The "Templin" solar farm north of Berlin has a capacity of 128 MW and feeds the electricity into the grid via 114 inverters.

PHOTO: SMA

Centralised or decentralised?

Megawatt solar farms do not necessarily have to feed into the grid through centralised inverters. Manufacturers of string inverters are pushing ever more strongly into the large system market, such that the boundary between a centralised and decentralised inversion of solar electricity is becoming blurred.

Two solar projects in Great Britain are examples of how flexible string inverters are. Across almost the entire roof area of the logistics building of Marks & Spencer in Castle Donington (in the county of Leicestershire), 24,272 PV modules with a total capacity of 6.1 MW have been laid out. The installer decided on a decentralised inversion of the solar electricity and ordered 90 Powador 60.0 TL3 string inverters from KACO new energy.

Two requirements had to be met; the installation was to take place during uninterrupted operation of the distribution centre and access to the 30 m high roof was solely via a single six-story stair tower. The inverters were lifted through roof hatches in order for them to be installed (see photo on page 27). It was not possible to avoid a shading of individual strings, and thus the three MPP trackers in the Powador inverters were ideally suitable for the design plan, says the installation company SBC Renewables Ltd. This is one argument in favour of a decentralised inversion of solar electricity.

1,000 inverters in one solar farm

Another example of a megawatt-scale solar system using decentralised inverters is the Sontheim solar farm (3 MW). The manufacturer, SolarMax from Bavaria, Germany, has installed 87 string inverters there with a capacity of 32 kW each. Considerably larger than this is the ground-mounted system at Vine Farm, which BayWa r.e. installed last summer in South Cambridgeshire. In this case, string inverters by ABB were used. In order to invert

a maximum of 46 MW of direct current, a total of 1,127 inverters were installed. Because the module strings have different lengths, ABB supplied 351 Trio 20.0 units, 341 Trio 27.6 units and 435 Trio 50.0 units to Great Britain.

At Toggam Farm, Lakenheath, UK, a 12.8 MW PV plant uses Huawei FusionSolar enabling fully digitalised automated O&M. A balanced and flexible infrastructure comprised of multiple string inverters (rather than a few central inverters) ensures system reliability; one inverter failure simply cannot impact the whole array. According to Huawei, as a result of string inverters and smart PV controller equipment, the plant generates higher yields, safely and reliably, whilst reducing O&M costs.

The manufacturers of string inverters have gained a lot of self-confidence in the last few years. "String inverters are generally suitable for all system sizes," states Christian Buchholz. The Head of product management solar at REFU Elektronik GmbH believes the 40 kW unit by the South German manufacturer could also be suitable for solar farms of over 10 MW.

In theory there is no practical upper limit, but "there are block designs which are dictated by the size of the transformers at each feed-in node." The transformer size differs from country to country; it could be 500 kVA or even 2 MVA. The power of a solar farm is generally many times larger than the transformer power.

A current example of a solar farm in which hundreds of string inverters are being used instead of a few centralised inverters is now under construction in Turkey. "We are currently building two similarly sized large PV systems there with a total of 42 MW," reports Buchholz, "and have recently delivered the first 800 string inverters of 40 kW each."

REFU is playing something akin to a home game in Turkey, as "we have been supporting the project development of our customers there for several years." On these terms it is possible to play along very well in this dynamic market. Three other markets are also of primary importance to REFU: the USA, Korea and Brazil. The company is currently putting out its feelers towards Australia.

Infeed not possible everywhere

Large solar systems on commercial buildings are also a subject for REFU. Supplying your own solar energy is meanwhile being carried out in many countries, but there is not always the possibility to feed in excess electricity. The question of direct marketing can thus not even be asked in Mexico, South Africa, Thailand and other countries with poor grid infrastructure, as you are not allowed to feed electricity into the grid there anyway. You are not even allowed to give it away.

For this reason REFU presented a small controller at the Intersolar (REFUcontrol Power Limit), which throttles back the inverter power to such an extent that there is no excess when your own demand is low. For those who

This12.8 MW PV plant at Toggam Farm in the UK uses Huawei FusionSolar.

PHOTO: HUAWEI

consider solar electricity to be too valuable to waste in this way, it is possible to increase your own consumption ratio by using a battery inverter. REFU supplies a 100 kW unit for high-voltage batteries, which can also be used for grid stabilisation.

The right mix

There is certainly going to be a technically or economically definable border between centralised and decentralised inversion somewhere along the line. It is not clearly visible right now, however. It also seems to be moving ever-further upwards. Fronius concludes this from observations made over the past few years. "Ever-larger projects are being implemented using string inverters," reports Jürgen Hürner, Product Manager at the Business Unit Solar Energy. This trend can be seen quite clearly and meanwhile even solar farms with 15 MW have been fitted with string inverters.

Fronius favours using the Eco inverter. This unit is "cost optimised" and does not have a boost converter. It thus requires relatively long module strings to get to a high enough input voltage. If individual strings at a solar farm are not long enough or are affected by shading, the Symo inverter is used. "The Symo is what you could call the supplementary unit for large systems," concludes Hürner, "and we thus use both Eco and Symo together in a solar farm."

The Agilo central inverter has been unceremoniously dropped from the range by Fronius. The Austrian company is now focussing fully on string inverters. What speaks for these from the Fronius standpoint is their ease of repair. Thanks to the SnapINverter concept, even workers just given a bit of training can replace broken parts. A specialist technician is no longer required.

A high input voltage brings profits

The optimism of string inverter manufacturers, who are convinced that they can supply large solar farms of pretty much any size, throws up the question of whether the market for centralised inverters will shrink. It is a question which can confidently answered negatively, however, as the Intersolar this year presented more centralised inverters than ever before. The worldwide market apparently provides enough scope for both inverter types. The solar farms announced in newsletters on an almost daily basis are becoming ever-larger, and for the really big ones only centralised inverters come into question anyway. The pie is becoming bigger and bigger, and everyone can cut off a piece for themselves.

Last year SMA earnt considerably more money in the utility field than it did in the fields of residential and commercial. Put simply: centralised inverters brought in the profits, not string inverters. This is certainly linked to issues of competition, which is particularly strong in the power range up to approx. 50 kW.

But meanwhile competition has also become stronger in the utility sector. Because SMA brought a centralised inverter with 1,500 V input voltage onto the market fairly on, however, the company is now profitting from this quickly having won out as the new standard. "In the USA the talk is now only about 1,500 V systems," reports Boris Wolff, Head of the Business Unit Utility. This is now already considered to be the "quasi-standard" for power levels of 30 MW and above.

The 5 MW "Sariogl an" solar farm near Kayseri (Turkey) is equipped with 136 string inverters with a capacity of 40 kW each.
PHOTO: REFU ELEKTRONIK

When hard to reach parts of the building are designated for the installation of the system technology, there is no other option but to use string inverters – as the example of the logistics building in Castle Donington shows.

PHOTO: KACO NEW ENERGY

The 1,500 volt technology, which has already been proven to lower costs, now has a free run since the suppliers, i.e. the manufacturers of modules, connectors, cables and all other necessary components, have designed their products for this higher voltage. The technology cannot be stopped, believes Wolff, as "the USA is the leading market and has set a clear trend."

Direct marketing requires support

Competition is now also present in areas which did not even exist until recently. The manufacturers not only have to continuously work on improving reliability and lowering costs, but also have to increasingly take care of marketing. Many installers are not up to this complex task and thus those manufacturers have an advantage that are not only able to supply their customers with the right inverters, but also provide a service at the same time which leads them towards direct marketing.

Above all this is true for the commercial sector. Obviously the own consumption of solar electricity generated on the roof of a supermarket or factory always has priority, but especially at weekends there will be many cases in which the generation unavoidably exceeds the demand. Then you have the question of what happens to the excess electricity.

Since 1st January, 2016, all systems with over 100 kW of capacity must market this electricity directly. But because thousands of users neither wish to be nor should be active on the electricity exchange, direct marketers have taken on this task. The installer who builds these commercial systems must ensure that his customer closes a contract with a direct marketer. Additionally he must fit the system with an interface which enables the technical means for direct marketing.

"For the installer this is a complex task that is not part of his main business," says Nick Morbach. The Head of the Business Units Residential and Commercial at SMA wants to make things as easy as possible for the installers. They can now buy an inverter with a cluster controller that has the required interface. As soon as the installer registers with the SMA portal, the technical requirements for direct marketing are already fulfilled. However, the contract is still missing. The installer can close this with SMA so that his customer, the operator of the system, can market the excess solar electricity. "This is in principle a back-to-back contract with MVV Energie, which as the leading direct marketer in Germany has the required tools for this," explains Morbach. SMA recently agreed a partnership with the energy supplier from Mannheim: "for we want to put our customers in a position to be able to carry out direct marketing with a professional partner." Through the partnership with MVV, SMA can avoid having to enter the complex world of direct marketing itself, a field completely foreign to its own core business.

The market is changing. The integration of solar electricity with the grid is becoming ever-more important, and the government is applying pressure to move this process forward. This comes with new challenges which the inverter manufacturers will have to tackle. Those which make things as easy as possible for their customers to find their way through the tangled undergrowth of legal regulations will have an advantage here.

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