

Built tough for Taiwan

System integration | Taiwan has set itself a target of 20GW of PV by 2025, but standing in the way of that are acute land shortages and some extreme weather conditions. Tom Kenning reports on the creative technological and construction solutions being found to address Taiwan's unique challenges



Credit: New Green Power

Taiwan has played its hand by targeting 20GW of solar by 2025 in order to move away from nuclear generation, but the island also contains some of the most peculiar and challenging environments for solar project development. Dense population and scarce land availability have led to lakes and ponds, seaside plots and even so-called "sinking land" being made available for PV deployment. As a result, developers need to invest in robust solar equipment, whether it be modules that can handle salt and mist corrosion, or strong solar inverters and frames to withstand some of the most violent typhoons in all Asia.

"The government is relying on solar to become the next economic engine in Taiwan," says Shawn Chuang, country manager for the Smart PV Asia Pacific business of inverter specialist Huawei. "Really in Taiwan we don't have much booming industry. The semiconductor industry or the LCD industry electronics are all beat by mainland China so we have

to find a new economic engine. Solar is the most ready one: we have the technology; we know how to build the projects. The only thing we lack is the land resource."

The capital city Taipei, to the north of the island, where population is most concentrated, also happens to have the poorest irradiation. Meanwhile, if solar deployment is concentrated in the more favourable conditions of the south, transmission infrastructure is limited. The island population of more than 23 million also requires plenty of land to maintain a solid agricultural industry. As a result, the government has had to release uncultivable land for its 20GW solar ambitions, much of which is close to the seaside where soil has become too salty for farming. Meanwhile, "sinking land", where groundwater has been withdrawn to the extent that the land is liable to sink in various locations, has also been released.

Land matters

Taiwan-based developer and EPC New Green Power (NGP) was one of the first

companies to complete a solar project on this challenging sinking land, with a capacity of 1.6MW in Yulin County. There are two major issues, says NGP director Kai Tan. Firstly, most solar farms tend to involve screws or cement for securing the plant, but sinking land is subject to extreme flooding from typhoons and every year a few points on the project land can start to sink, causing imbalance in the structure. As a result, EPCs in Taiwan have to design a completely new structure to overcome the land deviations in addition to using robust equipment.

NGP has a range of configurable structures with reinforced concrete piles and steel structures, which have the strength and flexibility to resist the severe typhoons and flood waters, says Andy Tang, chairman and president of NGP. For sinking land specifically, NGP's structures offer adjustable heights to resist the risk of land subsidence. The firm also uses equipment that can resist severe wind and rain with IP65 rating. The IP65 guarantees protection from water spray in any direction as well as dust ingress.

Maintenance also becomes very important in this kind of setting so NGP uses inverters from China-based manufacturer Huawei that have a 25-year lifetime and do not have fans or fuses, which saves time on operation and maintenance (O&M) in an already harsh environment.

Sinking land is certainly a more treacherous proposition compared to most traditional PV locations, but using such land will be almost unavoidable given that Taiwan is not only one of the most densely populated countries on earth, but two-thirds of the island are covered in steep mountainous forest and national parks; where Taipei ends, the forest begins.

An added burden is that the remaining suitable spaces for solar, such as landfills, subsidence areas, saline damaged land, contaminated land and other enclosed spaces will increase the development costs, says Tang. The conditions of these zones with salty, foggy, damp and rainy

offshore climates only strengthens the case further for prioritising sturdy solar equipment.

The second issue relating to land is that of ownership, says Kai Tan. Territory is historically divided into very small parcels of one or two acres of land in Taiwan, therefore building a large-scale project can involve negotiating with dozens of separate landowners. A single 50MW project can have as much as 100-200 landowners to deal with. This makes it very difficult to agree on the same contract with each individual. Under intense competition, these landowners also tend to be approached with many different offers.

"The major issue will be focusing on laws relating to the use of lands and solar plant development," says Tang. "We are looking for an efficient strategy to encourage and convince the landlords to work with us, in order to increase the number of solar projects."

Cell efficiency

Given the island's land constraints, it makes sense to use the highest efficiency solar modules to optimise land usage. As it happens, Taiwanese cell manufacturers tend to produce some of the highest efficiency cells across the globe. The country has roughly 2GW annual manufacturing capacity of these higher efficiency cells, and some observers have speculated these could play a central role in meeting Taiwan's 20GW target. Indeed the Taiwan government would appear to be thinking along similar lines by putting on the table a 6% feed-in tariff bonus for higher efficiency solar modules.

It may also be the reason why several Taiwanese cell manufacturers including Neo Solar Power (NSP) and AU Optronics have started to focus on vertical integration. For example, Alex Wen, senior vice president at NSP says that with cell prices dropping rapidly in the second half of 2016, the firm is increasing its module manufacturing as well as investing in solar PV projects to raise cash. Taiwan's proximity to the sea and floating solar opportunities (see box) are also driving innovation in modules, with NSP, for example, releasing a double-glass module that benefits from water reflection.

Typhoons

Water in the form of typhoon rains can be less beneficial. The Taiwan market has already been troubled by typhoons so

Potential for 500MW floating solar

Land restrictions mean the Taiwanese government has had to be creative, for example by encouraging floating solar. Government figures do not indicate a specific target for floating PV, but Thomas Hsu, vice president, SAS Sunrise, says that more than 2,000 lakes and ponds have been identified as having the potential for this technology, which he estimates could lead to around 500MW of such installations. The feed-in tariff also includes a special rate for floating solar, receiving a TWD4.94/kWh (US\$0.157) FIT rate, which is higher than the TWD4.547/kWh rate for ground-mounted projects.

Michael Sun, vice president and general manager of the solar business group at AU Optronics, says that the firm has recently released a humidity- and salt-resistant module, the SunPrimo PM060PW1, which suits Taiwan due to its prominent coastline and the new push for floating solar. It is also important to be resistant to typhoons.

However, floating technology is "still in emerging stages" and cannot be installed at every reservoir, says Sun. Small and medium-sized reservoirs are the most suitable. He understands from some customers that Taiwan may expect roughly 50MW to 100MW floating solar to be installed in 2017, but the industry is waiting for a clearer picture from the government before progressing.

Charles Huang of floating solar mounting rack producer Plus Renewable, which has already installed a 100kW floating system in southern Taiwan, says the government has started to "open up" for this kind of PV floating system and the opportunity for this technology is imminent.

However, Winaico's Sascha Rossmann, says: "Every manufacturer needs to consider if they want to carry this liability or not. If you do floating solar, you cannot use standard components in the panel, because there is always a certain amount of humidity that is leaking into the laminate. This will cause corrosion on the soldering and this will cause long-term reliability issues."

modules need to be able resist rain and high wind loads, says Sascha Rossmann, vice president, solar global sales at Taiwan-headquartered module manufacturer Winaico. Taiwan has wind speeds of up to 260km per hour, much higher than Hurricane Matthew in Florida for example where winds were 160-170km/h.

"That's nothing in Taiwan. The Typhoons are very scary here," adds Rossmann. "There is a lot of damage to the PV systems here because of the poor designs of the panels and also the mounting system. If the mounting system resists the wind speed, the panel must resist the vibration."

The solar cells can crack as a result of high winds, so Winaico, for example, has developed a silicon carbide paste to print on the back of the solar cell to prevent this.

Another issue is the increasing reluctance of insurance firms to cover solar systems as the market is so small in Taiwan. "That is also a risk to this industry because when insurance doesn't cover [...] the bank is not going to finance, so the project is not going to happen," Rossmann explains.



A floating solar solution on show at the recent PV Taiwan exhibition in Taipei

Credit: Taitra

20GW progress

To kick off the 20GW programme, the short target is to reach 1.52GW deployment in two years, including 915MW for rooftop and 610MW for ground mount, says Hung-Sen Wu, deputy division director of non-profit R&D organisation the Industrial Technology Research Institute (ITRI). The industry is waiting for Taiwan's energy ministry to formulate a concrete policy; however, Michael Sun, vice president and general manager, solar business group, AU Optronics, believes that overall 3GW will be allocated to rooftop solar, with 17GW left over for ground-mount projects.

Despite the multiple challenges around land, transmission and natural disasters, the regulatory environment can at least be trusted.

"The FIT is good; the regulatory framework is very good. Taiwan legally is a very safe place to invest," says Rossmann. "I would rather invest in Taiwan than UK, Spain or Italy, that's for sure. They can never do retroactive cuts here. There is a similar culture like the Japanese; there would be a total loss of face."