

How much sun will you harvest today?



Solar project Germany

PES was delighted to catch up with Birk Kraas, Commercial Head of Meteorological Services at CSP Services. He leads a team with experience in highly specialized and customized measurement equipment. Between them, they have built up a large bank of knowledge and know-how over many years. Being able to carry out work remotely, as well as having a network of local partners on the ground, have both proven valuable over the last year.



PES: Thank you for taking the time to talk with us Birk, it's lovely to welcome you to PES Solar. For those not familiar with CSP Services, could you give us a brief introduction to the company and what you do?

Birk Kraas: Our name is our program, in CSP Services we concentrate on solar power services, historically for concentrating solar power (CSP) projects, but for several years now also for photovoltaic plants.

We are an independent consulting company

that offers highly specialized and customized measurement equipment and services. As a privately founded spin-off of the German Aerospace Center (DLR) we establish bridges between science and industrial ventures. Our mission is to advance sustainable projects around the world: efficient, economical, durable and environmentally friendly, always with an open mind towards new approaches.

PES: Broadly speaking, what products and services do you offer?

BK: Our spectrum of products and services is

fairly large. For example, we supply large scale geometric measurement systems for solar concentrators of up to 200 m² size requiring sub-millimeters assembly accuracies. We perform prototype testing and look for possibilities to optimize the solar field operation, by flying with drones equipped with highly specific optical measurement technology.

In solar resource assessment we install and maintain customized automatic weather stations for solar projects worldwide. The data is then processed by us to provide

bankable solar resource reports, ranging from single sites to complete country or regional studies. Due to our extensive knowledge about solar plants and their energy source, the sun, we then developed an advanced now- and forecasting system. This was the birth of 'Q4cast'.

PES: We'd be interested to learn more about your irradiance now- and forecasting system, Q4cast. How does it work and what's its purpose?

BK: Q4cast gives answer to the question: how much solar irradiance will I get in the next minutes, and where exactly? It provides reliable information about the varying solar irradiance, typically caused by cloud movement.

The unique feature is that the irradiance forecast is not just one value but spatially resolved. It provides high-resolution maps of the expected solar irradiance for multiple time steps desired by the client. Starting with a live view, the system integrates multiple sky cameras and weather stations for the most accurate prediction over the next 20 minutes.

The results can be further combined with satellite data and numerical weather prediction for mid- and long-term irradiance and weather forecasts. This makes Q4cast the perfect irradiance prediction tool for operators of solar power plants of all types and for electricity grid operators.

PES: Can you give us further details of its functions and the type of projects it can be used for?

BK: It's delivered with a minimum of two sky cameras, an integrated weather station and our stand-alone evaluation software. As the name says, the sky camera records images of the sky, which are segmented to detect cloud and non-cloud pixels.

Since multiple cameras allow stereoscopic vision, a three-dimensional analysis determines individual clouds and cloud heights. Their movement over ground is derived from subsequent images. You can imagine that this may be rather easy for a clearly limited and shaped cloud, but imagine interlacing clouds that move in different heights in diverse directions.

This puzzle is solved by intelligent algorithms in our software that was developed together with the DLR. Knowledge of cloud location allows to calculate the position of cloud shadows on the ground, also considering the terrain profile. Subsequently local irradiance data is fed in from the weather stations and cloud transmittances and movements are being determined.

The resulting irradiance map (beam, global horizontal or tilted irradiance) can cover an area of up to 10 x 10 km² with up to 5 x 5 m² spatial resolution. Several systems can be combined, so there is no limit in upscaling and covering a bigger area according to needs.



Birk Kraas

Additionally, averages of defined areas, e.g., a complete solar field or subfields, can be generated. Q4cast serves all large-scale solar projects who require short-term solar resource prediction. This can be used to optimize the performance of the plant itself, the storage operation or the power interchange with the grid.

PES: It's a compelling concept; what are the main benefits of Q4cast for the end user?

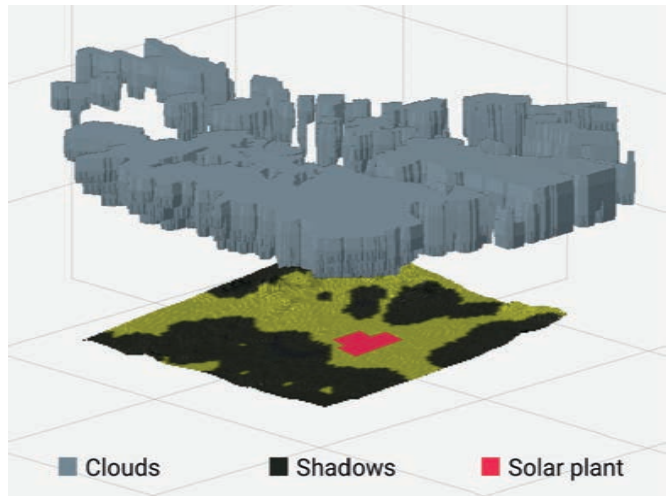
BK: The main benefit is fairly obvious: You can improve your power output



Solar project Spain



Solar plant for 3D imaging



3D cloud image

predictions, taking into account that especially in cloudy situations, the available solar irradiance is not evenly distributed. Q4cast enables PV-plant operators to predict the power output and to minimize production ramps. It supports a smooth plant operation and assists to avoid penalizations by the grid operator, and helps the plant operator to select the most efficient storage operation strategy.

In another use, grid operators who have to absorb the power from large or many distributed solar plants can get an overview of the solar power injected to their grid in the near future to optimize on-time measures for its stabilization.

Finally, a stable grid operation reduces other grid infrastructure requirements and thus permits the reductions of electricity costs. It's a win-win-deal for power producers, grid operators and power consumers. The benefit for each plant or grid operator depends on the plant design and location, solar technology and the individual market environment.

PES: Every project site and every client are different. What does your service look like?

BK: During more than 500 successful projects for more than 200 clients worldwide we have gained vast experience in site and plant specific conditions. We design our products and services customized to the particular need of each client. We manufacture and supply hard- and software, installation, maintenance and further expert consulting.

In regards to Q4cast: the system configuration, the data interface, the temporal and spatial resolution, with aggregation of specific areas, are customized and adaptable to individual requirements. If wished by the client, we deliver an automatic weather station, to operate Q4cast independently and with minimum downtime. CSP Services provides the complete system, including on-site implementation and expert

advice on how to make practical use of it.

PES: How innovative and competitive would you say Q4cast is, in terms of technology already available. What makes it different?

BK: What is the advantage of two-eyed creatures over one-eyed cyclops? The vision is not just doubled, it is 3-dimensional instead. Other sky camera-based systems utilize one single sky camera. With two cameras or more, our Q4cast allows a stereo view of the sky, which is the base to detect cloud heights accurately and to get the 3D-position of the cloud over the area of interest.

The stereo view permits the computation of highly resolved solar radiation maps from real measured data. Of course, it is true that two eyes are more costly than one, but we found a way to take standard cameras and increase accuracy through customized calibration. This is the part where our advanced image processing know-how comes in.

With all of this said, let me summarize our advantages: we get higher accuracies, we forecast for an area instead of a point and the spatially resolved forecasts allow improvements in the modeling of the electricity output.

Q4cast is extensively validated and has five years of data experience. To look ahead of the 20-minute nowcasting horizon, it can be combined with other satellite and NWP forecasts from external providers.

PES: Could you tell us about any other new solutions you are working on or that CSP Services has planned?

BK: CSP Services is constantly engaged in new technology to support its clients best. In concentrating solar power plants, we are implementing drones to ease plant installation, characterization and optimization.

Like Q4cast, our QScan uses two eyes to take everything out from its two cameras.



Cloud camera combined with other weather sensors



Data analysis

Implementing the enhanced image detection features for PV plants is only a small step. Our overall goal lies in quality assurance during construction and in optimization of plant operation and maintenance. 'Detect what is coming' drives us most.

PES: Where is CSP Services active? Are you predominantly working in mainland Europe or is your reach more global?

BK: We are founded and headquartered, close to the DLR, in Cologne (Germany). Our second office is located in the Mediterranean city of Almería (Spain), next to the PSA, the famous research lab for thermal solar power. This gives us the possibility to test and develop our products under different conditions.

However, our reach covers all continents. Our projects are mainly located around the 'sun-belt', namely in the MENA region, China, South Africa, Chile and the United States, just to name a few countries.

PES: Are there any countries that you don't currently work in that you would like to in the future?

BK: There is no particular country we are heading for. In order to be operative in difficult times like now, we can rely on a strong network of local partners all around the globe. They are located close to the project sites, know the regional culture and ensure the personal contact to the client.

We are very excited about where our projects will take us. One thing is certain: it will be a place with plenty of sun...

PES: How have you been impacted by the pandemic over the last 12 months and how do you think the industry as a whole will adapt as a result?

BK: Of course, like everybody else we have

been impacted. Nobody anticipated such an event. However, we were quite well prepared. Working remotely is not new for us. Measurement and maintenance could be performed from distance, above the usual, with the kind permission and assistance of our clients on site. We keep a positive mindset and as the saying goes, 'in every crisis also lies opportunity':

Due to our digital approach, we were able to not just keep going, but use the current situation to introduce new and improve existing remote solutions. We detected the potential to switch quite a lot of our work from the office to mobile working and we rely more on local partners to reduce traveling. Some of this will certainly stay as 'new normal'. But we also realized that external processes and delivery chains were affected and obviously not everything can be solved remotely, for manufacturing we need our

technicians 'in person'. Like you all, we hope that this pandemic will end soon.

PES: Finally, it would be great to learn a little more about what might be next for CSP Services.

BK: We are constantly looking for new ideas, technologies and partnerships. Large potential lies in ensuring that solar power plants are not only built, but keep a high-performance level or even improve over decades.

With the knowledge we have gathered over many years, we are exploring new solutions and services enabled by artificial intelligence, supported by big data. Due to the capability of carrying out our own research, we are in the lucky position to be able to quickly address upcoming challenges.

PES: What trends are you seeing in solar technology and why do you think that is?

BK: Solar energy is here to stay. We finally achieved such low electricity generation costs that have never been imagined. Energy payback times are in the order of months. These low costs will spark many new applications that have previously been unthinkable.

The greatest challenge to successfully fight climate change is energy storage and green fuels, also for remote areas. In hybrid systems, photovoltaics and concentrating solar power together may establish new methods to produce power 24/7 and as well as others, green hydrogen and green ammoniac may build the base for future liquid fuels.

A significant investment will be needed in the beginning, but if you consider the cost implications of unabated climate change, is there any alternative?

www.cspservices.de



Solar furnace Uzbekistan