

New Energy INNOVATION

Latest Innovations In
Renewable Energy

Decarbonising
Industrial Process

Renewable
Fuel Production

Renewable
Gases

First Solar's Thin
Film PV Technology

Vestas Showcases
EnVentus Platform

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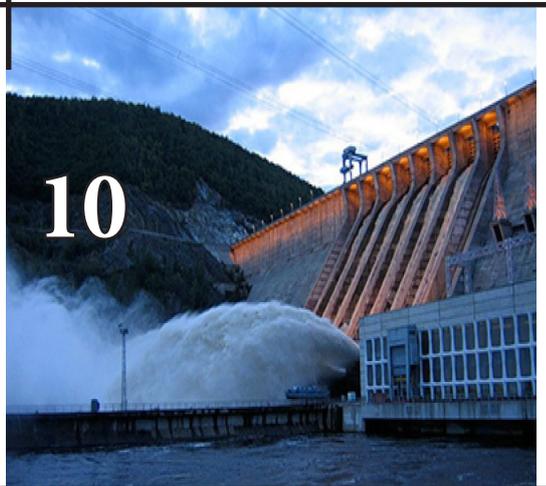
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Vestas Showcases EnVentus Platform

With an 189 MW order from Algonquin for two wind projects in the United States, Vestas shows off its EnVentus platform.



Vestas has received an order to supply EnVentus turbines for two wind projects in the U.S. totalling 189 MW, both owned by Algonquin Power and Utilities Corp. One project, Deerfield 2, is located in Michigan, USA and consists of 16 V162-6.2 MW turbines in 6.0 MW operating mode and one V150-6.0 MW turbine in 5.6 MW operating mode. The other project, Sandy Ridge 2, is located in Pennsylvania, USA and consists of 14 V150-6.0 MW turbines and one V136-3.45 MW turbine in 3.6 MW operating mode.

“We are happy to partner with Algonquin to execute on two projects in difficult-to-build locations due to land availability and transport limitations in Michigan and Pennsylvania,” said Jeff Fuchs, Vice President of Sales for Vestas in North America. “By leveraging Vestas’ EnVentus platform, which connects proven system designs from the 2 MW, 4 MW, and 9 MW platform turbine technology, we are enabling projects in unique markets and conditions that would not have been possible a few years ago and are able to do so with fewer turbines.”

Brenda Marshall, Senior Vice President of Renewable Generation – Wind for Algonquin, noted,

“We value our longstanding partnership with Vestas and are pleased to have their turbines powering our Deerfield 2 and Sandy Ridge 2 sites. These two projects represent an important component of our wind portfolio, and overall renewable energy program and sustainability-related initiatives”.



Powering ahead in the UK: Siemens Gamesa to double offshore blade facility

- Successful offshore blade factory in Hull, England to be expanded by more than 41,000 square meters; remains largest offshore wind manufacturing facility in the UK
- Investment of £186 million will enable manufacturing of next-generation blades in 2023
- 200 new direct jobs to be added
- Siemens Gamesa continues to be major driver of economic growth story in region; over 1,500 offshore wind turbine blades produced in Hull since opening in 2016

You need further information or have specific questions about this press release?

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Siemens Gamesa, the world’s leader in the offshore wind industry, will expand its successful offshore blade factory in Hull, England by 41,600 square meters, more than doubling the size of the manufacturing facilities. The expansion represents an investment of £186 million and is planned to be completed in 2023.

Manufacturing of next-generation offshore wind turbine blades will be enabled at the largest offshore wind manufacturing facility in the UK. It will grow to 77,600 square meters and add 200 additional direct jobs to the approximately 1,000 person-workforce already in place.

“Since our offshore blade factory opened in Hull in 2016, Siemens Gamesa has proudly served as the catalyst for the powerful growth the area has seen. The rapid development of the offshore wind industry – and continued, strong, long-term support provided by the UK government for offshore wind – has enabled us to power ahead with confidence when making these plans. We’re committed to unlocking the potential of wind energy around the globe, with solutions from Hull playing a vital role,” says Marc Becker, CEO of the Siemens Gamesa Offshore Business Unit.

He adds: “Siemens Gamesa continues to be the leading supplier of offshore wind turbine technology in the world’s leading offshore wind market, the UK. Through safe, efficient, and reliable manufacturing, over 1,500 blades from Hull have been delivered to customers worldwide. We’re very much looking forward to adding to this capacity in the future.”

Manufacturing of other offshore wind turbine blade types already in the Siemens Gamesa Hull factory pipeline will continue while the expansion is constructed. In total, Siemens Gamesa has an offshore wind power order backlog of €9.4 billion as announced during its Q3 FY21 results presentation on July 30, 2021.

Clark MacFarlane, Managing Director of Siemens Gamesa UK said: “The UK Government has provided strong and consistent support for offshore wind, having committed to a further 30 GW installed this decade, three times the current installed capacity. This underlines the commitment the UK Government has made since the Offshore Sector Deal was unveiled in early 2019.”



Nordex announces entry into the 6 MW class with the N163/6.X turbine

Like its sister model, the N163/5.X, the N163/6.X is designed for moderate and light-wind regions, but focusses on selected core markets in Europe.

The Nordex Group is adding the N163/6.X turbine to its product portfolio. The Group is following up its successful approach started with the introduction of the Delta4000 series, presented for the first time in 2017, of a flexible power range – initially with the 4 MW+ class, followed by the 5 MW+ class – and now with the 6 MW+ class.

Compared to its sister model in the 5 MW class – the N163/5.X – the N163/6.X is able to produce an up to 7 percent higher annual energy yield thanks to its much higher rated output. Its flexibility and a large number of operating modes mean that wind farms can be individually adapted to the customer's respective business model in terms of output, capacity factor, service life and sound emission requirements. The N163/6.X has a design lifetime of 25 years, but also comes with an extended lifetime for specific sites for up to 35 years. The long life of the components thus also contributes to the sustainability of a project.

A more efficient gearbox is used to achieve the higher rated output in the 6 MW range and the electrical system of the Delta4000 product series has been adapted by raising the nominal voltage and using an improved cooling system. In spite of this, the exterior dimensions of the nacelle have not been changed. The advantage of this is that the proven logistics and installation processes for the turbines in the Delta4000 series can be made use of as before.

In addition to this, a stronger version of the approx. 80 metre rotor blade from the N163/5.X, based on the proven GRP/carbon differential design, is employed, which the Nordex Group has been using in the series production of its rotor blades since 2011. The lower rotation speed means that the noise emission levels of the N163/6.X stand at max. 106.4 dB(A).

José Luis Blanco, CEO Nordex Group: “Our turbines in the Delta4000 series are based on a standard technical platform. Consistent modularisation means that type-specific components, such as rotor blades or gearboxes, can be adapted for different variants. The N163/6.X is yet another example of how highly efficient solutions that have proved successful in practice can be specifically implemented for special geographic regions.”

Different tower variants depending on the market, with a height of up to 164 metres, a cold climate version and the Advanced Anti-Icing System for rotor blades are also planned as options for the N163/6.X.

The start of series production of the N163/6.X is scheduled for the beginning of 2023. The Nordex Group has already received the first orders for the N163/6.X.

N163/6.X - ADAPTABLE TO VARIOUS SITE CONDITIONS



Siemens Energy warns no quick fix for Siemens Gamesa wind turbines



A model of a wind turbine with the Siemens Gamesa logo is displayed outside the annual general shareholders meeting in Zamudio, Spain, June 20, 2017. REUTERS/Vincent West

Turning around Siemens Gamesa (SGREN.MC) will take time, the CEO of its majority shareholder Siemens Energy (ENR1n.DE) said on Wednesday, adding that the latest profit warning from the wind turbine maker was “frustrating”.

Siemens Gamesa, the world’s largest maker of offshore wind turbines, is suffering from supply chain issues that have hit several industries as well as problems with its new 5X onshore turbine, prompting three profit warnings in nine months.

“In the current market environment the solution to the problem cannot be achieved in a few months,” Chief Executive Christian Bruch told reporters after Siemens Energy reported a 240 million euro (\$274 million) first-quarter net loss, compared with a profit of 99 million euros in the year-earlier period.

Bruch’s comments highlight the ongoing challenges posed by Siemens Gamesa, in which Siemens Energy owns 67% after a spin-off from former parent Siemens (SIEGn.DE), an ownership structure that has raised concerns due to limited influence.

“What I want to see above all is a steady improvement,” Bruch said, adding that successfully introducing the new generation of turbine would take several quarters.

Sources told Reuters last month that Siemens

Energy was stepping up efforts to buy the remainder of Siemens Gamesa, which analysts say would give the level of control it needs to speed up the turnaround.

Bruch side-stepped questions on whether a full integration was on the cards, saying that while such a step would have to create value for shareholders it would make sense addressing the needs of customers who demand a full range of products.

He declined to comment when asked whether Siemens Energy was currently planning to buy out Siemens Gamesa’s minority shareholders.

Shares in Siemens Energy rose as much as 2.5% after the comments, while Siemens Gamesa’s stock gained up to 4.1%.

The 33% of Siemens Gamesa which Siemens Energy does not own is currently worth about 3.8 billion euros.

CEO CHANGE

Siemens Energy released most of its quarterly results last month when it was forced to cut its guidance shortly after Siemens Gamesa slashed its targets, triggering the replacement of its CEO after 18 months in the job.

Bruch said Siemens Energy would continue to support turnaround efforts at Siemens Gamesa despite “a difficult market environment”.

To accelerate the turnaround, Siemens Energy board member Jochen Eickholt will take over as Siemens Gamesa’s CEO next month, in the latest sign that the German parent group aims to exert more influence.

Eickholt, a Siemens veteran who will leave Siemens Energy’s management board as a result of the move, will be replaced by Karim Amin, who is executive vice president of Siemens Energy’s generation division.



Renewable Fuel Production Heats Up in Kern

At the former Big West refinery on Rosedale Highway, work has begun for a fast-moving retrofitting project that, by next year, will begin producing at least 15,000 barrels a day of renewable diesel fuel to serve local truck transportation. This photo shows the southern part of the complex, where most of the renewable diesel refining will take place.

Renewable fuels production is becoming a bigger focus in Kern lately as investors launch projects that reinforce the county's prominence in biofuels and advanced facilities are proposed for deriving bioenergy from local waste streams.

Final preparations for a new renewable diesel project at the former Big West refinery on Rosedale Highway have roughly coincided with the recent expansion of a plant southwest of Bakersfield that leads the state in production of biodiesel. Plans are being made, meanwhile, for recycling centers that would turn household and other organic waste into biomethane, among other projects under consideration. Cooperation taking place locally aims to build on Kern's momentum.

Enthusiasm is running high as local initiatives stand to receive state money. But becoming a true center of excellence may depend on factors beyond local control.

Harry Simpson, CEO of Crimson Renewable Energy Holdings, recently finished a 50-percent increase in production capacity at the company's 88-acre biodiesel refinery off Millux Road near Interstate 5. As a local operator, he was encouraged by Gov. Gavin Newsom's proposal last week for an \$83 million energy innovation center at Cal State Bakersfield.

Hopefully a commercially viable idea will emerge from the new center, he said. But

he noted there's no guarantee any such innovation would be built locally.

"The question is, will this stuff get built in Kern County as opposed to somewhere else?" he said. "It would be cheaper and easier for me to do (business) in Texas or Louisiana than California."

That possibility isn't stopping local energy leaders from pursuing a collaboration geared toward capitalizing on Kern's existing strengths in renewable fuels.

One of the industry players participating in the county's B3K Prosperity economic development initiative is Jennifer Haley, president and CEO of Kern Oil & Refining Co., a 155-employee plant that makes renewable diesel and other fuels at its 26,000-barrel-per-day refinery near Lamont.

As her own company looks for strategic partners to do more waste-to-fuel processing and production of ultra-low-carbon intensity fuels, she sees the B3K collaboration as the best way to put local talent and other resources to use creating good local jobs.



“It’s how do we pivot or how do we evolve toward managing that carbon intensity and meeting our climate goals?”



Although it's hard to say what products and technology will finally help California achieve its goals, she added, "I think we can define what the future looks like and be a part of the solution."

California imports most of its biodiesel, just as it imports most of its crude oil. But to the degree that turning California's growing stream of organic waste into energy is a local affair, at least, Kern is expected to attract investment in the months and years ahead, as the state requires municipalities to divert food scraps and other organic waste away from landfills to fight climate change.

J.D. Gessin, operations CEO at West Coast Biofuels, is working to convert an idle produce plant in McFarland into a biodiesel and renewable fuels plant serving the commercial transportation industry. It is expected to employ more than 20 people turning waste oils such as grease and rendered fats into fuel for agriculture, heavy machinery, aviation, tractor-trailers and, eventually, maritime transport.

Separately, the company hopes to deploy a series of modular bioenergy refineries in Kern and as far north as Stockton to gasify organic waste that otherwise heads to a landfill. Each facility would employ three dozen or more people and process 20 to 30 metric tons of waste.

Gessin said the company expects to eventually produce not only conventional liquid renewable fuels for decarbonizing commercial transport in California but also renewable electricity, biomethane and hydrogen.

In 2020, 589 million gallons of renewable diesel accounted for only about one-sixth of California's total use of diesel fuel, according to the California Energy Commission. Renewables' share is expected to jump 40 percent just with the project Global Clean Energy Holdings Inc. is preparing to begin on a portion of the former Big West property.

Expected to employ more than 100 workers, the plant is planned to produce 15,000 barrels per day, or 230 million gallons per year. Like other local plants, its feedstock will include used cooking oil and

rendered fats, though eventually it is expected to incorporate oil from a crop called camelina.

Crimson's operation on Millux, now responsible for 36 million gallons of biodiesel per year, has been the state's largest producer of the fuel for almost 10 years. It brings in used cooking oil from as far north as Seattle, but still produces less than California biodiesel sources like Singapore.

Still greater potential may lie in biomethane and hydrogen produced from organic waste.

Executive director Julia Levin of the Bioenergy Association of California said the state's capacity for producing biomethane is pegged at the equivalent of 4 billion gallons per year of diesel — a third more than California's demand for that fuel — using only waste from landfills, wastewater treatment, animal manure, fats, grease and biomass such as ag trimmings. She noted hydrogen could also be created from such sources.

The California Public Utilities Commission has helped by requiring natural gas utilities to incorporate biomethane into the fuel it delivers residential customers for use in heating, cooking and drying.

Levin said it won't be long before more jets, ships and heavy-duty trucks are running on the fuel, given that some forms of transportation won't easily adopt batteries. There are signs as well that state government is preparing to invest hundreds of millions of dollars in biomethane, hydrogen and other renewable fuels.

She predicted growing demand as California works to replace the feedstock fueling its natural gas power plants and looks for different forms of long-term energy storage.

"I don't think we're going to see market saturation for a long time," Levin said. "The problem is opposite right now. We need to ramp up production much more quickly."

RusHydro Affirms its Leading Position in RSPP Sustainable Development Indexes



Russia. PJSC RusHydro (ticker symbol: MOEX, LSE: HYDR; OTCQX: RSHYY) announces its inclusion in category A of Russian Union of Industrialists and Entrepreneurs sustainability indices. The company's shares are included in Responsibility and Transparency Index and Sustainability Vector Index.

Russian Union of Industrialists and Entrepreneurs experts analyzed over 100 companies in RAEX-600 rating. Following the review, 52 Russian corporates were included in both indexes, with only five companies, including RusHydro, from utilities sector in both indices.

Being Russia's leading hydroelectric company, RusHydro strives to achieve high international sustainability ratings.

The Company took first place in Expert RA ESG transparency ranking. RusHydro is a member of the UN Global Compact and is continuously carrying out activities aimed at improvement of financial and non-financial information disclosure.

Predominant share of RusHydro's generation comes from water, a renewable resource. Increase of low-carbon share in

the Company's power balance, reduction of GHG-emissions, biodiversity and preservation of endangered species are among the key objectives of RusHydro's environmental policy until 2025. By that period CO₂ emissions from generation of electricity and transfer of heat will decrease by 7.7% and 6.4%, respectively as compared to 2015.

The new strategy is formed in the context of the global energy transition that is gaining strength in the world, the essence of which is to change the energy system - the formation of a clean, decentralized and digital energy of the future. RusHydro Group plans to lead the clean energy development agenda in Russia.



JinkoSolar's Subsidiary and CATL Sign Strategic Cooperation Framework Agreement

JinkoSolar Holding Co., Ltd. (the "Company," or "JinkoSolar") (NYSE: JKS), one of the largest and most innovative solar module manufacturers in the world, today announced that its principal operating subsidiary.

Jinko Solar Co., Ltd. has signed a strategic cooperation framework agreement with Contemporary Amperex Technology Co., Ltd. ("CATL"). The signing ceremony was attended by Mr. Jia Zhou, president of CATL and Mr. Kangping Chen, CEO of Jinko Solar Co., Ltd., on behalf of both parties.

Under the agreement, the two parties will establish a long-term, stable and solid strategic joint partnership in areas such as the promotion of carbon neutrality in the industrial chain, global solar-plus-storage business development, and the innovation and development of solar-plus-storage integrated solutions.

Mr. Jia Zhou, president of CATL, commented, "With the shared goal of achieving carbon neutrality, we believe that both parties can effectively join forces to carry out comprehensive and in-depth cooperation in the field of solar-plus-storage integration, and create greater value for global customers. This is a great opportunity to further advance on technology innovation, improve efficiency and reduce costs. At the same time, the two companies will bring their industrial resources together to promote solar-plus-storage integration solutions in collaboration with industry partners. We want to help our customers reduce their carbon footprint and lower carbon emissions, and in the process lead by example for the industry to set new green benchmarks."

"We're excited to be in partnership with CATL to jointly develop the global solar-plus-storage market. . With JinkoSolar's high-efficiency PV technology, global network and business operation model combined with CATL's advanced patented technologies in the field of energy storage and innovative models, the future is promising and we can provide more effective solutions for global customers. Both parties have their respective advantages, and we can optimize our strengths by integrating resources and synergizing development strategies. We want to build a new energy technology ecosystem and promote the use of solar in the energy field in the future, thus contributing to the realization of carbon neutrality," said Mr. Kangping Chen, CEO of Jinko Solar Co., Ltd.

Looking forward, both parties are confident that they will be able to optimize their respective strengths in PV and energy storage solutions, broaden the horizons of the solar-plus-storage industry, and innovate in multiple fields including technology R&D and alternative business models. Working closely together, both parties will continue to provide more comprehensive new energy solutions for global customers and lead the industry into a new era of carbon neutrality.

About JinkoSolar Holding Co., Ltd.

JinkoSolar (NYSE: JKS) is one of the largest and most innovative solar module manufacturers in the world. JinkoSolar distributes its solar products and sells its solutions and services to a diversified international utility, commercial and residential customer base in China, The United States, Japan, Germany, the United Kingdom, Chile, South Africa, India, Mexico, Brazil, the United Arab Emirates, Italy, Spain, France, Belgium, and other countries and regions. JinkoSolar has built a vertically integrated solar product value chain, with an integrated annual capacity of 22 GW for mono wafers, 11.5 GW for solar cells, and 31 GW for solar modules, as of March 31, 2021.



JinkoSolar has 9 production facilities globally, 22 overseas subsidiaries in Japan, South Korea, Vietnam, India, Turkey, Germany, Italy, Switzerland, United States, Mexico, Brazil, Chile, Australia, Portugal, Canada, Malaysia, UAE, Denmark, and global sales teams in China, United Kingdom, France, Spain, Bulgaria, Greece, Ukraine, Jordan, Saudi Arabia, Tunisia, Morocco, South Africa, Costa Rica, Colombia, Panama, Kazakhstan, Malaysia, Myanmar, Sri Lanka, Thailand, Vietnam, Poland and Argentina, as of March 31, 2021.

Hydro-Québec Reaches Agreement with Brookfield Renewable to Purchase Output from Rivière du Lièvre Generating Stations

Hydro-Québec and Evolugen, the Canadian operating business of Brookfield Renewable, today announced that they have entered into a 40-year escalating electricity purchase agreement under which Hydro-Québec will purchase the output of the Lièvre hydro-electric portfolio in Québec with 263 MW of capacity. The assets will continue to be operated by Evolugen.

Given the ongoing energy transition, it is expected that demand for clean, renewable base load electricity generation will increase sharply in the coming years. Hydro-Québec is implementing several strategies to address this demand, in particular by contracting the capacity comprised of four generating stations located along Rivière du Lièvre in Outaouais. The facilities will contribute approximately 1.5 TWh annually, which is equivalent to the energy used by close to 90,000 homes.

The agreement involves integrating Evolugen's Lièvre generating fleet, into Hydro-Québec's generation planning. It also includes priority access rights associated with the US market.

"With this strategic agreement, we are adding capacity and renewable energy to our supply in a context of increasing demand in both Québec and neighboring markets. The opportunity to purchase output from reliable hydroelectric generating stations that are currently in operation and already connected was appealing for many reasons. This agreement is particularly useful for us during winter peaks," noted Pierre Despars, Vice President –

Corporate Strategy and Business Development at Hydro-Québec.

"We are pleased to sign a strategic agreement with our long-standing partner, Hydro Québec, to contract our Lièvre assets for the next 40 years. This agreement offers a sustainable and Québec-based solution to meet Hydro-Québec's growing renewable energy demand" said Josée Guibord, CEO of Evolugen, the Canadian operating business of Brookfield Renewable. "Our team works hand-in-hand with customers to provide tailored clean energy solutions, like this one, that fit our customers' objectives and reduce their exposure risk."



Hydro-Québec generates, transmits and distributes electricity. It is Canada's largest electricity producer and one of the world's largest hydroelectric power producers. Its sole shareholder is the Québec government. As a leader in hydropower and large transmission systems, Hydro-Québec exports clean, renewable power and commercializes its expertise and innovations on world markets.

This agreement offers a sustainable and Québec-based solution to meet Hydro-Québec's growing renewable energy demand" said Josée Guibord, CEO of Evolugen, the Canadian operating business of Brookfield Renewable. *"Our team works hand-in-hand with customers to provide tailored clean energy solutions, like this one, that fit our customers' objectives and reduce their exposure risk."*

Brookfield Renewable operates one of the world's largest publicly traded, pure-play renewable power platforms. Its portfolio consists of hydroelectric, wind, solar and storage facilities in North America, South America, Europe and Asia, and totals approximately 21,000 megawatts of installed capacity and an approximately 56,000-megawatt development pipeline. Investors can access its portfolio either through Brookfield Renewable Partners L.P. (NYSE: BEP; TSX: BEP.UN), a Bermuda-based limited partnership, or Brookfield Renewable Corporation (NYSE, TSX: BEPC), a Canadian corporation.

Brookfield Renewable is the flagship listed renewable power company of Brookfield Asset Management, a leading global alternative asset manager with approximately \$650 billion of assets under management.



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Swift Current Energy Selects First Solar's Thin Film PV Technology for 1.2GW Order

First Solar, Inc. (Nasdaq: FSLR) announced that Swift Current Energy, a Boston-headquartered developer, owner, and operator of utility-scale clean energy assets has placed an order for 1.2 gigawatts (GW)DC of First Solar's advanced, ultra-low carbon thin film photovoltaic (PV) solar modules. The modules will be delivered in 2023 and 2024.

Founded in 2016, Swift Current has commercialized over 1 GW of renewable energy projects, including utility-scale solar and wind. The company also has a growing pipeline of over 6 GW of planned renewable assets across North America.

"This is our largest procurement yet and demonstrates our ongoing commitment to investing in renewable energy to create a sustainable future," said Eric Lammers, chief executive officer, Swift Current Energy. "First Solar, with its record of quality and sustainability, is a great match for our team and will support our work to develop, construct and own best-in-class renewable energy projects safely, on time and within budget."

"We pride ourselves on responsibly developing high impact projects for our host communities and constructing projects safely, taking a considerate approach every step of the way," said Matt Birchby, president, Swift Current Energy. "As a renewable energy developer and a long-term owner, it's essential for Swift Current to have the highest-performing, safest and most cost-effective products. We are excited to work with First Solar and look forward to bringing our most significant solar projects to date online."

Designed and developed at its research and development (R&D) centers in California and Ohio, First Solar's responsibly produced advanced thin film PV modules set industry benchmarks for quality, durability, reliability, design, and environmental performance. First Solar also operates an advanced recycling program that recovers more than 90 percent of CadTel for use in new modules.

"As US project developers look for reliable module supply partners, we're able to support their needs not only with advanced technology that reliably performs in the field, but also with our ability to provide long-term pricing and supply commitments," said Georges Antoun, chief commercial officer,

First Solar is investing \$680 million in expanding America's domestic PV solar manufacturing capacity by 3.3 GW annually, by building its third US manufacturing facility, in Lake Township, Ohio. The new facility is expected to be commissioned in the first half of 2023 and when fully operational will scale the company's Northwest Ohio footprint to a total annual capacity of 6 GW, which is believed to make it the largest fully vertically integrated solar manufacturing complex outside of China.

In addition to its Ohio manufacturing facilities, First Solar also operates factories in Vietnam and Malaysia, and is building a new 3.3 GW factory in India that is expected to be commissioned in the second half of 2023. With First Solar's expansion in the United States and India and optimization of its existing fleet, the company anticipates that its nameplate manufacturing capacity will double to 16 GW by 2024.

About Swift Current Energy

Swift Current Energy acquires, develops, constructs, owns and operates highly competitive, utility-scale wind, solar energy and battery storage projects across the United States. Backed by Buckeye Partners, L.P. and Nala Renewables, Swift Current has commercialized 1.1 GW of renewable energy projects and has a growing project pipeline with more than 6 GW across North America. Swift Current Energy is headquartered in Boston, Massachusetts and has offices in Illinois, Maine, Montana and Texas, USA.

About First Solar, Inc.

First Solar is a leading American solar technology company and global provider of responsibly produced eco-efficient solar modules advancing the fight against climate change.

Developed at R&D labs in California and Ohio, the company's advanced thin film photovoltaic (PV) modules represent the next generation of solar technologies, providing a competitive, high-performance, lower-carbon alternative to conventional crystalline silicon PV panels. From raw material sourcing and manufacturing through end-of-life module recycling, First Solar's approach to technology embodies sustainability and a responsibility towards people and the planet.



Decarbonizing Industrial Process Heat the Role of Biomass

This report highlights the opportunities for bioenergy technologies to deliver heat in industry and compares it with alternatives for decarbonisation such as CCS, electrification and hydrogen. The report provides specific policy recommendations to accelerate its adoption.

Bioenergy is currently the largest source of non-fossil industrial process heat, largely because of how forest industries utilize internally generated residues and by-products to e.g., dry timber in sawmills and produce process steam in pulp & paper mills. However, when it comes to broader opportunities of biomass for industrial process heat, it is key to understand the heterogeneity of diverse biomass feedstocks. There are many pathways by which the feedstock can be converted into process heat, including direct combustion but also by way of pre-processing like torrefaction, gasification or liquefaction. These can be used to produce biomass-based fuels that are quite similar to the fossil fuels currently in use and hence, in principle, biomass can meet most industrial process heat requirements. Costs of biomass (and required pretreatment) vary greatly between locations which makes it difficult to make general statements about cost competitiveness of biomass as a source of industrial process heat.



The opportunities for biomass to provide industrial process not only depend on the technological demands of the process itself, but also on (local) feedstock availability and how appropriate fuel logistics systems can be set up. Close collaboration between different supply chain actors and long-term fuel supply contracts can often be key to provide the certainty needed to reduce investor risk.



While there is a need for a broad and multi-faceted set of policy measures to meet the steep challenge of achieving net-zero emissions by 2050, the short timeframe and the radical changes needed will require focus on a few select policy measures that are particularly important to meet challenges that are specific to the industrial sector. Some examples:

Scale up-funding to bridge the demonstration project valley of death to overcome the barriers related to high upfront investments in immature technologies

Making carbon pricing work for companies working in global markets avoid reduced competitiveness of industries within the jurisdiction relative to competing industries outside the jurisdiction

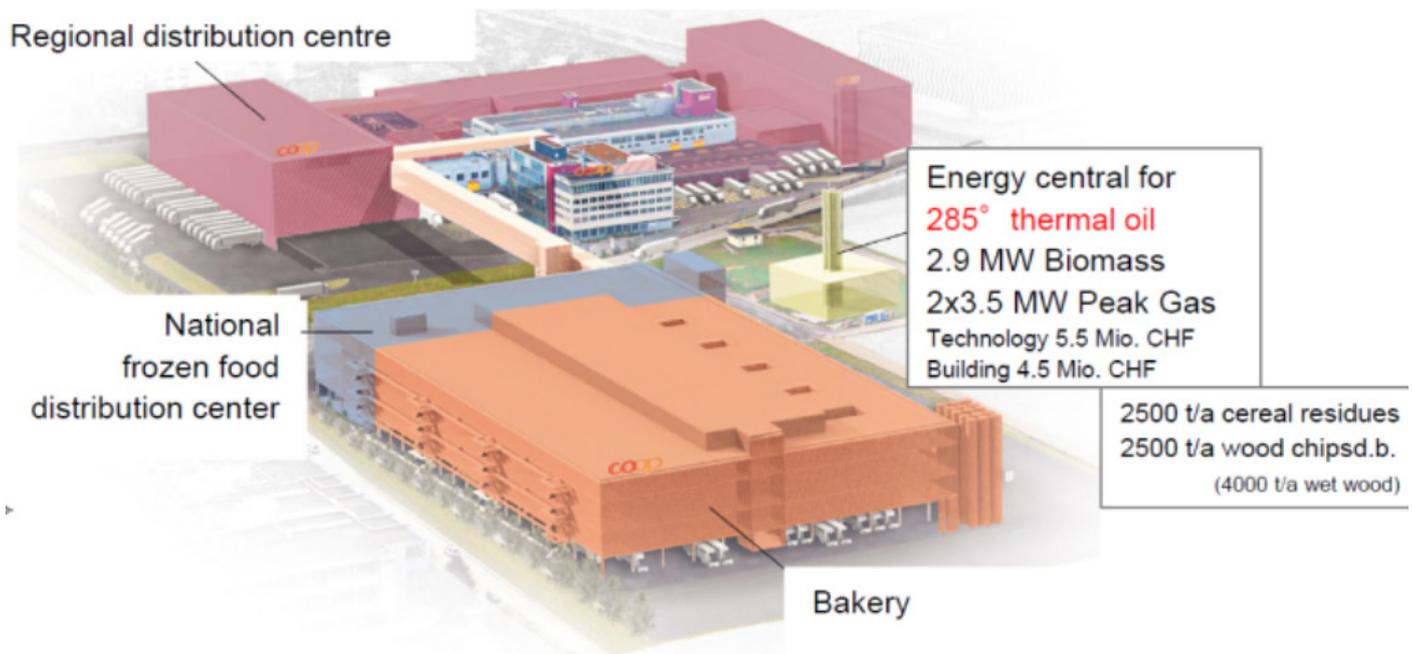
Creating demand for low GHG products that may be more expensive than conventional products. Potential measures are public procurement regulations or sector decarbonisation targets.

Combustion of Wood Chips and Grain Residues for Process Heat Supply in the Largest Bakery in Switzerland Economy

The Coop Group is Switzerland's largest retail and Europe's second largest wholesale company. In 2015, Coop built a new production and distribution centre in Schafisheim in the Swiss midlands. The building complex incorporates a high-bay freezer warehouse and Switzerland's largest bakery and confectioner with an annual production of 60 000 tons of baked goods.

The role that bioenergy plays in the global energy mix has expanded over the last decades, from predominantly domestic space heating and industrial heat until the 1990's to increased use in the electricity sector and more recently also large-scale production of transportation fuels. According to the IEA SDS scenario, the use of biomass to produce high temperature heat in industry will not decrease, but quadruple from 8 EJ today to about 24 EJ in 2060. Traditionally, the application of bioenergy in industry was performed in industries that can use their own biomass process residues to cover (some of) their own heat demand, e.g. sugar, palm oil, wood processing, pulp and paper, etc. With the increasing motivation in industry to reduce

CO₂ emissions, several other industry sectors are also shifting towards biomass-based heat generation in cases where there are suitable biomass resources and technologies available nearby.



In order to substitute fossil fuels, a biomass combustion plant was realized to provide process heat for the bakery by thermal oil. Since the treatment of the raw materials for the bakery causes residues in the up-stream milling process, the vision to use milling residues as energy for the bakery arose. The potential and technical opportunities were evaluated and a concept of co-firing wood chips and grain residues was developed. Swissmill, the largest mill of Switzerland located in Zurich and owned by Coop, was involved to provide fractions of grain residues, which are of low value for other purposes. To ascertain a flexible operation of the bakery, the decision was taken to implement a concept which enables a variable energy production by 50 % wood chips and 50 % grain residues with the opportunity to switch to 100 % wood chips. Consequently, a combustion system was designed, that enables the use of forestry wood chips from a respective silo with addition of pellets from grain residues from a separate storage compartment. The thermal oil boiler and the flue gas cleaning were adopted to comply with the challenges of increased slagging and fouling and with increased NO_x emissions due to the high ash and nitrogen content of grain residues. To cover the rapid load changes of the bakery process, a gas fired peak boiler complements the heat production.



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Renewable Gases – Hydrogen in the Grid

The role of renewable gases in national policies for GHG emission reductions by 2030-2050 and respective estimates for the amounts needed by 2030-2050 was analyzed with a focus on H₂ strategies and roadmaps.

Renewable gases, including hydrogen (H₂), will be a key component of the global energy system aiming at net zero greenhouse gas (GHG) emissions by 2050. Net Zero Emissions scenario for 2050 shows that under a strict GHG mitigation logic, fossil gas supply will be peaking in the mid-2020s and shrinking up to 2050. In parallel, renewable gases (biomethane, H₂, H₂-based synthetic methane) will have to strongly increase to displace fossil gas.

This report provides a synthesis of an IEA Bioenergy project on renewable gases (RG) and the effect of hydrogen in gas grids. The activity was funded by the European Commission, Germany, and Sweden, with contributions from the Netherlands. The project collected existing data, performance indicators, information on RG studies & projects and analysed national strategies. It also identified and discussed the numerous challenges and hurdles for the gradual replacement of natural gas by renewable gases, with emphasis on H₂ addition to the natural gas grid, and dedicated H₂ grids.

Overall take-away: biomethane and renewable synthetic methane can already be carried by the existing gas network infrastructure without any problems, and injection of a limited amount of renewable hydrogen (H₂) in the gas grid is also feasible. The injection of larger quantities of H₂ and the transition to 100% H₂ will require step-by-step technical modifications or further development of the gas distribution networks and the customer facilities connected to them.

The study analysed the role of renewable gases in national policies for GHG emission reductions by 2030-2050 and respective estimates for the amounts needed by 2030-2050, with a focus on H₂ strategies and roadmaps.

Most country strategies and roadmaps see H₂ as a means to overcome the limits of electrification and to help stabilize electricity grids against a growing share of variable renewable generation, especially solar and wind. Some H₂ strategies address the potential role of longer-term energy storage needs to bridge seasonal variations in renewable electricity generation. Several countries indicate their ambition to export H₂ in the 2030 timeframe and after, while others assume H₂ imports. Besides trade, most

strategies focus on domestic H₂ application in hard-to-abate sectors, i.e., those where GHG emission reduction by renewable electrification is hindered, e.g., the chemical industry, steel making, and transport (aviation, long-haul road, shipping), in some cases as H₂-based synthetic fuels. Nearly all country strategies and roadmaps address the role of existing gas infrastructure for future H₂ transmission and distribution and see H₂ clusters as an important step towards H₂ use, both in industry, and in regional H₂ networks.

Biomethane and synthetic methane (SM) can already be added to the existing gas infrastructure without problems. Co-processing biogas and H₂ to biomethane/synthetic methane in hybrid plants could boost near-term grid-compatible production. Next to that, direct H₂ injection in gas grids (HIGG) could provide a steppingstone for developing a H₂ infrastructure with adding up to 20 vol% of H₂ to the gas grid, i.e. about 7 % by energy content.



For higher H₂ shares in the gas grid without compromising downstream distribution and end-uses, the gas transmission system could be used for H₂ transport only (in blended form with natural gas) and H₂ could be separated from transported natural gas before it is distributed to end-users. H₂ separation would add \$2 – \$4 per kg of H₂ in the longer-term.

A potential alternative to HIGG (and later separation) is to convert H₂ into renewable synthetic methane (SM) to make it fully compatible with existing natural gas infrastructure and end-use technologies. Methanation of H₂ (biological or catalytic conversion of H₂ and CO₂ to methane) costs about 50% less than the longer-term additional cost of H₂ separation and could help balancing the electricity system and longer-term storage of renewable electricity.

Converting existing natural gas transmission pipelines to H₂ (“repurposing”) is possible in many cases. Cost of doing so would add approx. 0.05 \$/ kg H₂ (depending on the lifetime and throughput of the grid), while cost for new dedicated H₂ pipelines are twice as high. Costs to convert the gas distribution to be fully H₂-compatible are about 20 % of repurposing transmission pipelines, and approx. 1/3 of new dedicated H₂ pipelines, but strongly depend on the geographical distribution of end-users, and the topography of the area served.

There is a clear transition logic from natural to renewable gas which also helps integration with the (decarbonized) electricity system.

Yet, there are many hurdles and obstacles in the regulatory system: As H₂ in the grid is a rather new issue, the transformation of the gas system and “coupling” with other energy sectors is quite complex, and the international dimension of trade, especially when including climate policies, is challenging.

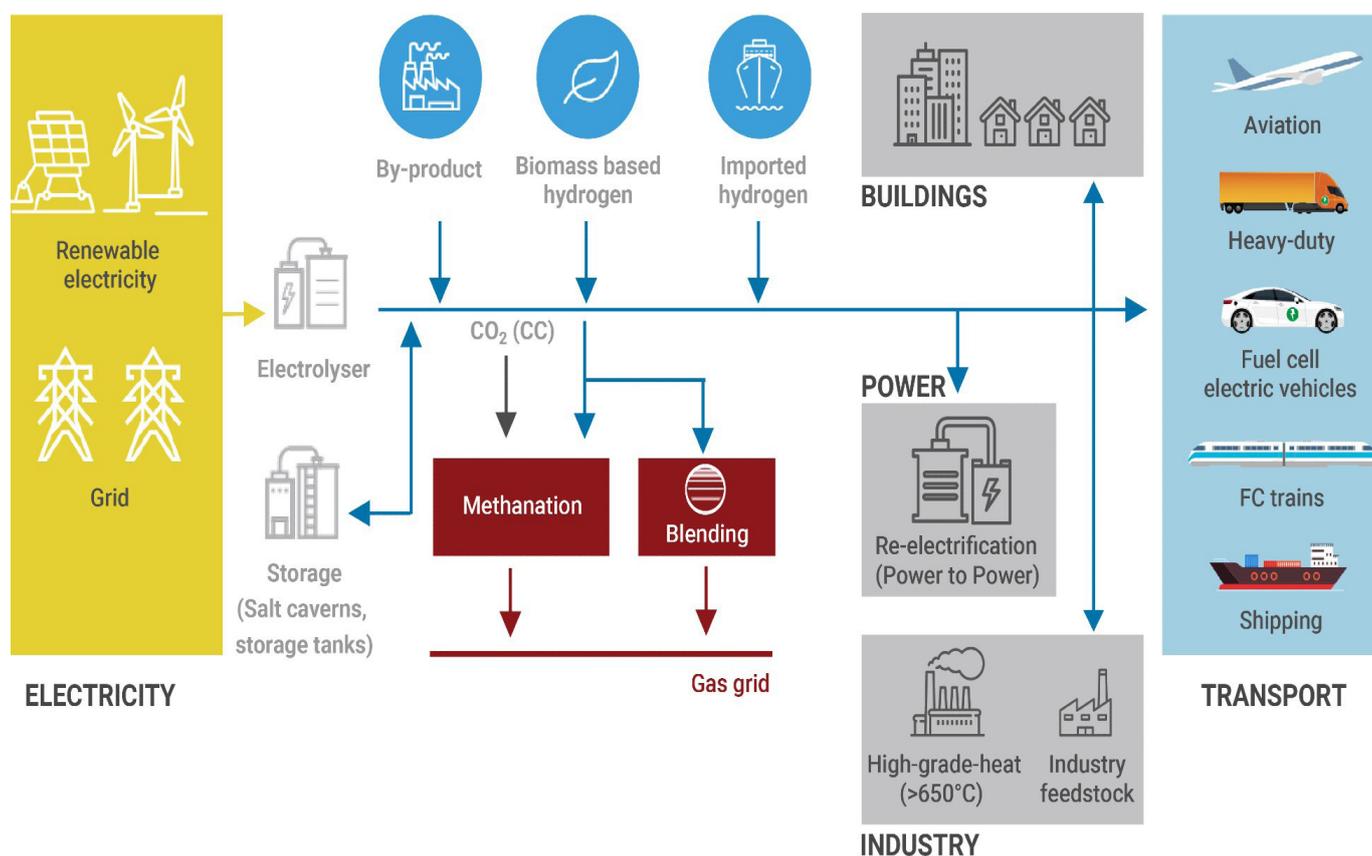
Fundamental legal and administrative barriers which hinder H₂ injection into gas grids concern legal complexity or absence of permitting rules, divergent regulation on H₂ concentration levels in gas grids, contracts and billing arrangements based on calorific value or Wobbe Index, safety requirements for connection/injection of H₂, and for all types of end-user equipment.

Among the regulatory issues, the color and origin of H₂ and respective GHG emission thresholds, the additionality requirements for green H₂, access for H₂ producers to the gas grid and respective grid development planning are, together with H₂ safety issues, the most relevant topics which need to be addressed.

Open questions on “H₂ in the grid” remain for which further research should be carried out:

Is H₂ more favourable than direct electricity use in the (non-industrial) heat and road transport sectors?

What is the longer-term perspective of H₂ vs. renewable synthetic methane, considering economic benefits for electricity system services and the economic value of existing gas infrastructure?



Hydrogen is an energy carrier and can be produced from a wide variety of sources.

Hydrogen from renewables can be produced through various pathways, with the most established being the use of renewable electricity to split water into hydrogen and oxygen in an electrolyser. IRENA’s report, Hydrogen from renewable power: Technology outlook for the energy transition, gives an overview of electrolyser technologies and highlights the technical potential to channel large amounts of renewable electricity to sectors for which decarbonisation is otherwise difficult – such as industry, buildings and transport, as well as in niche applications such as remote locations. By doing so, hydrogen from renewable power can directly displace hydrogen produced from fossil fuels, whilst also replacing fossil fuels as feedstocks in several processes. In addition, the IRENA report Hydrogen: A renewable energy perspective – released in 2019 at the second Hydrogen Energy Ministerial Meeting in Japan – expands on the previous report, providing insights on the steps required to develop hydrogen from renewables as well as related production cost forecasts. Hydrogen from renewable power has the potential to be a key driver of the energy transition by tackling various critical energy challenges.



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Biomethane Plant in Spain with a Capacity of over 55 Million m³ of Biomethane/Year

One of the biggest biomethane plants in Europe, located in Valdemingómez technological park in Madrid (Spain) waste treatment complex.

Valdemingómez technological park in Madrid (Spain) one of the biggest biomethane plants in Europe. The complex has two plants: Las Dehesas i La Paloma. And modern equipment is installed here to enrich the gas to biomethane, which allows it to inject 6,500 m³/h of biomethane into the grid, one of the highest capacities in Europe.

Las Dehesas can process 218,000 tones per year, 161,000 dedicated to biomethane production, while La Paloma's average capacity is 151,000 tones/year, with 108,175 used for biomethane production. Additional capacity is diverted to a CHP for electricity generation.

The plant was the first one commissioned in Spain in 2009 and it is owned by Madrid City Council, who is also in charge of the waste collection that feeds the 9 digesters. There are two lines of feedstock:

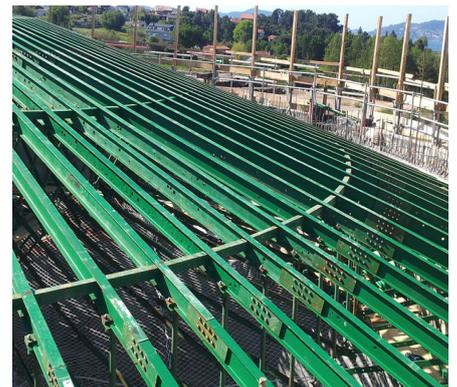
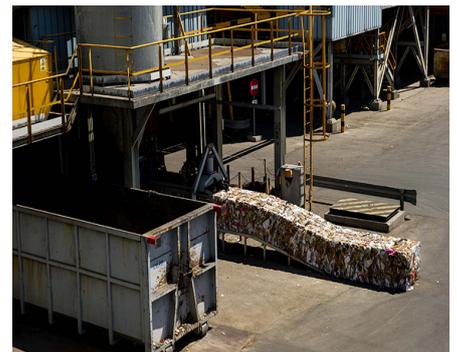
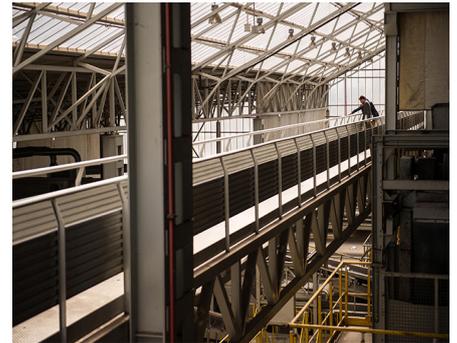
- food waste collected separately, as the collection scheme was extended to the whole city last year (including food organisations),
- organic fraction from the general waste, recovered in the waste treatment centre. Valdemingómez serves the whole city

of Madrid and neighbouring towns of Arganda and Rivas-Vaciamadrid.

The centre provides an integral treatment, recycling other materials from plastics, paper, and glass bins, and methane capture from closed landfill area. The produced biomethane has a quality above average natural gas in the Spanish grid, mostly imported from Algeria, with a CH₄ concentration of above 96%, CO₂ below 1%, and O₂ below 0.4%.

It is injected directly to the grid, with one of the main pipelines passing by the site. The city of Madrid is also powering its entire waste collection and the majority of its bus fleet with natural gas.

Also, the complex consists of the education centre, the waste reception area, the sorting process, the two AD plants, the biomethane upgrader, and an additional waste-to-energy plant where the non-recyclable fraction is combusted. The digestate is either composted on-site or used to maintain bacterial levels during the process.



Recurrent Energy Signs Agreement To Sell 150 Mwa Virginia Solar Project To Appalachian Power

Canadian Solar Inc. has completed a purchase and sale agreement with Appalachian Power for Recurrent's Firefly Energy solar project located in Pittsylvania County, Virginia. With a capacity of 150 MWac, the Firefly project will be Appalachian Power's largest solar energy acquisition to date and will help the utility meet its clean energy requirements under the Virginia Clean Economy Act (VCEA).

The Firefly Energy solar project will be developed and constructed by Recurrent under a Build Transfer Agreement (BTA). Once construction is completed, Appalachian Power, which serves customers in Virginia, West Virginia, and Tennessee, will be the long-term owner of the project. Pending local and state permits and other regulatory approvals, construction of the project is expected to start in early 2023 and reach commercial operation in 2024.

Recurrent received approval on its Siting Agreement for the Firefly project last month from the Pittsylvania County Board of Supervisors. The agreement provides \$2.25 million in upfront payments to Pittsylvania County in addition to long-term revenue for public services over the life of the project. "We appreciate Recurrent working with the County to strike a balance that allows solar development to happen in a way that minimizes visual impact and positively impacts our community," said County Administrator David Smitherman.

"The 150 MWac Firefly project in Virginia expands our growing footprint across the eastern United States, delivering turnkey projects for utilities and other investors," said Dr. Shawn Qu, chairman and CEO of Canadian Solar. "We are pleased to have been selected through a competitive process and to be a part of Appalachian Power's major solar energy expansion. We look forward to advancing this project through development and construction, and delivering a renewable solar energy project to Appalachian Power that will help them serve their Virginia customers."

Passed in 2020 by the Virginia General Assembly, the VCEA seeks to end carbon dioxide emissions from the utility industry in Virginia. Appalachian Power intends to meet its VCEA targets primarily through future investments in solar, wind, energy storage, and energy efficiency measures.

"This will be our largest solar project yet in our journey to deliver clean, reliable power to our customers," said Chris Beam, Appalachian Power president and chief operating officer. "We are eager to work with Recurrent and for the significant economic benefits construction will have on the surrounding community."

Appalachian Power has 1 million customers in Virginia, West Virginia and Tennessee (as AEP Appalachian Power). It is part of American Electric Power, which is focused on building a

smarter energy infrastructure and delivering new technologies and custom energy solutions. AEP's approximately 16,800 employees operate and maintain the nation's largest electricity transmission system and more than 223,000 miles of distribution lines to efficiently deliver safe, reliable power to nearly 5.5 million customers in 11 states. AEP is also one of the nation's largest electricity producers with approximately 30,000 megawatts of diverse generating capacity, including 5,500 megawatts of renewable energy.

About Canadian Solar Inc.

Canadian Solar was founded in 2001 in Canada and is one of the world's largest solar technology and renewable energy companies. It is a leading manufacturer of solar photovoltaic modules, provider of solar energy and battery storage solutions, and developer of utility-scale solar power and battery storage projects with a geographically diversified pipeline in various stages of development. Over the past 20 years, Canadian Solar has successfully delivered over 63 GW of premium-quality, solar photovoltaic modules to customers across the world. Likewise, since entering the project development business in

2010, Canadian Solar has developed, built and connected over 6.2 GWp in over 20 countries across the world. Currently, the Company has around 430 MWp of solar projects in operation, nearly 7 GWp of projects under construction or in backlog (late-stage), and an additional 17 GWp of projects in pipeline (mid- to early- stage). Canadian Solar is one of the most bankable companies in the solar and renewable energy industry, having been publicly listed on the NASDAQ since 2006. For additional information about the Company.

About Recurrent Energy (Canadian Solar Subsidiary)

Recurrent Energy is a leading utility-scale solar and storage project developer, delivering competitive, clean electricity to large energy buyers. Based in the U.S., Recurrent Energy is a wholly owned subsidiary of Canadian Solar Inc. and functions as Canadian Solar's U.S. project development arm. Recurrent Energy has approximately 5 GW of solar and storage projects in development in the U.S.





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