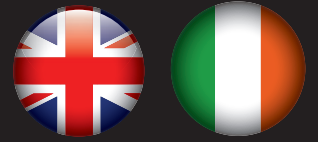


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UAV technology shines through in solar

UAV technology is central to inspection and maintenance across the industry

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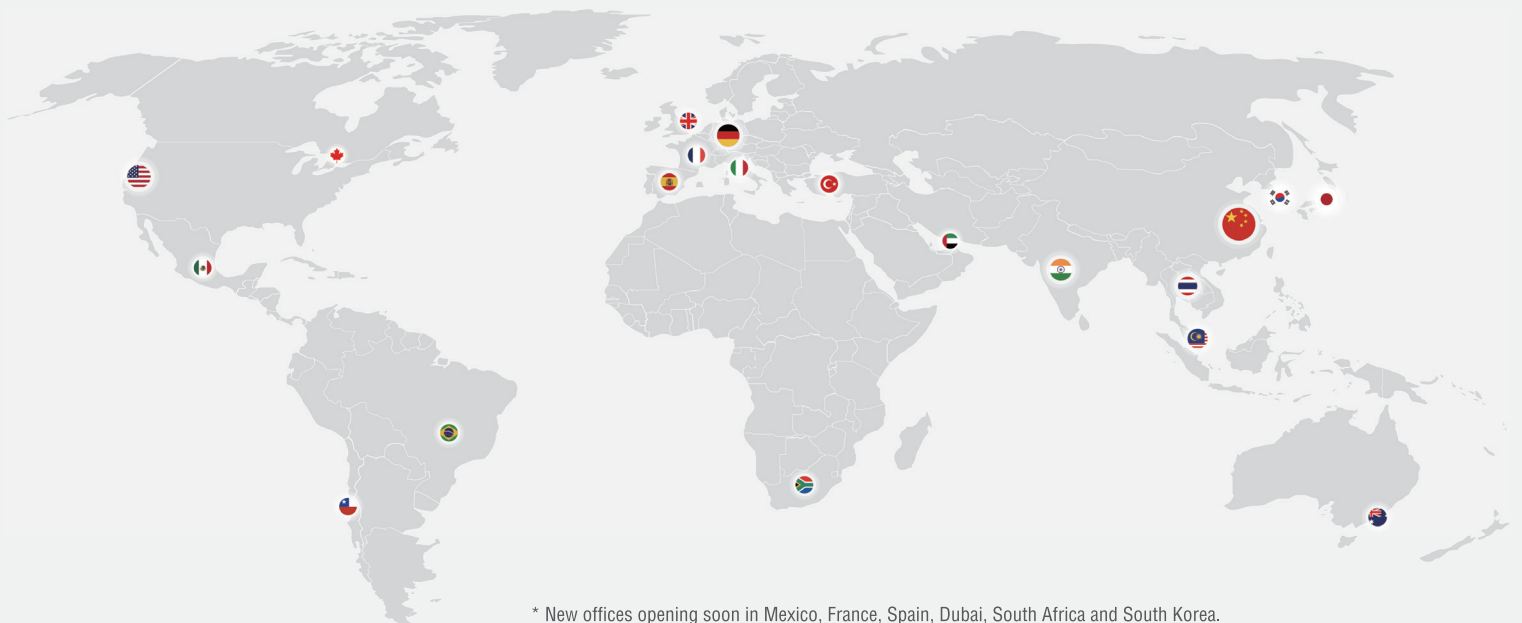
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UK Government pay out massive damages re FiT fiasco

A FREEDOM OF INFORMATION request response from the Department for Business, Energy and Industrial Strategy (BEIS) has confirmed that the UK Government made c. £60 million in payments to solar energy companies in a claim led by legal firm Asserson.

The claim, listed by The Lawyer magazine as one of the “Top 20 Claims” for trial in 2018, was unprecedented and followed seven years of legal wrangling. The pay-out is the largest ever sum recovered by a Human Rights Act claim in the UK.

The litigation was brought against the BEIS proposal to bring forward the date of cuts to “feed-in tariff” (FIT) subsidies to small-scale solar energy generation from the government’s publicised cut-off date of 1 April 2012 to 12 December 2011, a date before the end of the consultation on the proposal itself, and before the law making the change would be approved by Parliament. The proposal had disastrous consequences for the UK solar industry, with many companies becoming insolvent and others losing



millions of pounds. Asserson has not commented on the amount of money paid to the claimants, because the Government had insisted that the settlement terms be kept confidential. However, in light of the Government’s freedom of information response, the settlement sum is now public knowledge.

Trevor Asserson, senior partner at Asserson who ran the case, commented: “This claim was triggered

by an unlawful government decision to cut subsidies to the solar energy industry earlier than the government’s own published timetable. The outcome was a victory for the business sector and for human rights. This is by a significant margin the largest sum ever recovered on the basis of a Human Rights Act claim in the UK. The precedent set by this case gives businesses real protection in the event that government unlawfully interferes with their activities.”

Aquila Capital launches energy transition strategy ETIF

AQUILA CAPITAL has announced that it is launching its new energy transition strategy, ETIF (Energy Transition Infrastructure Fund). Advancing upon three fully invested predecessor funds, the strategy is to invest in energy infrastructure assets that are essential to Europe’s energy transition. Aquila Capital currently manages renewable energy generation assets with a capacity of about 2,200MW.

ETIF will pursue the three most important subsectors of the energy transition, namely renewable energy generation, energy storage and energy transportation. It is planned to launch the strategy as a Luxembourg-based Reserved Alternative Investment Fund (RAIF) with a target volume of EUR 750 million and a term of 12 years. The target net IRR is 8% to 10% per annum.

“There are numerous developments driving the need for strategic investment in European energy infrastructure projects,” says Susanne Wermter, Head of Investment Management Energy & Infrastructure EMEA at Aquila Capital. “Energy consumption is rising, which is increasingly being met by renewable energy assets such as photovoltaics and wind power rather than fossil fuel and nuclear generation.” “Sufficient transport and storage capacities must be created or amended to meet the challenges of the energy transition.

As such, the advancing decentralisation and necessary integration of the energy system offers investors attractive opportunities. This is why we have designed the ETIF to cover the entire value chain in renewable energy supply.”

The new strategy is primarily seeking investments in onshore and offshore wind power, photovoltaics, hydropower, electricity grids and heat networks, as well as energy storage with an emphasis on greenfield projects. The geographical focus is on continental Europe and the Nordic countries, with possible additional allocations in Great Britain and in Central and Eastern Europe. Ten to 15 investments with an average equity ticket of EUR 50 to 75 million are planned.

“Europe is entering a new phase of the energy transition. There has been significant progress in the development of renewable energy generation and grid parity has already been attained in many regions. In the coming years, investments in energy storage and grid capacity will become much more important. Our response to this development is the ETIF strategy, which allows investors to participate financially and ecologically in the Europe-wide energy transition on a sustainable basis,” says Roman Rosslénbroich, CEO and co-founder of Aquila Capital.

Ireland steps towards electric vehicles

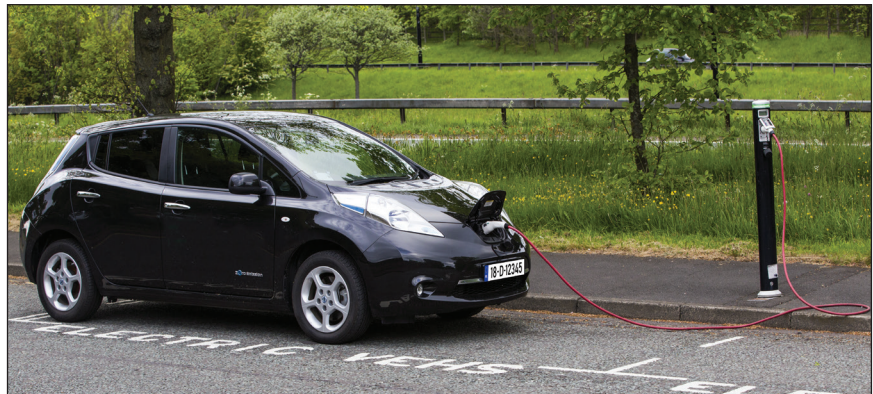
IRELAND'S Minister for Transport, Tourism and Sport Shane Ross TD, has announced a new Taxi/Limousine/Hackney (SPSV) grant scheme, aimed at increasing the uptake of electric vehicles (EVs) in the Irish taxi fleet.

This new electric vehicle initiative will help to stimulate the uptake of EVs in the SPSV industry by giving SPSV drivers up to €7,000 towards the purchase of an EV.

Speaking at the launch of the scheme Minister Ross said: "the electrification of the national SPSV fleet will play a significant role in our transition to a cleaner and greener transport fleet, not only will this be beneficial for our environment, in terms of improved urban air quality and reduced CO2 emissions, but reduced running and maintenance costs will also be of major benefit to the drivers themselves".

Analysis shows that fuel savings of up to 10 cent per km can be achieved by driving an electric vehicle in comparison to a conventionally fuelled vehicle. For a vehicle clocking up to 55,000km per annum, this would equate to fuel savings of over €5,000 and net reduction in over 3.5 tonnes of CO2 emissions.

Currently EVs in Ireland also benefit from government purchase incentives up to



a value of €10,000 (€5,000 VRT relief and €5,000 SEAI grant), qualify for the lowest band of road tax (€20 per annum), access to an extensive network of public chargers which are presently free to use, and a SEAI home charger grant scheme (up to a value of €500).

The Minister added "This new grant scheme will play a fundamental role in developing public awareness of EVs. It is a great opportunity for members of the public to experience an EV themselves, electric SPSVs will also be easily identifiable by a new type of EV sticker."

Welcoming the new grant scheme, the CEO of Nissan Ireland, James McCarthy said: "As pioneers of EV driving Nissan welcomes the new grant scheme to

encourage SPSV drivers to switch from diesel to electric driving. There has never been a better time to do so.

The 100% electric, zero emissions Nissan LEAF is the best-selling EV in Ireland. The new Nissan LEAF launches in Ireland in April with a range of 378 kilometres on a single charge making it the perfect partner for SPSV drivers who want to avail of the scheme and follow in the footsteps of the 2,000 Irish motorists who already drive a Nissan LEAF".

The Electric SPSV Grant Scheme, which opens for applications on 1 February 2018, will be administered by the National Transport Authority on behalf of the Department of Transport, Tourism and Sport.

Rexel chooses Solarcentury for their BIPV product of choice

AN EVER-INCREASING demand nationwide for an aesthetic BIPV product has been the catalyst for this partnership. Rexel's remarkable nationwide distribution network and Solarcentury's award-winning product broadcasts the perfect partnership to accelerate the 'UK home solar market'.

Head of Rexel Energy Solutions, John Lochrane said, "We have seen increasing demand for BIPV in both the new build and retrofit sector. We had an exhaustive selection process. The questions being asked of BIPV is about reliability, performance, installation and whether the product is attractive. We can confidently say Sunstation answers all these questions."

Rexel dedicates themselves to providing eco-efficient solutions to new construction and upgrade projects. They have a recognised reputation in the industry and pride themselves on providing solutions via the application of the

best electrical products. Sunstation has seen success since its launch in 2016 picking up an internationally renowned IF award for design innovation. The added benefit of being backed by solar veterans Solarcentury ensuring financial stability undoubtedly made them an attractive partner to Rexel. The ease at which it can be installed, its durability and aesthetics have made it very popular with solar installers up and down the country.

Colin Deans, the business development manager for Sunstation added "It is great to have Rexel on board as our distribution partner, the product has gone from strength to strength across the market and Rexel gives us at Solarcentury the opportunity to reach a wider audience of PV installers and building material specifiers. We all look forward to working closely with Rexel, who already have projects for us to work on together."

Demand for large scale solar carports drives growth at FlexiSolar

FLEXISOLAR, the solar carport specialist based near Cambridge, has announced details of its growing operations team; recruited to design, develop, install and maintain integrated large scale solar carport solutions at sites across the country. Backed by Innovate UK, the UK's innovation agency, FlexiSolar formally entered the market in 2017 as a design, manufacturing, installation and operations company specialising in the integration of solar panels, electric vehicle charging points and carports. Innovate UK has backed FlexiSolar as part of its focus on driving the science and technology innovations that will grow the UK economy.

FlexiSolar's delivery is led by Operations Director, Keenan Gratrack, who as well as being a seasoned electrical engineer qualified to 11KVa, brings over 10 years' experience specialising in the renewable energy sector; overseeing the installation of circa 800 MW of Solar PV. In his career, Keenan has been responsible for setting up commercial operations and solar park maintenance departments using market leading renewable technologies across the UK and overseas. The Operations and Maintenance team has grown fast in light of the high level of projects awarded to FlexiSolar so far this year. The department has also been working hard to gain maintenance contracts on existing Solar Plants; as part of its objective to grow their portfolio of maintained sites.

Electrical and Automation Design Engineer, Piervanni Fois, joined FlexiSolar having gained over 12 years' experience as a designer and consultant within several organisations and independently. Piervanni has developed detailed designs of electrical power networks, protection and control systems for industrial and commercial buildings, as well as wind and solar farms including applications for control and PLC systems, and software development. He developed his professional profile with a keen interest in renewable energy systems, solar generation, smart grids and energy storage including EV charging.

Construction Manager, Andrew Edwards, has over 10 years' experience within the Solar PV industry, with a proven track record in delivering multiple and complex projects on time and within budgets. With a passion for clean energy and a strong interest in pioneering energy storage deployment in the UK, Andrew was previously at Belectric Solar Ltd, where he dealt with rooftop solar installations and was responsible for a number of ground mount projects, ranging from 3.8 MW to 126 MW. In total Andrew has dealt with the installation of 88 solar parks.

Site Manager, Ashley Wass, joins FlexiSolar from Morrison Utilities, where he gained experience in civil engineering, emergency water work repairs, whilst authorising method

statements and risk assessments, and supervising multiple projects. Ashley has been in the Solar PV industry for over 4 years and has dealt with a number of ground mounted installations. The Operations & Maintenance team is supported by Project Co-ordinator, Rachel Wareing, who works to ensure the effective and efficient administration of all projects. Rachel has a technical background, having spent 12 years in the RAF as an aircraft mechanic, with a strong skillset also gained from a number of years in the NHS, managing 160 properties used for accommodation for staff and patients' families.

Speaking about the recently expanded operations team, Robert Carpenter, Managing Director of FlexiSolar said "Our large scale solar carports offer a significant opportunity to generate and harness energy at source. The level of complexity and understanding in the design and installation of these solutions is of paramount importance and needs clear expertise behind it; which is exactly what we have put in place with the FlexiSolar operations team. The growing team is focussed on developing intricate, bespoke solar carport systems for our clients, from concept to completion."

FlexiSolar's expert sales team were also introduced earlier this year and are working with organisations and local authorities across the country to discuss their large scale solar carport requirements.



TfL signs deal with ENGIE to expand use of solar power across its buildings

MORE BUILDINGS across London will be powered using green technology after Transport for London (TfL) awarded ENGIE with a contract to install solar panels across its buildings.

The contract will see up to 24 properties across TfL's estate fitted with the new panels, including bus stations, train depots, manufacturing workshops, train crew accommodation and office buildings. The project is being delivered through RE:FIT alongside the Mayor's £34 million Energy for Londoners programme, which aims to make homes warmer and energy bills more affordable, workplaces more energy efficient, and supply London's homes and businesses with cleaner and more local energy sources, like solar.

The first panels, which will be delivered as part of TfL's new Train Modification Unit at Acton Depot, will be installed from early 2019, helping to work towards the Mayor's commitment for London to be a zero carbon city by 2050. Further sites could also be fitted with solar panels in the future, subject to funding.

Across London, a number of TfL buildings already have solar panels, including Grade-I listed 55 Broadway in St James's Park, Palestra in Southwark, the Grade-II listed London Transport Museum in Covent Garden, train crew accommodation buildings at Brixton, Stratford and Cockfosters, as well as on the Hammersmith and City line station at Paddington and at Walworth Bus Garage.

Together, these sites can already produce around 245kW of electricity. This could increase by a further 1.1MW once the new panels are installed. Combined, they could cut TfL's CO2 emissions by around 480 tonnes a year - the equivalent to boiling 16 million kettles. In addition, energy efficiency upgrades, such as retrofitting older buildings with more modern heating and lighting, are anticipated to help reduce energy consumption in some of these buildings by around 20 per cent. All of TfL's property development projects are assessed to see whether they can incorporate solar, other renewables and energy efficiency measures, as part of their overall energy



strategy. TfL will also continue to look to install solar panels as part of other capital projects, such as future station upgrades and at train depots across the London Underground network to help reduce energy costs in the future.

Around 3,500 bus stops and shelters across London also have solar panels fitted to them, helping to provide power for LED lighting in the shelters and to illuminate bus timetables. These alone generated almost 280,000kWh of power and helped avoid 126 tonnes of carbon emissions being emitted – the equivalent weight of around nine double-decker buses.

Shirley Rodrigues, the Deputy Mayor of Environment and Energy said: "As part of the Mayor's ambitious Energy for Londoners programme, Transport for London will be expanding its use of solar power and upgrading its buildings so they use less energy. The Mayor wants even more local clean energy in London to power and heat our transport, homes, businesses and communities to help cut pollution and clean up London's air."

Graeme Craig, Director of Commercial Development at TfL, said: "Across TfL, we are committed to doing whatever we can to be as energy-efficient as possible. Improving London's air quality and reducing our impact on the environment are key elements of the Mayor's Transport Strategy and expanding our solar capability across the business will ensure we do this in a cost efficient and technologically-advanced way."

Wilfrid Petrie, CEO of ENGIE in the UK & Ireland, commented "We are delighted to be partnering with Transport for London on this solar project, which will not only lower energy costs and

optimise the use of TfL's estate but will also provide broader benefits to London inhabitants and businesses by improving air quality. ENGIE is committed to providing solutions for cities like London to reduce carbon emissions and enable greater efficiency."

The delivery of more solar power is just one of a number of schemes TfL is delivering to help reduce carbon emissions and become more energy efficient. As part of a 12-month pilot scheme run by City Hall, two TfL depots - Northfields in Ealing and Northumberland Park in Haringey, will be part-powered through locally generated cleaner energy. London is the first public body to secure a junior electricity licence, which went live in January 2018, and will use energy bought from Peabody Services and Scottish & Southern Energy (SSE Heat Networks). Both of the busy train depots service and maintain Tube trains round the clock. The Mayor is also helping both the public and the private sector to build larger-scale heat networks, including the use of local sources, like waste heat from the Tube, through a £3.5m Decentralised Energy Enabling Project to help make London cleaner and smarter.

The RE:FIT programme was originally created in 2008 by the Greater London Authority and is now a national scheme with over 200 organisations signed up and over 600 properties successfully retrofitted. The robust energy performance contracting approach provides the opportunity to reduce carbon emissions, achieve substantial guaranteed energy savings, and cut costs through energy efficiency and energy generation measures.

UK Government £30 million investment in V2G technologies

THROUGH the Industrial Strategy the government is committed to becoming a world leader in shaping the future of mobility and in the design and development of the clean technologies of the future. This investment will help deliver on that ambition, supporting vehicle-to-grid (V2G) technologies that could enable electric cars and other vehicles to deliver electricity back to the smart grid, to light homes and power businesses.

The funding has been awarded to 21 V2G projects, to pay for research and design and development, with the aim of exploring and trialling both the technology itself and commercial opportunities.

These schemes, including EDF Energy's V2GO scheme, will demonstrate how energy stored in electric vehicle batteries could be borrowed by the electricity system during peak hours, before being recharged during the off-peak in time for their drivers to set off on their next journey.

Using electric vehicles in dense urban areas like Oxford will significantly reduce local emissions and improve air quality, boosting the quality of life for residents and benefitting businesses. Led by EDF Energy R&D UK, the 'V2GO' is a large scale demonstration of V2G charging in Oxford using 100 electric fleet vehicles (cars and vans) from a number of organisations including several delivery and taxi companies.

The project will develop, trial and evaluate potential business models for fleet operators' use of electric vehicles and their suitability for vehicle to grid (V2G) charging.

The consortium is made up of 8 organisations with expertise in energy and power markets and systems, fleet operation value chains and electric mobility: EDF Energy R&D UK, University of Oxford, Oxfordshire County Council, Arrival, EO Charging, Upside Energy, and Fleet Innovation.

At the same time these electric vehicles will provide a cleaner alternative to many



of the fleet vehicles operated in UK cities, including Royal Mail vans, and Addison Lee taxis.

Transport Minister, Jesse Norman said: "As the number of electric vehicles grows and their battery capabilities increase, there is a huge opportunity for them to make a significant contribution to a smart grid.

"These projects are at the cutting edge of their field. Just like the visionary designs of Brunel and Stephenson in transport, they could revolutionise the ways in which we store and manage electricity, both now and in the future."

Business Minister Richard Harrington said: "The UK's automotive industry is a great British success story, and as set out in our ambitious Industrial Strategy we are determined to lead the way in innovative, low-emission vehicle production.

"We have shown that growing the economy while cutting emissions, can, and should, go hand in hand. Vehicle-to-grid technology provides another opportunity for the UK to showcase to the world our leading expertise in game-changing automotive and low carbon technologies."

Dan Bentham, Head of R&D, Smart

Customers, EDF Energy said: "Electric vehicles will play an important role in the future of UK energy and its economy. They will have a beneficial impact on the environment by reducing emissions and improving air quality.

"Through our research, EDF Energy will use new technologies, business models and smart systems to make low carbon transport, and the infrastructure and market conditions needed for its success, a reality."

The investment will help deliver on the government's ambition, set out in the recently published Automotive Sector Deal, to be at the forefront of low-emission and electric vehicle production, powering the next generation of innovative, environmentally-friendly vehicles.

The competition for government funding, run by Innovate UK, saw a host of winners including SSE Services, Nissan, OVO Energy, Octopus Energy, Cisco, Flexisolar and AT Kearney.

Innovate UK recently concluded the assessment process, with OLEV and BEIS providing almost £30 million to grant fund industry led collaborative R&D in electric 'vehicle to grid' technology for up to 70% of project costs.

SOLARWATT launches UK distribution of MyReserve Matrix

SOLARWATT is to launch its multi-award-winning MyReserve Matrix battery in the UK at ecobuild, the trade event for the construction and energy market. The company says MyReserve Matrix sets new standards in performance and efficiency, enabling householders and businesses to align power storage to their precise requirements. The system has been trialled at selected locations in the UK and Ireland and is now available for immediate installation.

SOLARWATT is inviting visitors to its stand, B133, at ExCel London on 6-8 March to view the units and discuss the technology.

MyReserve Matrix is completely modular, with battery and intelligence unit each housed in solid, highly secure aluminium blocks and no additional cladding required. Each shoebox-sized module weighs less than 25kg. The

battery is scalable to suit individual energy and performance requirements and installed solar PV panels. As each module increases power by 800 watts, MyReserve Matrix can be configured to any capacity, from 2 kWh to 2 MWh.

“After a quiet time for smaller-scale renewable energy we’re anticipating a big pick-up in solar PV in the UK and Ireland as people begin to appreciate the transformational effects of modular battery storage and self-consumption,” said Pol Spronck, International Sales Manager of SOLARWATT. “We are making some senior appointments in the UK and Ireland following our distribution tie-up with Fronius and expect MyReserve Matrix to increase our battery sales significantly in 2018. Do come and talk to us at ecobuild.”

“Interest in MyReserve Matrix has been extremely high,” said SOLARWATT

CEO, Detlef Neuhaus. “In the meantime, we have strengthened important sales structures and are now starting the Europe-wide sales of our battery with a powerful team. So far, we have been known by some as a manufacturer of premium PV modules. With the introduction of MyReserve Matrix, our international customers now also benefit from our complete systems concept, where all components of the PV system are perfectly coordinated and thus most effective.”

The SOLARWATT MyReserve Matrix battery was unveiled for the first time at Intersolar / ees 2017. Even before its official launch in August 2017, the battery won the coveted ees Award for its innovative, modular concept. MyReserve Matrix won the Smart Energy Storage Residential category at the Solar + Power Awards, Amsterdam in October.

Residential solar in Ireland gets a boost

AT RENEWABLE ENERGY SUMMIT 2018, Irish Energy Minister, Denis Naughten announced Ireland’s first support scheme for residential PV. The grant aided pilot scheme for PV microgeneration will focus on residential self-consumption and will begin this summer.

Minister Naughten acknowledged that bringing microgen onto a system designed for large generators is complicated.

“It impacts how we pay for the network, how we manage regulation and how we technically manage the system. These same challenges are now being faced by other EU Member States who have already implemented schemes and are now having to reform them.

While I will not let these challenges be a barrier to bring support to this key sector, it would be reckless if we didn’t learn from the experiences of other countries and implement best practice. The recast Renewables Directive recognises the rights, entitlements and obligations of both renewable

energy communities and renewable self-consumers; and the Directive will instruct Member States to implement measures to remunerate these micro generators who feed self-generated electricity into the grid.”

Minister Naughten has asked the SEAI to conduct a behavioural and attitudes study into the likely demand for and impact of microgeneration among the public with the intention to open a grant aided pilot scheme this summer for solar PV microgeneration, targeted initially at self-consumption and for domestic properties.

“This will be the first phase in a multi-phased implementation of supports for microgeneration in Ireland, as we explore other options and move toward the new Directive and enable the renewable self-consumer”. The cost of the solar PV cells has come down rapidly in price over previous years, putting a once expensive technology within reach of everyday consumers. Many believe targeting individual households will be key to boosting Ireland’s solar capacity.



The RESS (Renewable Electric Support Scheme) program, which was announced last year, will provide support for large-scale renewables through a competitive bidding process. The Renewable Electricity Support Scheme was conceived to incentivise the introduction of sufficient renewable electricity generation to meet national and EU-wide renewable energy and decarbonisation targets out to 2030. The scheme for solar microgeneration was not included in the RESS announcement much to the disappointment of the rooftop lobby.

The Irish government is currently offering no feed-in tariff and is one of the last countries in Europe to address the potential of solar as a viable renewable option. This means that Ireland has huge untapped potential for solar and storage.

Government funding of £42 million for energy storage research

The Faraday Institution has announced up to £42 million in new government funding to four UK-based consortia to conduct application-inspired research aimed at overcoming battery challenges to accelerate the electric vehicle (EV) revolution.

IF SUCCESSFUL, this research will put the UK on the map as being at the forefront of battery technology worldwide. It has the potential to radically increase the speed with which we can make the move to electric vehicles, as well as the speed with which we can decarbonize our energy supply, with obvious benefits to the environment.

The Faraday Institution is the UK's independent national battery research institute, and was established as part of the government's £246 million investment in battery technology through the Industrial Strategy. Its formation was announced in October 2017 by the Business Secretary Greg Clark.

The Faraday Institution's goal is to make the UK the go-to place and world leader for battery technology research and it has a clear mission to ensure the UK is well placed to take advantage of the future economic opportunities from this emerging technology.

Business Minister Richard Harrington said, "With 200,000 electric vehicles set to be on UK roads by the end of 2018 and worldwide sales growing by 45 per cent in 2016, investment in car batteries is a massive opportunity for Britain and one that is estimated to be worth £5 billion by 2025."

"Through our flagship Industrial Strategy and its Future of Mobility and Clean Growth Grand Challenges, we are committed to making Britain the 'go-to' destination for the development and deployment of this game-changing technology."

"Government investment, through the Faraday Institution, in the projects announced today will deliver valuable research that will help us seize the economic opportunities presented by battery technology and our transition to a low-carbon economy."

The topics for the four projects were chosen in consultation with industry, who will partner closely with each of them. This unique collaboration will help to ensure that the research is producing findings and solutions that meet the needs of business. In addition, industrial partners will contribute a total of £4.6 million in in-kind support to the following four projects:

Extending battery life - Led by the University of Cambridge with nine other university and 10 industry partners, this project will examine how environmental and internal battery stresses (such as high temperatures, charging and discharging rates) damage electric vehicle (EV) batteries over time. Results will include the optimization of battery materials and cells to extend battery life (and hence EV range), reduce battery costs, and enhance battery safety. With Cambridge, university partners include University of Glasgow, University College London, Newcastle University, Imperial College London, University of Strathclyde, University of Manchester, University of Southampton, University of Liverpool and Warwick Manufacturing Group.

Battery system modelling - Imperial College London (ICL) will lead a consortium of six other university and 17 industry partners to equip industry and academia with new software tools to understand and predict battery performance, by connecting understanding of battery materials at the atomic level all the way up to an assembled battery pack. The goal is to create accurate models for use by the automotive industry to extend lifetime and performance, especially at low temperatures. With ICL, university partners include University of Southampton, Warwick Manufacturing Group, University of Oxford, Lancaster University, University of Bath, and University College London.

Recycling and reuse - A project led by the University of Birmingham, including seven other academic institutions and 14 industrial partners, will determine the ways in which spent lithium batteries can be recycled. With the aim to recycle 100% of the battery, the project will look how to reuse the batteries and their materials, to make better use of global resources, and ultimately increase the impact of batteries in improving air quality and decarbonisation.

With Birmingham, university partners include the University of Leicester, Newcastle University, Cardiff University, University of Liverpool, Oxford Brookes University, University of Edinburgh, and the Science and Facilities Technology Council.



Next generation solid state batteries - The University of Oxford will lead an effort with six other university partners and nine industrial partners to break down the barriers that are preventing the progression to market of solid-state batteries, that should be lighter and safer, meaning cost savings and less reliance on cooling systems. The ambition of this project is to demonstrate the feasibility of a solid state battery with performance superior to Li-ion in EV applications. With Oxford, university partners will include the University of Liverpool, University of Glasgow, University of Strathclyde, University of Cambridge, University College London, and the University of St. Andrews.

Peter B. Littlewood, founding executive chair of the Faraday Institution, said: "To deliver the much needed improvement in air quality in our cities and achieve our aspiration for cleaner energy targets we need to shift to electric vehicles quickly. These research programmes will help the UK achieve this. To be impactful on increasing energy density, lowering cost, extending lifetime, and improving battery safety requires a substantial and focused effort in fundamental research." He went on to say that "Through steady investment in basic research on specific societal challenges identified by industry and government, the UK will become a world-leading powerhouse in energy storage."

Professor Philip Nelson, EPSRC's Chief Executive, said: "There is an urgent imperative for us to increase the efficiency of energy storage as we move towards low-carbon economies and attempt to switch to clean methods of energy production."

"The Faraday Institution will bring leading academics in the field of battery development together with industry experts to explore novel application-inspired approaches that will address the challenges we face. The UK has an opportunity to accelerate the development of new products and techniques. EPSRC will be working with the Institution and the academic community to help it succeed and keep the UK a prosperous and productive nation."

Richard Catlow, Foreign Secretary of the Royal Society and professor at University College London, said: "Using more electricity will be key in reducing greenhouse gas emissions. Last year the European Academies Science Advisory Council found that advances in large-scale electricity storage is a priority to manage our increasing dependence on renewable energies. The Royal Society welcomes the Faraday Institution's much needed investment in energy storage research."

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To deliver the much needed improvement in air quality in our cities and achieve our aspiration for cleaner energy targets we need to shift to electric vehicles quickly

UAV TECHNOLOGY has established itself as an essential part of maintenance inspections and surveys across the entire renewables industry. The accessibility and capability of the mission-critical data gathered for asset integrity inspections and maintenance regimes has been a 'game-changer'.

It is not just the savings in terms of time- and cost-efficiency that are decisive, but the numerous operational benefits that include improved monitoring and planning and the removal of risks to personnel. The UAV inspection method avoids the need for manual inspections and associated costly asset shutdowns, saving time and money as well as removing the risks of working at height and/or in dangerous locations.

The applications of the technology are numerous. Workscopes for maintenance can be quantified much more quickly and accurately through close visual inspection for example, but the technology goes far beyond that. Among other things, the versatility of

UAV technology shines through in solar

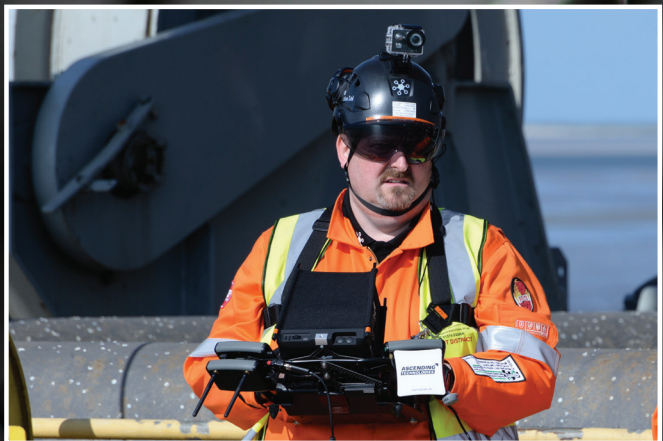
UAV technology is now, quite simply, central to inspection and maintenance regimes across the solar power industry. **David Williams, Principal Compliance Officer, Texo Drone Survey and Inspection** explains why.

UAV inspections also includes the ability to carry out precise asset information modelling, hyperspectral and thermographic investigations and a whole host of other applications from optical gas imaging to ultrasonic thickness (UT) testing.

A time and cost saving technology

On a solar farm, a UAV can be launched and deliver real-time high-definition footage in a matter of minutes. The level of detail coupled with the ability to review, slow down, revisit a location precisely (thanks to GPS positioning) and replay footage means that highly detailed inspections can be carried out to identify problem areas, common difficulties, or regular maintenance requirements. It also means that repairs can be precisely planned, based on the level of detail acquired, and potential problems monitored.

Skilled UAV pilots gather data that reduces time spent on a shutdown for repairs and can even



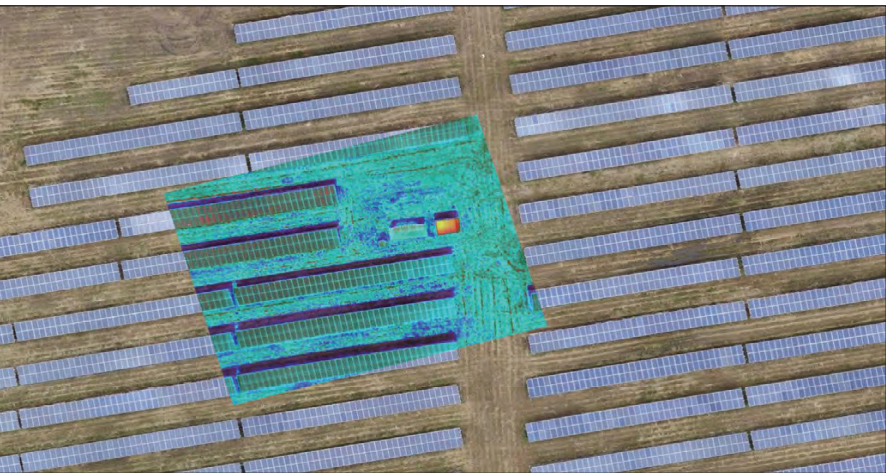


save an operational shutdown. They can also generate information that feeds into decisions about operational continuity: images and detailed analysis can often mean that the need for an unplanned shutdown can be avoided too.

At the heart of solar asset management

Solar farms present unique challenges to operators, particularly since they are often physically large or distributed over a large geographic area. Systems can contain tens of thousands to millions of individual modules, together with fuses, combiners and conductors. It is for these reasons that UAV specialists are now right at the heart of helping solar farm operators to design their asset management programmes.

An ongoing maintenance and inspection regime is key to ensuring that solar power plant maintains energy efficiency and energy generation; it is also about prolonging the longevity of an asset over decades. Undetected failures and small issues can have a real impact on overall operations, leading to lower energy generation and associated losses of revenue. Such losses can quickly multiply as more of these issues occur. UAV inspections monitor all array components to achieve maximum performance, providing information that is equally vital to analysing and reporting on production and budgets. Potential problems are also addressed as part of this, not just actual ones.



Providing immediately actionable data

UAV inspections and surveys are all about providing data that O&M managers can act on quickly. Reports need to be clear and in formats that allow repair teams to get a quick overview of a situation. Pinpoint accuracy is called for so that repair crews know exactly which string or module they need to fix: time saved here equals money saved for operators. UAV technology means that solar farm operators can now use high-quality UAV inspections to identify 100% of faults at any given site. The technology replaces a range of labour-intensive preventative maintenance activities, including manual I-V curve traces, voltage and current measurements, handheld IR thermography, module electrical connection tests

and visual inspections. Aerial inspections identify dc performance issues with a much higher degree of accuracy, and also give operators an overview of an entire plant under consistent operating conditions. Everything starts with agreeing objective measures of guidelines and condition ratings, which are based on detailed images that identify precisely what each rating represents for each component.

Dealing with solar farm issues – technical and environmental

Damage to PV cells, such as that caused by browning and discoloration, is one of the main issues that require to be addressed. This degradation in the film, a by-product of UV radiation, leads to impaired output and productivity. Shorted cells can be located too using infrared imaging; some shorting problems can be associated with defects present in semiconducting materials at the time of manufacture; this can be highly useful in warranty remediation as individual faults can be traced back directly to specific manufacturing batches, for example. Dirty panels are a further source of decrease in output; everything from dust to bird droppings can potentially cause problems. In fact, ‘solar clouding’, which is the term used for dirty panels, can negatively affect output by as much as 10-15%.

Solar panel condition can be quickly ascertained by the use of highly advanced thermal imaging cameras that can scan an array during normal operation, covering large areas within a matter of minutes. Anomalies can clearly be seen on a crystal-clear thermal image. UAV thermography is used to detect defects on panels, which show up clearly and are, depending on their location, indicative of a number of faults, ranging from interconnection problems to defective bypass diodes, internal short-circuits or a cell mismatch. If an entire module is warmer than usual that generally indicates interconnection problems; if individual cells or strings of cells show up as a hot spot or a warmer ‘patchwork pattern’, the cause can usually be found either in defective bypass diodes, in internal short-circuits, or in a cell mismatch. Shadowing and cracks in cells show up as hot spots or patches in thermal images, which are compared under load, no-load, and short-circuit conditions.

Other components also need to be constantly checked, including inverters which take low voltage photo voltaic signals and convert them to voltage compatible with the utility grid. Inverters need to be constantly monitored as changes to voltage and frequency can affect performance as well as creating safety issues. Inverter issues and damage are responsible for around 80% of PV system failures, making them a prime focus for all maintenance regimes. The condition of transformers can also be quickly checked to avoid problems associated with leaks, which can lead to land contamination and other safety risks as well as inefficiencies. Again, aerial inspections cut down the amount of time that

technicians spend accessing inverters and combiner boxes, reducing their exposure to electrical hazards: technicians are exposed to such risks every time they open an inverter or a combiner box. On plant with central inverters, technicians are also potentially exposed to arc-flash hazards, and, once again, the use of aerial inspections cuts down these risks too. The natural environment itself can pose a real threat to the integrity of solar farms. Earth movements and ground erosion can be a serious concern, but can be monitored by regular UAV surveys and inspections. While gradual ground erosion is to be expected as a natural process, sudden earth movements and erosion are highly damaging to PV plant. Loss of topsoil can lead to channels, holes and slopes forming, which can cause conduits to break, racking to shift and have an adverse effect on the efficiency of panels as well as exposing the site to possible water ingress.

Weather events such as high winds and hail storms can damage panels, racking and other equipment – again UAV inspections offer a way of getting a quick overview of just what has occurred. Other natural environmental issues that can be dealt with most effectively by UAV inspections include overgrown vegetation, which can shade cells, interfere with wiring, trackers and damage structures generally. Shaded cells can absorb the power output of many cells in the string, with consequent and drastic falls in output.

‘Future proofing’ the technology

The UAV landscape is ever-changing – and UAV companies and their technology need to be the same. Competition is fierce and companies have to be on top of and ahead of the challenges facing the industry, developing bespoke platforms that meet customer needs precisely by engineering solutions to meet their exact operational needs.

Texo Drone Survey and Inspection Ltd (Texo DSI) has been doing exactly this – investing in world-first technologies that enable deployment of game-changing sensors. Texo DSI operates under expanded permits, including EVLOS/BVLOS and a UAV increased weight class. Achieving ever greater accuracy in surveys Investment and innovation is driving ever greater accuracy across the UAV industry, and our survey grade LiDAR system is a prime example that is benefiting all renewables operators. Traditional ground surveys typically take ten times longer to carry out than a LiDAR survey – worse still, they come without the added benefit of high-definition images of the site or installation.

Advantages of LiDAR over traditional surveying methods include: dramatic cost savings; step improvement in safety; faster turnaround and improved site information to aid decision-making. As with so many UAV applications, it is the scale and accuracy of LiDAR that differentiates it and raises it above conventional survey and inspection methods.

Aerial inspections cut down the amount of time that technicians spend accessing inverters and combiner boxes, reducing their exposure to electrical hazards: technicians are exposed to such risks every time they open an inverter or a combiner box

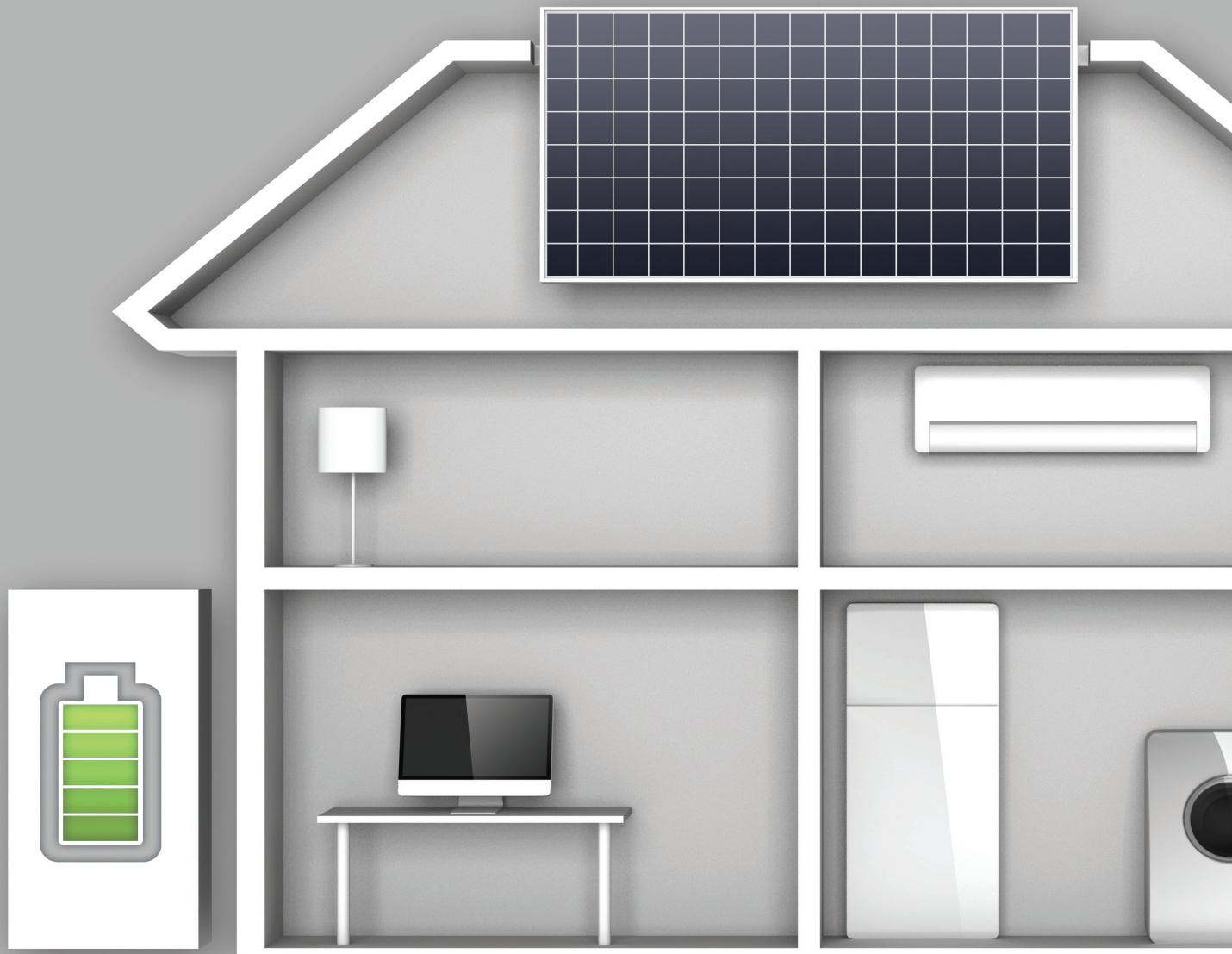
UAV surveys can cover hundreds of hectares in a single day and acquire thousands of high-definition geo-referenced aerial photographs. The principle of LiDAR is to measure distances via light in a pulsed laser form and record the time it takes from its generation and subsequent return to calculate distances. The images are then processed to provide highly detailed aerial mapping and topographic surveys.

In a standard LiDAR survey, accuracy of data is generally to around 40mm; However, substantial investment and development of its LiDAR UAV fleet and associated survey software has led to Texo DSI achieving accuracy of 1-3mm with its world-first survey grade UAV-integrated LiDAR system, which is delivered via a custom-built UAV platform that measures over 1,000,000 measured points per second. This degree of precision means that surveys of assets can achieve pinpoint accuracy, which act as highly reliable baselines for future surveys.

In addition, Texo DSI is able to conduct long range (BVLOS), precision inspection of renewable assets, via its UHS (Unmanned Helicopter System), allowing Texo DSI to offer a totally unrivalled and unique UAV service to potential clients around the world.

A constant technological evolution in solar Advances in sensors and customised UAV platforms are bringing ever more operational benefits to solar power plant operators, providing them with highly accurate data that removes subjectivity and errors from maintenance and planning, improves safety and maximises generating capacity. UAV technology is now, quite simply, central to inspection and maintenance regimes across the solar power industry. That looks set to continue due to the versatility and commercial effectiveness of the technology and constant evolution to provide ever more customised and accurate inspection solutions.

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Battery storage opportunities and pitfalls **behind the meter?**

Battery storage located 'behind the meter', as opposed to having a dedicated grid connection, is an emerging market which holds huge potential for energy cost savings and income opportunities for some commercial businesses, industrial businesses, farms and estates but beware the pitfalls! Hugh Taylor, CEO at Roadnight Taylor explains.



WHAT IS BEHIND THE METER? As the name suggests, a behind-the-meter energy system is installed on the customer side of the meter (electrically, downstream of the boundary between the Network Operator's assets and the site). The opposite is a standalone system which, by definition, has a dedicated grid connection and can only access 'front-of-meter' revenues.

Behind-the-meter technology isn't always energy storage. Gensets or renewables, for example, can be readily deployed either side of the meter point. Indeed, if a site already has intermittent renewables generation, such as solar, hydro or wind, then the business case for locating battery storage behind the meter is normally stronger.

Who is behind-the-meter battery storage for?

Behind-the-meter battery storage is mainly appropriate for larger commercial and industrial business with high electrical demand, and who are looking to reduce energy costs and/or generate additional income from within their energy system.

What are the benefits of behind-the-meter battery storage?

Reduce energy bills – behind-the-meter battery storage allows half-hourly metered businesses to buy and store power when electricity is at its cheapest and to use it at peak times when electricity prices are at their most expensive. (This is referred to as energy price arbitrage). More importantly, storage can be used to shift a site's electrical demand away from costly red and amber 'time-of-use' tariff bands and can flatten the demand profile of a site. Such 'peak-shaving' is used to reduce standing charges and (from April 2018) avoid costly penalties for exceeding contracted maximum import capacity.

Generate additional revenues – behind-the-meter schemes can also access National Grid's ancillary services markets. These services are used by National Grid to balance the UK's electricity supply and demand in real-time (on a second-by-second basis), and are procured via an array of auctions. There are various income streams available to storage schemes from National Grid (directly or indirectly), including frequency response, the Capacity Market, triad avoidance and reserve revenues. With the help of a reputable aggregator, even smaller businesses can stack these revenues to maximum benefit and participate in Demand Side Response mechanisms that would otherwise be out of reach.

Compliment and benefit from existing renewables schemes – if located behind the same meter as intermittent wind or solar generation, for example, battery storage can time-shift the energy generated by the renewables. This shift can either be away from a time at which energy might otherwise be exported from the site (peak generation or reduced demand) or to a time of use when costs are higher – or both.

Provide stand-by or emergency power – businesses can insulate their operations from power outages with behind-the-meter battery storage. Combining this with revenue and savings benefits will bring better value from a storage investment – and will be a cleaner and greener option than a backup generator.

Compliment export limitation – sites with limited export capacity can apply to the Network Operator to deploy approved export limitation technology. In these circumstances a storage system can be used, in conjunction with the export limitation device, to absorb excess energy when a generator would otherwise be curtailed or constrained off. This option can rarely (if ever) be justified financially without stacking additional revenues.

Allow business growth where grid capacity is limited – as some businesses grow and develop,

they may require access to more power on site. They may wish to increase core operations, or start charging electric vehicles on site, for example. However, the costs of increasing import capacity can include investing in reinforcing the Network Operator's network and this can cost millions. Where such costs are an obstacle to future business growth, deploying generation or storage behind the meter can help a business meet its needs without recourse to expensive grid development. Indeed, generation or storage assets can be sold or deployed elsewhere if peak power demand subsequently reduces and the investment might have represented a stranded asset.

However, beware the pitfalls of behind-the-meter storage investments. Not all sites and not all businesses have a genuine business case for a battery storage scheme behind the meter, and the miss selling of storage technology by installers is a growing problem. Behind-the-meter battery storage: the pitfalls to avoid

So far, we have talked about the many benefits of behind-the-meter battery storage for some commercial and industrial businesses and for some farms and estates. However, battery storage is not suited to all businesses or sites, and not all businesses will have a genuine opportunity or business case for a behind-the-meter battery storage scheme... yet.

Battery storage remains an expensive technology, and the risks of investing unwisely by jumping on this popular band wagon are high if you haven't done your research and correct planning first. Behind-the meter-storage is a sensible option for commercial and industrial businesses with a high, year-round demand for electricity and who are

looking to cut their energy bills and/or gain additional revenues from National Grid's response, reserve and capacity markets.

However, the technology won't suit every business. There are currently relatively narrow circumstances whereby investment in behind-the-meter storage will deliver significant financial performance. Many factors must combine to achieve a normal return on investment aspirations. These include having adequate import and export capacity on the grid at the site, sufficient base load and appropriate demand and/or generation profile to stack the revenues sufficiently. The site will also need to have historical half-hourly metering (at least a full year) with which to simulate the performance of potential storage schemes – and half-hourly metering is a must-have in order to capture many of the time-of-use-related revenues opportunities. The revenues generated from a scheme can vary widely. Modelling and stacking the revenues effectively requires considerable, niche expertise.

Grid connection and planning rarely an issue Available grid capacity and grid connection costs can limit the viability of standalone grid connected battery storage sites. However, for behind-the-meter schemes, whilst most sites will already have an established grid connection, it is important the site has sufficient export capacity as well as import capacity available. If the site does not require an increase in grid capacity, or where reinforcement work is not required, grid connection costs and fees are minimal for a behind-the-meter scheme. If the proposed storage scheme is on an existing, operational site, then planning permission is often not a significant barrier.

The noise surrounding the battery storage industry has become almost deafening now, but remember, this remains an unregulated market. The risks of being miss-sold to are high. The market is growing rapidly, and rogue installers selling the wrong technology at the wrong scale onto the wrong sites is a growing problem.

Achieving sufficient revenues and savings is hard to achieve without the right guidance. We'd caution anyone considering behind-the-meter storage to take specialist, independent advice to avoid being miss-sold and to determine if they have a genuine opportunity in behind-the-meter storage before they invest. At Roadnight Taylor, our Stop/Go feasibility study can quickly determine if you have a genuine viable opportunity to invest in behind-the-meter storage. We can then make sure you receive competing quotes for the right warranted technology from at least two of the best-performing installers, and help you select the best aggregator to deliver you the highest revenues.

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Towards the tipping point

The 2017 edition of Technology Radar has found that renewable energy was largely felt to have achieved cost parity, although hydrocarbons retained their dominant position in the global energy mix. This is a reflection of the energy transformation currently under way across the globe; as communities, businesses and organisations increasingly recognise and act upon the urgent need to decarbonise economies.

WHILST this is a global challenge and the end goal is universal, the solutions are not uniform. In fact, the best energy ecosystem for any given country depends on a set of characteristics that are specific to that nation – including the natural resources available, geo-demographics, energy demand, market design, policy, technology, public appetite and social acceptance. It needs to take into account what resources are available, how can they be harnessed, how the population and industry needs and uses power (and will in the future) and therefore how the network needs to operate and adapt.

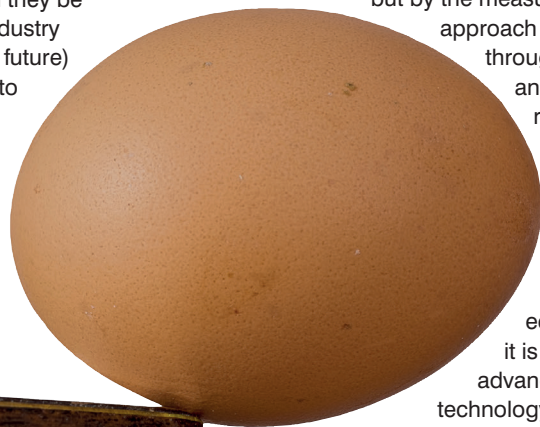
Taking this as its starting point, this research looks at the degree to which renewable energy has gained traction throughout the world – and what needs to happen to accelerate

it. Based on a large survey of renewable energy professionals across the global sector and the insights of a number of industry leaders, the research illuminates the outlook for renewable energy – and highlights the technologies that are expected to deliver the greatest impact.

We are heartened by not only the optimistic outlook, but by the measured and realistic approach that is displayed throughout the results and insights in the research. Grid transformation must be based on sound understanding of each country's individual ecosystem, and it is clear that this is advancing alongside technology, policy and investment.

If there were doubts that renewable energy sources can compete with oil, natural gas and coal in power generation, developments in the past two years should have dispelled them. According to the International Energy Agency (IEA), 2016 was a record year for renewable energy projects, which provided two-thirds of new global power capacity.

By July 2017 China, the world's biggest generator of solar photovoltaic (PV) power, had already met its 2020 target for installed PV capacity. Earlier in the



year, Germany's electricity regulator awarded bids for the country's first subsidy-free offshore wind farms; in December, the Netherlands' government followed suit. And September saw sharply reduced subsidies in auctions for similar projects in the UK, as well as the opening of the country's first subsidy-free solar PV farm.

This continuing growth of solar and wind capacity in many parts of the world, and the increasing incidence of projects involving low or no subsidies, have led some observers to proclaim the arrival of a 'tipping point' for renewables. This is the point at which one or more renewable energy sources match fossil fuels used in the grid in terms of their cost competitiveness.

Basing this sort of assertion on individual projects is a risky move. After all, every project has its own circumstances and economics, and these can differ—sometimes considerably—even within the same country. Nonetheless, tipping point predictions do provide an indicator of the progress made to date and of what is still required to reach the point where renewables overtake fossil fuels in each country's energy balance.

This 2018 edition of the Lloyd's Register Technology Radar provides an industry perspective on the challenges that need to be overcome for renewables to become the primary form of energy consumed in countries. It is based on the views of 792 senior executives from around the world who are close to their companies' renewable energy activities or renewable technology development.

As a group, they are cautious about their expectations of when renewables will overtake fossil fuels. But they are also optimistic that technology innovation in different fields will have a sizeable impact in the next five years on the performance of renewable energy generation, transmission and storage. Many eyes are fixed, for example, on the development of storage technologies. But it is important not to underestimate the cumulative impact of a series of less dramatic process improvements – especially those powered by digital technologies.

Key findings

○ **The tipping point is still in the future.**

Despite recent advances, grid parity for major renewable energy sources is still several years away for most countries. The industry expects parity for solar to be achieved earliest in China (2022/23), and for wind earliest in Germany (2024).

○ **A decisive tilt in the energy balance will take longer.**

Taken together, renewable sources are expected to surpass fossil fuels in countries' energy mixes first in Europe and North America (by 2025), in the

Middle East by 2028, and in Asia Pacific and Africa in 2033 or later.

○ **More than grid parity is needed to shift the energy balance.**

Achievement of grid parity is not by itself enough in most countries to tilt the energy balance decisively in renewables' favour. Issues with grid connection, transmission and storage often combine to limit the impact of individual projects.

○ **Technology advances can change the equation.**

Continued technology innovation could accelerate progress towards achieving grid parity. Most of the attention is on advances in solar and storage technologies that could have a big impact on performance, but these may take time before having the desired impact on cost.

○ **Technology innovation overshadows policy as a growth driver.**

Most executives believe that technology advances will do more to improve the economic case for renewables than policy or regulatory factors. But policy change remains a potential inhibitor in both developed and developing markets.

○ **Incremental advances will have an outsized impact.**

In wind energy, boosts to scale and optimised processes will be more influential in improving performance and cost-efficiency than breakthrough technologies. Larger offshore turbines and rotors, for example, and streamlined installation and maintenance practices (with the help of analytics) are expected to improve wind farm economics.

○ **Digitisation will drive performance improvement.**

Hopes are high for a favourable impact from digital technologies on renewable energy generation and transmission. For example, companies are looking to use predictive analytics, demand management and even machine learning to improve the operational performance and economics of energy transmission.

○ **Cutting innovation costs is a top priority.**

Uncertainty over returns constrains technology innovation in many firms, and this has much to do with the high costs of deployment. Better logistics and installation processes will help to ease deployment constraints.

○ **More standardisation is needed.**

In newer renewable energy technologies, such as wave and tidal, experts believe that significant improvements in economics await industry convergence around the design of key technologies.

To download your complimentary copy of the full report, visit lr.org/techradar

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Paving the sidewalks with solar

Solar Sidewalks will enable city councils to replace concrete pavements and use the electricity to significantly offset their power costs. John Halsted, the inventor of Solar Sidewalks explains how.

OTHER ORGANISATIONS likely to benefit from the installation of Solar Sidewalks© are Stadiums, Schools & Universities, Armed Forces, Hospitals, Refugee Camps & Disaster Areas, Companies and Individuals.

As far back as the Victorian era, steel frames with glass inlays were installed in pavement spaces of major cities to let natural light into basements. This type of pavement slab is still in production today and is being manufactured to the required ES and BS standards. This sidewalk (below) has been manufactured by New Age Glass of Chichester, West Sussex, England and has been installed in central London. It has a similar look to the Solar Sidewalk paver.

In the case of the Solar Sidewalk, instead of allowing light to pass into a basement, the light is trapped immediately under the surface of the sidewalk by a pad of PV cells which convert the light into electricity. Both the composite surface and the PV cells are set into a metal, or aluminium, frame for durability and strength. Electricity generated is fed into either battery storage as DC and/or inverted to AC and fed into the national grid. Unlike the Solar "Freakin" Roadway product, the Solar Sidewalk has been designed for pavement spaces only and is not for driving on. Having said this, the paver has been manufactured to a BS and EU standard which specifies it should be able to take the weight of an average family car.



The composite surface gives greater grip in inclement weather. Even though glass floors have been installed in major tourist spots world-wide, anecdotal research has shown that the public has grave concerns about walking on a surface of 100% glass, even if it is safety approved and manufactured to a national standard. The public has a valid fear of the glass becoming too slippery when wet. This fear is compounded by the fear of the glass surface shattering during a fall resulting in severe injuries.

In addition to which, the all-glass tiles have to have a non-slip layer applied to the surface. Installations in the Netherlands have found that this quickly wears out and has to be continually re-applied. The Solar Sidewalk does not suffer from this problem.

The Solar Sidewalk product is considered novel as the manner of this application has not previously been done before, nor is it being done right now; so, the opportunity to take a commanding market lead beckons.

Areas of impact:
First world applications

In a first-world environment, city and town councils will be the primary beneficiaries with their thousands upon thousands of kilometres of paved streets. The combined effect of 10,000 m² to 30,000 m² of Solar Sidewalk pavers in a city-scape will enable councils to significantly offset their electricity bills allowing them to divert freed-up funds to more critical areas e.g. Social Care.

Installing Solar Sidewalks in city spaces will also provide the infrastructure to meet, at least, the UK and EU governments drive towards electric vehicles as Solar Sidewalks will enable vehicles to be recharged at the curb side city-wide. Other devices, like mobile phones, tablets etc also have the potential for recharging at the curb side.

Other organisations likely to benefit from the installation of Solar Sidewalks pavers are:

- Sports stadia
- Schools & Universities
- Armed Forces
- Hospitals

- Refugee Camps & Disaster Areas
- Companies and Individuals to a lesser degree

United Nations Development Program (UNDP)

I am in regular contact with Helen Clark who was the Administrator of the UNDP from 2009 to 2017. She is now heavily involved in promoting renewable energy around the world and to this end has provided contact details within the UNDP. The UNDP has requested that I advise them when the product will be available as it has great potential for providing instant power to Refugee Camps and Disaster areas.

Third world applications

Not only will first world urban centres and organisations benefit, but Solar Sidewalk© pavers will also benefit Third World countries, many with enormous energy needs. Most of these countries are situated within the tropics and sub-tropics which have longer sunshine hours than countries outside this zone. The Solar Sidewalk will also benefit remote and rural communities, in some cases delivering electricity for the first time, which will have an effect on improving the quality of life in the long term.

Electricity will enable the creation of micro-industries. Remote and rural communities will in some cases receive electricity for the first time which will influence improving the quality of life in the long term. A few examples would be:

- Micro-water purification plants – delivering Clean, Drinkable Water
- The ability to install pumps and other equipment for sustainable local fisheries
- Conservation, storage, processing and packaging of fresh fruits e.g. Bananas, Papaya, Mangoes, Avocados etc.
- Improved Lighting & Heating – eliminating/reducing the need for cooking fires and heating which in turn will reduce injuries and fatalities from burns
- Improving/reducing the rate of Climate Change

Pavement access flaps



by reducing the rates of deforestation and CO2 created by burning wood. This will improve the Quality of Air / reducing air pollution, as the need to burn wood will be reduced

- With hard-surface solar paving, communities will also be able to be kept cleaner as dirt and refuse can be swept or washed away more efficiently than if on a sandy surface.

Having electricity on tap in remote communities may also encourage governments to start linking villages to their national grids as excess power can then be fed into the grid for use elsewhere in the region.

Potential earnings

Example: The City of London has a paved area of circa 20 city blocks. Using industry standard data, a standard city block 100m square, with a 2.5m width of pavement, has the potential to generate between 800 kilo watt hours (KwH) and 2,000 KwH per annum. This has been calculated after factoring in the mean hours of sunlight per day for London. Using the current Feed In Tariff, 20 blocks of London paved with Solar Sidewalk© pavers has the potential to earn London City Council between £2.1m and £3.1m annually.

NOTE: This will vary depending on sunlight hours received. Tropical installations will realise greater power generation and hence, savings.

As opposed to selling the Solar Sidewalk for a one-off “bite at the cherry”, it is proposed that the product is manufactured and installed at no cost to the councils with a profit share of the funds generated and/or avoided. This revenue model has been chosen for 2 reasons:

1. Councils do not have funds to spare – even if it could save them money.

2. This model gives rise to earnings in perpetuity as opposed to receiving “one bite of the cherry” at time of sale.

It is proposed that the profit share commences with a high percentage, say 75%, being paid to the company which will pay for the manufacture and installation. Thereafter, it is planned that the share percentage would reduce from 75%, by 5% per annum, to a minimum of 10% to 15% which would remain in place in perpetuity. The lower end would realise the company between £50m and £75m p.a. in perpetuity. Considering there are circa 4,400 large cities and circa 380,000 large towns in the world (source: Wikipedia) the potential annual earnings are considerable.

Overall technical impact

With hundreds of thousands of square kilometres of Solar Sidewalk© Pavers generating thousands of Kilowatt Hours (KwH) per day, the need to build bigger power stations will be reduced. In addition, power distribution costs are reduced because electricity will be generated locally. Juliet Davenport, CEO of Good Energy and many others in the renewable markets, believe the days of large power stations are nearing their end. This is something I also firmly believe and it is one of the reasons why I have invented two renewable energy products; to help meet this demand.

Project’s current development stage

A prototype/proof of concept has been developed (see below).

This prototype was used in a video segment recorded by the BBC1 and broadcast on BBC1 on 8 December 2017 – see <https://www.facebook.com/solarsidewalks/videos/1775638659404504>

This Prototype was not to prove the solar cells worked, but rather to show that the paver surface would not fail if walked upon, which is clearly shown in the video.

As previously mentioned the output can be connected to a DC/AC inverter or to a DC Battery Storage unit.

Next steps: Phase 2 – pilot site

£60,000 is required to assemble and install 25 pavers in a pilot site. The site will be run for 6 months during which time output from the pilot site will be metered and recorded so that accurate performance data can be collected. As the site will be in a commercial environment, it is expected to create an income stream from the electricity generated.

The PV cells are provided by UPV Solar of Tamil Nadu, India. Assembly will be done by John Halsted and Andrew Wallis of Redwood Electrical

Solar sidewalk (C) test bed



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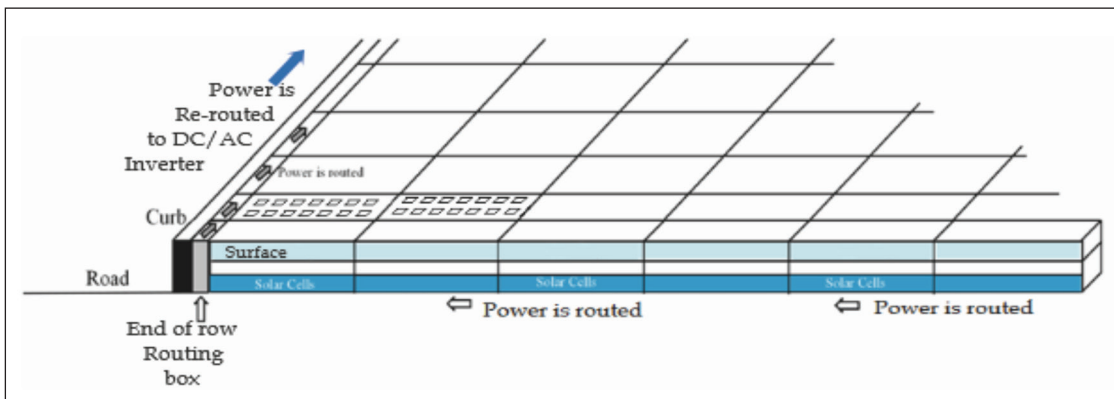
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Early system design

with installation being carried out by Andrew Wallis of Redwood Electrical, Camberley –www.redwoodelectrical.co.uk The company has been assessed and accredited by the NICEIC, (the Nation Inspection Council for Electrical Installation Contractors) the ECA (Electrical Contractors Association) and is a Which? Trusted Trader.

Each paver currently costs approx £1,200 to assemble. The bulk cost is the paver surface and frame, provided by New Age Glass, Chichester. Discussions are ongoing with New Age Glass, regarding discounts for bulk orders. We have identified the following as potential locations of a Pilot Site - Poundbury, Reading University, Reading City Council or Wokingham City Council or a local charity in need of financial release. We are also open to suggestions from investors.

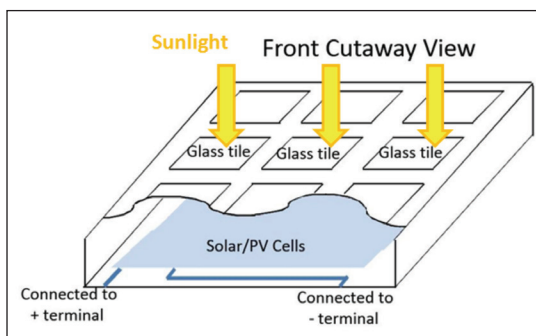
Phase 3 - International rollout

While the Pilot is being run, planning will commence for an international rollout. The product launch will be in the UK, Ireland and Europe.

Thereafter we are proposing launching in Brazil as Brazil has a positive renewable energy program and policies in place. Brazil is the “powerhouse” of South America and would be a good base for assembly and exporting and installing to other South American countries, most of which have long sunlight hours. In addition, we already have a person on the ground in Brazil. Mr Jonathan Nunn is a UK citizen and a colleague who moved to Brazil approximately 3 years ago. He has already been conducting work on the project’s behalf.

Thereafter I propose the product is launched in turn in India, China, Africa and Australasia. It is estimated that £500k will be required to launch and install the product in the UK and Europe and that a further £500k will be required for each subsequent continental launch.

However, as the income generated will occur from Day 1 of installation, it is likely that the income will be realised within 30 to 60 days. This income will be used to offset the required costs of subsequent launches.



Early paver design

Product design

The initial product was designed so that individual pavers could be plugged together like Lego® blocks with DC current being passing through each from one to the next. This design would also allow for easy expansion of any implementation. It would have also meant quick and simple maintenance of pavers. Unfortunately, this design was not used because the technology to enable the easy passing of the current from one paver to the next has not yet been designed. The design has instead progressed to that shown in the prototype images (see above). However, the “plug and generate” design has not been discounted as a future development, if only because of its simplicity.

Initial product designs

The combined output from the Solar Sidewalks© will be routed to an inverter, with the DC current converted to AC. This in turn will be fed into the mains system which usually runs under city streets. An alternative is to use a proportion of the electricity to top up a battery storage system which can be used to charge electric vehicles.

Intellectual property

The product has been granted a Patent Pending status for the Solar Sidewalk – ref Application Number 62/496,554. The product will not be using patents of products from other companies as Solar Sidewalks© will be providing the specification and each of the providers company will be producing a part of the final product.

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Irish Solar Energy Association



Who Are We?

The Irish Solar Energy Association (ISEA) was founded in May 2013. ISEA is committed to bringing attention to the value of solar energy's contribution to Ireland's economic and environmental future. ISEA will contribute to the development of viable renewable energy policies that support solar in Ireland including lobbying activities, conferences, and other forums that bring key stakeholders together to shape policy.

Solar is a rapidly developing technology that simultaneously combines minimal impact on the environment with maximum benefit. Solar is forecast to become the most economically viable renewable energy source globally in the coming years.

ISEA recognises the potential for solar in Ireland and will work tirelessly with our members to promote solar, not only as a means for meeting Ireland's renewable energy and electricity targets, but as a long-term sustainable and clean option with numerous benefits for Ireland economically, socially and environmentally.

Our Mission

- Work to influence government policy on renewable energy
- Work with members to provide industry evidence to government to inform policy
- Champion solar to investors, policy-makers and the public to educate and inform them on the benefits of solar

Benefits

- Grid Connection Group
- Groundmount Policy Group
- Rooftop Policy Group
- Planning Policy Group
- Standards and Training Group

For more information or to apply for membership visit us online at www.irishsolarenergy.org

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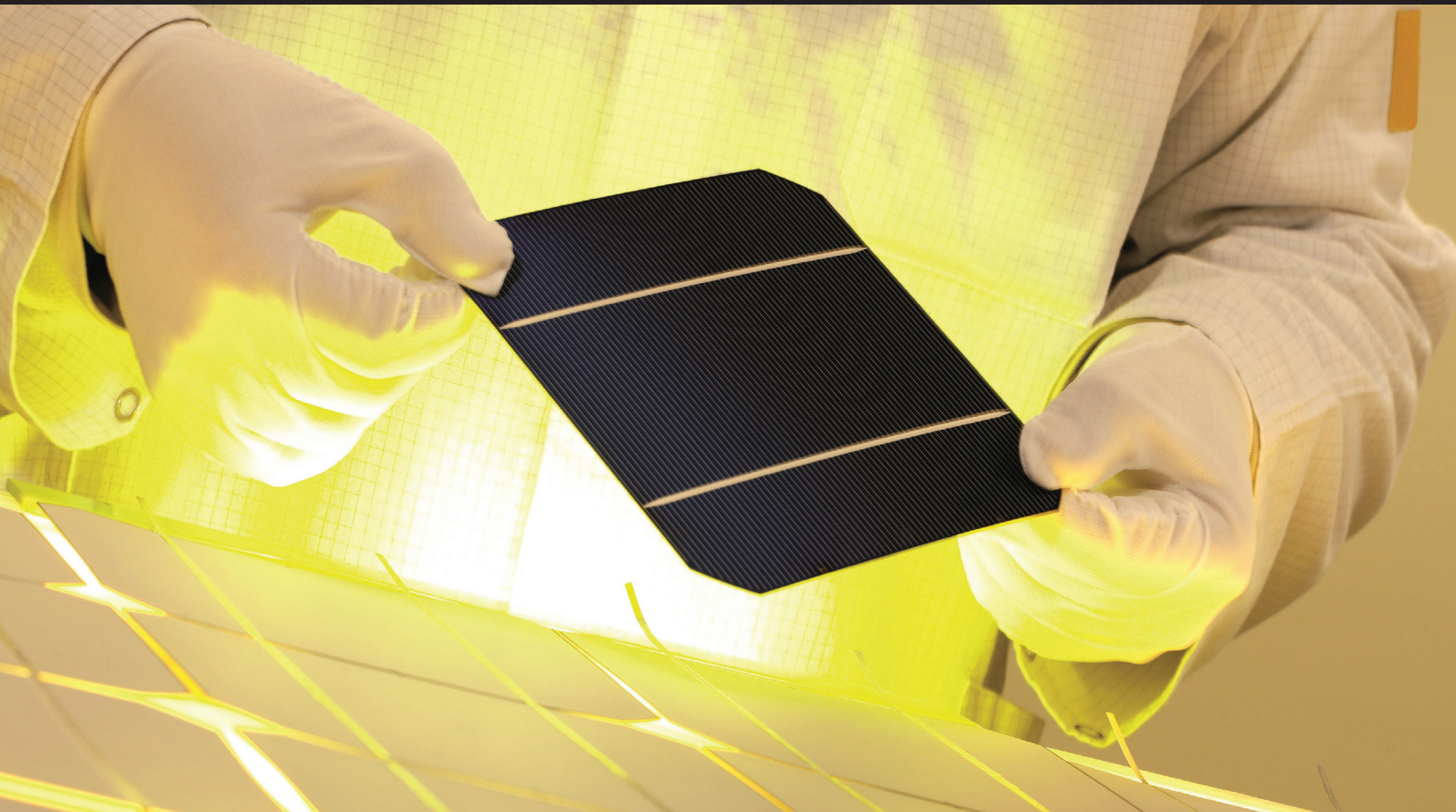
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European solar success: We need education and innovation

The phenomenal global success of solar has been driven by innovation in the last decade. But there is one key driver that will be crucial to unlocking more solar success in Europe: Education!! Emilien Simonot, renewable energy technology officer at InnoEnergy discusses the need to broaden skills and knowledge.

THE STORY of solar photovoltaics (PV) in Europe has progressed at a breathless pace in recent years. For example, while in 2005 solar contributed just 0.3 per cent of all electricity generated across the EU-28, by 2015 that figure had risen to 11.2 per cent. This is rightly celebrated, and industry commentators wonder how much further solar can go, speculating on topics such as falling cell costs and the integration of storage.

These are good and worthwhile things to talk about. Solar's success has been driven by innovation and we need that to continue. But there is one conversation we are not having in Europe (or at least, are having too quietly) that will be crucial to unlocking more solar success: we need to talk about education.

Solar's today and tomorrow

Solar panels are no longer new. Solar is considered to be a mature technology and many Europeans will be familiar with images both of large solar farms and rooftop installations at both the commercial and domestic scale. They are no longer a rare sight. But nor are they as common as they can be, or – in my opinion – as they should be. Solar energy has the potential to be one of the most widely available and cheapest sources of energy in society. Solar electricity generation overtook geothermal energy in 2008, but it has the potential to overtake natural gas, coal and nuclear too. The solar industry should be aiming for nothing less than a paradigm shift.

Partially this will be enabled by new technology.

Building-integrated photovoltaics (BIPVs) promise us new solar technologies integrated into buildings and materials – such as windows or roofing tiles that also generate energy. Energy storage also promises to change the game, helping asset owners and operators get the most out of their assets and avoid wastage. However, the potential impact these technologies can have will be hampered if we do not get some of the ‘soft’ challenges of solar right – the same ones preventing even broader uptake of today’s technology.

Soft problems, hard to solve

The challenges in bringing a solar project to life now are often not financial ones. Instead, companies are finding themselves getting stuck on all the elements around the project. For example, two key examples are regulation and the technical aspects of managing a solar asset.

Take regulation: not only do you have all the normal planning permissions and network codes that are applicable to any energy asset, you have a new set of challenges with the rise of distributed renewable energy. For example, if someone is a prosumer – an end user who produces their own energy (with solar) and sells it to, as well as takes it from, the grid, what are the rules around payments? Does this asset owner have to contribute in some way to broader transmission costs (which they may not use directly, but benefit from in terms of security of supply)? These are complicated matters that require expertise. The same goes for the installation and ongoing management of solar assets, especially larger ones. A new breed of solar asset management companies is emerging to support the sector here, but there is still a deficit of knowledge in the industry when it comes to ongoing management and reassessment of the business case for solar.

In Europe, this knowledge is absolutely vital, as the requirements change from country to country. Take Germany and France, both economically powerful Western European countries which share a border and a currency. The cost of a panel is identical or near-identical in each market. However, in France where the market is less mature, the total cost of a rooftop installation could be as much as four times more – all down to the so-called ‘soft’ costs. For energy companies looking to capitalise on market opportunity across Europe – and potentially beyond – the knowledge to navigate these differences can be the divide between success and failure.

The need for fast and effective education

These skills will undoubtedly evolve organically within the energy industry. Indeed, they already have. However, progress is nowhere near fast enough or wide enough.

We cannot wait for the next generation of talent – those who grew up in a solar age – to come through

and take leadership positions. We need today’s energy industry – from asset operators to executives – to understand the solar market. To get the business case, to be able to steer through regulation and to have clear sight of the future where solar has disrupted traditional models even more than it has done so already.

In essence, we need education. And we need it in a form that is able to reach those already entrenched in the workplace, who need support to better do their jobs. Traditionally, this might have been done via seminars or workshops, sending people into offices to instruct a handful of learners.

Given the pace and scope of solar’s proliferation across Europe, that is too slow and too piecemeal. Instead, we must look to modern learning models that are reinventing how we can learn and grow throughout our careers. Massive Open Online Courses (MOOCs) are a key innovation here. They combine the flexibility of the Internet with the institutional expertise of top universities and professional organisations. Courses can be collaborative, interactive and fit around a professional’s existing (no doubt busy) schedule. Furthermore, as the classrooms are virtual, there are no space or geographic constraints on participation.

At Innoenergy, we have partnered with Enerclub to provide just such a course, available both through our own portal and on FutureLearn. We hope to help unlock Europe’s solar innovation potential through exactly this type of education.

So, let us talk. Let us talk about the need to broaden skills and knowledge in the energy industry to deal with and thrive on the influx of solar power into our energy mix. Let us talk about education and how it can help foster innovation and guide us towards a cleaner energy future. And, finally, let us talk about what kind of education can help us get there.

InnoEnergy works across disciplines and borders to support Europe’s energy future. Describing itself as, the innovation engine for sustainability across Europe, InnoEnergy fosters education, discovery and business creation services to launch new companies as it works with inventors and industry, graduates, employers, researchers and businesses of all sizes for the long-range benefit of EU citizens.

Publisher’s Note: *This is the first instalment in a two-part series from InnoEnergy. In the next edition of Solar+Power Management, we will explore the evolution of Smart Cities and ways that urban planners can engage public support and better utilize data to benefit all residents.*

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Emilien
Simonot,
renewable
energy
technology
officer at
InnoEnergy



Price capturing:

French renewables' new hobby?

In this second feature dedicated to the entry of French renewables into the electricity market, we focus on a risk specifically related to the new Contract-for-Difference (CfD) mechanism: project captured price deviation. Everoze pose the question: Is the captured price a relevant indicator and should one take it into account for a project? The answer is yes.

AS INTRODUCED in the first feature, the CfD mechanism protects renewable projects from market price variations. Indeed, the contract terms consist in giving (or taking) to the project the difference between a reference tariff and a reference market price (also called M_0 , expressed in €/MWh).

The reference tariff is determined through different processes depending on the project's nature and the CfD award process. But what about the reference market price?

First of all, the reference market price is calculated on a monthly basis so that a given project will receive each month the following CfD revenue (see table below):

Furthermore, M_0 is defined for each technology (on the national scale) as the price captured on the day-ahead wholesale market within each month. The *Commission de Régulation de l'Énergie (CRE)* is in charge of publishing two values of M_0 on

a monthly basis: one for the solar industry and one for the wind industry.

Finally, the captured price refers to the average market price weighted of the hourly production (see table bottom left):

It must be noted here that the captured price so defined is intended to be a metric of the value of a project's production if entirely traded on the day-ahead market; the most liquid spot market. In practice, the party responsible for trading production on the market may apply a different trading strategy, involving forward sales, and day-ahead / intra-day spot sales. Hence, they will achieve a different price. However, the captured price metric so defines remains a good indication of how the specific value of a project's production.

Project captured price deviation

Each project gets compensated for the difference between the market and the reference tariff. So, what's the problem?

As one might have foreseen, the M_0 , as related to a technological sector as a whole, has no mean to match an individual project's day-ahead captured price (also called M_p). The following graphs illustrate how the captured price can differ for a given market price profile and a given



$$R_{CfD} = (T_e - M_0) * P$$

R_{CfD}	the overall project's revenue from CfD	[€]
T_e	reference tariff	[€/MWh]
M_0	reference monthly market price	[€/MWh]
P	project's monthly production	[MWh]

$$M_0 = \left(\sum_{h \in month} T(h) * P_{tech}(h) \right) / \left(\sum_{h \in month} P_{tech}(h) \right)$$

$T(h)$	day-ahead market price at hour h	[€/MWh]
$P_{tech}(h)$	technology (wind or solar) national production at hour h	[MWh]

production amount. Therefore, the specific shape and seasonality of the project's production profile will influence its captured price and will determine its deviation regarding the national value (Mp vs $M0$).

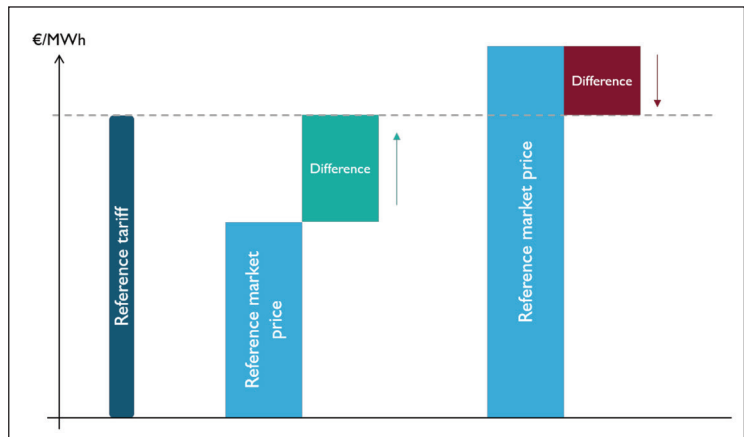
What drivers?

As concluded above, each production profile and seasonality will lead to a unique specific project captured price [1]. Therefore, any parameter likely to modify this profile will have an impact on the Mp value.

For instance:

- Local resource profile
- Project power curve (technology specific)
- Curtailments (noise, birds, bats, shadow, grid, ...)
- Maintenance strategies
- Failures

Due to market price variations, operational events and strategies such as curtailments, scheduled and



unscheduled maintenance, or even performance enhancements, can have a significant impact on the captured price.

The charts illustrated how this can apply for a wind project subject to a curtailment at night.

Figure 1: French Contract-for-Difference mechanism principle

In the case of solar, a good example is the impact of tracker systems on PV plants. By modifying the power curve, they not only improve the power output, but also push the captured price up.

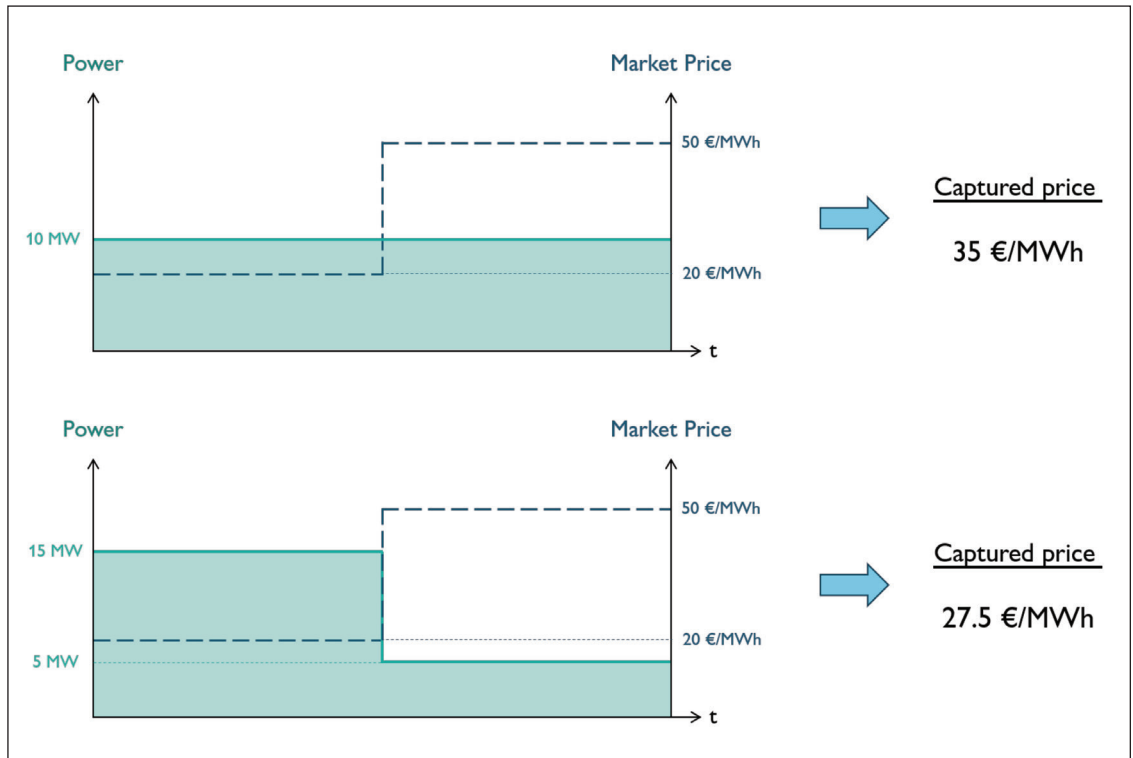
A *Statkraft* study of the German market in 2016, concluded that PV plants equipped with tracker technology captured an additional 0.5 €/MWh compared to fixed systems.

On the other hand, and quite obviously, the local resource profile is the major driver for the production profile (for a given technology), and regional trends can already be observed. On this matter, Everoze has developed a deviation model for onshore wind projects in France, based on historical data [2]. As a result, an estimation of the average relative deviation to $M0$ in each region of France could be calculated, which is illustrated below for wind energy:

From a market price capturing perspective,



Figure 2: For a given produced amount of energy, the production profile can lead to a different captured price



we can see it is more interesting – on a historical reasoning – to have projects in *Occitanie* (up to +5%) than in the *Hauts-de-France* (down to -2.5%). Indeed, projects located in this southern region of France, tend to have a different wind regime than in the North, making them produce more when market prices are higher.

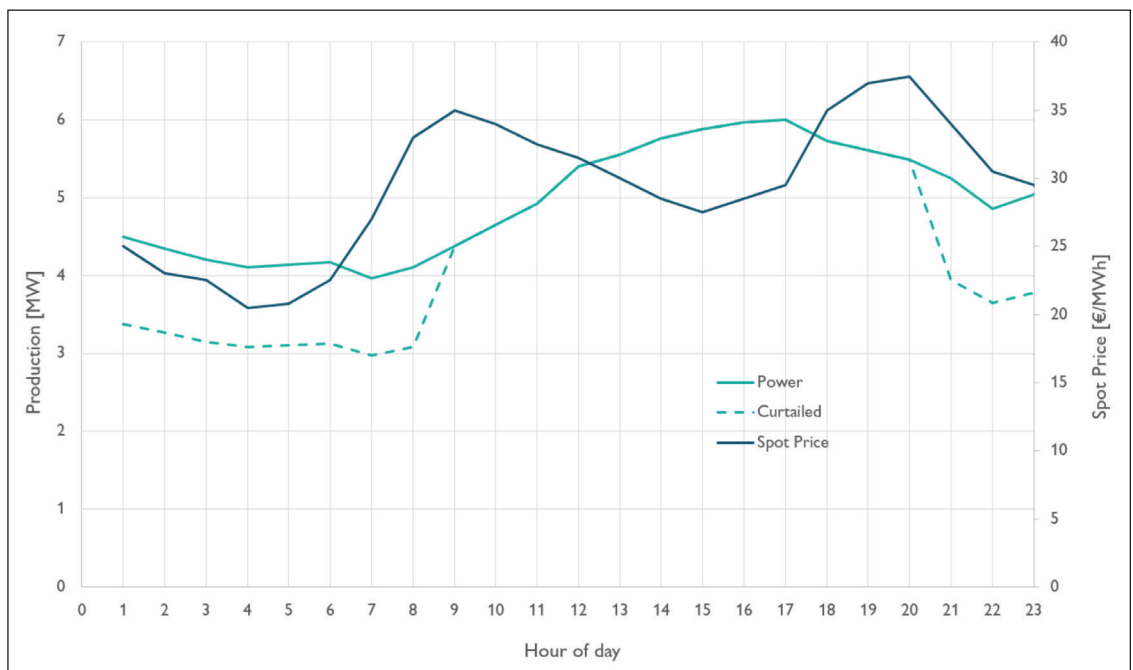
At the end of the day, projects with a positive deviation to *MO* will receive directly or indirectly more

than the reference tariff than the ones with a negative deviation:

How can all this affect a project individually?

In fact, these local trends are taken into account by the players the most directly involved in the marketing of the projects' production: the aggregators. Indeed, the aggregation contract will generally include the *MO* parameter through

Figure 3: Example of a night curtailment impact on captured price



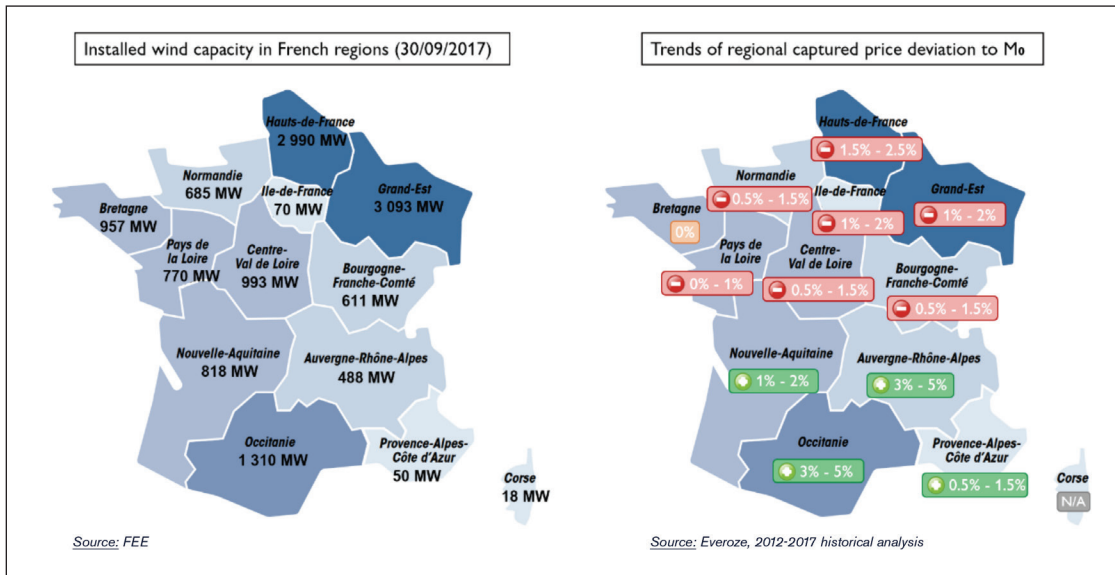


Figure 4: Everoze's historical analysis shows regional captured price deviation trends

a tariff for each MWh sold on behalf of the producer defined as:

An aggregator will define A's value based on the project's specificities including expected captured price. In broad terms, to cover the cost and risk of captured price deviation, the smaller the Mp relative to M0, the bigger the aggregation fee A. This means that the sponsors have a direct interest in getting a sense on deviations from M0. If the aggregation contract does not involve the M0 parameter, this assessment is also essential.

Are we done?

Captured price deviation is a notable risk regarding the revenue of renewable projects selling on electricity markets. Even more since the integration of an increasing proportion of renewables in the system will likely amplify this trend.

As mentioned previously, a brand-new player as arrived in town, eager to bear this risk on captured price deviation: the aggregators. However, it would

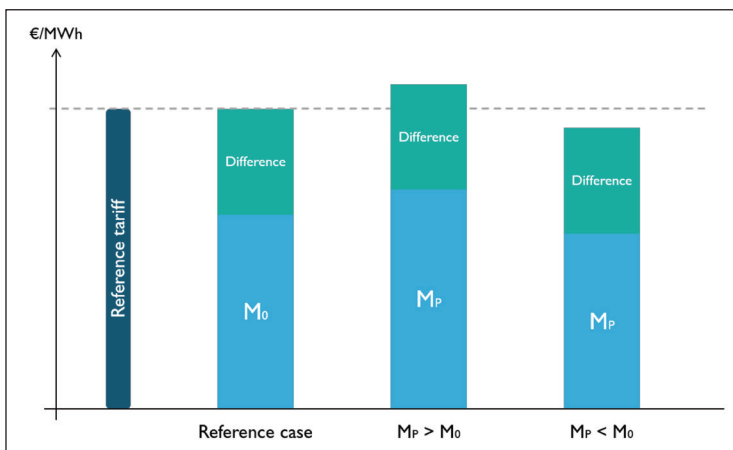
be wrong to consider that aggregators allow projects to be risk free regarding their merchant nature. Indeed, their key role as intermediary and facilitator on the electricity markets will necessarily have an impact on the way renewable power projects sell their production, bringing along new kinds of risks. Everoze is an employee-owned renewables and

		$M = M_0 - A$
M	tariff collected by the producer	[€/MWh]
A	aggregation fee (positive or negative)	[€/MWh]

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Figure 5: Following its captured price, a project may receive more or less than the reference tariff for each MWh produced



Further reading

[1] This blog focuses on the day-ahead electricity market, since it is the basis for the CfD mechanism and that most volumes are traded on this market. Of course, renewable power projects can benefit from other revenue streams such as the intra-day markets or PPAs, which can influence the "real" captured price.

[2] Day-ahead market prices and wind power production data on the 2008-2017 period.

Big boost

for energy storage research

Four projects awarded to ignite a revolution in UK battery research, and address battery challenges faced by industry.



THE FARADAY INSTITUTION has announced up to £42 million in new government funding to four UK-based consortia to conduct application-inspired research aimed at overcoming battery challenges to accelerate the electric vehicle (EV) revolution.

If successful, this research will put the UK on the map as being at the forefront of battery technology worldwide. It has the potential to radically increase the speed with which we are able to make the move to electric vehicles, as well as the speed with which we can decarbonize our energy supply, with obvious benefits to the environment.

The Faraday Institution is the UK's independent national battery research institute, and was established as part of the government's £246 million investment in battery technology through the Industrial Strategy. Its formation was announced in October 2017 by the Business Secretary Greg Clark. The Faraday Institution's goal is to make the UK the go-to place and world leader for battery technology research and it has a clear mission to ensure the UK is well placed to take advantage of the future economic opportunities from this emerging technology.

Business Minister Richard Harrington said, "With 200,000 electric vehicles set to be on UK roads by the end of 2018 and worldwide sales growing by

45 per cent in 2016, investment in car batteries is a massive opportunity for Britain and one that is estimated to be worth £5 billion by 2025.

"Through our flagship Industrial Strategy and its Future of Mobility and Clean Growth Grand Challenges, we are committed to making Britain the 'go-to' destination for the development and deployment of this game-changing technology. "Government investment, through the Faraday Institution, in the projects announced today will deliver valuable research that will help us seize the economic opportunities presented by battery technology and our transition to a low-carbon economy."

The topics for the four projects were chosen in consultation with industry, who will partner closely with each of them. This unique collaboration will help to ensure that the research is producing findings and solutions that meet the needs of business. In addition, industrial partners will contribute a total of £4.6 million in in-kind support to the following four projects:

Extending battery life – Led by the University of Cambridge with nine other university and 10 industry partners, this project will examine how environmental and internal battery stresses (such as high temperatures, charging and discharging rates) damage electric vehicle (EV) batteries over time. Results will include the optimization of battery



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Electric vehicle charging station in public space. The charging spot support by solar panels, storage batteries

materials and cells to extend battery life (and hence EV range), reduce battery costs, and enhance battery safety. With Cambridge, university partners include University of Glasgow, University College London, Newcastle University, Imperial College London, University of Strathclyde, University of Manchester, University of Southampton, University of Liverpool and University of Warwick.

Battery system modelling – Imperial College London (ICL) will lead a consortium of six other university and 17 industry partners to equip industry and academia with new software tools to understand and predict battery performance, by connecting understanding of battery materials at the atomic level all the way up to an assembled battery pack. The goal is to create accurate models for use by the automotive industry to extend lifetime and performance, especially at low temperatures. With ICL, university partners include University of Southampton, University of Warwick, University of Oxford, Lancaster University, University of Bath, and University College London.

Recycling and reuse – A project led by the University of Birmingham, including seven other academic institutions and 14 industrial partners, will determine the ways in which spent lithium batteries can be recycled. With the aim to recycle 100% of the battery, the project will look how to reuse the batteries and their materials, to make better use of global resources, and ultimately

increase the impact of batteries in improving air quality and decarbonisation. With Birmingham, university partners include the University of Leicester, Newcastle University, Cardiff University, University of Liverpool, Oxford Brookes University, University of Edinburgh, and the Science and Facilities Technology Council.

Next generation solid state batteries – The University of Oxford will lead an effort with six other university partners and nine industrial partners to break down the barriers that are preventing the progression to market of solid-state batteries, that should be lighter and safer, meaning cost savings and less reliance on cooling systems. The ambition of this project is to demonstrate the feasibility of a solid state battery with performance superior to Li-ion in EV applications. With Oxford, university partners will include the University of Liverpool, University of Glasgow, University of Strathclyde, University of Cambridge, University College London, and the University of St. Andrews.

Peter B. Littlewood, founding executive chair of the Faraday Institution, said: “To deliver the much needed improvement in air quality in our cities and achieve our aspiration for cleaner energy targets we need to shift to electric vehicles quickly. These research programmes will help the UK achieve this. To be impactful on increasing energy density, lowering cost, extending lifetime, and improving battery safety requires a substantial and focused

effort in fundamental research.” He went on to say that “Through steady investment in basic research on specific societal challenges identified by industry and government, the UK will become a world-leading powerhouse in energy storage. “

Professor Philip Nelson, EPSRC’s Chief Executive, said: “There is an urgent imperative for us to increase the efficiency of energy storage as we move towards low carbon economies and attempt to switch to clean methods of energy production.

“The Faraday Institution will bring leading academics in the field of battery development together with industry experts to explore novel application-inspired approaches that will address the challenges we face. The UK has an opportunity to accelerate the development of new products and techniques. EPSRC will be working with the Institution and the academic community to help it succeed and keep the UK a prosperous and productive nation.”

Richard Catlow, Foreign Secretary of the Royal Society and professor at University College London, said: “Using more electricity will be key in reducing greenhouse gas emissions. Last year the European Academies Science Advisory Council found that advances in large-scale electricity storage is a priority to manage our increasing dependence on renewable energies. The Royal Society welcomes the Faraday Institution’s much needed investment in energy storage research.”

The Faraday Institution is the UK’s independent, national institute for electrochemical energy storage science and technology, supporting research, training, and analysis. Bringing together expertise from universities and industry, The Faraday Institution endeavours to make the UK the go-to place for the research of the development, manufacture and production of new electrical storage technologies for both the automotive and the wider relevant sectors. The first phase of the Faraday Institution is funded by the Engineering and Physical Sciences Research Council (EPSRC) through the government’s Industrial Strategy Challenge Fund (ISCF). Headquartered at the Harwell Science and Innovation Campus, the Faraday Institution is registered charity with an independent board of trustees. To learn more, visit faraday.ac.uk and follow @FaradayInst on Twitter.

The Industrial Strategy Challenge Fund (ISCF) builds on the UK’s world-class research base and delivers the science that business needs to transform existing industries and create new ones. It accelerates commercial exploitation of the most exciting technologies the UK has to offer the world to ensure that scientific investment truly delivers economic impact, jobs and growth right across the country.

The ISCF is delivered by InnovateUK and Research Councils UK (RCUK), and eventually UK Research

and Innovation, the single voice for the UK’s research and innovation landscape. The ‘Faraday Battery Challenge’ is to develop and manufacture batteries for the electrification of vehicles – £246 million over four years – to help UK businesses seize the opportunities presented by the move to a low carbon economy. The challenge will be split into three elements: research, innovation, and scale-up. It is among the first of six investment areas announced by the government to be funded through the Industrial Strategy Challenge Fund.

The Engineering and Physical Sciences Research Council (EPSRC). As the main funding agency for engineering and physical sciences research, our vision is for the UK to be the best place in the world to Research, Discover and Innovate. By investing £800 million a year in research and postgraduate training, we are building the knowledge and skills base needed to address the scientific and technological challenges facing the nation. Our portfolio covers a vast range of fields from healthcare technologies to structural engineering, manufacturing to mathematics, advanced materials to chemistry. The research we fund has impact across all sectors. It provides a platform for future economic development in the UK and improvements for everyone’s health, lifestyle and culture. We work collectively with our partners and other Research Councils on issues of common concern via Research Councils UK. www.epsrc.ac.uk The Science and Technology Facilities Council (STFC) is keeping the UK at the forefront of international science and tackling some of the most significant challenges facing society such as meeting our future energy needs, monitoring and understanding climate change, and global security.

The Council has a broad science portfolio and works with the academic and industrial communities to share its expertise in materials science, space and ground-based astronomy technologies, laser science, microelectronics, wafer scale manufacturing, particle and nuclear physics, alternative energy production, radio communications and radar. STFC operates or hosts world class experimental facilities including in the UK the ISIS pulsed neutron source, the Central Laser Facility, and LOFAR, and is also the majority shareholder in Diamond Light Source Ltd. STFC enables UK researchers to access leading international science facilities by funding membership of international bodies including European Laboratory for Particle Physics (CERN), the Institut Laue Langevin (ILL), European Synchrotron Radiation Facility (ESRF) and the European Southern Observatory (ESO). STFC is one of seven publicly-funded research councils. It is an independent, non-departmental public body of the Department for Business, Energy & Industrial Strategy (BEIS). <http://www.stfc.ac.uk>

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