Project briefing

NEW CONCEPTS IN FLOATING SOLAR TAKE TO THE WATER

Project name: Sekdoorn
Location: Zwolle, Netherlands
Capacity: 14.5MW

In August 2019, a team at BayWa r.e. began construction of its 14.5MWp Sekdoorn floating solar project near the town of Zwolle in the Netherlands. Just eight weeks later, it was complete, 40,000 solar panels afloat on the former sandpit.

The project was the company's third floating solar farm in the country, built with Dutch subsidiary GroenLeven, following on from the 2MWp Weperpolder project in Oosterwolde, and the 8.4MWp Tynaarlo plant in the province of Drenthe. With 25MWp already built in the Netherlands in less than one year, and its biggest project yet, the 27MWp Bomhofsplas partway through construction, BayWa r.e. now claims to be one of the biggest floating solar developers in Europe.

The secret to its rapid build-out is a bespoke floating platform for the modules, designed by German engineering company Zimmerman PV Stahlbau. The decision to design an entirely new floating plant concept came about following careful consideration of those already on the market, explains Franz Krug, project manager of Zimmerman: "We found that that other structures all look nearly the same, so they had the same advantages, but also the same disadvantages."

The Netherlands was chosen as the location for the company's first floating PV projects since BayWa r.e's partner company GroenLeven had already secured tariffs for installation on various lakes. The Dutch feed-in tariff (SDE+) is relatively high, meaning that there was still a working business model in the Netherlands for floating PV despite the higher cost of the floating installation compared to ground-mounted systems.

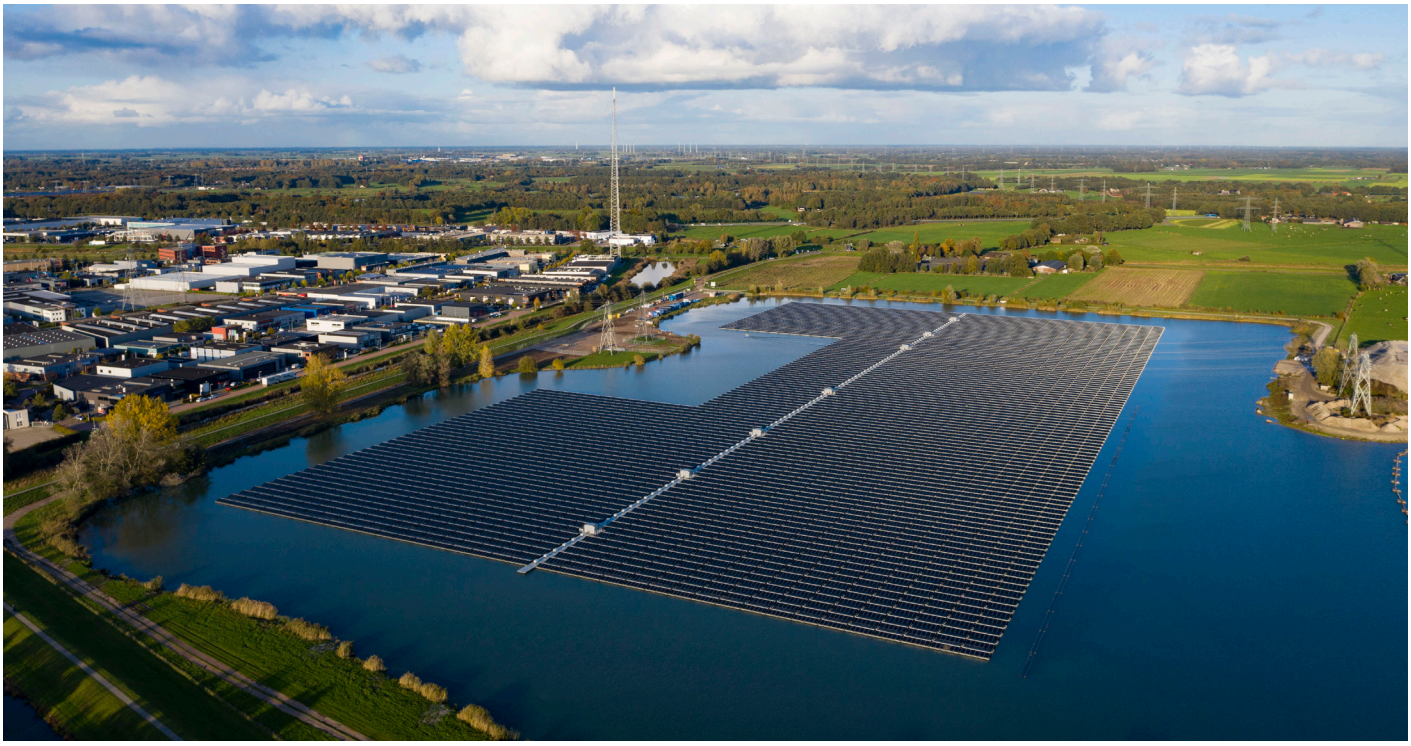
The partners developed and finessed the resulting 'Zim Float' system in around 18 months, with BayWa r.e. bringing its highly standardised electrical concept from ground-mounted projects to the water. It also prepared the layout of the plant, and the electrical concept from the panels to the injection point to the grid.

System anatomy

The so-called Zim Float platforms are square-shaped solar panel boats, with Huawei inverters floating alongside. The system also integrates maintenance walkways, cable ducts, wave barriers and a floating transformer station. The design makes it highly stable, improving its lifetime and easing maintenance.

The system's stability is the main difference between the Zim Float system and others on the market, explains Edgar Gimbel, head of power plant engineering at BayWa r.e. "We built a special boat, which is 12 modules packed in two floaters on a steel frame, which is very stable. Other systems on the market all have one floater on one module, which connect floater by floater, making them very flexible," he says.

The electrical components are fully integrated into the floating platform, and meet all regulations related to the installation of electrical systems. A grounding system protects from electrical failures, while all cables and components are certified for use in water. BayWa has VDE certification (VDE-PB-0016-2:2016-11) for electrical safety and energy yield, installation quality and planning compliance for solar farms. The VDE Institute has also certified BayWa installation of floating power plants and electrical systems on the water.



Credit: BayWa r.e.

By Catherine Early

"We are 100% safe on the electrical side. Nobody else in the market has this yet," says Gimbel.

Krug adds: "Floating solar is quite young technology and for our first project we wanted the verification of a third party, that what we developed fitted with VDE, the market standard."

The cabling design is kept completely out of the water, hidden under the subconstruction of the floating boats, so that cables are protected from the sun, and have only minimum contact with the water. This guarantees a longer life, as well as easy maintenance. The transformer station is also integrated into the floating system and is VDE certified.

Speed of construction

The system is built onshore, including the floaters, steel frame, modules and cabling. Up to nine of these "boats" are then attached to together in a kind of "roller conveyor", after which the system is floated out onto the water row by row. A small motorboat is then used to take each row out to its final location on the water.

Prefabricating the system onshore is another key difference to other systems. Typically, these are partly constructed onshore, where modules are attached to floats, but installation of cabling then occurs on the water.

"Prefabrication makes it much easier to install, we are able to build up to 1MW per day, which is roughly 2,700 modules. It's like building a car in a factory, it's a lot of automised stuff," Gimbel says.

He is so confident in the system that he is predicting that the 27MWp Bomhofsplas project, also in Zwolle, will be complete in less than two months.

Built to last

The Zim Float system is not only very fast to construct, but also very safe for workers, Gimbel says. Between each row there is a maintenance street around 2.5 metres wide, which together with the stability of the system make it very easy and safe for workers to walk up and down. All the inverters are also located in this maintenance street, he says.

Credit: BayWa r.e.

"It's very easy and safe if you need to change the inverter even in bad weather. Maintenance is actually easier on floating solar than for ground-mounted," he says.

Krug concurs that operations and maintenance (O&M) is very easy on the Zim Float system, which lowers the cost for customers. "Other systems move a lot when workers walk on them, which means it's not that easy to change cables and modules, especially when you have tools in your hands. O&M was really important for us to bring down the OPEX cost," he says.

The safety of the system was verified by Dutch organisation DNVGL, which conducted a risk assessment for O&M workers. This highlighted a few points for improvement, after which BayWa r.e. and Zimmerman tweaked the design. "They told us that we are way better than other systems," Krug says. So confident is BayWa r.e. in the stability of its system, that it tested it by two hundred workers standing on the Weperpolder project simultaneously (see photo above).

Gimbel says that the system will last for at least 30 years. Durability has been taken into account at each stage of the design, such as special covers with full UV resistance for the plastic floaters, and magnesium coating for the steel frame to prevent corrosion, he says.

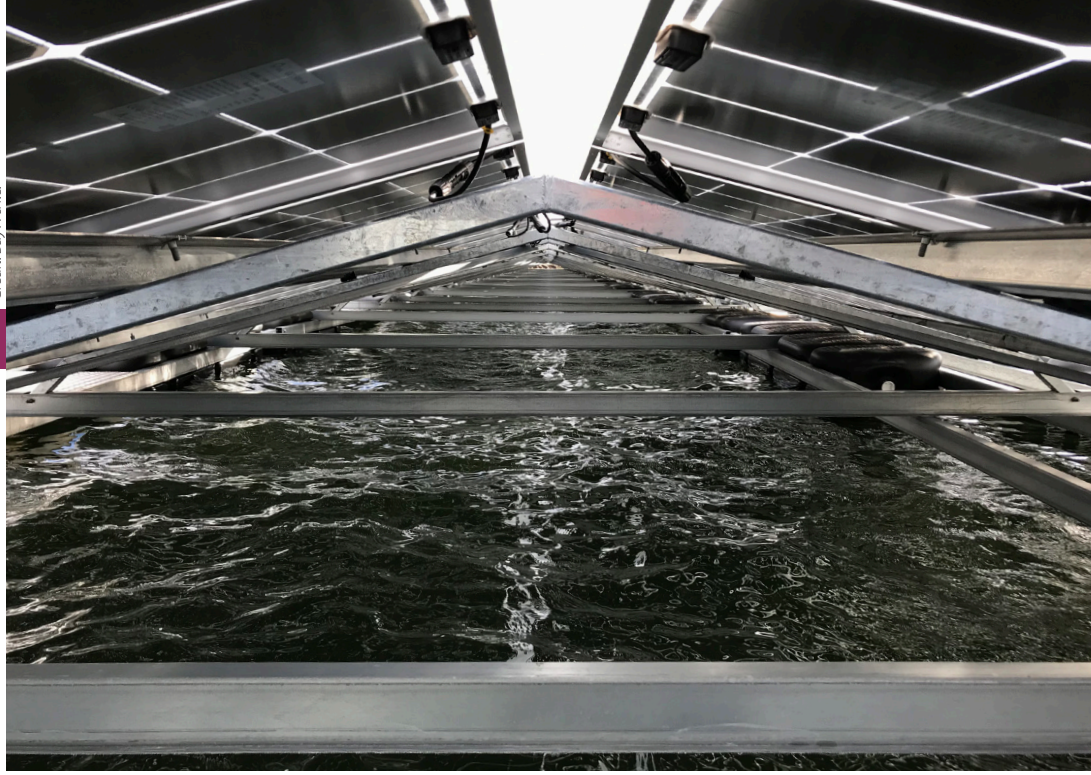
BayWa r.e. and Zimmerman have also developed different anchoring systems. Other systems are mainly anchored just to the shore, whereas the Zim Float system can also be anchored to the bottom of the lake up to 50 metres.

This improves security, Gimbel says. "Nobody can see where the anchor points are so they can't cut the lines. The standard method of other manufacturers is just to the shore."

Krug explains that the anchoring systems are tailored to each project, after an assessment of conditions at the location. "We don't have a generic solution for anchoring, we do separate mooring anlaysis and options for each project. Because of this we have brought down the anchoring costs a lot," he says.

The partners developed specialised anchors for floating projects. These are driven into the ground at locations defined by mooring engineers, and then tested to ensure they are in compliance with the Eurocode harmonised technical rules for structural design.

Cabling was also specially designed, Krug says. "We had a deep look to the cables, so that we have clear cable routing, with clear cable ducts. Cables or inverters can



Credit: BayWa r.e.

have high costs for O&M if they are under too much stress. This is a disadvantage we found from other systems on the market that float."

BayWa r.e. chose GCL-SI's monocrystalline, monofacial M6 72GF modules for the Sekdoorn project. These are glass/glass modules with an aluminium frame, which Gimbel says is better at dealing with the humidity created by the water than glass/foil modules.

The company asked research institution the Fraunhofer ISE in Freiburg to conduct quality tests on the modules. These included standard test conditions (STC), which is a standard performance test to confirm power output; a test for potential-induced degradation (PID); and tests for light-induced degradation (LID) and light- and temperature-induced degradation (LeTID).

Costs for the Zim Float system are around 20-30% higher than ground-mounted projects. The increase is mainly due to the construction costs of the substructure, which are up to 200% more expensive than those on ground-mounted projects, says Krug. However, the fast installation and shorter cables minimise the price hike, he says.

"The Zim Float system is really compact, we can do 1.7MW/hectare compared with 1.2-1.3MW/hectare on land, so you save a lot of money on cabling," he says.

Despite the systems' higher costs, Gimbel says that attracting investors for its floating solar projects has not been a challenge. Existing investors in its ground-mounted systems have queued up to finance the floating projects, he reports. Floating PV is not a new technology, only a new application of an existing technology, so the return, risk and administration are no different than when investing in ground-mounted projects, BayWa r.e. says.

"We had a waiting line for investment, in fact; we had more interest from investors than we have projects. Interest has been roughly the same as for our projects on land, as they are the same investors," he says.

Greater efficiency

The higher upfront costs of floating systems are rewarded by better efficiency, due to the system being located on water. Zimmerman also designed a special cooling system for the modules, which are installed directly facing the open water surface without any obstacles in between. This means that heat does not accumulate there. The cool water body below the panels is therefore cooling the heated modules. Warm air is rising up through the so-called chimney between the east- and west facing module (see photo above).

The extra efficiency gained through this system depends a lot on the maximum temperatures. BayWa r.e. has calculated that in a relatively cool country such as the Netherlands, the average gained over a year is around 3%. But on hot days, the additional cooling effect can be much more, the company says.

This cooling effect of the water, together with the easy installation of floating solar and the high energy density per hectare, mean that floating PV systems larger than 50MWp will soon be viable in Southern Europe without the need for subsidies or government support, BayWa r.e. believes.

The Zim Float system has other benefits in terms of the environment of water bodies it is built on. BayWa r.e. is undertaking studies to fully assess the effects of its system on water quality, but it believes that it will not have any negative impacts. The water has maximum movement under the panels, and growth of algae is restricted by shadows cast under the panels.

Floating solar systems are also very efficient in terms of land use, and do not conflict with food production. They also have lower levelised cost of energy (LCOE), and construction and maintenance of floating PV plants bears lower risks for employees than working on rooftops. Compact installation and smart cabling result in a very low electricity consumption.

The module layout is designed to promote cooling and enhance performance

BayWa r.e. has a policy to install floating solar only on water bodies that have already been exploited for industry, such as reservoirs, fish farming waters or lakes on former open-cast lignite mines. All of its current projects have been built on former and active sandpits, which are suitable because they cannot be reused for many activities after the final digging depth is reached. Using them for solar therefore creates a double usage of the land.

Both activities can also work in parallel, BayWa r.e. says. Many sandpit operators are still active and creating even bigger water surface while the first finished part of the pit is already used for harvesting the sun's energy.

BayWa r.e. has a further 100MWp of floating PV projects at a late stage of development in the Netherlands, and says it intends to install "several hundred MWp" in Europe over the next few years. The potential for expansion of floating PV technology is huge: the Fraunhofer Institute for Solar Energy Research estimates that 15GW could be installed on decommissioned coal mining lakes in Germany alone, while a study by the World Bank Group identified the potential for 20GW in Europe using only 1% of the surface of man-made freshwater reservoirs.

"We think floating technology will spread quickly over Europe and make a significant contribution to the energy transformation. Grid parity for these systems is around the corner," says Gimbel. ■