In the last of a series of blogs, solar pioneer Philip Wolfe looks at areas where solar generating stations are clustered together, without the coordination afforded by organised solar parks.

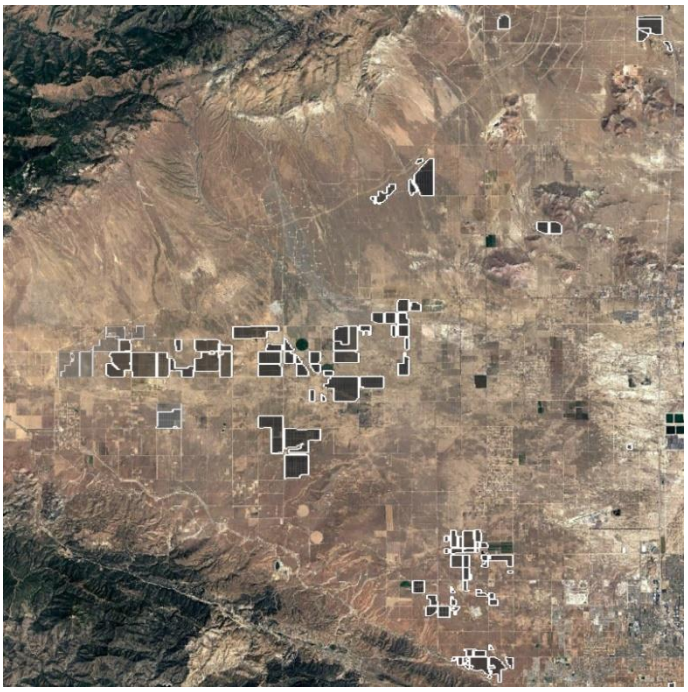
Large clusters of solar power stations

We have seen that the world's largest individual solar power plants are approaching 1 GW of AC capacity. Meanwhile solar parks, where several projects are co-located in one site, are expanding from about 2 GW towards 5 GW.

This 'solar park' model is most widely adopted in China, India and the Middle East, where the electricity industry is highly regulated. In other countries, where the power market is more liberalised, solar projects also congregate together around the best locations, but without the formal coordination that solar parks offer. We call these groups of neighbouring plants 'solar clusters'.

Solar clusters typically form in areas where there is abundant grid connection capacity and sunlight levels are favourable. This blog looks are some of the largest clusters; but in this case size is more subjective, because it depends on how wide an area is defined. For consistency, and for reasonable comparison with the largest solar parks and plants, I have totalled the capacity of all plants within a 50 km (31 mile) radius. Acknowledging that this is somewhat arbitrary, we will not give a ranking number, as in the earlier blogs.

Antelope Valley, California, USA



Located north of Los Angeles and west of the Mojave Desert, around the city of Lancaster, this triangular valley has high sunlight levels and good connectivity to the electricity markets of south and central California. The climate is less well suited to intensive agriculture than the valleys of northern California.

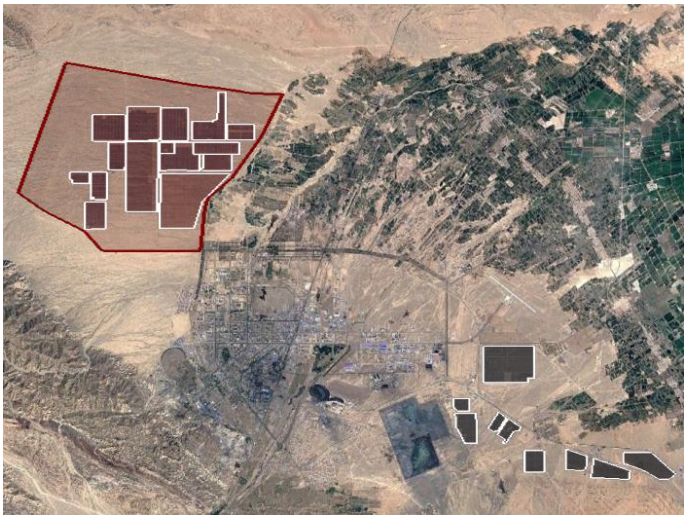
This combination of factors has attracted over 3 GW of PV plants to the region. Furthermore, projects in development will take this total to over 4 GW.

The largest individual solar generator in Antelope Valley is the US's largest PV power plant, Solar Star, ranked #6 in the world.

Jinchang, Gansu, China

The area around the city of Jinchang accommodates, in addition to the world's #5 solar park to the north west, several more solar plants to the south east, the largest of which is 200 MW_P.

The combined capacity of this cluster is 2.3 GW, and that too can be expected to rise as Jinchuan Solar Park is further built out.



Eldorado Valley, Nevada, USA

In the desert to the south of Las Vegas, around Eldorado Dry Lake are clustered several large solar plants, including the multi-phase Copper Mountain PV projects and the Nevada One CSP plant.

Further projects under development will take the capacity to over 1.7 GW, from the present 1.3.

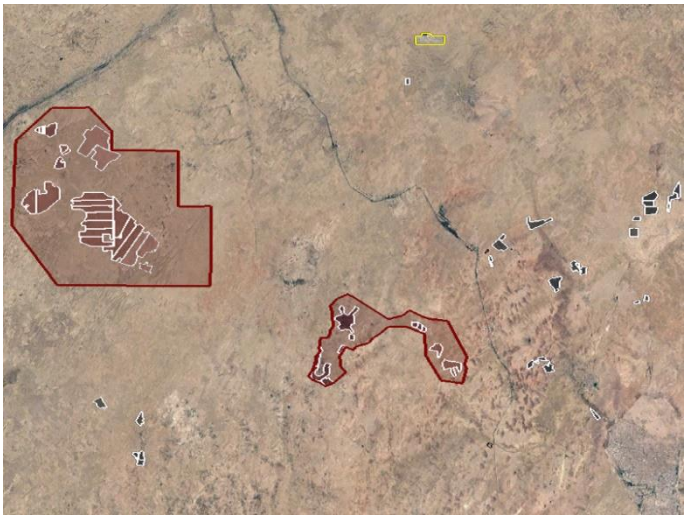
Visible in the western part of this view are the facilities that make this area so attractive to solar developers – the three high capacity electricity substations and the power lines heading north to power-hungry Las Vegas and south west to California.

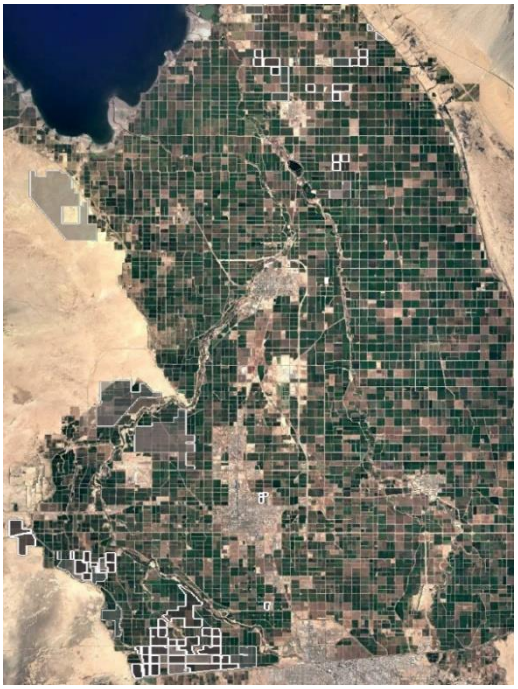
Phalodi, Rajasthan, India

The arid region north of Phalodi in Jodhpur district hosts two solar parks and a number of smaller individual solar plants.

Thanks mainly to Bhadla Solar Park, currently #2 in the world, and the smaller Rawra Solar Park, this area houses about 2 GW of capacity, which should increase to some 4 GW, when Bhadla is fully operational.

The Godawari CSP plant at Nokh is also in this cluster (see the yellow outline near the top).

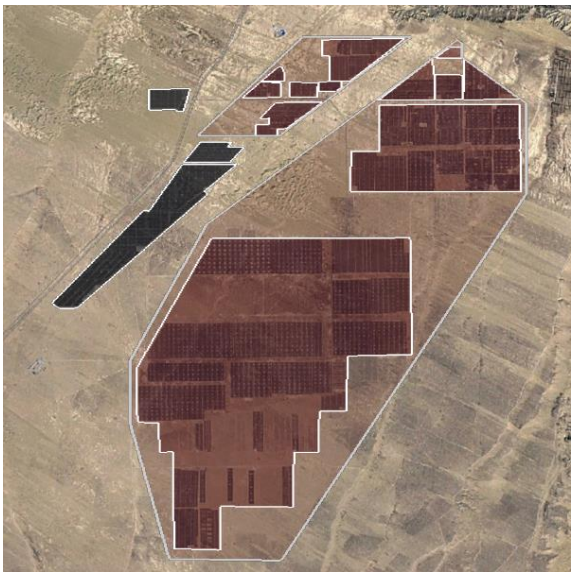




Imperial Valley, California, USA

Imperial County borders Mexico at Mexicali and has become home to many solar projects, including the multi-phase Mount Signal, Centinela and Imperial Valley projects. Unlike the previous clusters in arid and desert regions, this is relatively fertile land, making the solar arrays harder to spot in this aerial view.

The combined capacity is currently 1.2 GW, but projects in development could add a further 3 GW over the next few years.



Gonghe, Qinghai, China

In Gonghe county alongside (2015 world #1 solar plant) Longyangxia Solar-Hydro, are several further PV power plants.

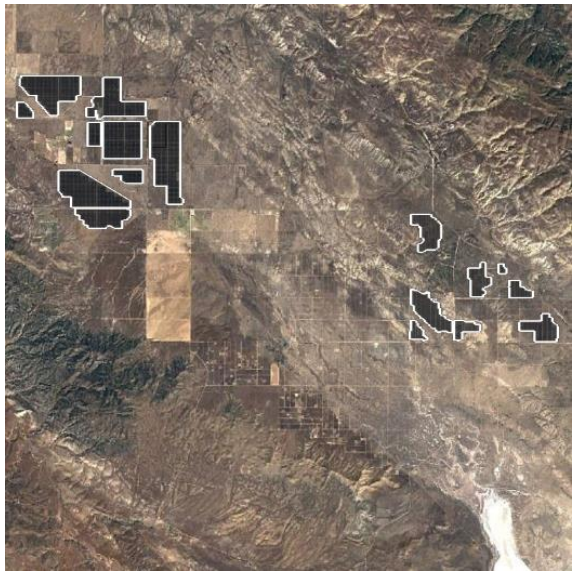
The combined capacity of this cluster is some 1.2 GW_{AC}. It is unclear whether this area will be further developed in the future.

Carrizo Plain, California, USA

California's third cluster is on Carrizo Plain to the east of San Luis Obispo. It currently consists of just two large projects, Topaz and California Valley.

These have a combined rating of 0.9 GW currently. However new projects within a 30-mile radius just over the ridge in the San Joacquin Valley could increase total capacity to 1.7 GW.

Topaz's 1370 hectares include the 65 ha site where Arco Solar's 5-MW Carrizo Plain project was installed in 1983 (decommissioned in 1994).



We have yet to identify other solar clusters in the GW range, but highlight below a few smaller but interesting congregations of solar projects.

Growing markets; Chile & Australia

Chile has a huge pipeline of projects under development. Several are located in the area around Diego de Almagro in Atacama region's Chañaral province. This cluster has a current capacity of just 0.5 GW, which is scheduled to grow to at least 1.5 GW, as further plants are built and connected. Another cluster is growing around Calama in Antofagasta.

The accelerating uptake of solar power plants in Australia, too, can be expected to lead to clustered solar projects. The area around Dubbo in New South Wales, for example, is scheduled to accommodate about 1 GW of PV projects.

Clusters in Europe

Europe does not have the wide-open spaces available in solar power's largest markets, so typical plant and cluster sizes are smaller.

In Brandenburg, East Germany the area around the open-cast mines of Finsterwalde and Senftenberg (shown right) houses over 0.5 GW of solar capacity. A similar concentration is installed around the city of Halle in Saxony-Anhalt.

In Spain, the Badajoz region hosts about 0.5 GW of solar power plant, of which the major share is CSP plants. With a resurgence of new projects in Spain, new clusters are likely to emerge – including probably one in Murcia.

At a smaller scale still, this aerial view shoes the hillsides north of the seaside town of Montalto di Castro. This area is home to 9 different solar projects with a combined capacity of 0.2 GW.

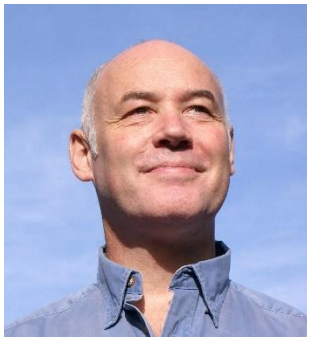
Terminology and acknowledgements

The term ‘solar **plant**’ is used 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 defined area under the coordination of an identified agency, this is called a ‘**solar park**’. And I use the word **cluster** where multiple solar farms are co-located in an area without formal coordination.

Image Credits: The satellite views are from Google Earth, using imagery from Airbus, CNES, Copernicus, Digital Globe and Landsat. In these shots, individual PV **plants** are outlined in white or dark grey and CSP plants in yellow, while **solar parks** are outlined in red. To aid clarity, solar plant areas are tinted in grey (unlike the images in previous blogs). Colour coding on Wiki-Solar’s maps is different, with operational PV plants highlighted in blue, CSP plants in red and solar parks in green.

For consistency, all capacities are quoted in MW_{AC} (unless specifically stated as MW_P) 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 about 20% higher than the rated AC capacity, quoted here.

The first blog in this series was a guide describing the differences between solar plants, parks and clusters. The second highlighted the largest solar parks and last week’s blog listed the biggest solar power plants.



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 last year.