SANTERNO
CARRARO GROUP

PV plants similar to Kathu, South Africa

Kathu Project, South Africa

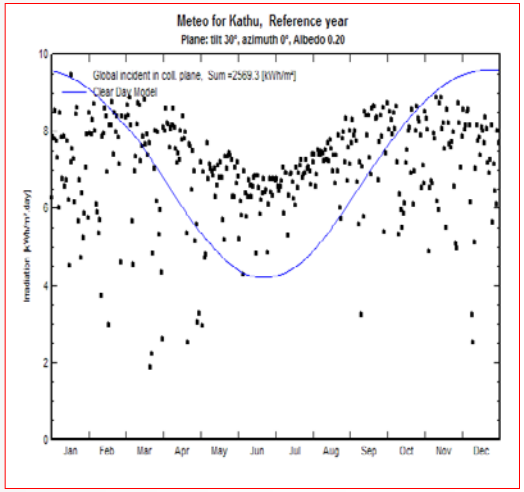
Latitude: **27° 48' 00" S**
Longitude: **23° 00' 00" E**
Altitude: **1197 m** above sea level

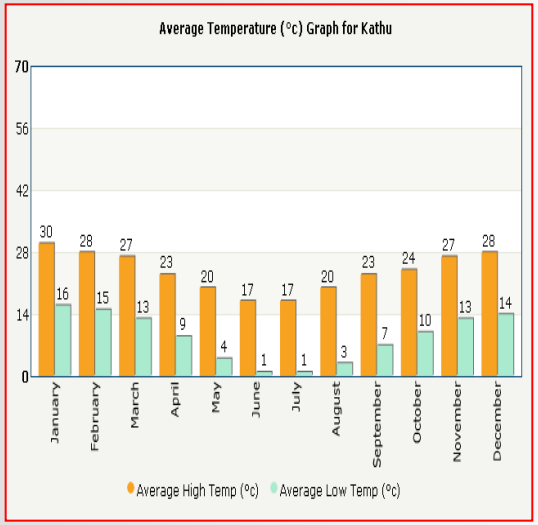
The plant has single axle trackers

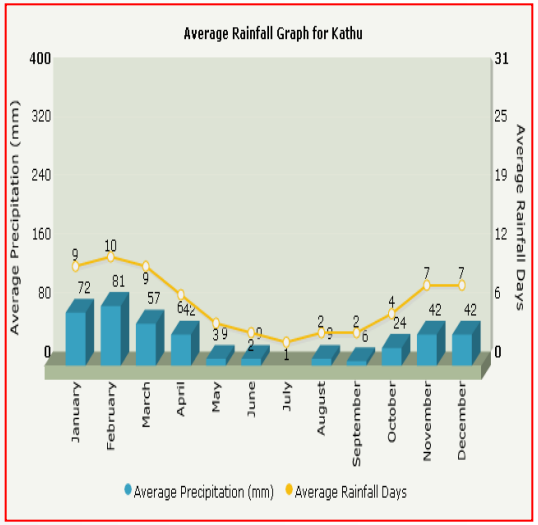
Weather conditions in Kathu

- High temperatures all over the year
- Very Low rainfalls for 5 month/year.
- Solar Irradiations: **2569,3** kWh/m2 (30° tilt)
- Average year Wind Speed is **4,5 m/s**
- Average year air relative humidity RH% is **43,8%**
- High level of sand and dust in the air.

	Wind(m/s)	RH(%)
Jan	4,28	46,0
Feb	4,12	50,3
Mar	4,01	49,7
Apr	4,12	44,6
May	4,01	44,1
Jun	4,16	47,5
Jul	4,30	44,5
Aug	4,63	35,9
Sep	4,70	32,8
Oct	4,76	39,2
Nov	4,63	42,1
Dec	4,50	49,0
Average	4,35	43,8







Worldwide Santerno PV Plants vs Kathu Project

• Vilanueva de Alcardete, Spain	2 MW	Trackers, Temperatures, Uptime
• Ravenna Project , Italy	124 MW	Big Project, Temperatures
• Kutch Project , Gujarat, India	20 MW	High irradiation, desert area (8 month/year)
• Golmud Project 1, Qinghai, China	10 MW	Altitude, desert area.
• Shigatze Project, Tibet, China	10 MW	Altitude, desert area.
• Fuente Alamo, Spain	26 MW	Temperatures, Uptime
• Calasparra, Spain	20 MW	Temperatures, Wind Speed, Uptime.
• Renault Project, France	55 MW	Strong Engineering, 6 weeks delivery

SANTERNO
CARRARO GROUP

2008 Villanueva de Alcardete, (Spain)

Villanueve deAlcardete , Toledo - Spain

- **2 MW** plant
- Commisioned **Oct 2008**
- n. **20 SUNWAY™ TG 145 ES**

The project location is situated about 200 km south of Madrid in Villanueva de Alcardete, Toledo province.

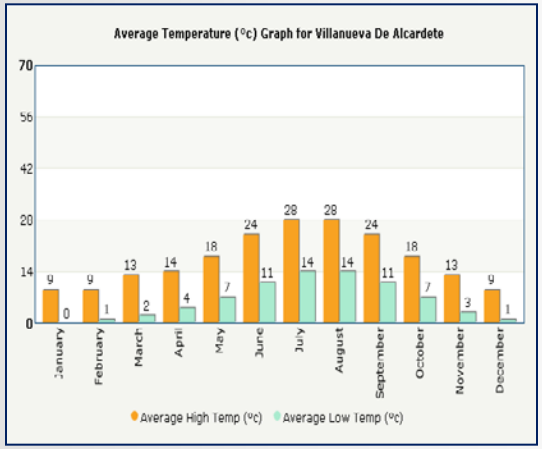
Latitude: **39° 42’ 50” N**
Longitude: **2° 58’ 20” O**
Altitude: **745 m** above sea level

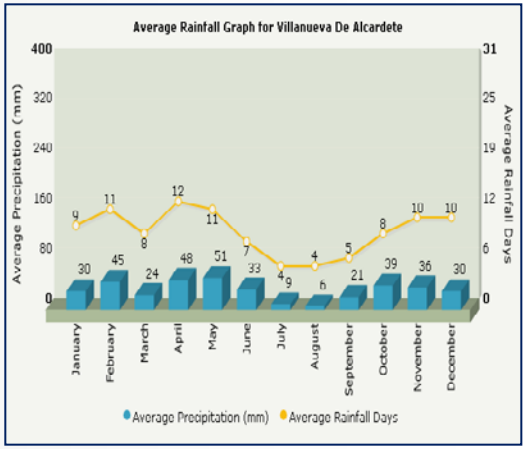
Customer: Gestamp Solar

Villanueve deAlcardete , Toledo - Spain

Weather conditions, Villanueva

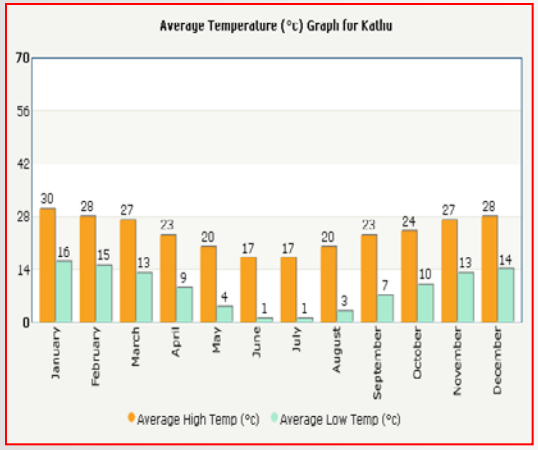
- High temperatures all over the year
- Low rainfalls all over the year.
- Solar Irradiations: **2005,2** kWh/m2 (35° tilt)
- High level of sand and dust in the air.

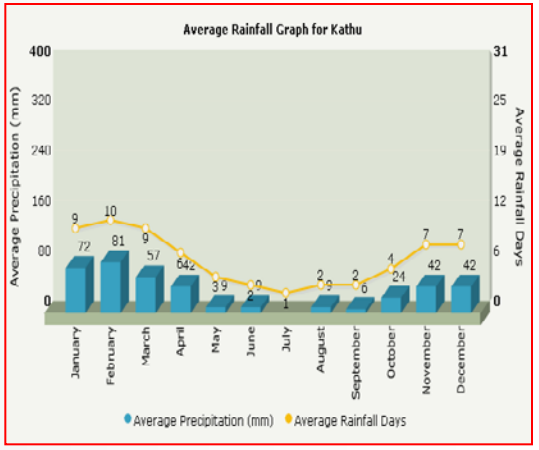




Weather conditions in Kathu

- High temperatures all over the year
- Very Low rainfalls for 5 month/year.
- Solar Irradiations: **2569,3** kWh/m2 (30° tilt)
- High level of sand and dust in the air.





Source: Weatheronline.com

Villanueve deAlcardete , Toledo - Spain

- **A plant with single axle trackers**
- **During last 3 years the recorded inverter uptime is 99,98%**

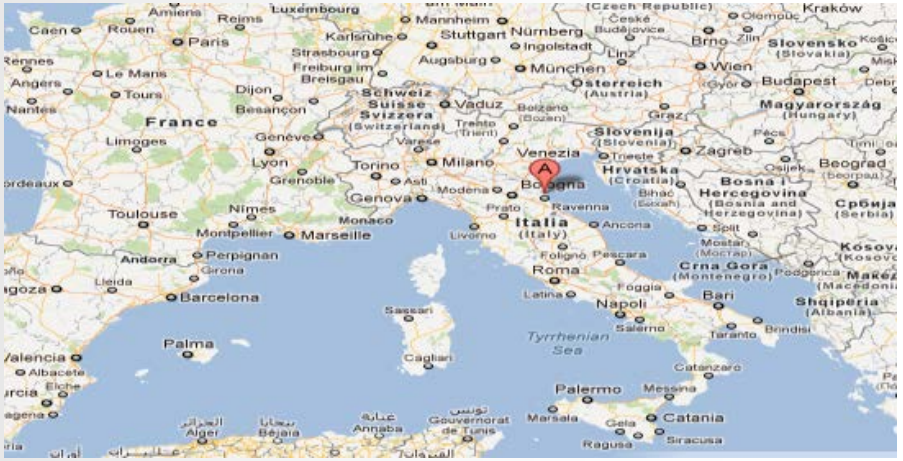
SANTERNO
CARRARO GROUP

2011 Ravenna, (Italy)

Ravenna Project - Italy

SANTERNO
CARRARO GROUP

- Power: **124 MW**
- Commissioning : **2010 – 2011**
- **82 Sunway^{TM} Station 1.350 (Tot. 164 Sunway^{TM} TG 750 1000V)**
- **1312 Smart String Box 1000V**



The project is located in north-est Italy, 20 km from Ravenna.

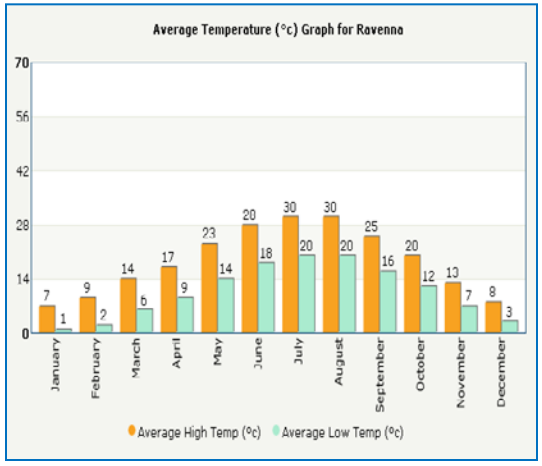
Latitude: **44° 31’ 51” N**
Longitude: **12° 10’ 29” O**
Altitude: **-8 m** above sea level

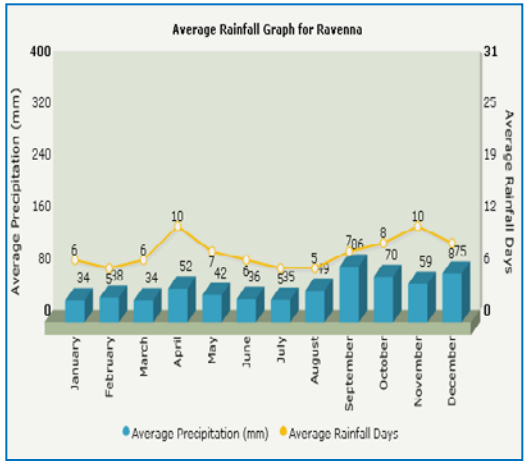
Customer: Terna

Ravenna Project - Italy

Weather conditions in Ravenna

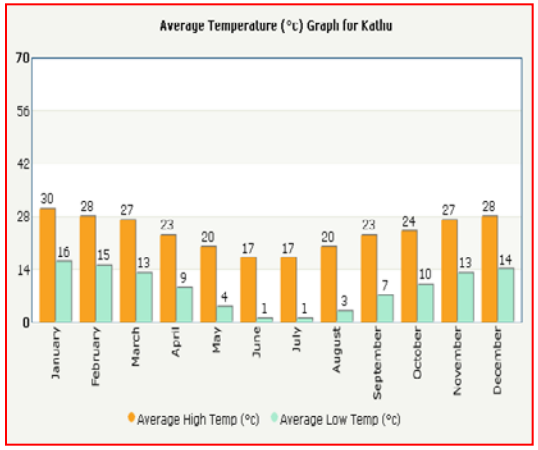
- High temperatures all over the year
- Good rainfalls all over the year.
- Solar Irradiation: **1991,9** kWh/m2 (35° tilt)

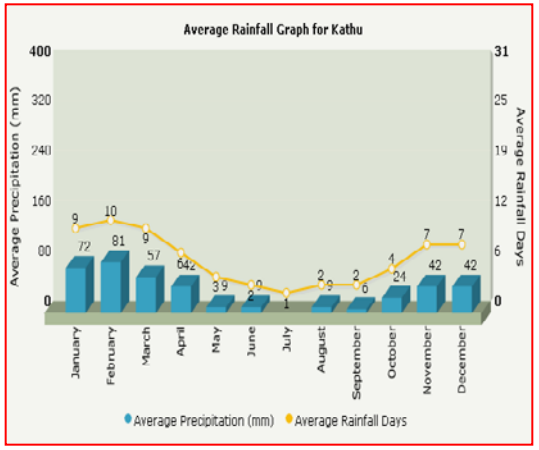




Weather conditions in Kathu

- High temperatures all over the year
- Very Low rainfalls for 5 month/year.
- Solar Irradiation: **2569,3** kWh/m2 (30° tilt)
- High level of sand and dust in the air.





Source: Weatheronline.com

Ravenna Project - Italy

Key Notes

- PV plant completed in five months thanks to SANTERNO plug-
  and-play solutions
- Bearing structure of the modules: galvanised steel and aluminium with no use of concrete (Supplied and installed by Schletter Gmbh)
- Oil MV transformers supplied by Santerno
- Area size: total of 240 ha (2,4 Km^2)
- 97% availability and maintenance contract for 20 years warranty
- Expected production: total of 148 GWh/year
- A specific High Voltage substation was built to connect the plant to the 132 kV transport grid

124 MW: The biggest operating plant in the world !

SANTERNO
CARRARO GROUP

2011 Kutch, Gujarat (India)

Kutch Project, Gujarat, India

- **Power :** **20 MW**
- Commisioned **Dec 2011**
- n. **28** Sunway^{TM} **TG 750 1000V**
- n. 300 String Boxes with 4850 monitored strings

The project location is situated about 7 km from (Ahmedabad-Kandla Port) National highway **Mouje Village Shivlakha** in Kutch district ,State of Gujarat.

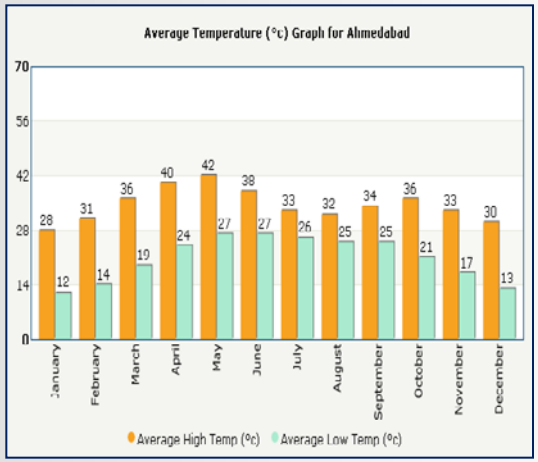
Latitude: **23º19”28’ N**
Longitude: **70º24”1’E**
Altitude: **24 m** above sea level

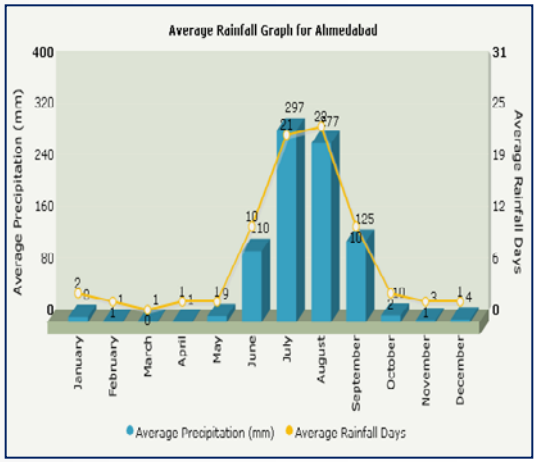
Customer:

Kutch Project, Gujarat, India

Weather conditions in Kutch

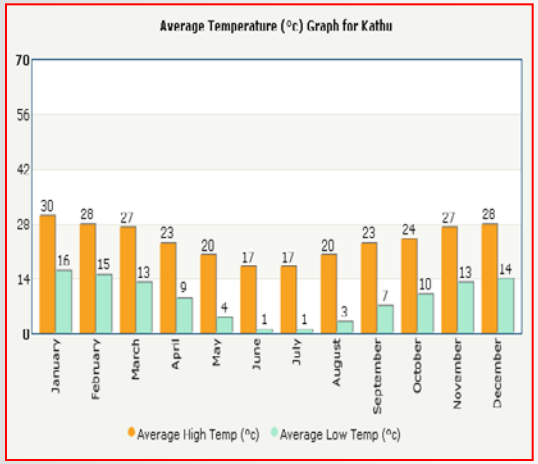
- High temperatures.
- Low rainfalls for 8 month/year.
- High rainfalls for 2 month/year
- Solar Irradiation: **2190,7** kWh/m^2 (30° tilt)
- High level of dust in the air.

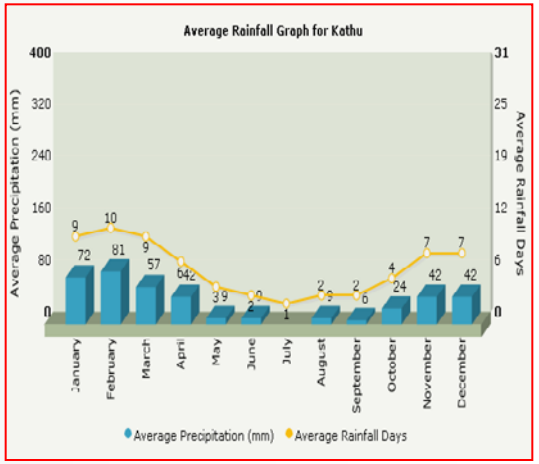




Weather conditions in Kathu

- High temperatures all over the year
- Very Low rainfalls for 5 month/year.
- Solar Irradiation: **2569,3** kWh/m^2 (30° tilt)
- High level of sand and dust in the air.





Source: Weatheronline.com

Kutch Project, Gujarat, India

The direct current from the photo voltaic modules will be converted into alternating current by 28 inverters each having nominal capacity of 665 kW.
This exportable power will be stepped up to 66kV by a **20MVA** transformers to be located in the proposed **66 kV** plant switchyard and paralleled with the **Gujarat Energy Transmission Corporation Limited** (**GETCO**) substation at Chitrod.

Adequate protection system will be in place in the form of multifunctional relays and circuit breakers. Central inverters or PCU operate on MPPT (Maximum Power Point Tracking) mode to ensure maximum output from the solar generators at different ambient conditions. Central inverters use higher system voltages to reach very high plant efficiency.

The conventional AC power (320V) from the inverter is fed through the LV (Low Voltage) panel to the main step up transformer. From the transformer, 66kV power is fed to the **HT (High Tension)** power panel and required measuring and protection devices before connecting to the grid.

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2011 Golmud, Qinghai (China)

Golmud Project, Qinghai, China

- **10 MW** plant
- Commisioned **Dec 2010**

- n. **18** Sunway™ **TG 730 1000 V CN**
- n. **2** Sunway™ **TG 750 1000 V CN**

The project location is situated near the Golmud town in Qinghai region in China, the area is almost totally uninhabited desert.

Latitude: **36° 21'42"N**
Longitude: **95° 01' 29"E**
Altitude: **2850 m** above sea level

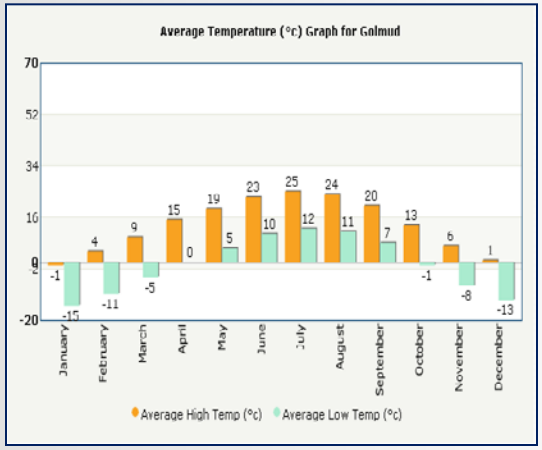
Customer :
is one of the biggest chinese State Grid utilities

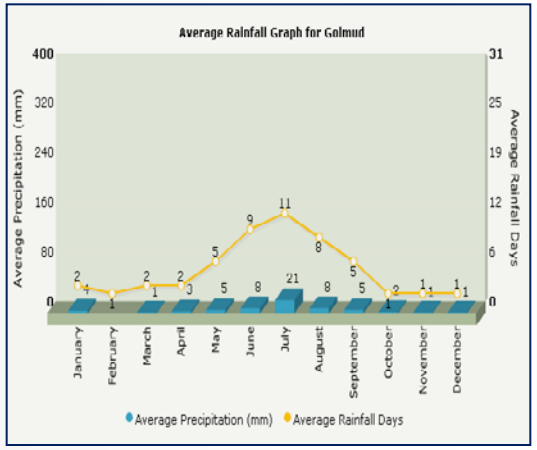
中国国电 CHINA GUODIAN
龙源电力集团公司 CHINA LONGYUAN ELECTRIC POWER GROUP CORP.

Golmud Project, Qinghai, China

Weather conditions in Golmud

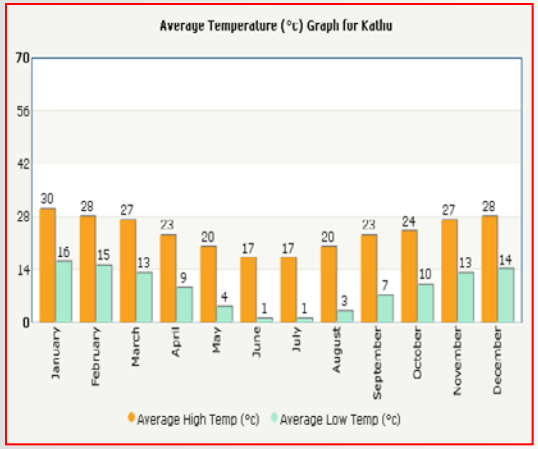
- Both high and very low temperatures.
- Very Low rainfalls all over the year.
- Solar Irradiations: **2183,7** kWh/m2 (30° tilt)
- High level of sand and dust in the air.

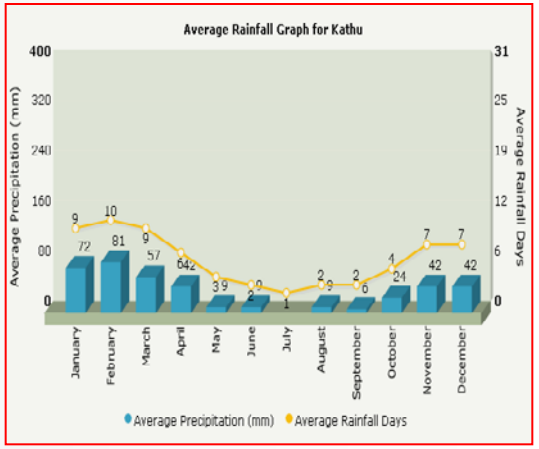




Weather conditions in Kathu

- High temperatures all over the year
- Very Low rainfalls for 5 month/year.
- Solar Irradiations: **2569,3** kWh/m2 (30° tilt)
- High level of sand and dust in the air.

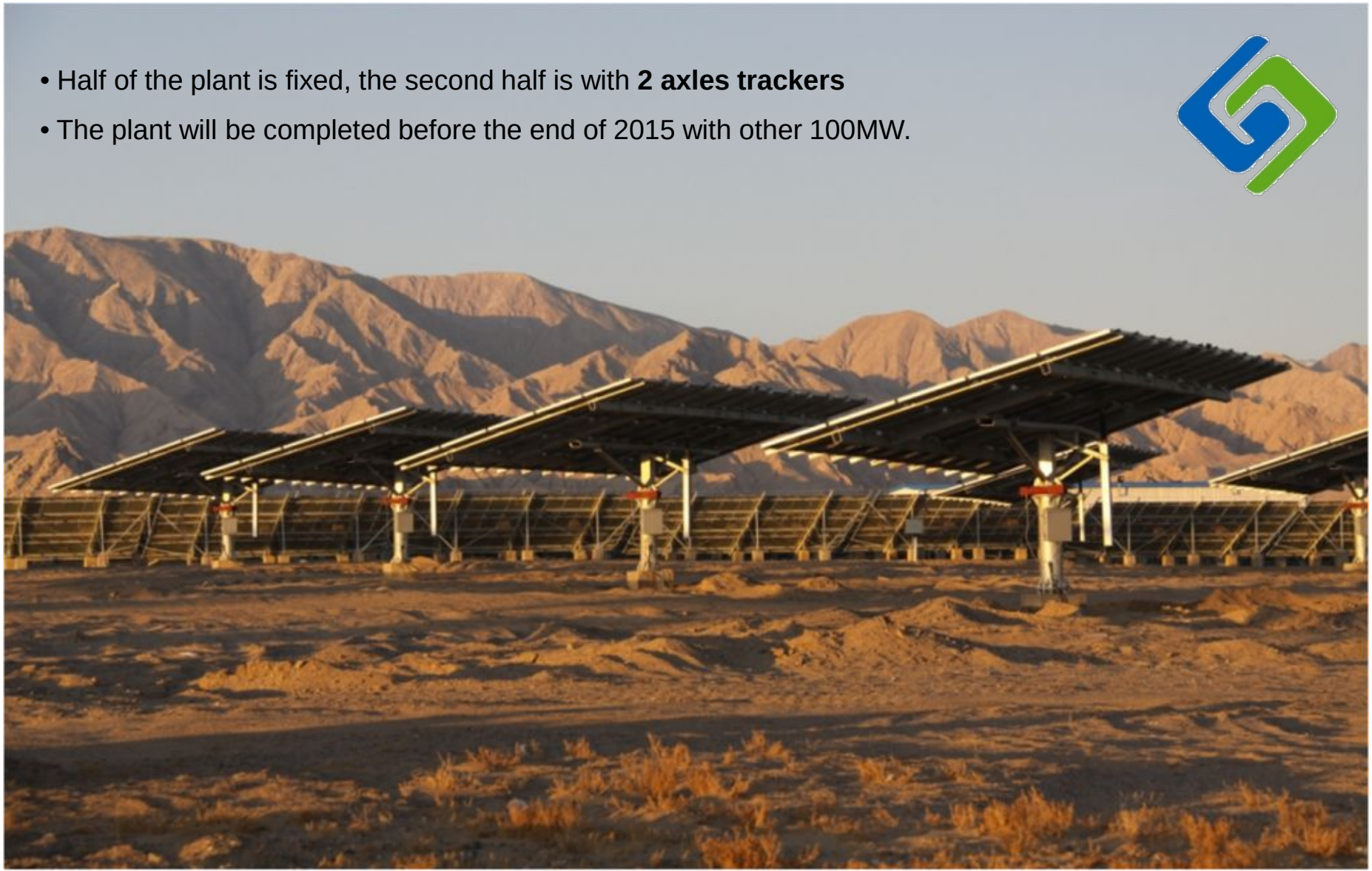




Source: Weatheronline.com

Golmud Project, Qinghai, China

- Half of the plant is fixed, the second half is with **2 axles trackers**
- The plant will be completed before the end of 2015 with other 100MW.



Golmud Project, Qinghai, China

Santerno supplied the inverters, the EPC realized the cabinets.

Santerno technicians supported for the commissioning of the PV plant and for after sales services.

Santerno R&D Solar Inverters Platform Manager Simone Bernardi visited the plant after 2 month from commisioning to check the proprer functionality of the plant.

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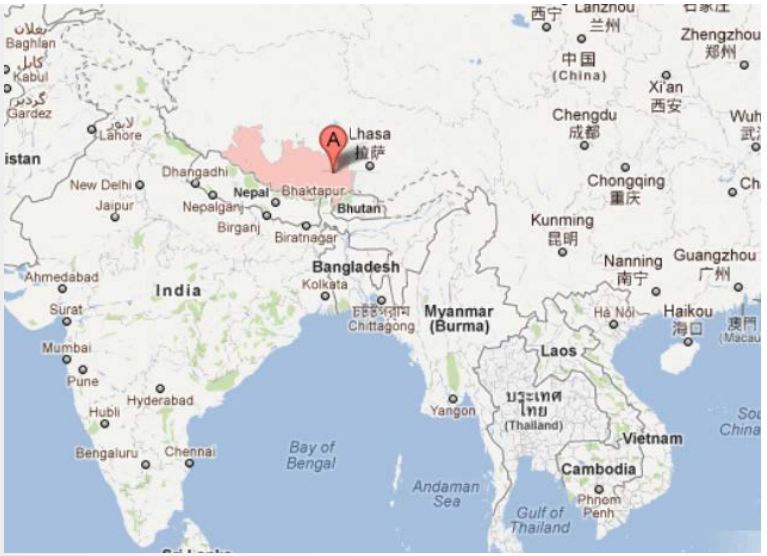
2011 Shigatze , Tibet, (China)

Shigatze Project, Tibet, (China)

- **Power:** **10 MW**
- Commisioned **Dec 2010**
- n. **20** Sunway™ **TG 750 1000 V CN**



The project location is situated near Shigatze, the second biggest town in Tibet with 40.000 inhabitans

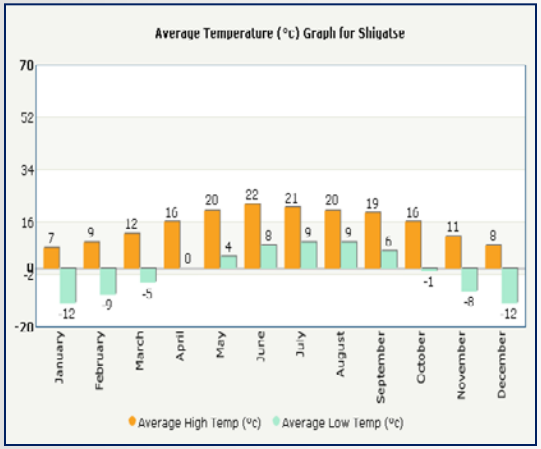
Latitude: **29° 14' 13" N**
Longitude: **88° 49' 52" E**
Altitude: **3895 m** above sea level

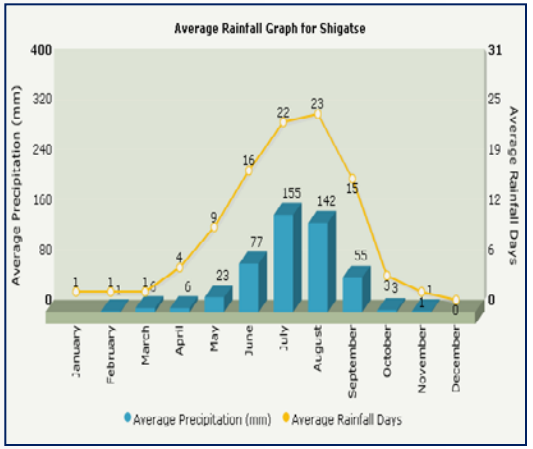
Customer : Linuo Group of Shandong province is one of the biggest Chinese State Grid utilities

Shigatze Project, Tibet, (China)

Weather conditions in Shigatze

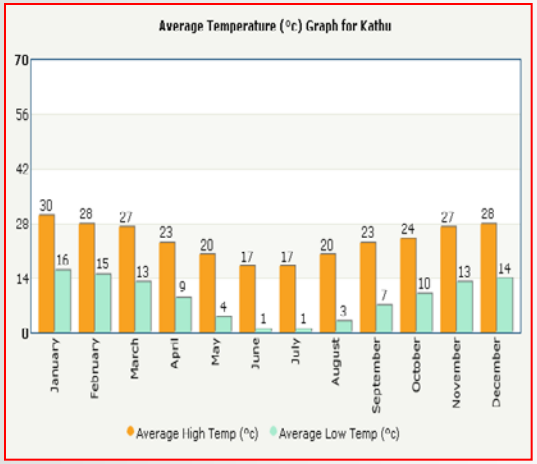
- Medium and very low temperatures.
- Very Low rainfalls for 8 month in one year.
- Solar Irradiations: **2417,17** kWh/m2 (33° tilt)
- High level of sand and dust in the air.

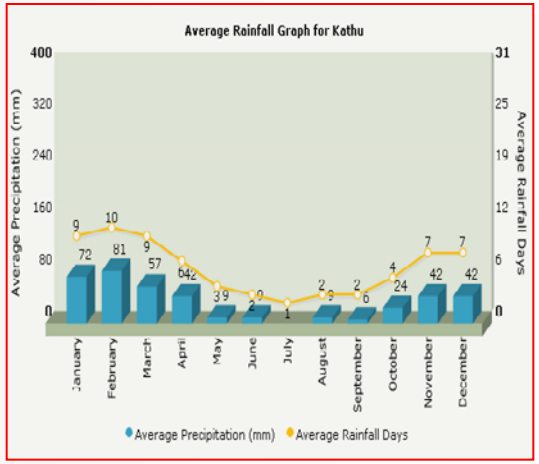




Weather conditions in Kathu

- High temperatures all over the year
- Very Low rainfalls for 5 month/year.
- Solar Irradiations: **2569,3** kWh/m2 (30° tilt)
- High level of sand and dust in the air.





Source: Weatheronline.com

Shigatze Project, Tibet, (China)

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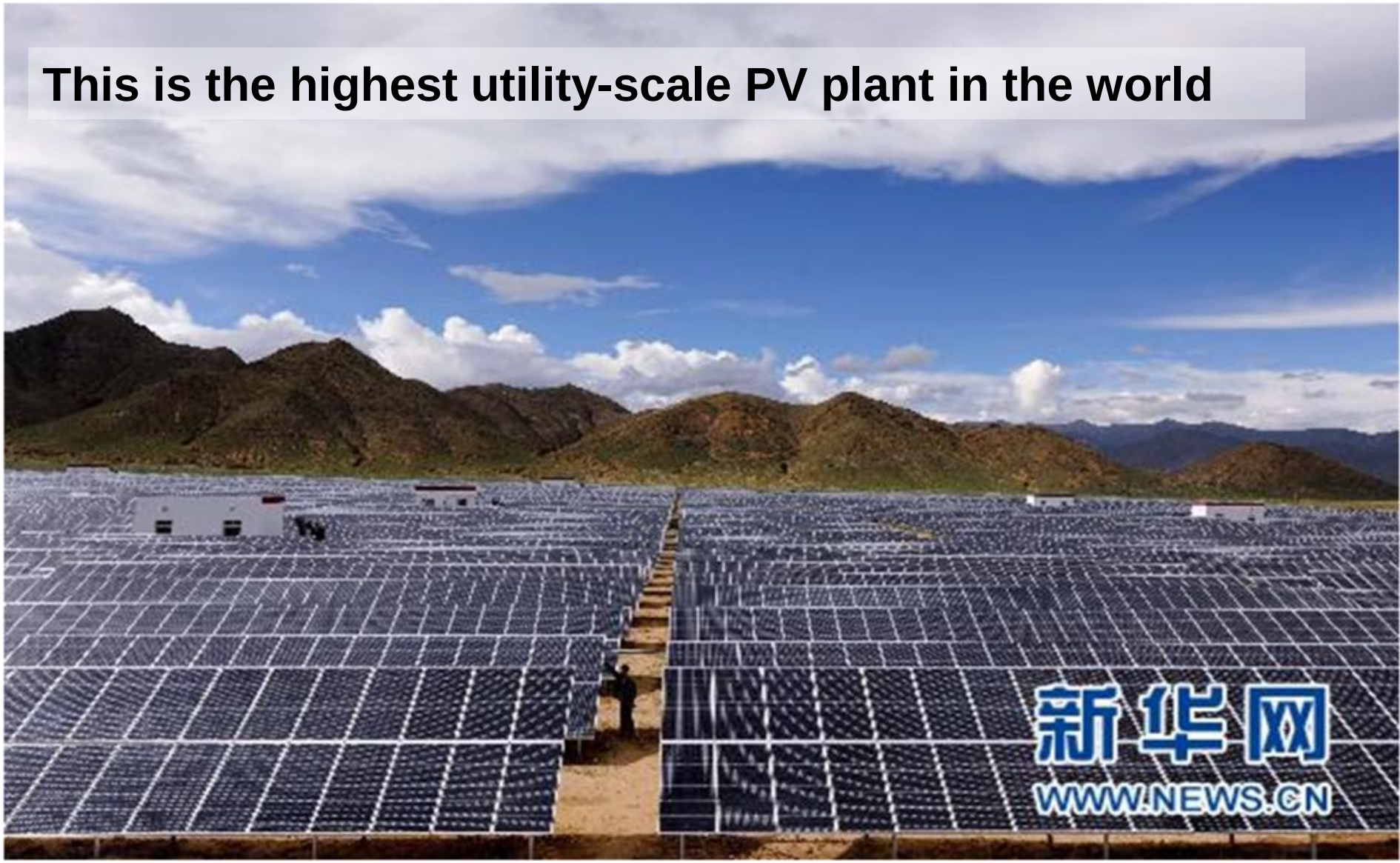
This is the highest utility-scale PV plant in the world



Shigatze Project, Tibet, (China)

Solar panels are set in Shigatse Prefecture in the Tibet Autonomous Region.The solar photovoltaic power plant in Shigatse was built by Linuo Group of Shandong province, which is involved in different industries including solar power and medicine, to help the Tibet Autonomous Region develop its power industry

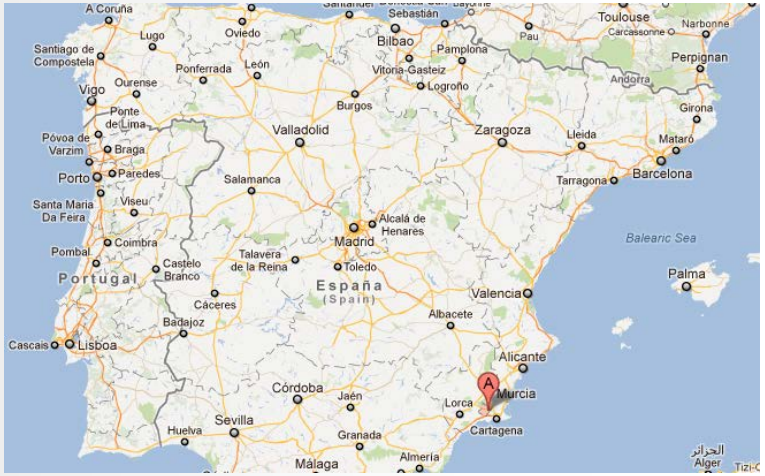
SANTERNO
CARRARO GROUP

2008 Fuente Alamo, Spain

Fuente Alamo, Spain

- Power: **26 MW**
- Commissioned: **July 2008**

- n. **160** Sunway™ **TG 145 800V**,
- n. **32** Sunway™ **TG 385 800V**



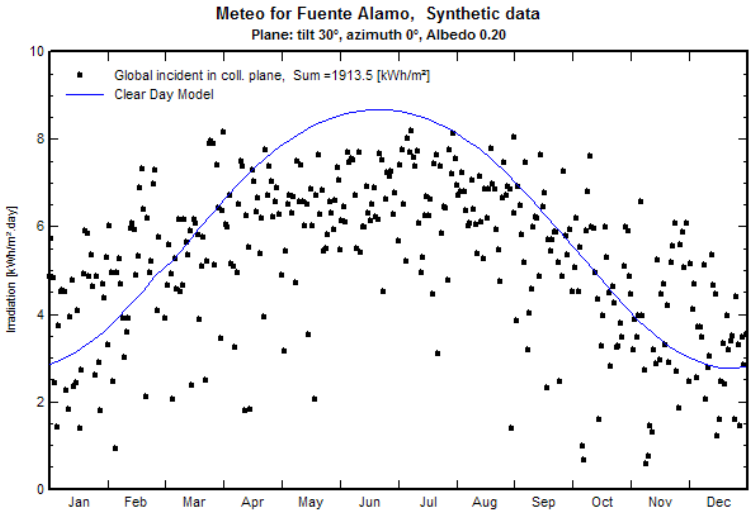
Latitude: **37° 45’ 15” N**
Longitude: **1° 13’ 00” O**
Altitude: **196m** above sea level

Customer : Gestamp Asetym

Fuente Alamo, Spain

Weather conditions in Fuente Alamo

- Low temperatures.
- Solar Irradiations: **1913,5** kWh/m2 (30° tilt)
- Windy area, same **wind speeds** as Kathu



Fuente Alamo

	Wind(m/s)	RH(%)
Jan	4,44	66,5
Feb	4,69	63,5
Mar	4,65	59,8
Apr	4,63	52,8
May	4,25	53,6
Jun	4,19	50,8
Jul	4,28	50,1
Aug	4,16	52,9
Sep	3,86	59,1
Oct	4,04	62,1
Nov	4,28	64,7
Dec	4,48	68,1
Average	4,32	58,6

Kathu

	Wind(m/s)	RH(%)
Jan	4,28	46,0
Feb	4,12	50,3
Mar	4,01	49,7
Apr	4,12	44,6
May	4,01	44,1
Jun	4,16	47,5
Jul	4,30	44,5
Aug	4,63	35,9
Sep	4,70	32,8
Oct	4,76	39,2
Nov	4,63	42,1
Dec	4,50	49,0
Average	4,35	43,8

Fuente Alamo, Spain

- **During last 3 years the recorded inverter uptime is 99,98%**

SANTERNO
CARRARO GROUP

2008 Calasparra, Spain

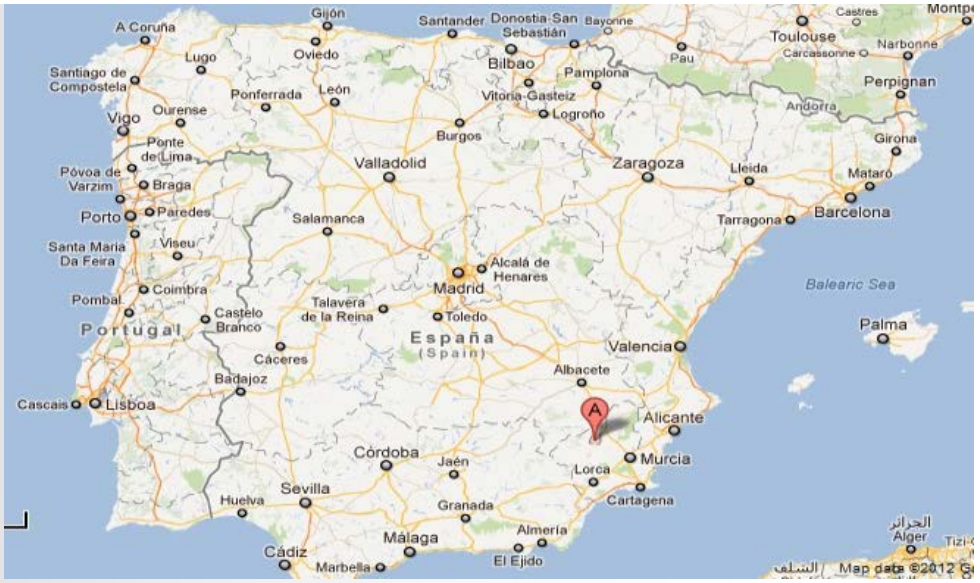
Calasparra, Spain

- Power: **20 MW**
- Commisioned: **2008**

- n. **80** Sunway™ **TG 145 800V**
- n. **40** Sunway™ **TG 385 800V**

Latitude: **38° 13’ 52” N**
Longitude: **1° 43’ 32” O**
Altitude: **449 m** above sea level

Customer : Gestamp Solar



During last 3 years the recorded inverter uptime is 99,98%

SANTERNO
CARRARO GROUP

2011 Renault Project

Renault Project , France

- **Power:** **5 x 11 MW**
- Commisioned: **Dec 2011**

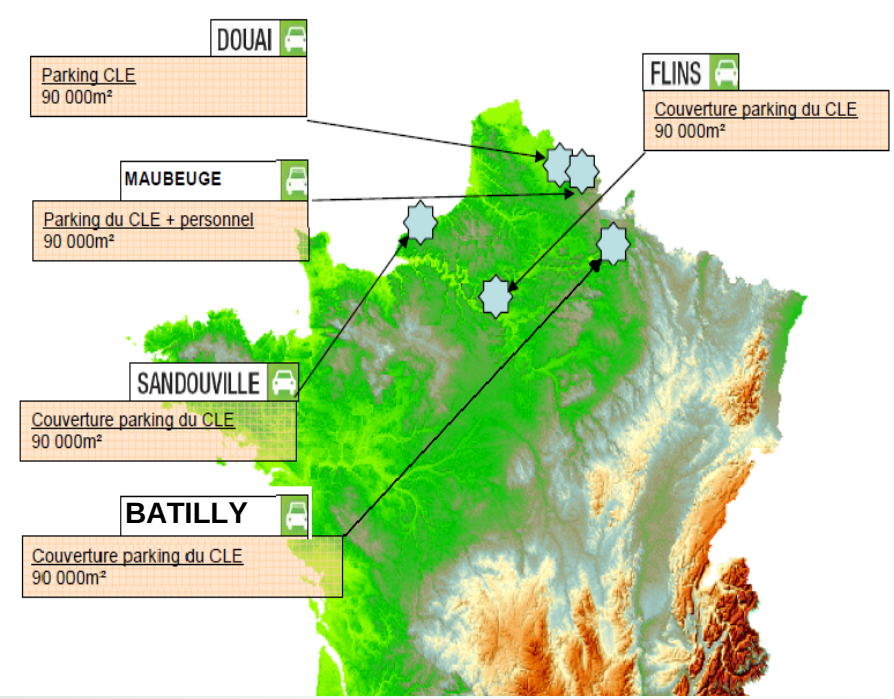
The project is for 5 different Renault Factories carports, 11 MW each.
It is the biggest Pv Power Plant in the automotive sector in the world.

Latitude: **48˚ 57’ 45” N**
Longitude: **52˚ 09’ 93” E**
Altitude: **48 m** above sea level

End Customer :

Engineering:

EPC :



Renault Project, France

The project started in 2009 by LUXOLIS Ingegnerie, EPC operating in the photovoltaic industry, part of EIFFAGE Group

EIFFAGE is the third group of civil engineering and public works in France.
It is a group known for the history of the Eiffel Tower and more recently for the impressive viaduct of Millau, in addition to a series of projects or renovations: Pyramid the Louvre, Sydney Opera House POPB.

Renault Project, France

- n. **84** Sunway^{TM} **TG 750 1000V** PQ were **delivered in 6 weeks** !
- It is the only operating Utility-Scale PV plant in France **fully compliant with "Arretè 28 April",** the **most severe grid code in Europe** for power quality and LVRT.

SANTERNO
CARRARO GROUP

Thank you