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Issue I 2016
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Scottish want renewables made a priority

RENEWABLES has come out top of a new poll that asked people in Scotland which energy source the next Scottish Government should prioritise.

As Scotland heads to the polls on May 5, the YouGov survey asked more than 1,000 respondents whether the next government should prioritise the continued development of renewables, extend the life of fossil fuel plants, use shale gas or build new nuclear power stations.

70 percent of those polled want to see more renewable energy such as wind, solar, wave and tidal, and two-thirds agreed that the next government should "continue to take forward policies that tackle greenhouse gas emissions and climate change". Only 19 percent said the next government should prioritise the use of fracking for shale gas while 42 percent said they should not prioritise building new or extending the life of fossil fuel power stations. 33 percent support new nuclear power plants being treated as a priority.

Niall Stuart, Chief Executive of Scottish Renewables, said: "The poll suggests that the people of Scotland continue to be strongly behind the growth of renewable energy, with support for the sector way ahead of any other.

"Just months after the Paris climate change agreement, the poll also shows clear support for Scotland's next government to prioritise policies to reduce greenhouse gas emissions."
When asked about their own household energy needs, respondents were given the option of picking from a list of renewable energy devices they would consider installing in or around their own homes. The most popular response was for solar PV panels (39 percent) followed by solar thermal panels (36 percent), wind turbines (21 percent), biomass boilers (20 percent), heat pumps (20 percent) and then small-scale hydro turbines (13 percent).

Of those who indicated they already had a renewable energy device installed, solar panels were most commonly featured along with biomass boilers and heat pumps.

Mr Stuart added: "While only 4 percent of the sample has small scale renewables at home, there is clear appetite amongst householders to generate their own renewable energy. More than a third of those surveyed saying they would consider solar panels to power or to heat their homes, and 20 percent interested in installing a wind turbine or biomass boiler.

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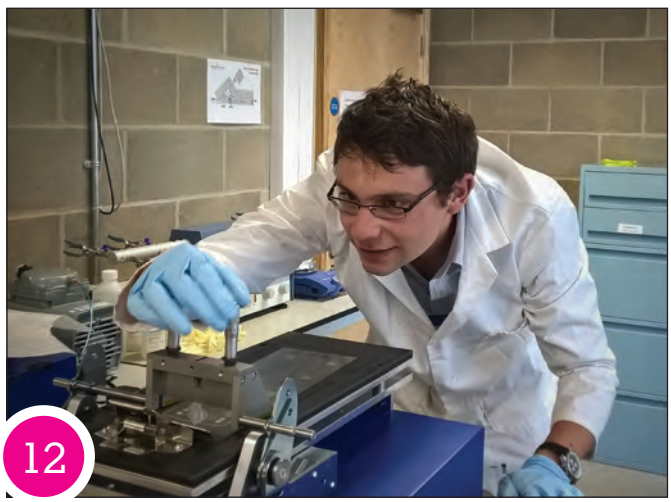

Plans for largest solar farm in Wales submitted

A PLANNING APPLICATION has been submitted for the largest solar farm to be built in Wales. Plans for the 49.9MW scheme at Llanbadrig in Anglesey have been submitted on behalf of Countryside Renewables (North Anglesey) Ltd by Bilfinger GVA.

The scheme will generate sufficient renewable energy to power approximately 15,500 homes on an annual basis – this is equivalent to half of Anglesey's homes. The CO2 savings over the 30-year lifetime of the project will be 612,000 tonnes, the equivalent of taking nearly 14,000 cars off the road.

To be developed on 220 acres of agricultural land, which will continue to be used for grazing, the scheme includes extensive mitigation in the form of landscape and biodiversity enhancements.

The installation will also be the first in Wales of a new generation of cutting-edge solar photovoltaic projects that includes an option for battery storage. This capability enables the project to be a "peaker plant," storing electricity generated during the day and releasing it at times of peak demand.

Battery storage smoothes the project's output, avoiding the intermittency of current-generation renewable energy projects. This storage option combined with the economies of scale from the size of the project allow it to deliver the best balance of DECC's three objectives of secure, clean and affordable energy supplies. The application site was chosen given its high irradiation, inconspicuous location, proximity to a grid connection and limited visual impact. The location of the site was carefully selected using a top-down approach and extensive assessment of all of Anglesey. Irradiation at the site is in the top 20 percent of the UK and in the top 5 percent of Wales.

The development is entirely in line with planning policy at the local and national levels, and the aspirations and objectives of the Energy Island Programme. Ben Lewis, energy specialist at Bilfinger GVA in Cardiff says, "This solar farm will be a landmark development, not just because of its capacity, but also its efficiency thanks to new storage technology.

The size of the project allows it to make a meaningful contribution to energy generation in Wales and the UK, whilst complying with best practice guidelines to have minimal environmental and visual impacts on the surrounding landscape.

"If determined, the development will add greatly to Wales' projections for renewable clean energy provision and help meet the targets set in the Welsh Government's Climate Change Strategy for Wales to reduce emissions of greenhouses gases by 40 percent by 2020.

Autarco solar modules now manufactured in Europe

THE DUTCH PV system brand Autarco have announced that all monocrystalline solar panels for the European market will now be manufactured in Poland. This shift in production from China to Europe, the company believes will enable them to further differentiate within the marketplace.

Autarco are one of the few brands within the solar market that has switched exclusively to European manufactured panels with most competitors still selling Chinese or Asia manufactured panels. Roel van den Berg, founder and CEO of Autarco said: "I like to sell a European product. People feel more comfortable because they are assured of a well finished product from a reliable factory. Moreover, we can offer a truly high-end product to the market." Our European panels have the darkest shade of black cells available and are made in a fully automated, Polish factory which is cutting edge. Autarco's micro-inverters are also manufactured in Europe, as are all our various mounting solutions.

The import duty on Chinese solar panels is another important consideration for Autarco's shift to Europe. Many European political parties declared that the import duty is slowing down the potential of the European solar sector. Earlier Autarco wrote a much debated Dutch opinion article about this statement. Their main message is that the import duty is an opportunity for Europe to compete with China. Van den Berg explains: 'Our European panels are 285 and 335 watt peak. In China they rarely use these very efficient cells, because it's all about volume, volume, volume. All production lines have to be working to full capacity. Innovation has a subordinate role."

ABB string inverters to get Shropshire farm performing

THE FIRST solar power plant in the UK to use the new ABB PRO-33 string inverters is set to produce 900,000 kWh a year at a farm in Shropshire.

The Priest Weston project uses nearly 4,000, 250 Wp solar modules, arranged into 166 individual strings. A total of 28 ABB PRO-33 string inverters are mounted in four groups on the backs of the rows. The plant was built by solar power company Westflight Energy, which specialises in designing, building and commissioning renewable energy solutions for farmers and landowners.

Owner of Westflight Energy Chris Brooks says: "I wanted to use string inverters rather than central inverters because this is a low voltage site and central inverters are more suitable for 11 kV sites with powers of around 4 to 5 MW.

"I usually use another vendor's inverter but I was persuaded to try the ABB PRO-33 and have found it to be an excellent product. The Aurora Vision monitoring system is the best I have used and the offer is very competitive. Another major attraction for me is the fact that ABB is a global brand."

ABB's three-phase PRO-33 string inverter is designed for medium and large de-centralised photovoltaic (PV) systems, either on large scale commercial and industrial rooftops or ground-mounted PV plants such as Priest Weston. The single maximum power point tracker is suitable for this type of uniform-shaped PV plant, with long strings connected to the inverter. As commercial PV plants get larger, installing the 33 kW, PRO-33 allows more PV modules to be connected in series to each inverter. This means that fewer inverter units are needed, cutting cabling costs and installation time.

This contributed to the short build time of the project, with the entire plant installed in eight weeks.

The PRO-33 incorporates a built-in string combiner box. This includes a DC switch,

string current monitoring with alarm, PV fuses and monitored surge protection devices, reducing the need for costly external devices. The inverter is also protected to IP65, making it suitable for continuous service at outdoor sites.
A major attraction for Westflight Energy is the complete electrical connection package provided by ABB's system integration partner Barrett Energy, which installed the low voltage connection to the supply grid and sub-distribution connection to the inverters. It also provided its expertise on issues such as electrical balance of plant and earthing.

ABB's Aurora Vision® Plant Management Platform is another benefit cited by Brooks. Provided as a free service, it is flexible, scalable and expandable – suitable for any size of installation, from domestic systems to commercial scale power plants. It offers a traditional solar monitoring system and a comprehensive asset management system.
Says Brooks: "Aurora Vision's impressive in-depth analysis offers the functionality to drill down to string level, which is very important.

"All our installed systems are client owned by farmers, so they have a great interest in how their system is performing. They need to be confident the system is producing as it should - Aurora Vision gives them that.

"For my part, I see all plant performance figures from the system. It also offers me the ability to fault monitor, allowing me to see any issues before the client.
"Personal trust is paramount in this business so it is vital I use quality products."

Westflight is contracted to provide continued monitoring, support and maintenance. ABB can also access data for the inverters on the end-user's site, contributing its expertise to resolving any performance or fault finding issues.
Another benefit of ground mounted installations such as Priest Weston is that the land occupied by the power plant can continue to be used for some agricultural purposes such as sheep grazing.

The project is accredited to receive the feed-in tariff and the generation output is forecast to exceed 900,000 kWh per year. The generation is sold within a Power Purchase Agreement on an annual contract. Renewable Energy Guarantees of Origin (REGOs) are claimed and passed to the PPA provider as part of the contract.

Trina Solar acquires solar cell factory in the Netherlands

TRINA SOLAR LIMITED has announced that its wholly owned subsidiary, Trina Solar Netherlands, has completed the acquisition of all the assets from Solland Solar, a solar cell manufacturing company with approximately 200 MW solar cell manufacturing capacity located in Heerlen, the Netherlands.

Upon completion of the transaction, Trina Solar Netherlands acquired all of the manufacturing machines, equipment, stocks, office inventory, and real estate etc. from Solland Solar. Trina Solar will commence operations at the facility in the coming weeks.

"We are delighted with the successful completion of the transaction and believe that the acquisition enables us to expand the global manufacturing footprint of Trina Solar in an efficient manner," commented Mr. Jifan Gao, Chairman and CEO of Trina Solar. "This investment will be one of the components of our ongoing global expansion strategy. In particular, this new

cell facility in Europe, along with our in-house manufacturing capacity in Thailand and other overseas capacities allows us to leverage our global resources so that we can further expand our presence and enhance our competitive edge in overseas markets, especially the U.S. and Europe.

We are also pleased to be investing in the Netherlands PV sector, in which we believe we can help create job opportunities for the local area, and support economic development in the region."

New service for UK solar installers

DUTCH COMPANY Yonego has its sights set on the growing UK solar PV industry and recently launched a new service www.comparemysolarpanels.co.uk. The service went live in October 2015 and is beginning to attract solar panel installers throughout the UK. Yonego has established itself over the past 12 years by operating in over 40 similar lead generation markets throughout the Netherlands, Belgium and recently Spain. Solar panel companies have the opportunity to register with Yonego CompareMySolarPanels.co.uk – free of charge, and only pay for leads they receive from their selected postcodes. The service covers both residential and commercial enquiries. Consumers looking for solar panels complete a simple form and are then contacted by a maximum of six companies in their area.
Yonego is an online marketing agency based in Breda, Holland, Headed by Joris Toonders, with Niels Buijs being responsible for the lead generation division. Yonego use a number of online techniques to create brand awareness and drive customers to the website CompareMySolarpanels.co.uk. A UK marketing team led by UK Country Manager Joe Yoffe is contacting solar panel companies in areas of the UK not yet covered and also servicing and updating current key accounts.
Joe Yoffe said, "We have just began in the UK and it's exciting to replicate the success we've had from our removals website www.compareamover.co.uk. With all the changes in the Solar market due to take place in the early part of the year it is a good time for companies to think about another source for enquiries in 2016. What we noticed in Holland with the change in tariffs was although the volume of enquiries went down slightly, the quality went up as those coming through the site were even more serious about getting solar panels installed."

LUXCARA acquires 34.4 MW

LUXCARA, European asset managers for renewable energy investments, has acquired a portfolio consisting of five solar projects with a total output of 34.4 MWp in the UK, for its third renewable energies fund FLAVEO Infrastructure Europe SCS SICAV-FIS – Wind and Solar. The portfolio has a total value of around GBP 40 million (around EUR 52.6 million).

"We have acquired an attractive project portfolio from Conergy. Each of the five facilities has been developed and built to the highest standard of quality, which is key to ensuring our long-term returns. As the solar facilities were all built on brownfield sites and exhausted farmland, the projects will also have a sustainably positive impact on the environment," said Dr Alexandra von Bernstorff, Managing Partner of LUXCARA.

The seller is the UK branch of Conergy, based in Hamburg, Miami and Singapore, one of the world's largest global solar companies, specialising in the development and turnkey implementation of large solar power systems. Conergy developed and constructed the five solar projects itself, and will continue to operate and maintain them for LUXCARA. The projects are part of the feed-in tariff scheme, long-term subsidised projects with a fixed feed-in tariff.

They also have further positive effects for their respective communities thanks to the selection of special non-profit company forms. They receive benefits, e.g. for their education and healthcare systems, that they can use for investment in renewable energies. All the sites were connected to the grid in December 2015. "Our extensive market access enables us to identify attractive investment opportunities in renewable energies for our investors and to quickly invest the funds entrusted to us in high-quality assets. Other target projects have already been identified," announced von Bernstorff.

Solar Cloth Company and Base Structures merge

SOLAR CLOTH COMPANY LTD (SCC) and Base Structures (BASE) have announced that they have merged. The joining of the two companies will make it possible for lightweight fabric structures and carports to generate clean solar energy which has not been possible until now.

SCC are experts at applying light-weight copper indium gallium selenide (CIGS) solar technology to non-load bearing roofs. BASE design, manufacture and install iconic fabric structures including 'Up at the O2' Walkway on the Millennium Dome, London 2012 Basketball Arena, and Ben Ainslie's Racing Headquarters at Portsmouth.

In combining their expertise, the two companies' will integrate renewable energy generation into elegant fabric structures at a competitive price point and without compromising on design or aesthetics – a first for the industry.
The initial focus of the two companies will be on a range of solar carports, a nascent market that is failing to coalesce due to a high price point and poor design.

The planned solar carports will charge electric vehicles, power lighting, CCTV and parking management as well as generating energy for power hungry sites.
Mike Staplehurst, Chief Exec said:
"There is huge potential for public and private business with large car parks, such as retail, hospitals, universities, airport parking, business parks and local government authorities to reduce their energy bills through solar generation and meet their carbon footprint goals.

At present, the price is too high and the structures too utilitarian and inflexible. Our merger with Base Structures means we can build light weight, adaptable and beautiful structures with a realistic business case – making solar generation possible where it wasn't before. In addition, it will help companies begin to address the infrastructure deficit for the growth in electric vehicles"

The market in electric vehicles is growing rapidly, rising from 3,500 registered in 2013 to 48,000 in 2015 and a predicted 1 million on the roads by 2022 (Future Energy Scenarios, July 2015). This will add 2TWh/year to the UK's electricity demand. Charging from a fossil-fueled grid, negates many of the sustainability benefits of electric vehicles, so providing a renewable infrastructure for this growing market is a priority. The combination of CIGS and fabric canopy expertise, enables the merged organization to develop innovate carport solutions that benefit the market and can be designed to fit the aesthetic of any environment.
The merger brings together in depth knowledge of fabrics, bonding, solar technology and structural skills. Together, the companies have over 18 years of the experience enabling it to exploit opportunities for solar generation where traditional solar is constrained.
Chris Ives, Managing Director of Base said:

"Our customers know us for the value we add, our experience is unrivalled in all aspects of the project cycle, from concept to maintenance to end of life. At the foundation of who we are and how we operate is the Base mission statement - a set of principles that describes our culture of integrity, respect, performance excellence and accountability. Through joining with The Solar Cloth Company and their extensive understanding of light-weight solar generation we will be able to offer our customers something not yet on the market – cheap, green energy that doesn't compromise on aesthetics and doesn't cost the earth. That's a really exciting prospect."

Good Energy commissions new 5 MW solar farm in Dorset

WILTSHIRE based renewable electricity supplier and generator, Good Energy, has announced that it has commissioned a new 5MW solar site near Wareham, Dorset.

Oaklands Plantation will generate enough renewable electricity to supply around 1,300 homes and brings the number of solar farms the company has built and operates to seven. Combined with its two owned and operated wind farms, Good Energy's installed capacity now totals 52.5MW.

Juliet Davenport OBE, Chief Executive and founder of Good Energy, said: "The commissioning of this latest solar farm demonstrates our continued commitment to owning and operating a growing portfolio of renewable generation sites.

"The site will make an important contribution towards Dorset's renewable energy targets, and will also deliver benefits to local people in the form of a community fund and bespoke biodiversity plans."

The company has also received planning permission for three additional solar farms totalling 12MW. Newton Downs, in South Devon, Warren Park in Dorset and Delabole, in Cornwall, will together have the capacity to supply renewable electricity to around 2,990 average homes. The Delabole site is located next to Good Energy's wind farm.

BayWa r.e. sells 27 MW solar park to MEAG

BayWa r.e. has sold Lynt Farm solar park with an output of around 27 MWp to MEAG, the asset manager of Munich Re. Closing took place on 31 December 2015. The solar farm is situated approximately 40 kilometres to the southeast of Oxford and was realised by BayWa r.e last year. It was commissioned as early as March 2015, allowing the project to be accredited to the ROC scheme (Renewables Obligation Certificates).

MEAG acquired 100 percent of the shares in Lynt Farm on New Year's Eve. "With this sale we are continuing our excellent working partnership with MEAG", commented Matthias Taft, Board Member of BayWa AG, responsible for the energy business. He went on to say: "For this project we could once again secure a long-term PPA, making this a significantly more attractive investment." The present PPA (Power Purchase Agreement) secures the sale of the power generated at a fixed price. As with previous projects of BayWa r.e., the purchaser is McDonald's Restaurant Ltd. "With solar parks like this we are continuing to diversify our portfolio with sustainable investments characterised by limited risks and good returns. In doing so we are making use of the entire group's expertise", says MEAG's Managing Director Holger Kerzel.

BayWa r.e. is responsible for the technical and commercial operations management of Lynt Farm. The operator is guaranteed a 99 percent technical plant availability. Thereby the operator is benefitting from highest possible revenues. Over the coming months, BayWa r.e will be realising further solar projects in Great Britain before the end of March, with a total output of around 130 MW. BayWa r.e. continues to be on the lookout for projects of under 5 megawatts to realise during 2016 and 2017.

Construction starts on Vattenfall solar farm in Wales

WORK is now beginning on Vattenfall's first solar farm, Parc Cynog in Wales, UK. It will be a combined wind and solar farm. There has been a wind farm with eleven turbines at Parc Cynog for 14 years. The 5 megawatt (MW) solar farm could already begin generating electricity at the end of March 2016.

"Wind and solar power complement each other well, as the sun shines in summer while winter is generally the windy season. By building the solar park adjacent to a wind farm, we obtain a number of synergies that we can use. This applies not least to the roads and existing electrical installations that can be used for shared power feed to the grid from both solar and wind. And as we already have good relations with the landowners, we can build on these in order to conclude agreements for using the land," says Claus Wattendrup, Head of Business Development within BA Wind.

A commercial investment in solar energy extends Vattenfall's portfolio of renewable energy, and the company is now looking at further ways of combining solar energy with wind power.

"Solar energy is a proven technology, and its costs are dropping quickly. We will also invest more in decentralised solar energy and help our customers with the planning, construction and operation of their solar installations. Electricity generation from solar installations will increase in the years to come and is a growth sector for Vattenfall," says Claus Wattendrup.

The Parc Cynog solar farm will consist of a total of 18,860 solar panels and will have an installed capacity of 4.99 MW, which will mean an annual output sufficient to supply 1,441 households. The site is currently used for sheep grazing, and will continue to be used for that purpose even after the solar park is completed.

Trina Solar most bankable PV manufacturer

TRINA SOLAR has announced that it has been named as the most 'bankable' PV module manufacturer globally by Bloomberg New Energy Finance (BNEF). In its survey of key PV stakeholders asked about 50 different module brands, 100 percent of respondents said that Trina Solar was bankable, confirming the Company's leading position in the solar PV market. The report (available through BNEF subscription) details the findings of a survey conducted by BNEF to identify which module manufacturers are most likely to obtain non-recourse debt financing by commercial banks. Survey participants, which were banks, technical consultants, engineering contractors, asset managers and independent power producers (IPPs) from all around the world, were asked which PV module brands they considered bankable by their own internal criteria.

Trina Solar topped the list of 50 module manufacturers, being the only company that all survey respondents believed was bankable. The report also details how Trina Solar modules were used in more debt financed projects than any other manufacturer's modules since the start of 2014, having secured funding for more than 1.2GW for 15 different projects tracked by the BNEF database. The BNEF database is not fully comprehensive, but contains almost 14,000 solar financings worldwide.

Commenting on the report findings, Teresa Tan, Chief Financial Officer of Trina Solar, said: "The findings from this report are highly positive and we believe that they come as further confirmation of our leading position in the industry around the world. Trina Solar prides itself on the sustainability and strength of its way of doing business and this latest acknowledgement of our leading bankability comes as a logical result.

Solarcentury expands European presence with new solar farm in Germany

UK EPC Solarcentury has developed, constructed and sold a 4.7 MWp solar farm in Sachsen-Anhalt state, eastern Germany that will provide enough energy to power 1,150 local homes. The "Calvörde" solar farm was constructed in just five weeks on the brownfield site, demonstrating solar's speed of deployment. The Solarcentury team already has experience of delivering solar projects in Germany, with several roof installs in the last decade. Calvörde is the first solar farm Solarcentury has built in Germany and is the biggest project the company has completed in this market.

For the Calvörde solar farm, Solarcentury developed the rights for the site together with well-established partner Sybac Solar GmbH. Solarcentury secured the debt financing and an investor, designed the system and managed the build. The solar farm was made financially feasible by the new auction tariff for ground mount installations in Germany introduced in April 2015. The Calvörde project is the first to complete of the 25 projects awarded which together have a combined capacity of 150 MWp.

Nikolaus Krane, Director for Solarcentury in Germany commented, "Calvörde solar farm is the first in a pipeline of new projects we are looking at in Germany. The levelised cost of solar electricity in Germany is below the wholesale market price for industrial / commercial off-takers, which makes ground mounted solar of this size financially viable. Our long history of building successful solar projects makes Solarcentury an attractive solar partner, with a vast bank of EPC knowledge and experience. Our team is ready to develop commercial scale ground and roof projects in Germany and we're also looking at markets in Central Europe."

Solarcentury's German team brings cumulatively 65 years of solar industry experience, and they are supported by colleagues at the company headquarters in London which has been established almost 20 years, making it one of the oldest and most experienced solar companies in the world. Solarcentury is currently present in countries across Europe, Africa, north and south America. Frans van den Heuvel, CEO at Solarcentury commented, "The German market is highly competitive but the Calvörde solar farm demonstrates that with the right partnerships in place, it is possible to deliver successful solar projects. This latest project is part of Solarcentury's international growth strategy, bringing our engineering expertise and experience to deliver solar projects in Africa and LatAm, and in European markets.

We believe the outlook for solar in Germany is getting brighter, despite mixed fortunes of the recent past. Solar in Germany is welcome news for businesses who can adopt solar as a way to fix their long term energy costs, reduce reliance on grid energy and cut their carbon emissions."

The solar farm is now connected to the grid and generating energy, which is being fed into the local grid.

Sunergy supplies modules to Southend Airport project

CHINA SUNERGY CO., LTD has successfully completed a 2.5MW solar module supply agreement with Stobart Group. The modules will be used for the construction of the solar farm located at London Southend Airport owned by Stobart Group to satisfy around 20 percent of the airport's annual electricity requirement. The solar array, which consists of over 9,500 individual solar panels and occupies 3.2 hectares of unused grassland at the north of the airport site, makes it the largest at a UK airport. "I am pleased that our solar products were accepted by Stobart Group for its symbolic airport PV project and delighted to see that the quality of our products together with our knowhow in solar industry has helped us get access to a wider customer base," said Mr.Tingxiu Lu, chief executive officer of CSUN. "We will continue to execute our growth strategies by diversifying geographical mix, extending products portfolio and targeting an extensive downstream PV applications"

New materials to drive panel price down

Harry Cronin is one of only ten exceptional graduates in the UK to be honoured with an Industrial Fellowship from the Royal Commission 1851. In this article he explains how the long-awaited dream of high performing printed solar cells may soon become a reality.

A PRESTIGIOUS INDUSTRIAL FELLOWSHIP has been awarded by the Royal Commission for the Exhibition of 1851 for doctoral work on printable Perovskite solar cells. These fellowships are awarded to around ten doctoral researchers annually with the aim of fostering UK science and engineering to aid productive industry, and involve a collaboration between academic and industrial partners.

This project, which forms part of an Engineering Doctorate (EngD) at the University of Surrey, England is led by doctoral researcher Harry Cronin in collaboration between the University's Advanced Technology Institute and DZP Technologies Ltd., a technology development business based in Cambridge, UK. The aim is to fabricate Perovskite active layer materials in a printed solar cell structure to produce flexible, low cost solar cells.

The research in this project builds on two decades of progress in the solution processing of electronic materials, a field known as large-area or printed electronics. This is an emerging industry, forecast to be worth $70 billion by 2024 (IDTechEx 2014). As well as allowing low-cost devices to be manufactured on a range of substrates including flexible plastics, as an additive manufacturing technology printed electronics also offers environmental benefits arising from the reduced use of materials and elimination of energy-intensive processes such as vacuum deposition and high temperature treatments. While this is a nascent industry, some successes have been achieved in printed logic and memory circuits, and Radio Frequency Identification (RFID) sensors.

However, despite intense research interest, printable solar cells have yet to become a large-scale commercial reality. One reason is that until now, active layer materials which combine solution processing with high solar power conversion efficiency have not been available; this is where Perovskites come in.

Perovskite solar cells have become a hot topic in PV research in recent years, driven largely by the rapidly improving power conversion efficiencies (PCEs) achieved. These solar cells, based on organic-inorganic hybrid semiconductors, offer the potential to combine high performance with low cost, a goal which has proved elusive in solution-processable PV research to date. The high PV performance of these materials arises from their excellent opto-electronic properties, including strong light absorption, a near-optimal bandgap of around 1.55 eV and high electron and hole mobilities.

Furthermore, Perovskites consist of earth-abundant materials and can be processed entirely at temperatures below 150°C, meaning that the energy payback time of such cells could potentially be very short. These advantages are combined with the fact that Perovskites can be dissolved in an appropriate solvent and cast from solution, opening the way for the use of high-throughput, low cost techniques such as printing and coating. It is this last property which this project aims to exploit, by combining an improved understanding of the Perovskite active layer materials with the printed electronics and formulation chemistry know-how of DZP Technologies, an SME with world-leading expertise in the development of functional inks and novel printing processes. By using large-area techniques such as printing to produce solar cells, their financial cost and energy payback time can be greatly reduced.

It is hoped that if a printed solar cell with high performance can be produced at large scale, then the cost per watt of the power produced would be drastically reduced. Such cells could furthermore be deposited on plastic substrates, which would open up new applications

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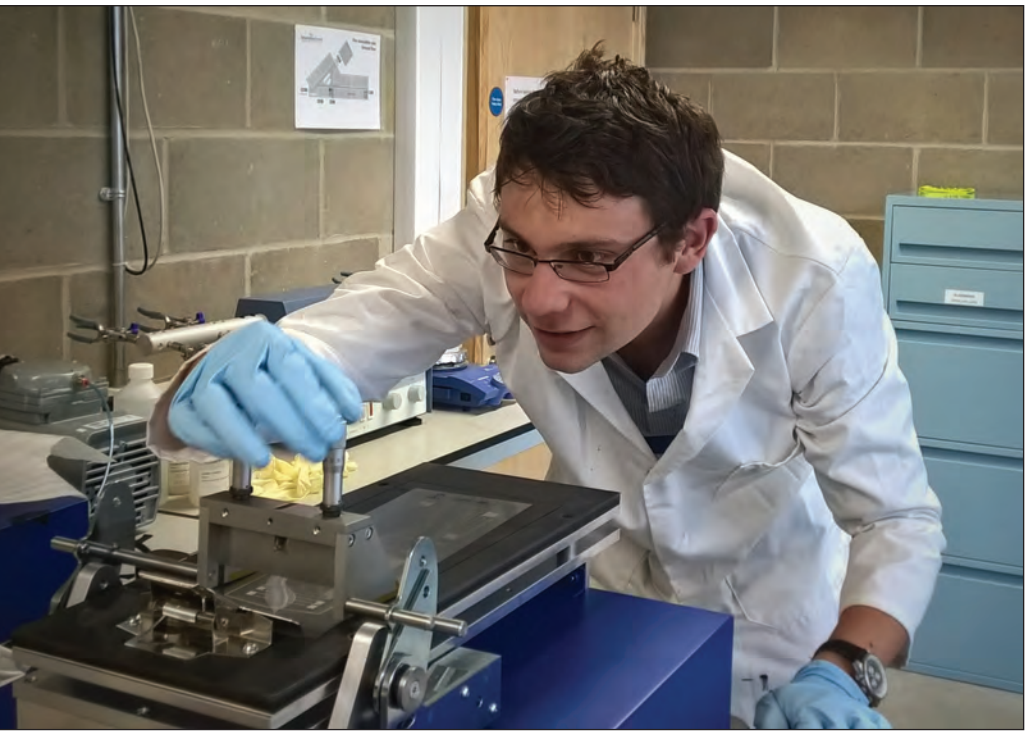

where properties such as mechanical flexibility and low weight are important. One such area is use for off-grid power generation in remote or disaster areas, where low weight and the ability to rapidly deploy would be critical; or as an ultra low-cost distributed power supply to enable the sensor networks which are widely expected to emerge as part of the so-called Internet of Things. By using solution processing, conformal coating of existing structures with PV materials may also become a reality, opening up applications in building-integrated PV; an area for which Perovskites may prove uniquely suited because their band gap, and therefore colour, can be tailored chemically.

In the most general sense, the name Perovskites is given to the class of compounds with general formula ABX3, which adopt the crystal structure seen in the calcium titanate mineral of the same name, which is named after the 19th century Russian mineralogist Lev Perovski (Rose 1839). Both oxide and halide Perovskite materials have been known for many years, and many of them have interesting properties beyond photovoltaics, including antiferromagnetism and superconductivity. However the Perovskites of interest for PV applications are metal-organic halide materials, in which the "A" cation is a small organic molecule, the "B" metal cation is typically lead or tin, and the "X" anion is a halogen. The archetypal compound is methylammonium lead triiodide ($CH_3NH_3PbI_3$).

The first use of such halide Perovskites in Light-Emitting Diode (LED) and Thin-Film Transistor (TFT) applications was reported by a team at IBM Research in the 1990s (Mitzi et al. 1995), but at the time no report was given of their use in solar cells. The first such report came in 2006, when a team of researchers from Korea used Methylammonium Lead Tribromide ($CH_3NH_3PbBr_3$) and later in 2009 used Methylammonium Lead Triiodide as a drop-in replacement for the commonly-used organic dyes in a dye-sensitised solar cell (DSSC) structure, with a liquid electrolyte (Kojima et al. 2009). This structure uses a mesoporous TiO_2 scaffold infiltrated with the sensitising material – in this case the Perovskite – which absorbs incoming light to generate an electron-hole pair. The photo-excited electrons are then transferred to the external circuit through the TiO_2, a good *n*-type conductor, while the holes are transported through a *p*-type liquid electrolytic hole conductor. However, the use of a liquid as the hole conductor severely limits such devices as these materials are corrosive to the Perovskite active layer. Due to the very limited lifetime of such cells, this research was not widely followed up on by the community for several years.

However, two breakthroughs occurred in 2012 which split the field wide open. Researchers working in Switzerland (Kim et al. 2012) overcame the problem of corrosion by the electrolyte, using a solid state hole conductor (consisting of an organic molecule known as Spiro-MEoTAD) in a mesoporous device structure containing TiO_2. Almost simultaneously, a team working at Oxford University (Lee et al. 2012), also using solid-state devices, showed that the electron-conducting TiO_2 scaffold was not necessary for charge transport by replacing this with Al_2O_3 – which provides a similar morphology but is insulating. This breakthrough realisation that the Perovskite can provide all three necessary processes for solar energy conversion (light absorption, charge separation and charge transport) has driven a frenzied research interest in these materials in the last three years.

A number of further refinements have been reported, including the introduction of simpler planar heterojunction device structures, which resemble the well-known p-i-n structures used in some inorganic PV cells, with the Perovskite absorber layer sandwiched between solution-processed p-type and n-type materials. The A cation can be changed, with options including formamidinium (HC(NH2)2) and caesium – in the former case the bandgap can be slightly reduced and power conversion efficiencies greater than 20% have been reported. For a solution processable material to reach such levels of performance in a few short years of R & D is unprecedented.

As with any new technology, there are several drawbacks of Perovskites. The keen-eyed reader will have noticed that the Perovskite compounds referred to so far contain lead, and the environmental and toxicological issues of this will need to be addressed prior to commercial scale-up of this technology. One solution

may involve re-engineering the structure to contain more benign materials, and work on tin-based perovskites is ongoing. As another possible avenue, some recent studies have suggested that the lead content in a future commercial Perovskite solar cell may be low enough to be tolerated, providing that the device is very well encapsulated; however this would likely require some regulatory support.

A further issue is that the Perovskite materials are sensitive to moisture and severely degrade if exposed to the atmosphere. However, recently published work has shown great progress in this area, pushing device stability up to and beyond the 1000 hour mark. Another open question is whether the excellent performance achieved so far can be retained when the devices are scaled up. Lab-scale cells currently used in many research studies are tiny – often less than 0.1 cm^2 – which will have to be enlarged by several orders of magnitude to be commercially useful (This project works with a minimum device size of approximately 1 cm^2 – which is still small, but at least larger than many lab scale devices).

A further unknown factor in Perovskite technology is the detailed influence of processing conditions on the structure and performance of the active layer, and the current project has started off by gaining a deeper understanding of the influence of environmental factors by producing Perovskite cells under a range of controlled conditions and measuring their structure and performance,

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making use of the advanced materials characterisation facilities at the University of Surrey.

The next steps in this project will be to build upon work already undertaken at DZP Technologies in the field of printable solar cells in order to integrate the Perovskite active layers with the necessary charge transport and encapsulant layers in a cost-effective manner to form prototype printable solar cells.

One aspect of this work is extending the use of high intensity visible light photo-curing, a high-throughput and low-cost post-processing method for printed electronics, to improve the conductivity of the printed metallic structures needed to collect electrical charges from the active region, This work has already shown large improvements in performance on lab-scale test structures.
It is hoped that by integrating the recent advances in academic research into Perovskite materials, the materials expertise of the University of Surrey, and the commercial and technological knowhow of an innovative SME, the long-awaited dream of high performing printed solar cells may soon become a reality.

In addition to the Industrial Fellowship, Harry's EngD research is supported by EPSRC and DZP Technologies through the University of Surrey's Centre for Doctoral Training in Micro- and Nano Materials and Technologies (CDT in MiNMaT), in collaboration with the Advanced Technology Institute. DZP Technologies are able to provide contract research, collaborative R & D and market-leading functional electronic inks, and can be contacted through www.dzptechnologies.com

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New hybrid solar panel roof slashes energy bills

Could heat pipes be a solution to a major technical issue with PV panels? Scientists at Brunel University say yes.

SCIENTISTS at Brunel University London have designed a new hybrid roofing system which could halve energy bills in new homes.

The patented new system harnesses a unique mixture of technologies to pre-heat domestic hot water for radiators, baths and showers while also generating electricity. More than half of domestic energy use in the UK is to heat water.
At its heart is the use of heat pipes – super conductors of heat energy - found in high tech devices from PCs to the International Space Station where they prevent it from melting in the heat of the sun on one side and freezing in the vacuum of space on the other.

Dr Hussam Jouhara of Brunel's Institute of Energy Futures, who led the British team which developed the new system explained: "As a professional engineer with a long-term research interest in heat pipes I could see many advantages in applying this technology to a renewable energy system".

"Until now there was no system which fully addressed all the technical and practical issues that face making an entire building's roof a solar-powered generator of both heat energy and electrical energy." Heat pipes seemed to Dr Jouhara an obvious solution to a major technical issue with solar cell or photovoltaic (PV) panels used to generate electricity.
"PV panels have an inherent challenge to the engineer," he said. "The more intense the sunlight the more electricity the cells will produce but only a fraction of the sun's energy can be turned into electricity. "So the sunnier it is the more of that unusable energy hits the cell which, in turn, heats it up. As PV cells heat up their electrical generation ability is degraded. Heat pipes, in this case, constructed in flat panels 4m x 400mm, will whisk that away to heat domestic hot water."

In proof of concept tests, PV cells cooled by Dr Jouhara's methods outperformed identical panels by 15 per cent. And rather than being wasted, almost the full spectrum of energy from the sun is harnessed.

The new system also addresses a wide range of practical issues in installing solar panels in new properties.

Attempts to integrate installing solar panels with conventional roofing techniques have a poor track record. "What was needed was an engineered, systems approach," said Dr Jouhara. "Our solar panels are PV coated for the most southerly-facing aspect of the roof and are designed to clip together as a weather-tight roof as simply as clicking together laminate flooring.

"When we constructed our test roof using standard "off-the-shelf" roof trusses, tradesmen were able to quickly and easily screw together the panels with no extra guidance than a simple set of written instructions.

"The heat pipe technology also turns the biggest downside of integrating solar panels into conventional roofs into a positive.

"Currently the panels would get hottest in the summer and roofs need to be designed to dissipate that heat. Simply insulating the house below is not a good solution as that simply traps it driving up the PV panel temperature and further lowering its performance. With our system there is no waste heat."

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The solar roof is now undergoing extensive further trials at the Building Research Establishment (BRE) in Watford where a prototype is powering a standard UK three-bedroom detached house.
And already there has been one unexpected finding. "Our flat heat pipes are so efficient that they can actually capture the energy from early morning dew evaporating off the trial roof," added Dr Jouhara.

A better way to manage PV energy

Taking charge of your energy future begins with choosing a photovoltaic system. Realising that system's full potential requires effective energy management software solutions.

WHILE ONE PV module may look much like another, how well the overall system functions depends largely on its management software. Choosing the correct energy management solution can optimize performance and increase ROI.

Even though PV modules, racks and inverters often receive purchasers' greatest attention, smaller system elements should never be overlooked; this is especially true of 'invisible' components like software and interfaces that manage system operation. By choosing the right management system, PV plant owners can take the guesswork out of daily operations to gain the most benefits from self-consumption while keeping their plant aligned with local feed-in regulations and export restrictions.

Smarter energy

Experts including Solare Datensysteme (SDS) GmbH have pioneered systems and products including their Solar-Log™ family, which was created with the practical needs of system owners in mind. As the popularity of photovoltaic systems increases, so does the need for a smart energy system like Solar-Log™ that accurately and reliably maximizes system performance.

SDS recently announced new upgrades and capabilities in its Solar-Log™ family of products to further automate and simplify operations for optimal PV plant output.

Solar-Log™ WEB Enerest

Solar-Log™ WEB Enerest tools offer a wide range of software options with all-round support. Using the WEB Enerest system empowers PV plant owners by tailoring services to project-specific needs. PV plants can be monitored in real time with remote access from any location the owner chooses. If errors occur, relevant data can be accessed and analysed to take appropriate actions.

The Solar-Log™ WEB Enerest system is available in three editions: M, L and XL that make it possible for owners to find the perfect fit for plant monitoring based upon their individual requirements. The modules are continuously evolving and by end 2016 will be capable of monitoring multiple forms of renewable energy such as conventional photovoltaic plants, CSP, wind and so forth. Plant owners can monitor their own system or leave it to a designated service provider. Because SDS offers systems with wide-ranging capabilities Solar-Log™ can also provide banks and investors reliable protection and professional monitoring for their solar energy investment programs.

Solar-Log™ WEB Enerest M

The Solar-Log™ WEB Enerest M edition is easy to configure and is intended for private plant owners.
It features basic plant monitoring functions and visual presentation of the PV plant and its power generation as well as self consumption. It is compatible with the Solar-Log™ App (iOS/Android/Fire OS) and Solarfox® display, free for PV plant sizes up to 30kWp.

Solar-Log™ WEB Enerest L

The Solar-Log™ WEB Enerest L is easy to configure and offers basic plant monitoring functions as well as status notification analysis. It provides concise presentation and visualization of PV plant yields and power consumption through clear graphical interfaces.

The Solar-Log™ WEB Enerest L includes visualization of powermanagement functions such as reference data comparisons and presentation of fixed percentage reductions 'X%'. PV plant output data can be displayed on its dashboard and through Solar-Log™ Insight. User-defined, automated reports are available. It is compatible with the Solar-Log™ App (iOS/Android/Fire OS) and Solarfox® display.

Solar-Log™ WEB Enerest XL

The Solar-Log™ WEB Enerest XL system is designed for plant owners that

typically require installers or other service providers to address operational needs quickly and efficiently. Error messages are sent directly to the professionals tasked to act whenever issues arise.

Plant owners have around-the-clock access to yield and other vital PV system information. Additional services include access to weather forecasts and performance ratio data. An unlimited number of reports can be set to run automatically to always have access to the latest status and plant performance information.

Advantages for plant operators

The Solar-Log™ WEB Enerest XL is the most convenient solution for plant owners. No in-depth technical knowledge is required for setup or operation, nor is there any need to invest time in personally managing and monitoring plants. In case of malfunctions, designated installers or service providers can immediately provide professional solutions as needed.

Monitoring functions

- **Connecting the PV plant**
  PV plants are easy to set up in the Solar-Log™ WEB Enerest portal. Pages can be automatically generated for the initial set-up phase, saving a considerable time. The system also provides remote access in real time for any necessary corrective action.
- **Yield reports**
  Concise yield reports can be created for every plant monitored with Solar-Log™ WEB Enerest XL. For example, energy balance reports can be automatically generated and sent to any authorized recipient on a daily, weekly, monthly and/or yearly basis.
- **Uploading documents**
  Plant-specific files such as string plans, contracts and data sheets can be uploaded to the portal and are available at all times to users with the corresponding access rights.

Display

- **Display and search functions**
  The Solar-Log™ WEB Enerest XL offers additional presentation and search functions, plus advanced monitoring and management capabilities for the yield line, input voltage, individual strings, MPP trackers and inverters.
- **Reference values**
  It is possible to display irradiation values and other reference points that aid plant monitoring through Sensor Box Professional, Professional Plus or the Weather Data Comparison module.
- **Custom designed monitoring platform**
  The option to customize a monitoring platform design of is a huge service benefit for installers. A range of function modules are available that can be integrated at the touch of a button without expert programming knowledge. Pages individually designed with HTML can also be integrated. The appearance of monitoring programs can also be customized to match the customer's corporate design through HTML coding.

Advantages

Professional maintenance
The "Full-Service" maintenance concept offers plant operators ideal plant maintenance.

Reliable protection
Reliable monitoring and protection for PV investments with the Solar-Log™ WEB Enerest.

Efficient monitoring
The Weather and Reference Data Comparison module facilitates the detection of deviations from the potential power output of the plant and its current production.

Fast service restoration
Review the status of all monitored plants at a glance. Detect, analyse and remedy errors quickly with the diagnostic tools.

Simple documenting options
With the Timeline module, events such as inverter replacements and configuration modifications can be documented.

Detailed reports
Keep plant operators informed on a regular basis with easy-to-read reports. These reports only need to be configured once and will then be automatically generated and sent in defined periods.

Concise presentation
In connection with the WEB Enerest L & XL, the Solar-Log™ APP, Solar-Log™ Dashboard, Solar-Log™ Insight and Solarfox® can access plant data and offer various options to present that data.

Protection against data loss
Plant yields, error messages and configuration data are stored and backed-up on Solare Datensysteme (SDS) secure servers.

Solar-Log™ Export Restriction Box

From products to solutions!
Power grids were originally built to distribute energy from a central source to individual consumers. Decentralized renewable energy has changed that paradigm. The increasing amount of PV power fed into the grid has led to feed-in process regulations and export restrictions to protect the integrity of the grid and to guarantee electric power access to customers at all levels.

Ancillary services are already required in some countries to improve the stability of the grid. These services require that grid operators will be able to control the output and regulate the amount of reactive power from the PV plant.

Fixed regulation -minimize losses
Solar-Log™ is ideally designed to enable PV plant operators to comply with local regulations concerning export restrictions including 'X%' functions that take into account calculations based upon plants owners' self-consumption. The Solar-Log™ solution minimizes losses that can result from fixed export restrictions.

Only a consumption meter is needed to implement 'X%' compliance. This records and transmits the self-consumption of power to the Solar-Log™. The Solar-Log™ then calculates the amount of power being fed into the grid based upon the self-consumption of power and the current amount of power being produced by the

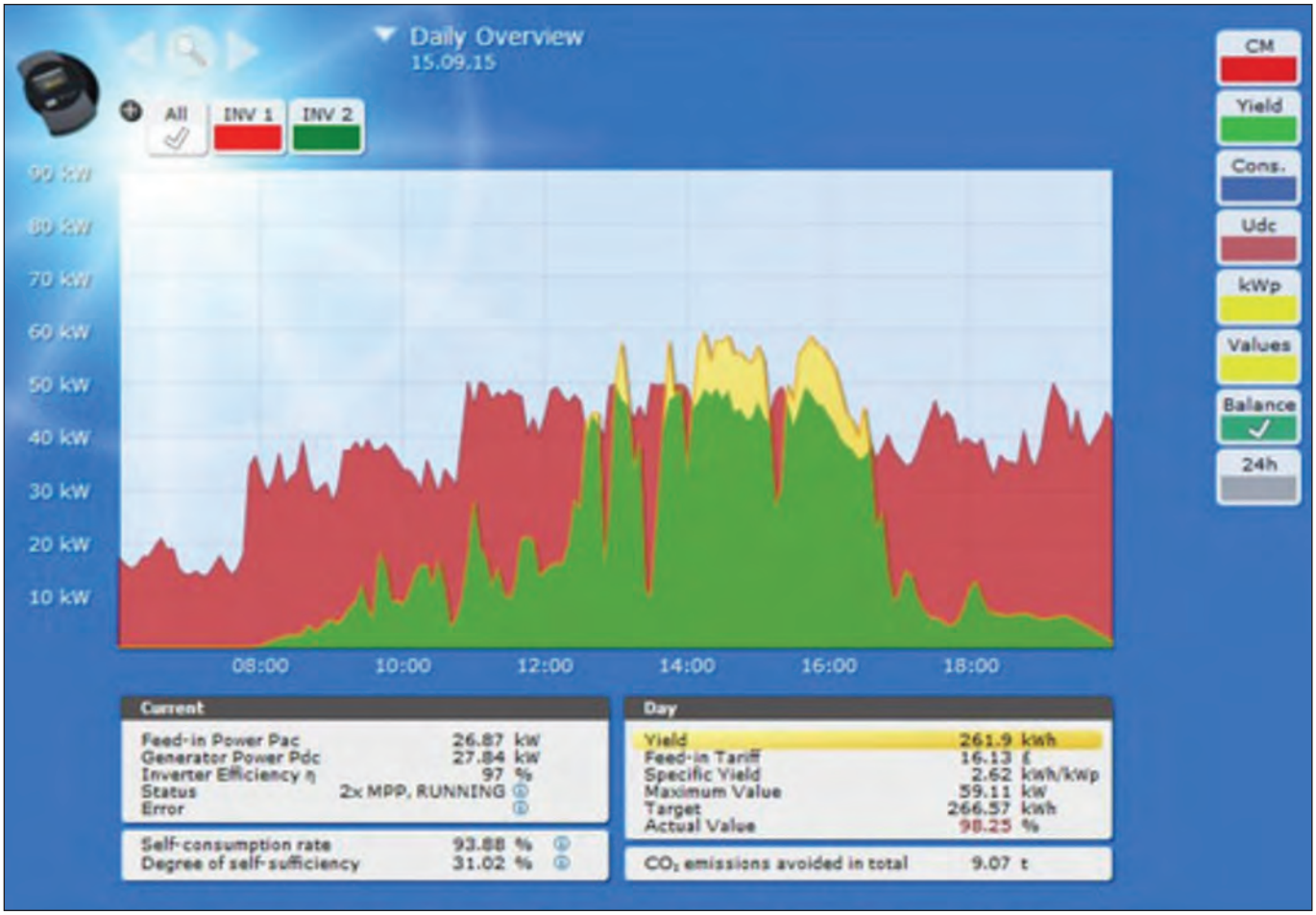


Image of a 100kWp installation with 11kW export limitation.

inverters. Before the feed-in power (the difference between the current production and consumption) exceeds maximum allowable amounts, the inverters are regulated accordingly. This means that a PV plant can continually generate at full power by taking self-consumption into account and adjusting output accordingly.

Solar-Log's ability to support 'X%' export restrictions can also be used to fulfil 0 kW feed-in requirements. At the same time, PV plant owners need to remember that due to the wide variety of inverters utilized across the industry, SDS does not guarantee that absolutely zero power is fed into the grid. Solar-Log™ assumes no liability for power reductions.

Solar-Log™ Export Restriction Solution

Solare Datensysteme GmbH (SDS) with its distributor, Sibert Instruments Ltd (Sibert Solar), co-developed the Solar-Log™ Export Restriction Solution to manage power export limits that apply in various communities, regions or country-wide. Managing the UK's grid network capacity for feed-in energy (produced by photovoltaic or other forms of renewable energy,) is becoming more of a concern as the amount of feed-in power increases relative to legacy generation methods. In some cases G59/3 applications could be refused completely by the responsible DNO.

In other areas, grid saturation constraints have led to stipulated maximum reverse power limits imposed by the DNO, which is often far less than the theoretical peak limit that the Solar PV array can produce.

Historical solutions to overcome these export limitations were focused primarily on basic electro-mechanical shut-down of part or all of the solar PV inverter bank, which is not ideal since the generation/ yield of the system is potentially severely compromised—generated power could go unused or underutilized.Solar-Log™ presents a solution that combines advantages of its inherent power-management capabilities with a 'fail-safe' backup should the control system fail or cease to be effective.

This solution is a standardized, yet scalable framework to provide dynamic, closed-loop powermanagement control over the inverter bank, suitable for up to 2MWp size arrays.

Red - Facility's total consumption
Green - Generation from PV
Yellow - Feed-in/export (never more than 11kW above consumption)

The Solare Datensysteme GmbH will be exhibiting at the Ecobuild 2016 from 8 to 11 March - Booth E1330

Paving the way for a solar transformation in Scotland

The Solar Trade Association (STA) Scotland, the Scottish arm of the solar industry trade body, has put forward a set of 'key asks' on solar to support the Scottish Government's ambitious plans to meet 100 percent of electricity demand from renewables by 2020.

SCOTLAND is currently over half way to reaching its target of 100 percent of electricity demand from renewables by 2020 and has over 7.5 GW of renewables, of which over 5 GW is onshore wind. Solar can make an important contribution to the rest of the 100 percent target and provide an essential balance to the mix of renewables in Scotland.

Despite the Department of Energy and Climate Change's (DECC) recent reduction in support for solar [1], there remains strong support for the technology in Scotland, both politically and commercially. In September of last year, the Scottish Government used its devolved powers within the Renewables Obligation to boost investor confidence in large-scale solar in Scotland [2].

STA Scotland is proposing that the Scottish Government achieves its renewables targets by putting together a dedicated Solar Action Plan for Scotland and suggests targets for both solar PV and solar thermal for 2020. The action list also contains specific recommendations on business rates, social housing and community energy, and covers both solar PV electricity and solar thermal hot water heating.

STA Scotland launched in March 2015 and has assembled some of the leading solar businesses in Scotland, to work with the Scottish Government to ensure that Scotland remains at the forefront of the solar market, not only protecting the more than 3,000 solar industry jobs in Scotland, but supporting the growth of the industry, potentially tenfold, over the term of the next Scottish Parliament. Energy Minister Fergus Ewing MSP has already been working with STA Scotland and is supportive of the body's work.

John Forster, Chairman of STA Scotland and of Scottish solar business Forster Energy, said: "The fact is that solar is seriously under-deployed in Scotland, particularly when you look at the big success story for Scottish renewables, the onshore wind sector. With opinion varying on the exact ratio it's clear that for solar to balance wind deployment, as clear evidence shows it should, it would have to rise more than tenfold from its current level of less than 200 MW to as much as 2.5 GW.

In-roof solar PV on House of Dun bunkhouse, Montrose

Photography credit Foster Group

Let's be clear. For the Scottish Governments 2020 target of 100 percent electricity from renewables, when it's over half way there at around 7.5 GW of which 5 GW is onshore wind, this solar contribution would come at a very important time.

When the Solar Trade Association launched STA Scotland in March 2015, the timing seemed ideal. A growing interest in solar across all sectors, and at all scales, reflected well with the Scottish Governments 2020 target for renewable electricity. Positive engagement with Scottish Energy Minister Fergus Ewing and the relevant teams at Scottish Government seemed aligned with the 'solar revolution' expected from the new UK Government. Yet just as the summer sun was rising high in the Scottish sky, it quickly became clear that the new UK Government had a very different agenda. In the short term, the Scottish Governments decision to retain Grandfathering has stimulated sub 5MW deployment. Despite the DECC cuts, Commercial roof top solar continues to attract demand even at the lower FiT rates. Social housing energy efficiency targets (EESSH) stimulate ever increasing interest from landlords, and Scotland's new building regulations are driving rapidly growing demand for integrated new build solar.

So where's the catch? I hear you ask. Well that's the challenge and I'll call it the 'Gap'.

For some time it has been clear that solar will be one of the first subsidy free renewable technologies by the early 2020's, if not before.

The 'Gap' represents the period of time until that subsidy free status is reached, and has been created by the UK Government's move to slash essential support for solar. Combined with UK and EU policy decisions, this has left a gap between solar benefits and solar costs which must be closed if Scotland is to achieve its solar potential and reach its renewable electricity target.

The STA Scotland 'Asks' set out the solution, and in short the Scottish Government can deliver that solar solution through the introduction of a combination of small scale, short term fiscal incentives, alongside a series of policy and regulatory changes.

There are a number of simple, practical things the Scottish Government can do to boost solar north of the border, whether it is encouraging wind and solar to share grid capacity or changes to planning." We are also keen that the Scottish Government look at options to establish its own financial support mechanisms for solar to bridge the gap between now and the early 2020s when we hope to see mainstream solar projects become subsidy-free.

We are optimistic that the next few years will be good for solar in Scotland. There is scope for Scotland to lead the way within the UK, encouraging markets for solar on residential homes, commercial rooftops, new build homes and buildings and solar farms.

Ambitious? Perhaps, but the STA Scotland headline 'Ask' for 2GW of solar PV by 2020 looks increasingly achievable, and would make Scotland one of the fastest growing markets in Europe let alone the UK."

In drafting a new Energy Strategy for Scotland and to meet its 2020 100 percent renewable electricity target, it is clear that Scotland needs significantly more solar. The STA Scotland Asks are aimed at bridging the gap to the early 2020s when solar is expected to become one of the first subsidy free renewable technologies.

1. Put in place an ambitious Solar Action Plan for Scotland, for both solar PV and solar thermal, and establish Scottish targets for both technologies. We suggest that a target of 2GW for solar PV and 200,000m2 or 141MWth for solar thermal by 2020 are both ambitious and achievable.

2. Establish Scottish financial support mechanisms for all solar projects under the transfer of powers as set out within the Scotland Bill. This would ensure that Scotland's renewable energy mix is balanced with a sufficient amount of solar energy generation and would bridge the gap to the early 2020s when mainstream solar rooftops and farms can become subsidy-free.

3. Actively support the implementation of energy storage for both electricity and heat at all levels. Recognise its role in relieving pressure on the grid, extending the contribution of renewables to baseload power, and its potential to alleviate fuel poverty. Ensure solar thermal storage and space heating are permitted under the Renewable Heat Incentive, and that hybrid PV-thermal is supported.

4. Recognise the benefits of co-locating solar, wind and storage and sharing grid connections. Note in particular the highly complementary output characteristics of solar and wind, both when collocated and within the same broad geographical area. Ensuring the proper assessment of this effect will increase the use of existing grid assets, and allowing solar to proceed without requiring additional grid connection.

5. Address major grid constraints in Scotland for distributed power generation at local, regional and national level. Help establish a detailed long term UK Grid Strategy that is fair and enabling for distributed power, with a control mechanism that will ensure the delivery and coordination of the collectively agreed programme of works. Engage with the National Infrastructure Commission on this issue and the move to smarter energy networks.

6. Reconsider the proposed removal of the Renewable Energy Generation Relief Scheme from 1st April 2016. Further, confirm and clarify the policy with regards to schemes in community ownership, particularly with regards to eligibility criteria and levels of relief.

7. Introduce a Scottish replacement for the Green Deal covering both domestic and commercial properties that leverages available resources and empowers people to take responsibility for reducing their own carbon emissions. The programme should encompass both energy efficiency measures and renewable technologies.

8. Support the case to HM Treasury/ HMRC that the 5 percent reduced rate of VAT be retained for all domestic solar retrofit, particularly for solar thermal, roof integrated PV and renovation as part of a social policy, as per their recent consultation on raising this to 20 percent.

9. Mobilise the Scottish Government's representation to the EU in Brussels to push for the removal of damaging anti-dumping and anti-subsidy tariffs, and by extension the artificially high Minimum Import Price undertaking, on imports of PV modules and cells from China.

10. Recognise solar technologies as 'reasonable measures' within the Energy Efficiency Standard for Social Housing (EESSH) programme. Bring forward legislation within the next Scottish Parliament to extend similar standards to the private sector within Regulations of Energy Efficiency in the Private Sector (REEPs) and include solar as a reasonable measure within this.

11. Assess the capacity and adopt an ambitious target for the rollout of solar on the Scottish Public Estate. The Scottish local authority estate in particular has significant potential, including public buildings, schools, leisure facilities and local authority offices. We propose a clear mandate by the Scottish Government to direct local authorities in the development of solar installations across their portfolio.

12. Ensure that official centralised guidance is issued to assessors to

> "Ambitious? Perhaps, but the STA Scotland headline 'Ask' for 2GW of solar PV by 2020 looks increasingly achievable, and would make Scotland one of the fastest growing markets in Europe let alone the UK."

John Forster, Chairman of STA Scotland and of Scottish solar business Forster Energy

ensure clarity, consistency and fairness throughout Scotland on the interpretation of legislation on business rates for rooftop and ground mounted solar. Set guidelines to ensure realistic installation costs with annual reviews to reflect reducing prices. Consider changing the relevant legislation so that buildings in Scotland with solar are treated in a balanced manner akin to the rest of the UK.

13. Extend permitted development to all rooftop solar installations, as proposed in the ongoing consultation on permitted development rights for non-domestic solar. Clear guidance should be distributed to each individual local authority building control department clarifying that Building Warrant is not required in the absence of any structural alteration to the roof, in line with the rest of the UK.

14. Put forward ambitious regulations to further decrease on-site carbon emissions from new buildings in the next round of Scottish Building Standards and set a clear trajectory for meeting the 2020 requirements of the Energy Performance of Buildings Directive.

15. Modify Scottish Building Standards so that heating systems for new homes are required to include 'solar-ready' thermal storage (e.g. a hot water cylinder), and where existing thermal storage is replaced in existing buildings that this is with 'solar-ready' storage.

16. Review and update planning guidance in Scotland with regards to solar in Conservation Areas and on Listed Buildings. Consider extending permitted development rights within set criteria as has been done in England and Wales. Jointly develop criteria and guidance for listed buildings based on a presumption of acceptance.

17. Ensure that planning policy and guidance for ground-mounted solar provides a positive and consistent framework for deployment while protecting the environment, embracing the principles of responsible development and the STA's 10 Commitments for Solar Farms.

18. Ensure that the Scottish Government Good Practice Principles document for Shared Ownership of Onshore Renewable Energy Developments offers workable recommendations for solar and embraces the broad range of options for community investment. Adjust the Community and Renewable Energy Scheme (CARES) loans so that they are more supportive of solar projects.

19. Make the Energy Performance Certificate (EPC) register for domestic and non-domestic buildings publicly available, as is the case in England. Promote its availability to raise awareness of carbon emissions and steps that can be taken to reduce them.

20. Actively support knowledge transfer in the public and private sectors in Scotland to enable greater up-take of solar and accelerate a cost effective transition to a low carbon economy using the successful example of the NFU Renewable Development Initiative project.

Further reading

[1] Feed-in Tariffs for solar were cut by up to 64 percent, in a decision announced just before Christmas which came into force on 8 February 2016 http://www.solar-trade.org.uk/government-heeds-national-backing-for-solar-and-improves-on-feed-in-tariff-proposal/

[2] http://www.solar-trade.org.uk/scotland-shows-support-for-solar-energy-with-key-guarantee

Ireland plans renewable energy transition by 2050

The Irish government has announced a framework for cutting carbon emissions up to 95 percent by 2050, radically altering its energy future. Renewable and low carbon resources will replace Ireland's long-standing reliance on coal, peat and oil for heating and electricity generation.

AFTER YEARS of study and consultation with citizens, industry and academia, coupled with mounting evidence of global climate change, the Irish government in December rolled out an ambitious framework for eliminating fossil fuels as a means to heat, cool and energize the nation.

In his 125-page white paper, 'Ireland's Transition to a Low Carbon Energy Future,' Energy Minister Alex White described ways that Ireland could transition from traditional reliance on fossil fuels, embracing not only EU mandates but the opportunity to rework the nation, creating jobs and new industries along the way.

"For the first time an Irish Government has set its course on the eventual elimination of fossil fuels from our energy system," Minister White said at an event officially releasing the plan. "We will only achieve this ambitious degree of decarbonisation by engaging all citizens in energy policy and its implementation. Meeting the challenge of global warming can no longer be confined to the realm of international treaties or government decisions. It is about changing the way we heat our homes and businesses… reassessing how we travel…participating in decisions about the infrastructure needs of a low carbon Ireland."

The white paper identifies 90 actions that will be key to moving away from high carbon fuels like peat and coal to low carbon or renewable alternatives; fossil fuels will largely be replaced by

renewable energy sources by 2050 under the plan. The ultimate goal of eliminating greenhouse gas (GHG) emissions from the nation's energy economy is set for 2100 when energy derived from fossil fuels should fall to "zero or below," the minister said.

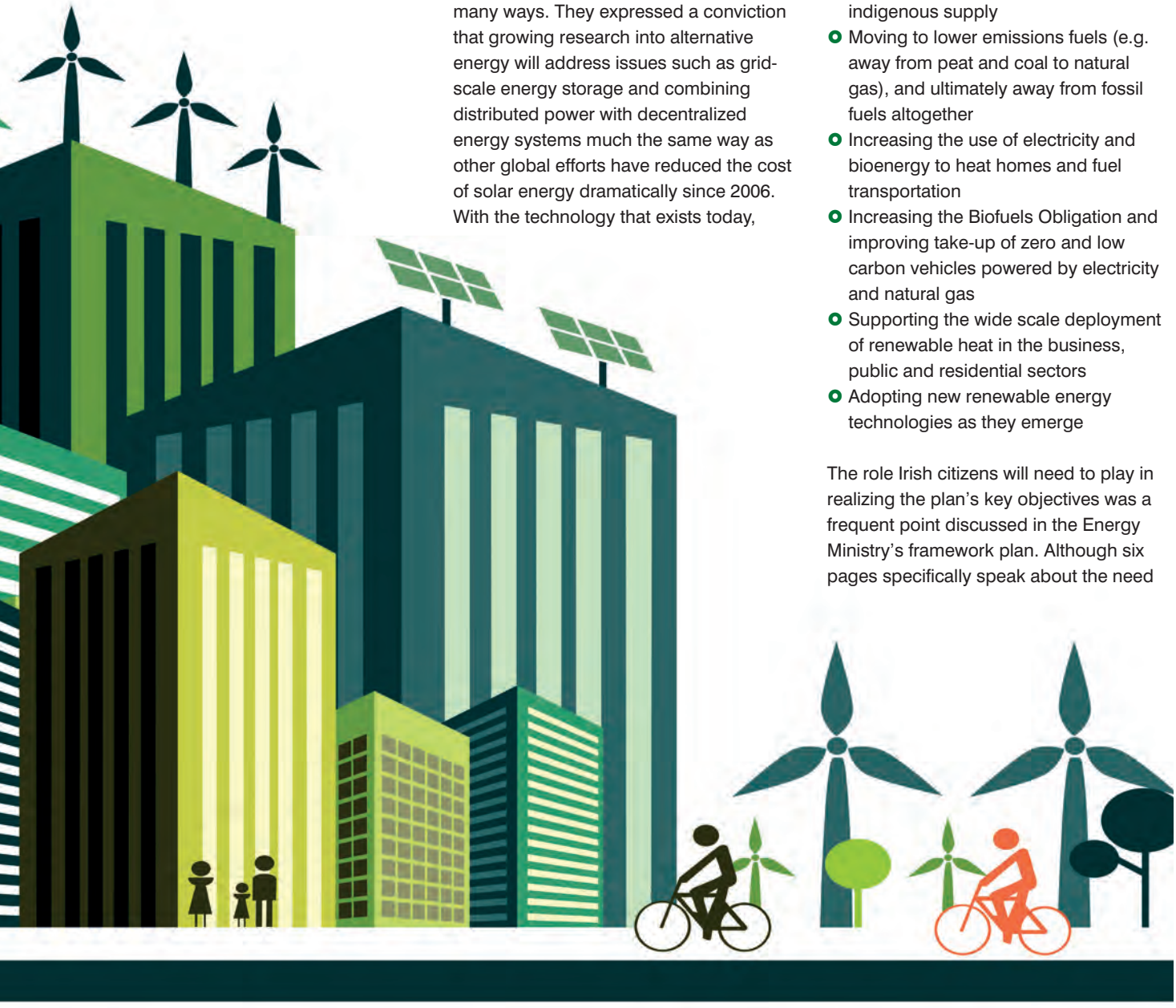
Work on the new Irish framework for a renewable energy future has been proceeding since Ireland's last energy white paper was published in 2007. The new framework focuses on current and medium-length plans through 2030, leaving room for technological advances, public interaction, and regular progress assessments to guide the plan toward its ultimate goals in 2050 and beyond. This new energy plan builds on the Department of Communications, Energy and Natural Resources (DCENR) publication of a Green Paper on Irish energy policy in 2014.

From the outset government leaders acknowledged that fundamental change—even when desirable—is never easy. Their efforts were driven by the prospects of facing runaway global warming and direct consequences for Ireland, other EU member states and the entire world, they stated. The technology already exists to affect positive change in many ways. They expressed a conviction that growing research into alternative energy will address issues such as grid-scale energy storage and combining distributed power with decentralized energy systems much the same way as other global efforts have reduced the cost of solar energy dramatically since 2006. With the technology that exists today, and new innovations that are logically expected, the Irish leadership said its 2050 goals are not only achievable, but may be met even more quickly than is foreseeable today.

Outlining key elements of the plan, the Irish Energy Ministry white paper describes actions and detailed processes needed to enable Ireland's transformation to a low carbon future. They believe this can be achieved by:

- Substantially changing the behaviour of citizens, industry and government
- Becoming more energy efficient
- Generating electricity from renewable sources of which Ireland has a plentiful indigenous supply
- Moving to lower emissions fuels (e.g. away from peat and coal to natural gas), and ultimately away from fossil fuels altogether
- Increasing the use of electricity and bioenergy to heat homes and fuel transportation
- Increasing the Biofuels Obligation and improving take-up of zero and low carbon vehicles powered by electricity and natural gas
- Supporting the wide scale deployment of renewable heat in the business, public and residential sectors
- Adopting new renewable energy technologies as they emerge

The role Irish citizens will need to play in realizing the plan's key objectives was a frequent point discussed in the Energy Ministry's framework plan. Although six pages specifically speak about the need



for citizen engagement, consultations between government and citizens saw some type of reference throughout the white paper. Barely a page goes by without comments concerning interaction between government and its constituencies.

The Aran example

Taking charge of their energy future is nothing new to the Aran Islands whose residents participated in a number of projects designed to create energy independence by 2022. Like much of the Irish coastline, the Arans have great potential for off-shore wind generation, but given the cost and grid connection issues of sea borne turbines, islanders focused on means that could benefit daily life without massive government programs. They created pilot energy co-ops, retrofitted homes and businesses for higher energy efficiency and took part in the trial use of electric vehicles (EVs) for public transport. A large portion of the Arans' 1,247 residents ultimately participated in various projects that resulted in a 78 percent reduction in transportation energy costs and a 68 percent reduction in energy imports, along with many other benefits. Results such as these were characterized by government officials as indicative of what Ireland can do to take charge of its unique energy requirements without increasing energy costs, compromising daily life or forfeiting business opportunities.

Becoming active energy consumers

Unless someone is actively engaged in the business of energy, the paper describes most Irish citizens as 'passive' consumers like almost everyone else across the globe. To achieve success the government envisions citizens changing from passive to 'active' energy consumers: persons who look for ways their lives can be made better by understanding proposed transitional energy practices and then taking charge of their own energy futures.

Ireland is not unique in its present day energy consumption practices. In most parts of the world the generation of electrical power, home and business heating/cooling all depend to some degree on government entities or utilities. These paradigms of energy generation came into existence more than a century ago when centralized power generation developed because of electricity's potential to transform daily living. The Ministry's white paper envisions an Ireland in which everyone not only knows how much energy their home or business utilizes, but works to actively conserve energy while embracing new technologies enabling independence.

A renewable foundation

Ireland is already committed to renewable energy. At the time its white paper was published, the government noted that Ireland obtained nearly 23 percent of its energy from renewable resources, with most of that coming through wind energy.

Solar (either thermal or photovoltaic [PV] power) is currently playing a minority role in the Irish energy economy. Solar is outpaced by contributions from inland wind electricity generation, hydroelectric and geothermal power. But as the government white paper concludes, the dramatic cost reduction in PV power over the last 10 years has translated into cost parity or near parity with fossil fuel generation. In looking at levelized cost of electricity (LCOE) comparisons, PV power is already cost-effective in many locations. In Germany, for example, solar energy (most of it PV,) accounts for anywhere between 20 percent and 50 percent of the country's electricity needs, depending on the time of year and other variables. The upside potential for solar in Ireland is very great.

Summary

Ireland's transition to a renewable energy future has been charted by its Energy Ministry within a framework of global concerns for reducing GHGs and thereby reducing the threat of global warming. But beyond esoteric concerns for collective world welfare, the plan also charts a course that shows energy independence has real benefits beyond those highlighted in the recent Paris Climate Accord.

Taking charge of a nation's energy future empowers everyone from citizens to industry to international business with confidence that local energy supplies are securely held within Ireland's borders. Modernization of the electricity grid, cooperation with Ireland's neighbors and the international community provides a basis for future business and economic growth that benefits everyone. By taking charge now, Ireland can say with confidence that it is creating its own future with independence from foreign interests. Although its plan is ambitious, Ireland is demonstrating real commitment; this should help every citizen see his or her role in a low carbon energy future as something they can take charge of starting today.

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Professional O&M

Protecting PV Plant Profitability

Stefan Degener, Senior Director O&M EMEA First Solar explains what investors look for when considering a PV project.

UTILITY-SCALE PHOTOVOLTAIC (PV) solar plants have emerged as much-desired assets drawing experienced investors looking for steady, reliable returns. But what is it that investors look for, or should look for, before considering a PV project?

A quick straw poll would probably point to technology being the key differentiator. Of course, not all manufacturers are equal and a real distinction has to be made been bankable module manufacturers with, among other things, the financial fortitude to stand behind their warranties, and those whose debts require them to take out insurance to cover potential warranty claims.

Then, the PV technologies themselves play a critical role in the energy output of a plant. While the investors are buying the asset, more importantly, they are buying a stake in its future energy generation; and with energy being the only monetizeable product, it is in their interest to ensure that the modules powering their plants are able to provide a certifiable energy yield advantage in real-world operating conditions.

However, beyond bankability and module technology, experienced investors will also place a premium on a critical service that ensures plant availability and optimizes energy generation for the life of the plant: professional and accountable operations and maintenance services (O&M).

For solar power plants, O&M is much more than just fixing a damaged electrical component or vegetation management. This may still be part of the overall service, but the main purpose of O&M has evolved: a professional O&M service will maximize the availability of a plant in order to optimize its output and reduce risks through predictive analytics.

When choosing an O&M provider, an experienced investor will always look at the return of investment that can be delivered by engaging an O&M service provider with extensive experience, significant fleet size, expertise, staff qualification and the service of performance engineering.

The key to effective O&M services is to monitor and analyse the Key Performance Indicators (KPIs) of a PV power plant and take respective actions, ideally in advance of a potential failure that can affect the energy generation negatively. In Europe, the first PV plants were built about

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15 years ago. At that time, O&M services were certainly undervalued. Owners didn't think operations and maintenance is relevant, since a PV plant does not have moving parts.

Today we know that the high quality O&M is paramount to the returns of a PV asset and also to the lifetime of a plant which has been assumed to be 25 years or more. The earlier we start to continuously monitor PV power plants with high data granularity, and translate the data evaluation into actionable measures, the easier it is to avoid expensive repairs and trouble shooting and the longer the owners benefit from reliable output and performance.

In fact, the benefits of professional O&M services are not lost on the owners of older European PV assets: in recent months, First Solar has seen much interest in high quality O&M services from investors who have either made an investment into secondary assets in Europe or have a portfolio of plants worldwide. In order to properly monitor the output of their plants – and their revenues - they choose to have their solar assets supervised by a single platform and maintained by a single operations service provider. The growing need for professional O&M services has clearly been acknowledged by SolarPower Europe – formerly the European Photovoltaic Industry Association – which partnered with First Solar to set up an O&M task force to develop standards and best practice guidelines for the industry.

As the industry tries to keep pace with a fast-growing market and the solar O&M market consolidates, these guidelines will be a valuable aid for investors, plant owners, lenders, technical advisors and other interested professionals to find guidance for standards and best practices on O&M.

As a matter of fact, if one image defines professional O&M services it would be that of a hi-tech operations centre - like the one operated by skytron energy and First Solar in Berlin - where operators remotely supervise the performance of PV power plants across many countries thanks to the digitalization of O&M.

It is from operations centres such as this that power plants are monitored, performance is predicted, availability is ensured, grid-stability is safeguarded and ground assets management is directed or advised This is the new reality of solar power O&M.

Stefan Degener is First Solar's Senior Director for O&M services in the EMEA region. With over 4.2GW in operation and more than 5GW of total contracted capacity worldwide, First Solar is the world's leading provider of operations & maintenance (O&M) services for utility-scale plants.

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Diverting power:
Managing excess solar energy

The Powerdiverter provides free hot water from the excess electricity from PV: Working in partnership with Housing Associations and Local Authorities to help eliminate fuel poverty.

What is the Powerdiverter?

- The Powerdiverter takes the excess electricity from a solar PV system and automatically diverts the free electricity to the immersion on the hot water storage tank, where it stores the energy as hot water
- Helping reduce energy consumption and maximising the benefit of solar PV or tenants and home owners

Key features and benefits

- Quickest system to fit – less than 20 minutes to install
- Wireless as standard – no additional wiring to consumer required
- Easy to use – one button Easyboost option – minimal support
- High level of reliability – less return visits or service calls
- Payback in just 1 to 3 years – Excellent Return of Investment (ROI)

What did we do?

We have now installed over 300 Powerdiverters in to selected Town and Country Tenants properties that already had individual domestic solar PV installations in place within Kent. The aim was to provide free hot water through heating water with the excess energy produced by solar PV. We had zero failures during this testing which was completed over the course of a year.

How did we do it?

The bidirectional current sensor communicates the amount of available energy which can be directed to the hot water tank via the Powerdiverter typically located in the airing cupboard. Storage heaters or underfloor heating can also use the Powerdiverter to heat homes with the excess solar PV energy.

Why did TCHG choose Powerdiverter?

After extensive Government supervised testing against a number of other water heating devices TCHG chose to install the Powerdiverter for all of its existing individual domestic solar PV systems. Powerdiverter proved to be the most reliable low cost option. Powerdiverter is robust, easy to install, and very easy to use.

Benefits for TCHG

- Maximising return or benefit to tenants
- Provide free hot water or heating
- Helping reduce fuel poverty
- Reducing energy consumption of tenants

Financial benefits to Town & Country Tenants – saving £14 to £34 per month on heating hot water

We have had some amazing feedback from TCHG tenants who have had the Power Diverter fitted with them typically saving between £24 to £34 per month from Spring to Winter. One of the Housing Association tenants, Chelsea and Chris, have had one of our Power Diverters installed for the past year. Chris confirmed that they had saved £306.46 pence in 9 months from June 7th 2013 to March 7th 2013, (average £34.38 per month during summer, autumn and winter months) Chris said that 'the Powerdiverter has saved us half of what they would usually pay through the meter and has a real impact on our fuel bills'. On moving house in April, Chris has requested the installation of the Powerdiverter for his new home. Nigel and Susan , 'We have used 1614.7kWh from the solar PV system which equated to a £243.01saving from using the Power Diverter', again this is over 9 months from June 7th 2013 to March 7th 2014.

Who are Powerdiverter?

The Powerdiverter was initially developed through joint development between Award winning solar PV installers and the University of Brighton in 2011. The initial focus for the design of the Power Diverter was to be extremely quick and simple for the installer to fit and extremely easy for the householder to operate.

For further details or information please contact Powerdiverter on 0800 059 9515 or find your local Powerdiverter installer on **www.powerdiverter.com**

Solar securitisation

A rising solar financing strategy

WonJu Sul, Associate Cadwalader, Wickersham & Taft LLP tell us how securitisation represents a rapidly emerging financing strategy.

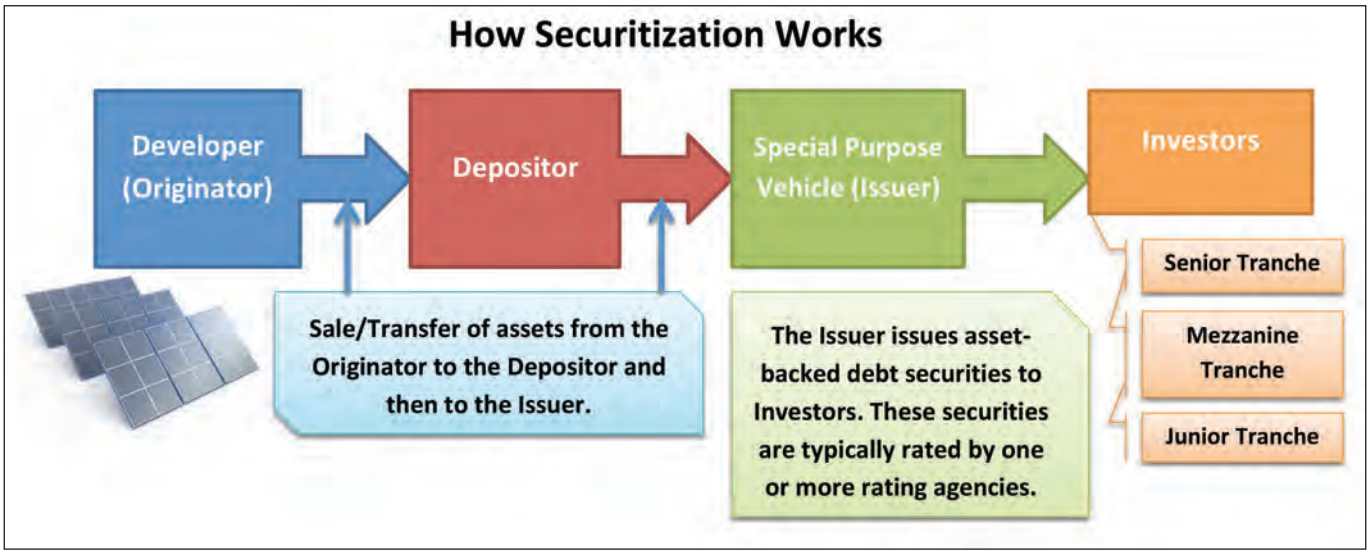
THE GLOBAL INTEREST in climate change is greater than ever and so is the importance of renewable energy technologies as a means to achieve climate targets both nationally and internationally.

With its abundance, relative reliability and adaptability to urban settings, solar energy is widely considered as the most promising alternative to fossil fuels and coal, and is one of the most popular renewable energy sources in both the US and the UK. However, despite the critical need to decarbonize the energy system, fewer financing options remain available from traditional players such as government, banks and tax equity investors. In the UK, the government has repeatedly scaled back its green subsidy schemes and seemingly plans to retreat completely by mid-2020s. In the US, the federal investment tax credit, which allows investors to realize tax benefits from financing solar projects, is set to reduce from 30 to 10 percent at the end of 2016, thereby significantly reducing the tax equity investors' incentive to continue funding at the current level. On both sides of the Atlantic, a host of post-crisis regulations constrain banks' lending ability and, with interest rate expected to increase soon, the borrowing costs via traditional routes will rise quite significantly.

Solar securitisation represents a rapidly emerging financing strategy. The solar receivables are particularly well suited to securitisation technology as solar technology lends itself to long-dated contracts, which is very attractive to investors. This article explores how securitisation can open up the access to the capital markets for solar developers and installers to obtain favourable financing opportunities and expand their businesses and allow solar industry to gain greater liquidity and scalability faster.

What is securitisation?

Securitisation is a form of asset-backed financing that transforms a pool of assets, through financial engineering, into debt securities to be offered either in public markets or to large institutional



investors through private placements. The beauty of securitisation is the ability to turn illiquid assets into liquid, standardized and tradable instruments. The process begins by delinking credit risk of the assets from other business risks of the originator by selling the assets to a special purpose vehicle (SPV) that is structured to be bankruptcy-remote. The SPV then sells the rights to the underlying assets by issuing the debt securities, typically in multiple tranches to match different risk appetites of the investors. The proceeds of the issuance are used to finance the business operations and pay the purchase price of the assets acquired from the originator. The SPV uses the revenues generated from the underlying assets to make interest and principal payments to the investors on the securitized bonds over a set period of time.

Why securitise?

Securitisation offers many potential benefits to solar developers including:

Access to capital markets

The ability to access broader and more diverse investors provides the developers much-needed flexibility and liquidity while also reducing the reliance on government subsidies and other equity financings. Most investors are much more comfortable dealing with debt securities than solar assets directly; and the relative ease of securitised bonds to be marketed, sold or listed abroad can broaden available financing options for many solar businesses.

Upfront lump sum payment

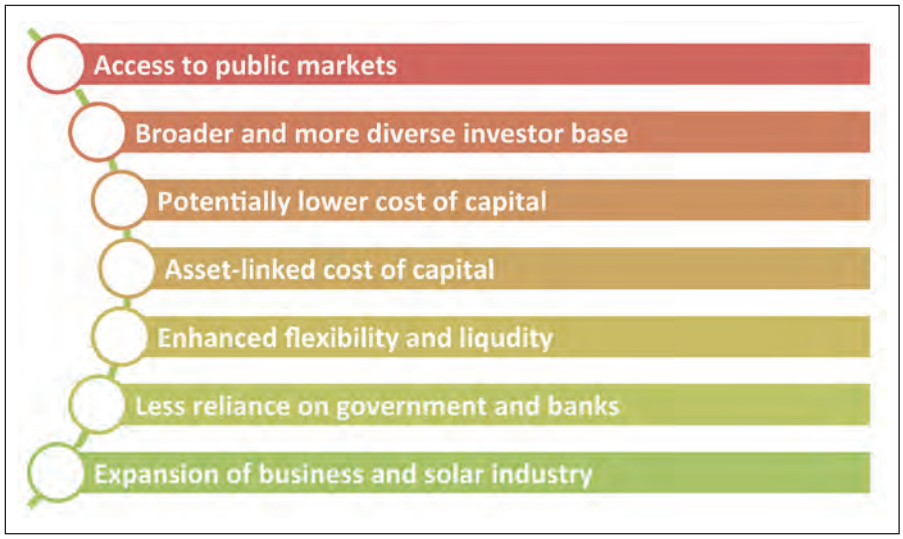
The developers will receive a lump sum payment of money reflecting the value of the underlying assets upon closing securitisation offerings instead of having to wait for years for the payment streams to pay back the principal over time. This lump sum payment from investors can be reinvested to expand the business and grow market share faster than it would have been without the securitisation.

Leverage

Different securitisation techniques such as subordination, over-collateralization or use of up-front cash reserves may allow the developers to lower the overall costs of capital. Using these techniques, together with offloading of the assets to a SPV that frees up the balance sheet capacity and the monetization of the assets that were previously illiquid, the solar businesses may benefit from the increased leverage, originate more assets and securitize those assets to fund expanded operations.

Longer tenor

Securitised bonds tend to have much longer maturities than other bonds, making them much more attractive to solar developers given the relatively longer time necessary for the developers to fully recoup the costs of typical solar projects. In solar securitisations, the maturities to date have ranged from 8 to 30 years.



Delinking of credit risks

Because the assets are transferred to a bankruptcy-remote special purpose entity, investors primarily account for the riskiness of cash flows from the investment itself and not the credit risk of the originating company. This is a significant advantage over secured or unsecured bank facilities and corporate bonds, under which credit ratings, hence the price, are directly tied to both the company's performance and the quality of the assets.

Who can securitise?

The full benefits of securitisation can only be achieved if certain commercial conditions are met. First and foremost, the developer must have operational assets of certain scale and quality to take to market. Broadly, there are two types of collateral typically used in solar securitisations: government-mandated subsidies and customer payments under leases and consumer contracts. If the developer owns a robust portfolio of intellectual property rights, it may be able to securitize the future payment streams generated by such rights as well. The assets must be able to generate a relatively stable stream of cash flows over the life of the securitisation.

Additionally, unless the size of the asset pool to be securitised is sufficiently large, the costs associated with setting up securitisation facilities may outweigh the benefits of savings from lower margins on the financing. Although future-flow securitisation technique is available to raise financings against assets that have not yet come into existence, enabling the originators to raise capital multiple times larger than the current annual cash flows, only those solar developers who can demonstrate the reliability and consistency of their operations may be able to benefit from such technique.

It should be noted that, because solar systems require ongoing monitoring and periodic maintenance in order to ensure optimal energy production, in most solar securitisations, the originating developer will typically act as the operations and maintenance services provider for the term of the securitisation.

Thus, the rating process thus far has been quite developer-centric and demanded the developers to have a fairly robust credit quality and sufficiently broad presence or network of subcontractors to effectively manage the securitized portfolio.

Market status: it is still nascent but growing fast

In the UK, the solar securitisations have centred on its feed-in tariff (FIT) and renewable obligation certificates (ROC) schemes. Under the FIT scheme, there is certainty of subsidy generation and of minimum sale price for selling solar power back to the grid.

The ROC scheme is slightly different and its prices fluctuate, unless an agreed power purchase agreement is in place. In any event, under both schemes, there is a long-dated cash flow that is government mandated, providing certainty that investors look for.

Among the first securitisation deals were the two FIT securitisations closed in 2012, each with the size of £66 million and £40 million issuances, securitizing the FIT revenues for two 20 megawatt (MW) and two 5 MW solar projects respectively.

Both deals were unrated and indexed to the retail price index (RPI), with 24-year and 25-year maturity respectively. In 2013, the UK saw its first solar conduit bond issuance that pooled small projects. This £60 million senior secured RPI-linked deal priced at a 2.59 percent coupon, was

SOLAR PV SECURITIZATION (as of October 2015)

Closing Date	Deal	Notes	Amount	Coupon	Ratings	Rating Agency
November 2013	SolarCity 2013-1	Class A	$54,425,000	4.80%	BBB+	S&P
April 2014	SolarCity 2014-1	Class A	$70,200,000	4.59%	BBB+	S&P
July 2014	SolarCity 2014-2	Class A	$160,000,000	4.02%	BBB+	S&P
		Class B	$41,500,000	5.44%	BB	S&P
		Total	$201,500,000			
July 2015	Sunrun 2015-1	Class A	$100,000,00	4.40%	A	KBRA
		Class B	$11,000,000	5.38%	BBB	KBRA
		Total	$111,000,000			
August 2015	SolarCity 2015-1	Class A	$103,500,000	4.18%	A	KBRA
		Class B	$20,000,000	5.58%	BBB	KBRA
		Total	$123,500,000			
Nov/Dec 2015	Aurora Master Funding 2015-1	Class A	$92,500,000	N/A	BBB	KBRA
		Class B	$7,500,000	N/A	B	KBRA
		Total	$100,000,000			

listed on the London Stock Exchange, and the proceeds were used to refinance four solar parks developed in the UK with an aggregate output of 15MW. The underlying revenue stream for this deal consists of renewable obligation certificates.

On the other hand, the US solar securitisations in the private sector developed around customer agreements in connection with commercial and residential rooftop solar photovoltaic (PV) systems. These customer agreements are structured as either leases or power purchase agreements (PPAs). The lease customers pay a fixed monthly fee with an electricity production guarantee whereas the PPA customers pay a rate based on how much electricity the solar energy system actually produces. These long-term lease and PPAs create recurring customer payments, investment tax credits, accelerated tax depreciation, and other incentives.

To date, there have been five solar PV securitisations completed in the US. All of them have been privately placed and their collateral pools consisted predominantly or exclusively of residential solar PV systems. The size of the pool ranges from 5,033 to 16,400 PV systems with the weighted average of remaining terms of the related contracts ranging from 217 to 233 months. The customers weighted average FICO scores ranged from 742 to 767. All of these securitisations required originators to put aside at least 6 months of interest payments as well as expected inverter replacement expenses in cash reserve accounts at the outset. The table below shows the specifics of each US solar PV securitisations to date:

Solar PV securitisations to date have been limited to a single developer deal that is sponsored by a large-scale, experienced developer. Also, there has not yet been a pooled solar securitisation or a purely commercial solar PV securitisation in the US. But some developers are now targeting standalone commercial and industrial portfolios and many other developers are adding securitisation to their financing repertoires. As market becomes more comfortable with the asset class, multi-borrower deals are likely to emerge allowing smaller developers to take part.

Because the solar securitisation industry is still embryonic, there are still many hurdles to be overcome for the asset class to burgeon. So far, the lack of historical data for solar systems and the lack of standardization of underlying contractual arrangements have made it difficult for rating agencies and investors to accurately evaluate the risks involved with solar-backed securities. If rating agencies can build models and methodologies based on historical data, it would help to make solar a scalable market, allowing traditional investors to join the buy-side. As more deals are issued and historical data accumulates, ratings are expected to improve, thereby further lowering the costs of capital for the originators.

Another issue to keep an eye on is, as technology evolves and costs continue to come down, securitised contracts may be terminated or renegotiated. Although originators may agree to make up for any potential shortfalls, investors may feel nervous about those uncertainties and be discouraged from actively investing in solar-backed securities. Additionally, as is applicable to all fledgling industries, new regulations can impose unexpected constraints on how solar businesses operate, which in turn may adversely affect the value of the assets.

Conclusion

For the renewable energy sector to play a key role in tackling the risks posed by climate change, enormous upfront investments are necessary. However, with constraints on traditional funding sources and reduced governmental subsidies, solar developers are facing increasing challenges securing near-term financings and finding an alternative financing venue.

Securitisation can help developers to monetize future cash flows, gain access to larger and diverse pools of investment and expand their businesses, which in turn may potentially lower the costs of capital and make solar more affordable for consumers to further ramp up demand.

That said, securitisation of solar assets could be instrumental in meeting the increasing demand for solar financing, particularly in an environment where traditional sources of financing are diminishing.

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