

# Monitoring Efficiency at Benban Solar Park – the World’s Fourth Largest PV Area

## Challenge

The performance of a PV plant depends on multiple criteria, atmospheric and technical ones. Especially on huge plants as the Benban Solar Park, quick determination of failures as a root cause for output loss is key for efficient operation.

## Solution

To quickly identify the cause for sinking performance and to mitigate losses, Beijing Intell-Sun Technology installed environmental monitoring systems including Kipp & Zonen pyranometers, sun trackers, and soiling monitoring sensors.

## Benefits

Accurate real-time monitoring of solar irradiance, soiling, weather parameters, and the back panel temperature gives operators clear indication what output they can expect under given conditions. Deviances indicate technical issues.



# Introduction

Monitoring the output data of a PV station reveals volatilities every day. There are many reasons that lead to different output data. Identifying them and taking the right measures is an important challenge for plant operators.

Typically, power output volatilities are caused by one of these four reasons:

- Intensity of solar radiation energy received by PV panels
- Technical deterioration from elements as the DC bus, inverter, etc.
- Dust and sand on PV modules blocking the sunlight
- Photoelectric conversion efficiency caused by the modules' back temperature

We cannot change the weather, and we have little impact to control the back panel temperature. What we can do is to improve the operating efficiency of the whole PV station, that is, reducing the operating loss of the power station and cleaning the panel to improve the percentage of solar radiation reaching the PV panels.

In this case study, Beijing Intell-Sun Technology Ltd. shows its approach to reduce performance losses at a large PV power plant in the Benban Solar Park together with EPC experts.

## This is Beijing Intell-Sun Technology



**北京智阳科技有限公司**  
Beijing Intell-sun Technology Co.,Ltd.

Beijing Intell-Sun Technology Ltd. is a Chinese company with a focus on meteorology, ground-based remote sensing, water environment, renewable energy, plant physiology, and other fields. It can customize a variety of system solutions for users.

Depending on good strategic relations with many well-known domestic and global instrument manufacturers, it customizes standardized systems for various applications. Its tailored solutions range from low-end to high-end, from business to scientific research, always according to the customer's needs.



*A Kipp & Zonen pyranometer tilted in the same angle as the PV panels to measure the Global Radiation that reaches the modules.*

# Benban Solar Park – the City of Photovoltaics

The project showcased in this case study is located in Benban Solar Park. This giant PV park has been built amid the Nubian Desert, about 40 km north of Aswan, Egypt.

It consists of various PV plants structured as long rectangles and run by different operators. The total area of the Benban Solar Park will be 37 square kilometers with a total power of 1,800 MW, making it one of the largest PV areas in the world.

The total installed capacity of project showcased here is 186 MW, divided into three plants, each of them is about 60 MW.

Building Benban Solar Park is extremely significant for Egypt, which took 90 percent of its electricity from oil and gas in early 2018. With help of this and other projects, Egypt hopes to increase domestic renewable energy production to 20% by the end of 2022 and 42% by 2035.

## Share of oil & gas within Egypt's energy mix

**90 %**  
in 2018

**80 %\***  
in 2022

**58 %\***  
in 2035

\* Planned

# How to reduce losses of a PV power station

Output losses of a PV power station are mainly caused by failure or deterioration of DC converters, inverters, and other. If not found in time, they will have a huge impact on the generation of PV station in the long term. Our breakthrough point is to find and determine its location quickly, then remedy it in time.

We can monitor the output data of PV station in real time. If we know the ideal output data of a power station under given conditions, we can estimate if something is wrong.

The calculation of theoretical power generation requires mainly two parameters, namely the solar radiation in the inclination direction of the PV panel and the temperature of PV back panel.

We can easily judge whether there is a problem of power station through calculating the capacity ratio between the actual and theoretical, that is Performance Ratio (PR). That ratio will become smaller as time goes on due to aging of technical components. We can observe the ratio change by a real-time data trend. Ideally, the PR presents a smooth line.



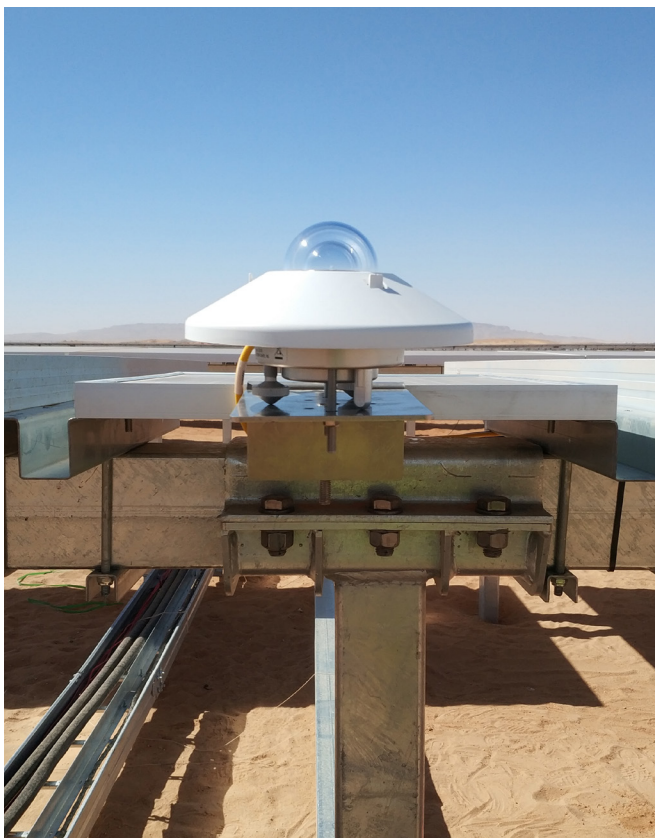
*The back panel temperature impacts the efficiency of the PV module.*

# Precise instruments for quick problem solving

Thorough monitoring the performance ratio of a PV plant requires precise instruments for solar radiation and back panel temperature. Weather parameters bring additional insights.

In order to locate a problem on the PV plants quickly, we subdivided the three rectangular plants into several areas with a set of measurement instruments to represent each area, and then divided the whole plant into dozens of small areas for fine management. When the problem is found, the O&M site staff can locate the fault area accurately. It is not necessary to search the whole plant, which ensures the timeliness of solving the problem.

Take a 60 MW power station with five to six O&M site workers as an example: By dividing the total area into smaller pieces, we can solve the contradiction between the shortage of manpower and the increased difficulty of inspection on a large-surface plant.



*A Kipp & Zonen SMP10 pyranometer*



*A Kipp & Zonen SOLYS2 sun tracker and a weather station.*

To ensure the data authenticity of these small regional devices, we install two sets of more accurate measurement systems including sun trackers and weather stations in the central of each plant. The weather stations can measure atmospheric parameters as air temperature, wind speed and wind direction, and precipitation. This data serves as a benchmark to provide data support for O&M site staff to make decisions. For quick detection of problems, we set the frequency of data acquisition and calculation to 1 Hz – that is one signal per second.

# Soiling monitoring detects the need for cleaning

Benban Solar Park located amid the Nubian desert. Land use costs are low, but strong winds blow lots of dust and sand onto the PV panels. Soiling monitoring helps to determine the right time for cleaning.

Soiling can significantly decrease power generation. Cleaning them regularly, especially after sandstorms, is mandatory. However, there is a large area of PV panel in a power station, making one-time cleaning costs relatively high. Timing of cleaning is an important issue. If the cleaning time is too frequent, the costs will explode, and if the cleaning time is missed, the plant performance shrinks. We try to balance these two factors by installing the soiling monitoring system Kipp & Zonen DustIQ.

We divided this station into several zones according to the prevailing wind direction and dust conditions, and installed DustIQ's in each zone to monitor dust everywhere.

We can calculate the threshold of dust index by analyzing the relationship between dust index and power generation. Below this threshold, the loss of power generation benefits equals the cleaning costs. Thus, we increase the intervals between cleaning procedures. Doing so, we can determine when to clean PV panels based on this threshold and find a balance between the generation benefits and cleaning costs.



*Innovative soiling monitoring system:  
the Kipp & Zonen DustIQ*

# Technologies used



## DustIQ Soiling Monitoring System (optional)



### Know when and where to clean

Optical soiling sensor to optimize the yield of your PV plant. Maintenance-free operation after simple integration into the plant management software.



## CMP10 Pyranometer



### ISO 9060:2018 spectrally flat Class A

Spectrally flat Class A pyranometer with lowest maintenance and maximum performance for both meteorological and solar energy applications.



## SOLYS2 Sun Tracker



### The world's most popular sun tracker

Follow the sun with highest precision at Baseline Surface Radiation Network (BSRN) levels of performance and reliability. Exceptionally simple installation and operation.