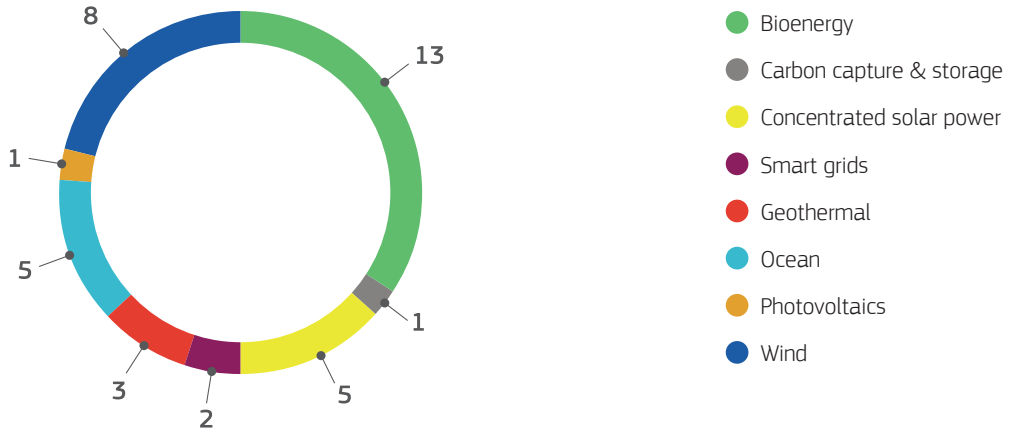
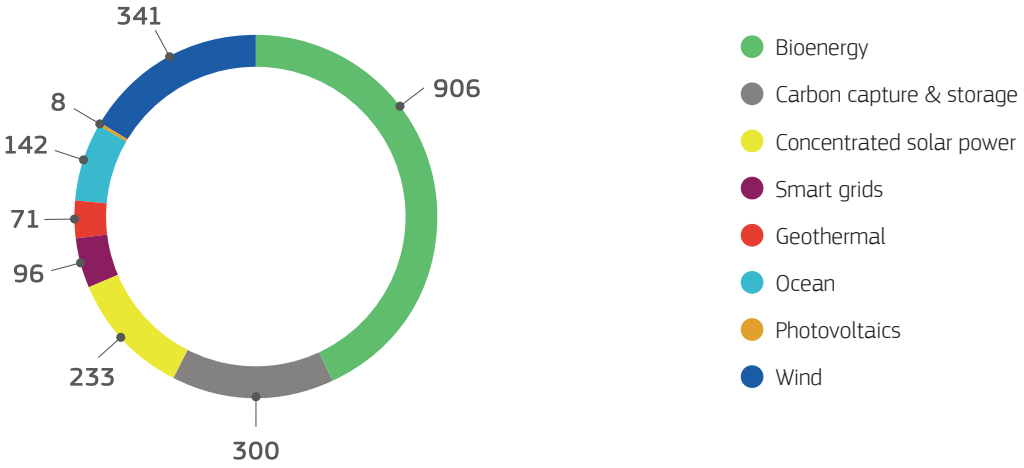


Figure 7: Amount of funding awarded according to technology category (in EUR mln)



NER 300 project Verbiostraw ©2015 Verbio Ethanol Schwedt GmbH & Co KG

The NER 300 projects are now moving towards implementation, with three already operational and a further thirteen that have reached their final investment decision.

The operational projects are the Italian bioenergy BEST project, the German bioenergy VERBIOSTRAW project and the Swedish wind WINDPARK BLAIKEN project (Photos 1-3).

Knowledge sharing

Knowledge sharing requirements are built into the programme as a tool to lower risks in bridging the transition to large-scale production of innovative RES and CCS deployment. The goals of knowledge sharing are, amongst others, to: de-risk CCS and RES with regard to scaling up to commercial size; accelerate the deployment of CCS and innovative RES; and increase the uptake of, and confidence in, CCS and RES by the wider public.

For these reasons, project sponsors are obliged to submit annually to the European Commission the relevant knowledge (RK) gained during the implementation of their project. The European Commission assesses the submitted RK with a view to establishing whether the project has adequately complied with its knowledge sharing obligations and will disseminate relevant knowledge.

The knowledge sharing activities encompass participation at conferences and major events, technology-specific sessions for the NER 300 projects to exchange on challenges and best practices. More information about relevant communication and knowledge sharing activities can be found on the Joint Research Centre's NER 300 news updates on SETIS.

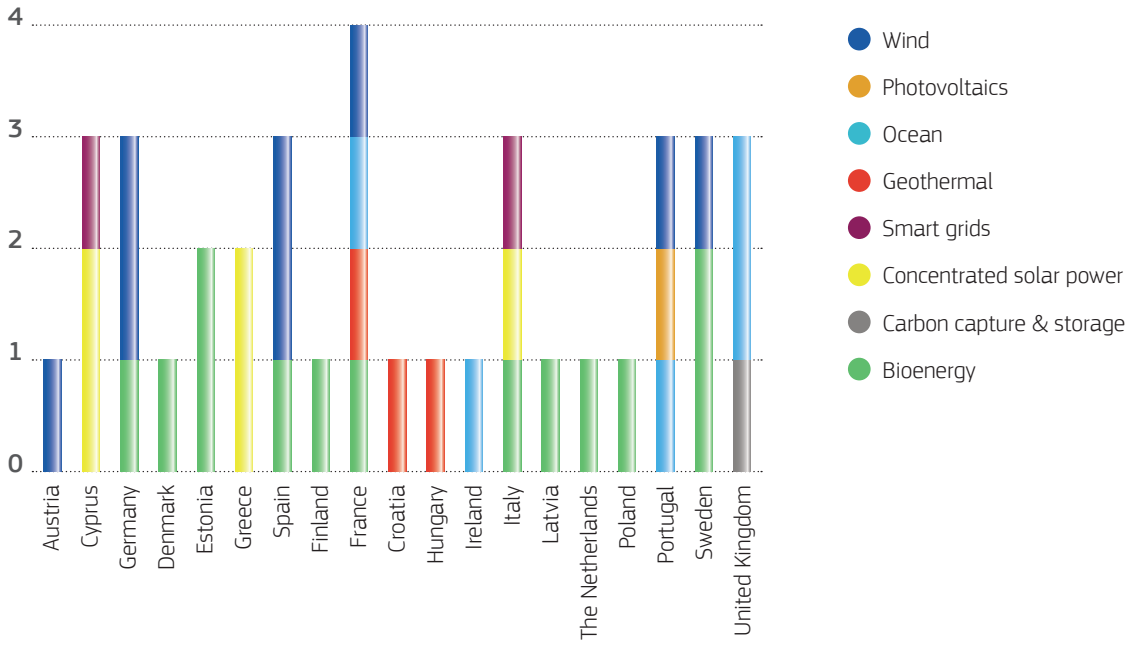
The future

In its proposal for a revised ETS adopted on 15 July 2015, the Commission suggested building on the NER 300 experience and setting up an Innovation Fund. This new programme should be endowed with 450 million allowances to support large-scale demonstration of activities in carbon capture and storage, renewable energy, as well as low-carbon innovation in energy intensive industry, including carbon capture and use, thus providing support to a wider range of low-carbon technologies.

It will be a means of directing further revenues from the ETS towards the demonstration of innovative low-carbon technologies in the industrial and power generation sectors.

NER 300 project Windpark Blaiken © 2015 Blaiken Vind AB

Figure 8: Projects awarded per Member State



Andreas Uihlein

Andreas Uihlein is a Scientific/Technical Project Officer at the Joint Research Centre of the European Commission. His main interests are the socio-economic and techno-economic assessment of emerging renewable energy technologies, in particular geothermal and ocean energy. He also coordinates the Joint Research Centre's activities related to the NER 300 programme. Andreas holds a PhD in Engineering from the Technical University of Darmstadt.

Filippo Gagliardi

Filippo joined the Commission as Policy Officer in DG Climate Action in 2013. His responsibilities include the implementation of the NER 300 programme and its successor - the Innovation Fund. Filippo implements Private Energy for Energy Efficiency (PF4EE), a financial instrument for energy efficiency investments. Prior to joining the Commission, Filippo was Secretary General of the European Wind Energy Technology Platform. He holds a degree in Business Administration.

Cohesion policy support for sustainable energy investments

What is the EU cohesion policy?

Cohesion policy is the EU's main investment policy, representing about a third of the EU budget - close to EUR 352 billion for the 2014-2020 period. For this period, the policy has been profoundly reformed, making an important contribution to key EU priority areas as the biggest EU source for investments in smart, sustainable and inclusive growth. The support also goes beyond funding as it offers capacity building, technical assistance and cross-border cooperation opportunities.

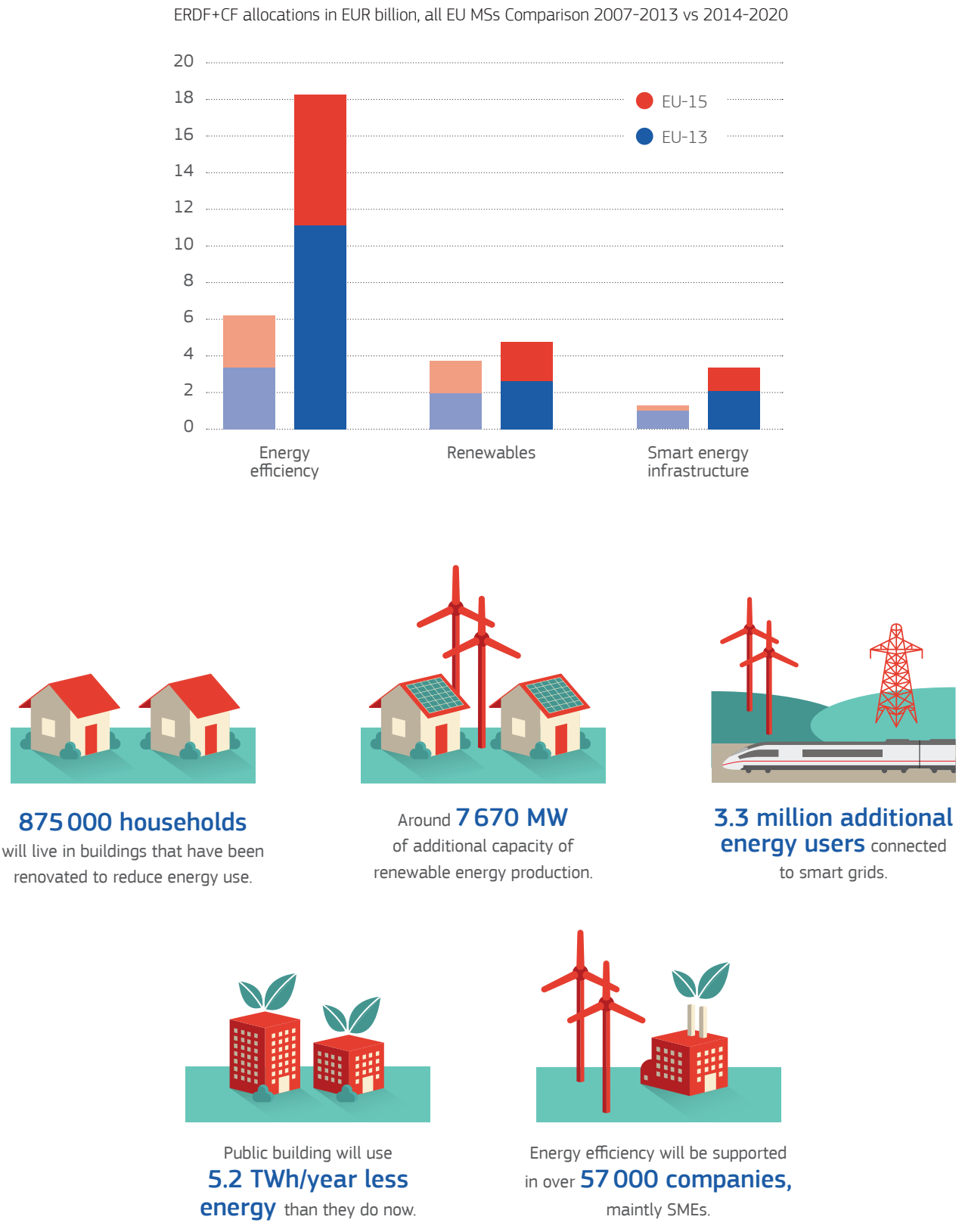
The policy is delivered through three main funds: the European Regional Development Fund (ERDF), the Cohesion Fund (CF) and the European Social Fund (ESF). All EU Member States and regions can profit from these funds, with the bulk concentrated on the less developed regions. Based on a shared management approach and with the operational support of the European Commission, Member States and regions will lead the uptake of the funds to foster the decarbonisation process in their territories.

What support for sustainable energy projects?

Under the reform of the EU cohesion policy agreed at the end of 2013, the shift towards a low-carbon economy has gained significant support under the 2014-2020 investment programmes, due to its importance for citizens, regional development, competitiveness, growth as well as geopolitical leverage. The cohesion policy investments aim at becoming a crucial tool assisting Member States and regions to achieve the 2020 energy and climate objectives and to boost the security of energy supply. A new mandatory earmarking of ERDF funds for investments in low-carbon projects has resulted in the following ERDF and CF allocations:

- EUR 13.4 billion will be invested in energy efficiency in public and residential buildings, leading to 875 000 families living in homes that have been renovated to reduce energy use and to public buildings using 5.2 TWh/year less energy than they did at the end of the previous funding period.

Figure 1: Planned allocations from the European Regional Development Fund (ERDF) and the Cohesion Fund (CF) as of May 2016



- EUR 3.3 billion will support energy efficiency in over 57 000 companies, mainly SMEs, and EUR 1.7 million will be invested in supporting high-efficiency cogeneration.
- EUR 4.8 billion will be invested in renewable energy, contributing to around 7 670 MW of additional renewable energy capacity.
- EUR 1.1 billion from the ERDF and the CF for investments in smart distribution grids will result in 3.3 million additional energy users connected to smart grids.

The above funds will be complemented with national public and private co-financing. Indeed, the investment needs are much higher than the available EU and national public support and there is a necessity to achieve a much higher leverage of public funds through a more extensive use of financial instruments. In this regard, Member States have indicated their political commitment through the planning of financial instruments of about EUR 3.8 billion of ERDF and CF funding for low-carbon investments, mainly for energy efficiency. This is about an eight-fold increase compared to the 2007-2013 period, but further opportunities are available.

The significant cohesion policy funding allocations for sustainable energy are in complementarity with the European Fund for Strategic Investments (EFSI). This was highlighted in the June 2016 Communication on the state of play of the Investment Plan for Europe and in the November 2016 Communication on Clean Energy for All Europeans. The Commission is working closely with the European Investment Bank (EIB) and Member States in order to support the further development of such schemes or projects.

Energy research and innovation in the framework of the Smart Specialisation Strategies

Furthermore, there are also significant opportunities for research and innovation investments, including in the energy sector. For the 2014-2020 period, the cohesion policy funding for research and innovation – which now amounts to EUR 41 billion in total – is based on the so-called Smart Specialisation Strategies ('S3P') that are developed in a bottom-up process with the involvement of key stakeholders across different value chains. Energy is placed on the top of the list of smart specialisation priorities, with more than 100 regions having chosen energy-related priorities (S3P-Energy).

Investments based on pre-conditions and alignment with national action plans

The pre-conditions for the funding, the so called 'ex ante conditionalities', ensure efficiency and effectiveness of the investments, providing the best possible framework for the preparation and implementation of high quality projects. They have also shown to be drivers for faster transposition of the EU acquis, for example for the relevant parts of the Energy Performance of Buildings Directive in several Member States.

A better alignment with national strategies is also part of this process. More precisely, investments should be planned according to the national action plans on energy efficiency and renewable energy. Such a strategic planning results in differing investment allocations among Member States, ensuring that the funding is adapted accurately to national and regional needs and priorities.

Additional support

The Commission services are also undertaking a number of initiatives to help Member States implement low-carbon investments, including:

- The Smart Specialisation Platform on Energy supports regional energy innovation and the broad adoption of cohesion policy energy projects, including with policy advice and analysis as well as by bringing regions together in partnerships to deliver innovative projects in key areas.
- The Energy and Managing Authorities (EMA) network brings together national energy and cohesion policy managing authorities and provides implementation support by acting as an informal platform for exchange of information and sharing of good practices, experiences and latest developments, to ensure the best possible use of the significant funding.
- fi-compass, a knowledge hub and advisory tool, supports managing authorities and other interested parties by providing practical know-how and learning tools on financial instruments.
- Off-the-shelf financial instruments provide standard terms and conditions to facilitate the use of financial instruments by the managing authorities; this includes the 'renovation loan' for energy efficiency and renewable energy in the residential building sector.

Furthermore, European Territorial Cooperation plays an important role in promoting and supporting low-carbon projects, contributing actively in terms of networking and the development of joint initiatives. Cross-border programmes incentivise better cooperation among different actors in different Member States and establish partnerships for low-carbon investments. EU Macro-Regional Strategies provide 'tailor-made' responses to specific challenges in wider geographic areas, beyond the national borders, thereby placing the investments in a wider framework.

Cities and urban areas have a key role in the energy and climate challenge. The Urban Agenda for the EU focuses on concrete chal-

lenges in cities, including topics such as energy transition, and defining concrete actions on which the Commission, Member States, cities and stakeholders work together, in synergy with the European Innovation Partnership on Smart Cities and Communities.

Delivering the Energy Union Strategy

In all these ways, the EU cohesion policy makes a key contribution to delivering the Energy Union objectives on the ground – in Europe's regions and cities. It helps bridge the gap between the ambitious EU framework and the changes needed on the ground to effectively accomplish the shift towards a low-carbon economy and the implementation of the Energy Union. By involving stakeholders at all levels and supporting capacity-building, it builds ownership and commitment at regional and local level. Indeed, the cohesion policy funds destined for sustainable energy projects serve the broader EU objectives of regional development and cohesion through growth and job creation while also tackling energy poverty and enhancing energy security.

Related web links

InfoRegio
List of the funds' Managing Authorities
Open Data Platform
Project examples
ESIF support to Energy Union

Dr Gergana Miladinova

Gergana leads a team at the European Commission that oversees the integration of sustainable growth issues into Cohesion Policy funding. Previously she worked on the development and implementation of several key Directives (including the Energy Efficiency Directive and the Energy Performance of Buildings Directive) and of various strategic documents. She also served as a Member of Commissioner Piebalgs Energy Cabinet. She did her Doctoral research on policies for distributed electricity generation at Central European University and at the University of Oxford.

Maud Skäringer

In the Commission since 1995, Maud Skäringer is currently working as a policy analyst in the field of regional policy, focusing on promoting the Energy Union and sustainable energy investments in a regional development context. She has also been working on promoting an innovation-friendly business environment, in particular for SMEs. Prior to this, she encouraged Member States to improve their national research policies and also contributed to economic analysis to further the European Research Area. She holds a degree from Stockholm School of Economics.

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