Project briefing

MOVING THE NEEDLE FORWARD

Project name: York Solar Farm
Location: York, UK
Capacity: 34.7MW

When it was announced in early 2019 that UK developer and EPC Gridserve was laying claim to designing and constructing one of the most technologically advanced solar farms in the world in York, a northern city in the UK, there was a degree of trepidation in the sector.

But that is exactly what Gridserve has produced, unveiling a 34.7MW solar farm that boasts bifacial panels and single-axis trackers, a first for the UK solar market and what is thought to be the most northerly combination of the two technologies in the world.

Gridserve broke cover in February this year with York, and a sister project located in Hull, that have a combined generation capacity in excess of 60MW. One of those projects has been underpinned by a power purchase agreement with Warrington Borough Council, providing the council with its annual power demand.

Construction of the sites has been financed by international bank Investec and Leapfrog Finance, including a financing agreement that took in thousands of pages and incorporated detailed calculations based on the sites' prospective performance, and detailed analysis by DNV GL.

But the real detail lies not in the pages of a financing agreement, but in the planning – and execution – of a solar farm that, in truth, is years in the making.

Moving the needle

The site itself was known well to Gridserve chief Toddington Harper, having already secured planning consent for the land at his previous company Belectric, sold to German utility innogy after the UK's ROC-rush of 2012-2016. Some new, additional consents were needed, but the land, planning and, pivotally, grid connection potential remained largely the same.

The land itself is relatively low-grade – 3B – agricultural land, meaning its use for farming and crop cultivation is limited. There's a pig farm located nearby, but years of use of pesticides and other chemicals has impacted the land's potential for farming, making it an ideal plot for a utility-scale solar farm.

Credit: Gridserve

The true value of the site lay, however, in the aforementioned grid connection. Given the saturation of renewables in certain parts of the country, gaining a grid connection agreement can be notoriously difficult in the UK. At the York site, Gridserve was able to negotiate not just for an export agreement, but for an import connection agreement too, allowing the project to draw from the grid should it become economically beneficial for it to do so, posing significant benefits for revenue streams and project economics.

> "You can't move the needle by building the same type of solar projects that we used to"

And it's those revenue streams, driven by the combination of bifacial panels, trackers and battery storage, which have allowed for the project to come forward without the need of subsidies. Harper's previous developments at both Belectric and community energy-focused initiative Big60Million relied heavily on subsidies to bring projects forward, however Gridserve has had to think outside of the box and be progressive in its adaptation of business models to bring solar into the realms of economic feasibility.

"You can't move the needle by building the same type of solar projects that we used to," he says, adding; "We needed to work out how to make the business case work again, because without subsidies we'd lost a really valuable part of the income."

In replacing that revenue, Harper and Gridserve went back to the drawing board and all but redesigned a solar farm from the ground up, taking into account marginal gains provided by new technologies, greater efficiencies and new revenue streams available to solar farms. "How can we extract more value, to at the very least make up for what we lost in terms of income from the subsidy era? The solution is all about replacing artificial value in a subsidy with real, sustainable value elsewhere," he says.

"We've done a deep dive into each area, seeking the best possible technology, the optimum solution that currently exists on

Project specifics

Storage Capacity: 30.4MWh
Panels: Suntech bifacial
Trackers: NextTracker single-axis
Inverters: Sungrow
Batteries: Samsung

By Liam Stoker

the planet which is bankable, proven, but really still at the top end of the game, and then we've worked out how to combine those best-of-the-best pieces, individually, into a single project, so you get an overall concept of synergy i.e. the whole is greater than the individual parts. And that's what we're seeking. That's the objective."

With each of those three technologies playing a crucial role in the project's economic feasibility, their respective roles were carefully designed.

In pursuit of albedo

Many an eyebrow was raised at the inclusion of bifacial panels in the York project. There's a near industry-wide consensus that bifacial panels make perfect sense close to the equator and in certain applications, but on agricultural land in the north of England? The jury was out.

Harper, however, is adamant that bifacial panels in this project make "perfect sense", given the amount of natural diffused light there is in the UK. This stems from a need to utilise as much irradiation and eke as much generation from each and every panel on site given the lack of subsidy support.

"You need to harness as much energy at the lowest cost possible, which in our opinion makes bifacial panels a pretty obvious part of the solution," he says, noting that opting for bifacial panels did not add a material additional cost to the project's capex over more traditional monofacial panels.

Attaching a value to the performance boost recorded by bifacial panels is a complex calculation owing much to a number of moving parts, not least of all the albedo effect. A not insignificant amount of modelling was conducted by Gridserve as it sought to assess not just how bifacial panels could bolster project economics, but how operating conditions and the albedo effect could perhaps be manipulated.

No stone was left unturned – quite literally – in Gridserve's pursuit of performance as attention quickly turned to what was happening underneath the rows of panels. Spreading white chalk was considered, as were other surfaces and materials, but Harper has taken inspiration from previous projects once again for this and stumbled upon a solution that could set a precedent other developers and bifacial fanatics follow keenly.

Big60Million was renowned for its use of wildflowers to increase project biodiversity, returning land to former glory by welcoming pollinating insects. Gridserve turned once again to the same scientists, but with one added caveat; is there a species of pollinating plant that possesses high albedo properties? The answer, Harper says, is yes.

> "We are the evidence that's being created as opposed to being able to draw on somebody else"

Gridserve is remaining tight-lipped over precisely what that species is, but the science would suggest that planting them underneath rows of bifacial panels would contribute towards a performance boost, while simultaneously helping improve the site's biodiversity in what is unquestionably a win-win situation for sustainable solar.

Those plants will be tested, but if they grow successfully and do, indeed, deliver measurable increased gains for the bifacial panels resting above them, then Harper is adamant that it will create what is essentially an entirely new business case to plant and maintain acreages of such pollinators. It's just one contributing factor as to why he refers to the project itself as not just as a clean power station, but as an "ongoing R&D project at the same time".

When it comes to measuring the actual benefit of using bifacial panels over standard-issue, Harper says Gridserve has been reserved in its estimates. "I am optimistic that we have underestimated a number of factors, and something that we're particularly interested in is working at how we can optimise that bifacial gain," he says.

The difficulty for Gridserve, the company says, is that it is very much at the cutting edge of this deployment and cannot point to a precursor or similar case study for financiers to refer to. "We are the evidence that's being created as opposed to being able to draw on somebody else," he says.

What are perhaps more tangible are the fiscal benefits of employing trackers and batteries and making full use of that richly valuable export/import grid connection.

At the grid's service

Of the UK's ~13GWp of generating solar capacity, a significant majority is south facing, fitted on fixed mounts that produce the generation 'bell curve' the industry is all too familiar with. As the integration of renewables has grown, there have been burgeoning issues relating to supply and demand. Power produced in the middle

Credit: Gridserve

of the day is of less value and, following in the footsteps of other markets, the UK has witnessed prolonged instances of negative pricing in recent months.

Taking the same approach, as Harper frequently states, was not an option for this project.

By employing single-axis trackers – the first time the technology has been deployed in the UK – Harper says the company is giving the York project "broader shoulders", and shifting more of its peak performance into times of the day where its generation is of more value both to the grid and to the off-taker. While there may be a slight dip in performance around the usual midday peak, this is more than offset by producing more power than usual earlier and later in the day, when prices are steeper. In that sense, the trackers are performing a load-shifting role more commonly associated with battery storage.

That, handily, frees up the 30.4MWh of battery storage capacity co-located with the solar farm to derive revenue from other means, stacking on additional streams that help with the project's business case. The project stands ready to bid into UK electricity system operator National Grid's frequency reserve markets, including Fast Frequency Response (FFR), the Balancing Mechanism and the Capacity Market. It is also able to deliver reactive power services, critical at maintaining voltage levels on the UK's transmission grid, an area of works which is quickly rising in importance as more variable generation comes onstream.

But Gridserve also has eyes on those negative pricing periods, wherein the project's batteries can effectively be paid to draw energy from the grid, store it, then get paid again to discharge when the supply/demand metric has been flipped on its head. This is made possible by the import/export connection agreed with distribution network operator Northern Powergrid and stems once again from Gridserve examining the bare bones of a solar project and calculating how to optimise each and every cost.

Milking every last drop

More traditional solar farms in the UK might use their grid connection's maximum capacity for somewhere around 15% of the time, Harper says, meaning that for more than 85% of the time, that value is standing idle. "[Your grid connection] is one of the most expensive pieces of the project, which is where you derive 100% of your income, and you use that for a fraction of its time. That's not very clever," he says.

Adding the value of those grid-related services to its energy generation has meant that calculating project returns has been complicated, with Harper arguing that as projects become more sophisticated, the standard form of assessing their fiscal benefit becomes irrelevant. "You almost have to rip up the rulebook," he says. "We've spent a lot of time in the past working out things like levelised cost of energy (LCOE), but LCOE doesn't really make sense anymore in the context of all the additional revenue streams that projects like this can generate, many of which are completely independent to solar, so don't logically fit into LCOE calculations."

Nevertheless, in the weeks since York's switch-on, the site has surpassed expectations for what a solar farm might be able to produce in the north of England as autumn turns to winter. "So far the results are very encouraging and the amount of energy we're producing is impressive for this time of year," Harper says.

Despite the technological innovations, Gridserve's intent was always to under-promise and over-deliver, which is why the expectations of performance gains from bifaciality, trackers and additional revenue streams were reserved when the business case was put together.

Next on Gridserve's agenda is York's twin site, located a little more than 30 miles away in Hull, on England's north-east coast. That site is slightly smaller at 25.7MW, but it stands to pack just as much of a punch in terms of clean power per pound spent. When complete, both projects will transfer to Warrington Borough Council's ownership, who will pay around £62.3 million for the duo.

In combining new technologies with a detailed, holistic approach to energy generation and management, Gridserve is professing to have ripped up the rulebook for post-subsidy solar developments. If the intent of the York project was to move the needle forward somewhat, the company has certainly proven to do just that. ■