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Photo: Jeda Villa Bali

Markets & Trends

Indonesia: PV is the perfect fit for Indonesia's power needs, but can the market reach its potential? *Page 27*


Photo: Huawei

Industry & Suppliers

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PHOTOVOLTAIC MARKETS & TECHNOLOGY


Photo: Krinner GmbH

Supersized solar

Bigger, smarter, lower cost and higher yield: pushing the boundaries of PV power plants. *Pages 18 – 22, 32 – 41, 50 – 60*

Photo: Solarpraxis AG

pv magazine's Jonathan Gifford and Andrea Jeremias with some solar engineers of the future in Istanbul, at the Solarex trade show.

Still a place for going big

It is the season for records. With spring having sprung in the northern hemisphere, the past few weeks have repeatedly shattered records for solar electricity being fed into Germany's grid. With its 38.5 GW of installed capacity, each time a high-pressure weather system moves into place over central Europe, Germany's electricity network is on the receiving end of a flood of solar power. And the lights stay on.

Only weeks ago Germany's grid also survived the country's first eclipse of its solar (and wind) powered age. During the partial solar eclipse, Germany's electricity supply from solar dropped by 15 GW, requiring a range of alternative power sources from thermal, demand response and pumped hydro to kick in to make up the shortfall. Then, as the eclipse passed, the solar rushing back had to be actively balanced.

Theses fluctuations and those caused by a range of random and expected weather events prove challenging for grid operators, and backup capacity by thermal sources, generally coal and gas, is still required at present. Excellent weather data is also vital, and monitoring equipment at solar parks crucial, as data becomes king in this heavily renewable grid.

"Our job has become much more complex," Gunter Scheibner told Bloomberg in an interview from the 50Hertz Transmission control center outside Berlin, in one of Germany's four main grid operators. "It's not an easy mission, and it will cost money. But if you are doing it consciously, then it will be doable. We have already come so far."

And how far Germany's solar industry has come, too. It is clear that recent years have not been a particularly happy time, with installations slumping as the government has actively sought to cool the market, but surviving German companies are back with some success on the global stage.

The ability to quickly and skillfully deploy utility-scale solar has been one of the key skills the German industry has developed, and a healthy large-scale sector was a big driver of economies of scale and price declines from which the entire industry has benefited.

In this edition of **pv magazine** we take the temperature of the PV power plant sector, addressing a range of global markets, applications and enabling technologies. While distributed generation (DG) may prove to be a better fit for PV in the long run, **pv magazine** finds a large-scale sector still with an important role to play and much remaining to be achieved in the years to come.

On to the emerging MENAT region, where Turkey appears finally to be delivering on its promise (pp. 22 – 25) and Egypt's market is heading in the right direction. In Asia, Indonesia's many islands (pp. 26 – 29) are proving a good fit for PV, while island powerhouse Japan (pp. 32 – 35) is still driving a significant proportion of mega solar. Australia too might finally see some policy roadblocks removed (pp. 36 – 39) – a 2 GW multi-stage project is even in the works (pp. 40 – 41). Although China continues to push DG despite strong headwinds, we find smart PV power plants being deployed (pp. 50 – 53), and on the technology front, the trend toward three-phase string inverters at large scale is also noteworthy (pp. 54 – 57).

In the U.S., where prices for PPAs are hitting new lows, we find a market maturing beyond Renewable Portfolio Standards (pp. 60 – 61) and American Indian communities deploying PV for their energy needs (pp. 64 – 66). It is also hard to ignore Europe's largest PV power plant, in Cestas, France, which is taking shape thanks to innovative installation robots (pp. 62 – 63).

Big PV is an important part of the industry's heritage, and as the market matures and enters into a new phase, there are plenty of signs that it will continue to have a strong future.

Jonathan Gifford
Editor in chief

Photo: Huawei

Photo: Jeda Villa Bali

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Photo: Jinko Solar

Photo: Michael Tapp/Flickr

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Photo: AGL Energy

AGL CEO Andy Vessey with New South Wales government minister Anthony Roberts at the installation of the final module.

Big PV's prospects Down Under

Australia: The largest utility-scale projects in the country's history are currently being built out, but in terms of a financed pipeline, the cupboard is bare. Will a shift in policy open the doors to the literally gigawatts of projects that are under development? **pv magazine** investigates.

With red earth under foot and on an unfortunately cloudy autumn day in western New South Wales, the CEO of a company that owns and operates over 6.5 GW of aging coal generating capacity in Australia holds a solar panel in his hands.

AGL Energy's new Managing Director and CEO Andy Vesey is ceremonially installing the last of the 1.36 million First Solar modules on the 102 MW Nyngan Solar Plant.

"AGL is the nation's largest privately owned renewable energy investor and we will continue to invest in low emissions technologies to reduce the emissions intensity of Australia's electricity supply," says Vesey.

New South Wales state politicians from the conservative Liberal state government, the local Bogan Shire Mayor Ray Donald, the CFO of the Australian Renewable Energy Agency (ARENA) Ian Kay and First Solar's Jack Curtis are joining Vesey at the laying of the module. It is an unlikely group, to say the least.

A political impasse over the last 18 months has brought the large-scale renewable sector in Australia to a standstill, with the Liberal-led conservative federal government having first launched a review of Australia's Renewable Energy Target (RET) and then attempting to dramatically reduce the target. It has also repeatedly attempted to wind back ARENA itself and its sister body, the

Clean Energy Finance Corporation (CEFC). Luckily for the renewable sector, and for ARENA and the CEFC, the federal government has lacked a majority in the upper house of the Australian Parliament, the Senate, and has therefore been unable to push through its changes. But it has effectively stalled investment.

New figures from Bloomberg New Energy Finance (BNEF) show that investment in large-scale wind and solar projects in Australia has almost come to a complete standstill. In December 2014 there was zero investment in large-scale renewables, with the first three months of 2015 delivering only AU$6.6 million (US$4.73 million) of project investment.

The only highlight was the innovative floating PV system being developed by Australian/Singaporean company Infratech in South Australia. Year-on-year the result is even more startling with BNEF finding that investment for the 12 months to March 2015 large-scale renewable investment fell 90%.

"Investment has been stifled by policy uncertainty for over 13 months since the Abbott government's [Renewable Energy Target] review was announced on 17 February 2014," BNEF wrote. "The Australian large-scale clean energy industry has become practically uninvestable due to ongoing uncertainty caused by the government's review."

Renewable divestment

The large-scale renewable investment landscape has deteriorated to such an extent that Australian-based developers are now facing the prospect of divestment by major shareholders.

Mid-last month the Australian Financial Review reported that the Australian trade union movement's Industry Funds Management had retained Bank of America Merrill Lynch and Credit Suisse to sell Pacific Hydro, one of Australia's largest utility-scale renewable developers.

Despite the poor outlook for large-scale PV and wind, and the negative effect the repealing of Australia's carbon price has had on the company's hydropower assets, the sale is still expected to fetch AU$2 billion (US$1.55 billion). The irony of fossil fuel divestment campaigns gaining momentum internationally while renewable divestment continued in Australia was lost on few.

Moving out of the development of renewables has been underway for some time Down Under. The recent BNEF report noted that leading large-scale solar and wind investor Banco Santander had wound up operations in Australia this year.

AGL, whose new CEO installed the final module on the Nyngan Solar Plant last month, has undergone a remarkable transformation from natural gas and renewables developer to the owner and operator of one of Australia's most polluting fleet of power plants.

Photo: AGL Energy

The Nyngan project has been through a number of changes of both state and federal governments and corresponding shifts in subsidies.

Last year AGL acquired Macquarie Generation, bringing on board a number of large brown and black coal-fired power plants, some of which have been in operation for over 40 years. By doing so, it has become one of Australia's biggest carbon polluters.

This is the assertion of activist group GetUp, which produced a report last month in which it is claimed that the operation of AGL's fleet of power plants release some 40 million metric tons of carbon dioxide into the atmosphere each year, about 7.5% of the country's total carbon emissions. AGL has, however, been a supporter of renewables as it has a generation mix of 81% coal, 7% gas and 11% renewables, according to the GetUp report. GetUp labels AGL, along with EnergyAustralia and Origin Energy, as Australia's "Dirty Three," the worst polluting electricity generators.

AGL's Vesey took the completion of the module installation at the Nyngan Solar Plant as an opportunity to release the company's Greenhouse Gas Policy, in which it committed to exit coal fired generation by 2050 and neither build nor finance any new coal-fired power stations in Australia, unless they be equipped with carbon capture and storage technology. While this may be indicating a move in the right direction, GetUp notes that the Dirty Three including AGL have been active in lobbying the federal government to wind back the RET, the primary cause of utility-scale renewables' woes.

RET-lock

The RET was previously a bipartisan policy, to encourage renewable development and to begin the transition of Australia's generation capacity away from coal. The goal was to realize 20% renewable generation by 2020, which was then locked in, again with bipartisan support, at 41,000 GWh. At the time when Australia's electricity demand was predicted to rise more-or-less indefinitely, generators had lobbied for a solid GWh figure, rather than the potentially variable 20%. How things change.

When the federal government of Tony Abbott was elected a little over 18 months ago, he and his ministers began turning up the rhetoric against the RET. Essentially their argument was that the RET was adding to electricity costs for consumers and industry.

"We should be the affordable energy capital of the world, not the unaffordable energy capital of the world and that's why

Photo: Solar Choice

Solar Choice CEO Angus Gemmell believes he's found the perfect site for his 2 GW Bulli Creek multi-stage project.

the carbon tax must go and that's why we're reviewing the RET," Tony Abbott told the Australian Financial Review last July. He populated the RET review panel with members of the traditional electricity generation industry and with Bill Warburton, a senior Australian businessman who publicly disputes anthropogenic climate change.

Even with the deck stacked against large-scale renewables, the government's own review in fact found that achieving 41,000 GWh of large-scale renewables would put downward pressure on wholesale electricity prices and reducing the RET would in fact be the highest cost alternative for the public.

Not dissuaded by data, the government proposed cutting the RET to reflect a "real 20%" of generation capacity, given that Australia's electricity demand had fallen rather than risen since the first RET was adopted in the 1990s. Without a majority in the Senate there has since been deadlock in negotiations between the government and opposition Labor party about the RET, leaving it and the large-scale renewable sector stranded. In a recent editorial piece on the website Climate Spectator Stephen Bygrave from Beyond Zero Emissions laid the government's logic bare.

"Clearly, the RET review is all about protecting the profits of the big three retailers, who are not prepared to move with the times and innovate, unlike the renewables sector – constantly innovating in the face of subsidies being provided to their competitors," wrote Bygrave. "The RET review is about holding on to an antiquated way of providing energy, using some of the most inefficient, dirty, old power generation facilities in the world (which includes the developing world)."

PV projects

Given this context, the outlook for PV power plant development has not been good. Last November **pv magazine** compiled a list of around 20 utility-scale solar projects that have been either cancelled or indefinitely put on hold since the RET review began.

There has been some activity, as projects previously approved and financed have been built out as well as a number of projects supported under regional schemes, such as FRV's 20 MW Royalla Solar Project in the Australian Capital Territory. Two of these projects are AGL's soon-to-be-completed Nyngan Solar Plant and the 53 MW Broken Hill power plant, both in New South Wales.

Jack Curtis is the Asia Pacific Regional Manager for First Solar and he accompanies AGL CEO Vesey as he lays the last of his company's CdTe thin film modules required for the Nyman project. Curtis reports that the learning curve for building out a project the size of Nyngan has been steep.

Logistics, the training and supervision of local staff and also the local sourcing of components have all presented challenges. None of these were insurmountable and Curtis reports that mounting structures could be produced in Austra-

lia below the cost of those that could be sourced from China. He also says that installation could be carried out more quickly than first thought. Because of this and the potential for reduced financing costs if a more solid policy framework came to be realized, Curtis believes that there exists considerable opportunity for cost reductions for PV power plants in Australia in the future.

"Solar has demonstrated extremely aggressive cost reduction trajectory over the past five years and still has a lot of ground to cover especially in Australia, I think there is a very sensible argument around 'solar can genuinely compete without subsidies within three to four years,'" says Curtis. "The RET was always intended to achieve a more diverse generation mix and there is a wide group of stakeholders that agree with that."

Curtis estimates that PV power plants in Australia at present could achieve costs of around AU$0.12 to AU$0.14/kWh. (US$0.093 to US$0.109) This does not compare favorably to large-scale wind, however solar has a series of qualitative advantages over wind, including a more favorable generation profile, and reduced environmental and local community opposition.

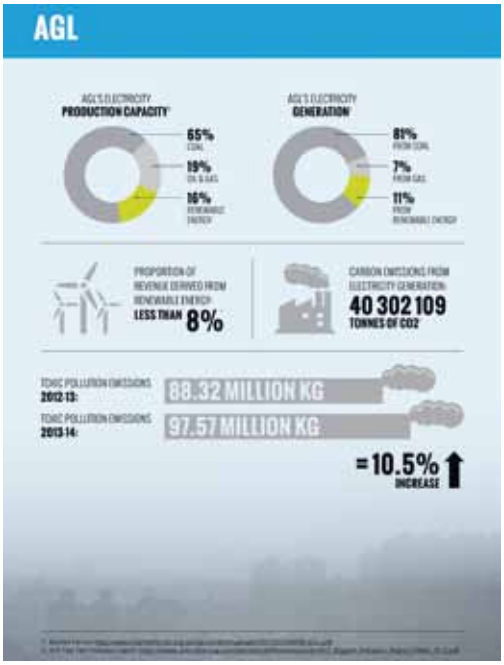
"I think that solar needs to get to AU$0.10/kWh (US$0.0781) while wind is at AU$0.085/kWh (US$0.0664) and the delta between there will be covered by those qualitative factors," says Curtis.

It is worth noting that AGL's Nyngan array was subsidized by a AU$166.7 million (US$130.3 million) grant from ARENA and AU$64 million (US$50.75 million) from the New South Wales state government.

Curtis' opinion is one shared by solar brokerage and prospective utility-scale developer Solar Choice, whose CEO Angus Gemmell is pursuing plans to develop a 2 GW project, in smaller stages at a site called Bulli Creek in Queensland (see p. 40). Gemmell says that while wind has drawn widespread criticism in rural communities and a Senate inquiry into the health effects of turbines is currently underway, he believes with public consultation and the careful selection of sites, large-scale PV will have few of such problems.

"I think you need to keep in mind that in Queensland and in South Australia, one in every three homes now has solar on their own roof," says Gemmell. "So Australians love the technology, it is ubiquitous at the residential level in that we have the highest per capita penetration of residential rooftop in the world. So as a part of our national outlook, solar is a better fit."

At the time of going to print, the federal government had rejected a proposal from the opposition to reduce the RET to 32,500 GWh by 2020, saying that 32,000 GWh was its "final offer" and that it would be unlikely the renewable sector would be able to realize that capacity within the specified time frame. The compromise figure is supported by a number of industry bodies outside of the renewables sector and the Clean Energy Council.



Graphic: GetUp

Curtis suggests that some mechanism to allow large-scale PV time to get to AU$0.10/kWh before the wind consumes the remaining RET would be a favorable outcome, given solar's overwhelming support when compared to wind, even within government ranks. Without a compromise on the RET however, there are far fewer reasons to hope.

"It leaves us in a pretty dire state," says Curtis. "It is really going to curtail any new development of any technology, which isn't a great outcome." ◆

Jonathan Gifford