Solar energy pioneer Philip Wolfe updates his series of blogs on the world's largest solar power stations, first published in PV Magazine in 2019.

The world's largest solar power stations

There were no single solar power plants over 1 GW_{AC}, when we first published this series of blogs about two years ago. The record now is 2.2 GW_{AC}.

The top 5 solar parks then had a combined capacity of 6.6 GW_{AC} – today's top 5 total over 12.5 GW_{AC}. The intervening pandemic clearly has done little to slow the explosive global growth of utility-scale solar.

In three further blogs in coming weeks we will list the top solar power plants, solar parks and clusters. First let me remind readers where the records stood in 2019; and how we distinguish between **solar parks**, individual **plants,** and regional **clusters**.

Individual solar power plants

In most cases, solar power plants are designed and built singly, with the project developer choosing a site with a suitable connection to the electricity grid. Project size may be dictated by the site area available, connection capacity or financial restrictions. Where those factors do not impose limits, developers aim for economies of scale often by maximising plant size.

In 2008, the largest PV project – at about 50 MW_{AC} – was near Olmedilla de Alarcón in Spain. By 2012 the Agua Caliente solar farm in Arizona had taken the record to over 250 MW_{AC}. When we published our previous list of top plants, the Sweihan project was about to be commissioned in Abu Dhabi with a capacity of 938 MW_{AC} (or 1,177 MW_P).

ADWEA's Sweihan plant developed with Marubeni & JinkoSolar, and built by Sterling & Wilson, densely covers 8 square km of semi-desert. It was the world's largest individual solar plant when commissioned in 2019.

But not all solar projects are developed individually. There can be benefits in grouping plants together to take advantage of prime locations and strong grid connections.

Plants co-located in Solar Parks

By the second decade of the millennium, a number of national and state-level energy agencies had realised that solar power could be produced even more economically if multiple projects were co-located in an area, where they could share grid connection and other site related costs.

Probably the most notable early example is the Charanka Solar Park in the Patan district. When this was first opened in 2012 by Gujarat's then chief minister, Narendra Modi, it had a combined capacity of 224 MW from 19 individual solar power plants, of which the largest were 25 MW each. It has since been expanded to over 600 MW of overall capacity. Agencies of the state of Gujarat arranged the grid connection and leased land to the project developers.

A similar approach was adopted in China most notably in Qinghai, Gansu, Ningxia and Xinjiang provinces. This approach lends itself particularly to centralised economies where state agencies can arrange grid connections, land allocation and other shared services. This model is also now being adopted in several countries in the Middle East and North Africa, with a few instances in Europe and America.

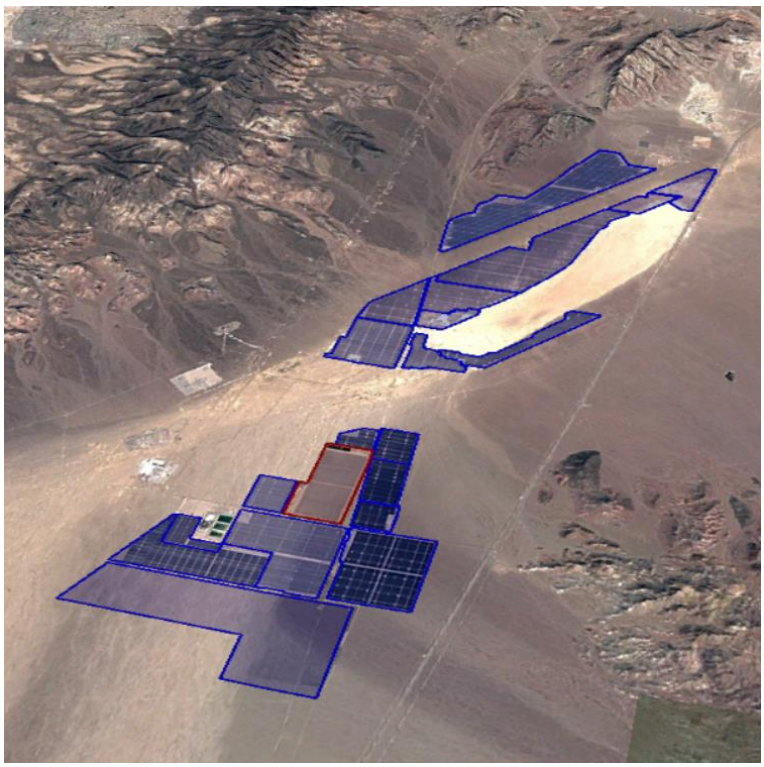
A compact example of a Solar Park is at Ma'an in southern Jordan, which contains 9 plants with a total capacity of about 200 MW.

The Golmud Solar Park in China's Qinghai province was the largest at 1,800 MW_{AC}, when our previous list was printed. Many of these solar parks have been progressively expanded over the years, with several now achieving combined capacities running into the multi-gigawatt range.

Clusters of solar projects

The co-located solar park model has not been widely adopted in Europe and America where energy markets are more deregulated. However, less formal co-location of multiple projects can sometimes be found in areas where suitable land and grid connection capacity is plentiful and solar radiation is good.

The Antelope Valley in Los Angeles county hosts the largest cluster we identified in 2019, with a total of about 3,000 MW_{AC}.



A cluster of large solar plants in the Eldorado Valley in Nevada, looking North with the outskirts of Las Vegas just visible at the top left.

The largest power stations of each type

Press reports of *the largest solar power station* may refer any of these arrangements and may therefore ‘compare apples with pears’. Subsequent blogs in this short series will identify the world's largest solar power stations, distinguishing between individual plants and groups of multiple co-located projects.

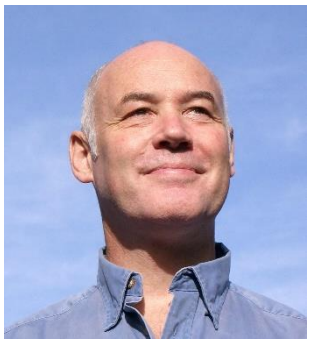
For consistency, I use the terminology solar **plant** for an individual project that has been developed by a single developer or consortium, even if it is spread over several geographical plots or built in various phases. Where multiple plants are co-located in a discreet area under the coordination of an identified agency, this will be called a **solar park**. Where several solar farms are co-located in an area without formal coordination, I call this a **cluster**.

Single plants are often colloquially known as solar farms. Readers should note that this terminology is not universally adopted, and that some developers and owners choose to call individual plants a 'solar park'.

Image Credits: The satellite views are from Google Earth, using imagery from Airbus, CNES, Copernicus, Digital Globe and Landsat. In these shots, **solar parks** are outlined in green, with individual **plants** in blue (if PV, or red if CSP). Colour coding on Wiki-Solar's maps is similar.

Also for consistency, all capacities are quoted in MW_{AC} to allow direct comparison between PV and CSP plants (and other forms of generation). Readers will be aware that the DC peak capacity of PV plants is typically ~25% higher than the rated AC capacity, quoted here.

The next blog in a couple of weeks' time will identify the largest individual solar **plants** in the world, to be followed subsequently by **solar parks** and then **clusters**.



Philip Wolfe has been active in the renewables arena since the 1970s and is the founder of Wiki-Solar. His book on utility-scale solar was published in 2012 and one on the early years of the terrestrial PV sector was published in 2018.