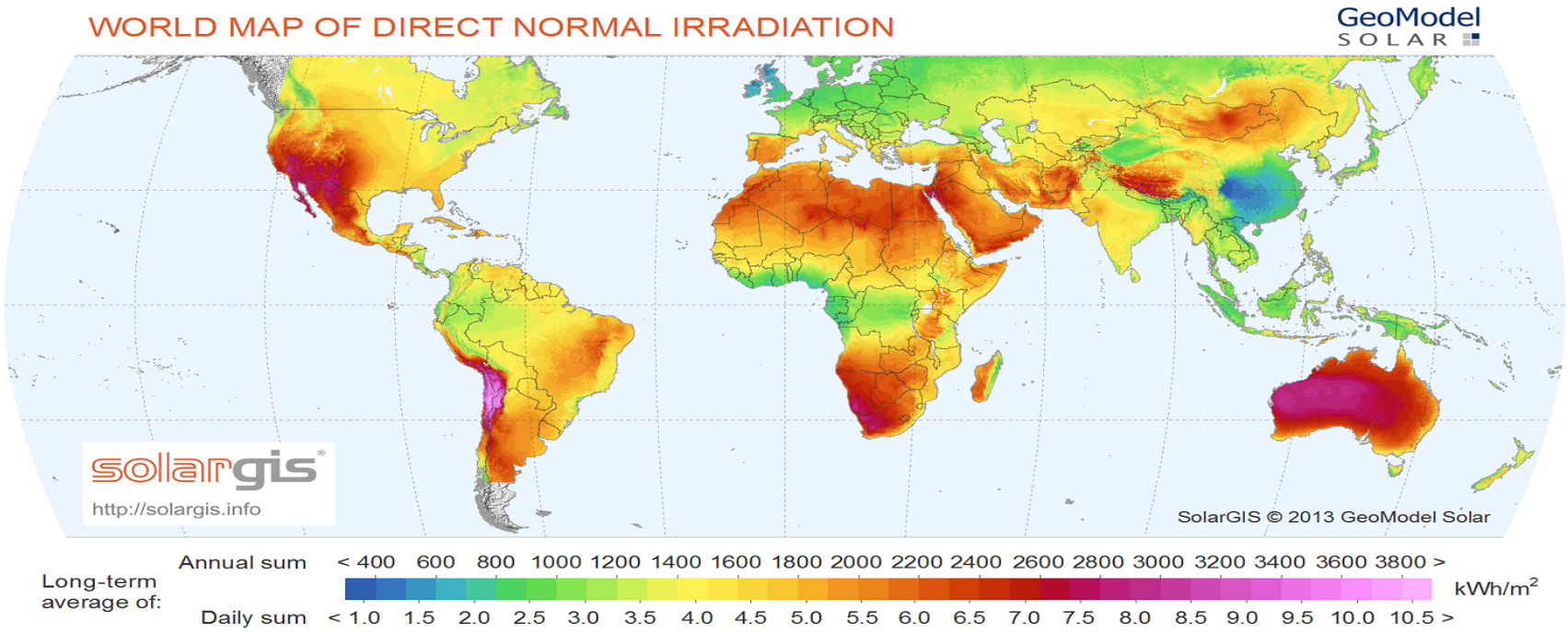
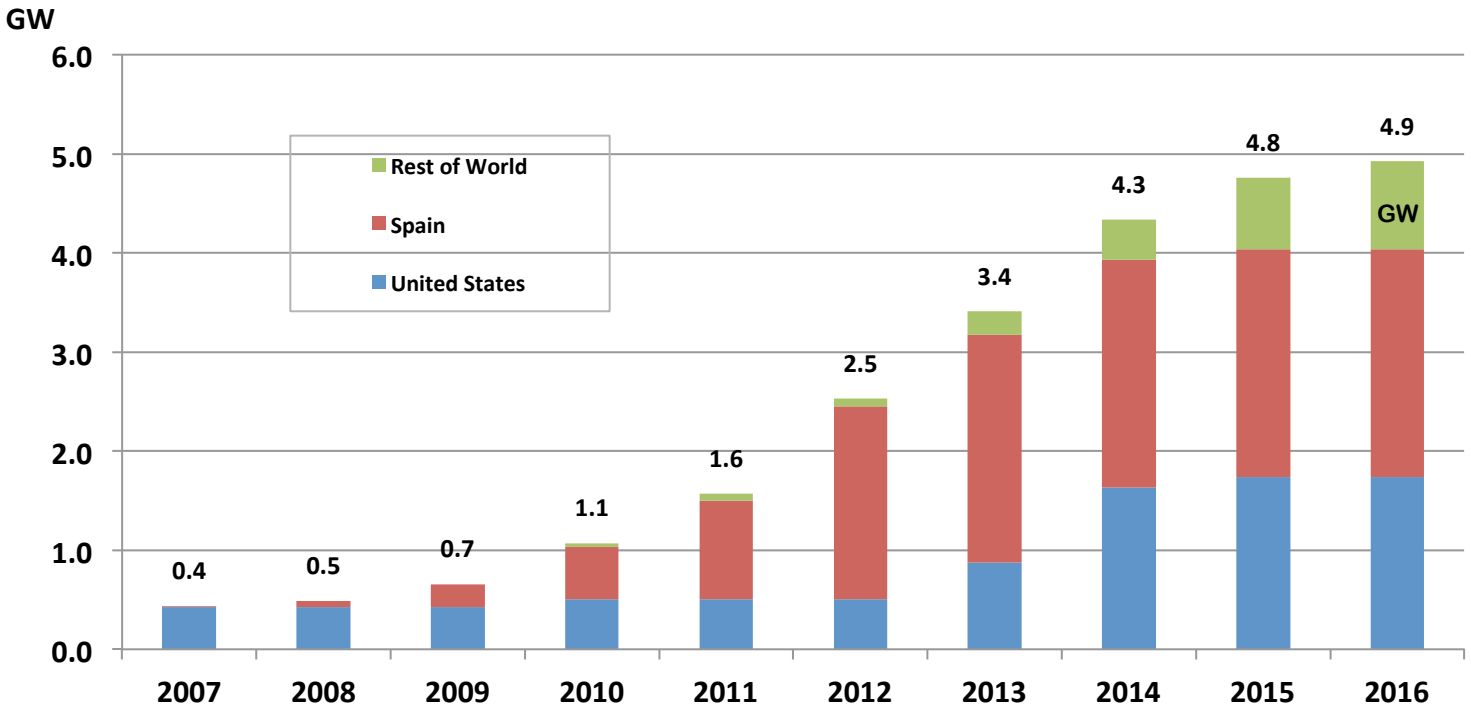
The World of CSP

- CSP became a commercial electrical power source in the mid 1980's with the installation of the SEGS parabolic trough plants in 30 MW and 80 MW units in the southern California high desert
- CSP plant development steadily increased internationally, early with parabolic trough plants but now with a trend towards power tower configuration
- The ability of CSP to include significant thermal storage capability adds considerably to the value of the technology

Best places for CSP



How much CSP is there?



Solana – Arizona

Parabolic trough 250 MWe

4

Ivanpah – California

Steam-water Towers 400 MWe

Noor I-II-III – Morocco

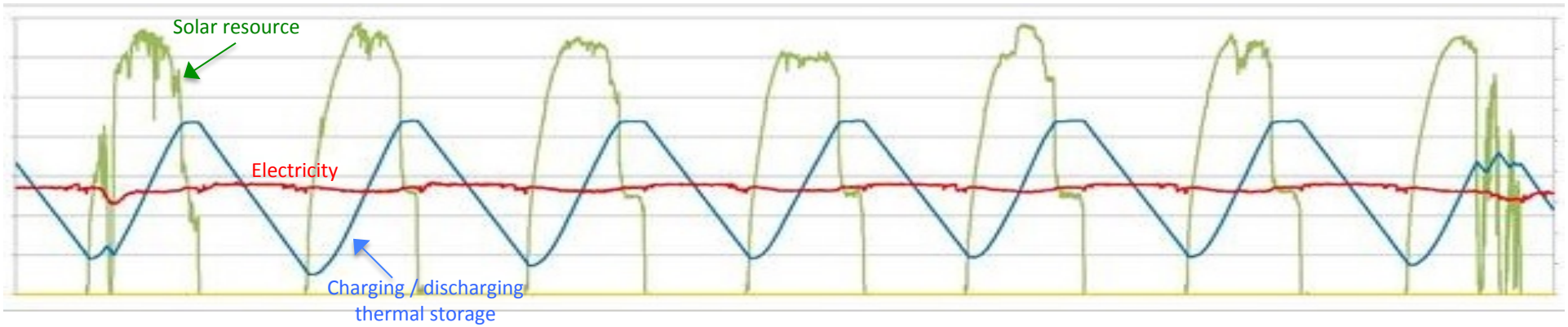
- Noor I

I	Parabolic trough	146 MWe
II	Parabolic trough	185 MWe
III	MS Tower	134 MWe

Noor I (far left) Noor 2 (middle) Noor III (far right)

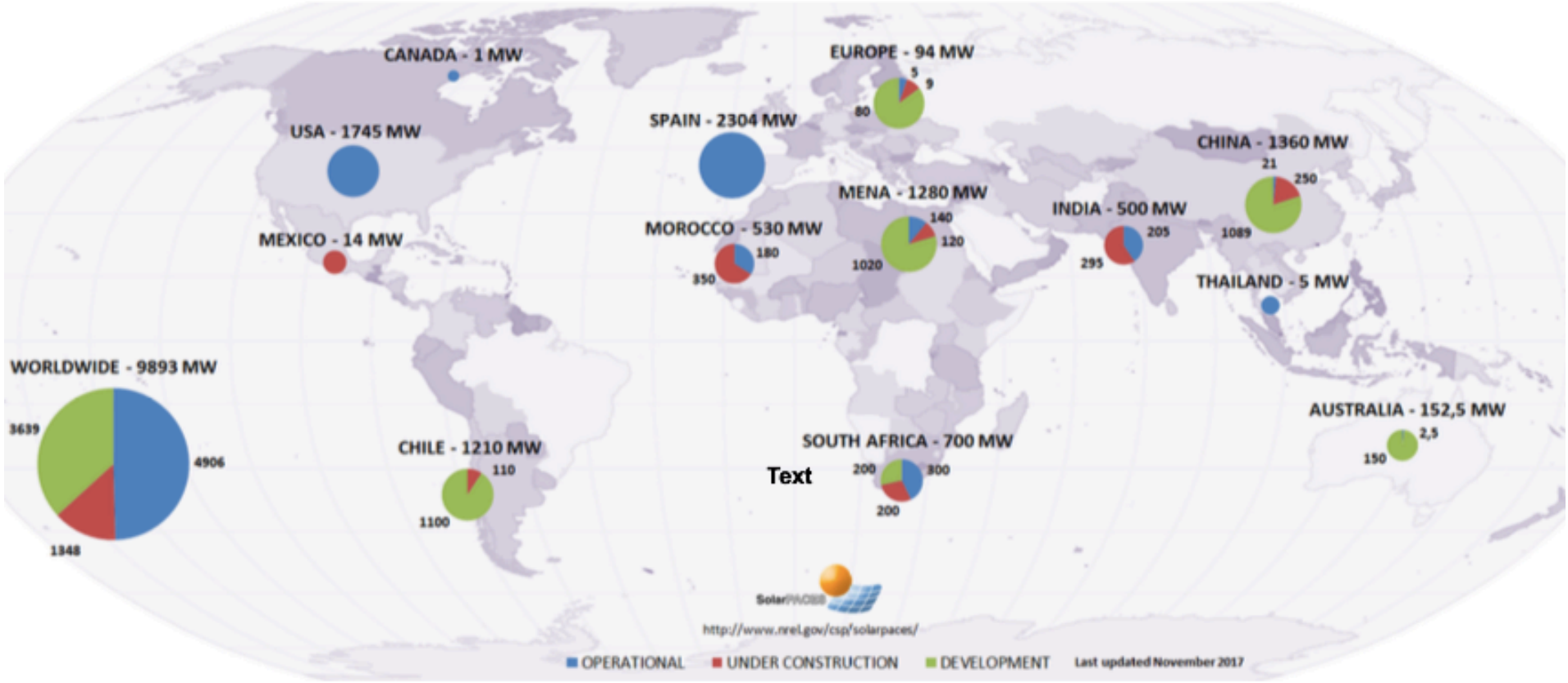

CENTRAL TOWER PLANTS
with
MOLTEN SALT STORAGE
(Gemosolar)
Torresol Energy
MS Tower 20 MWe
SENER

Gemasolar plant in Spain: Summer Operation

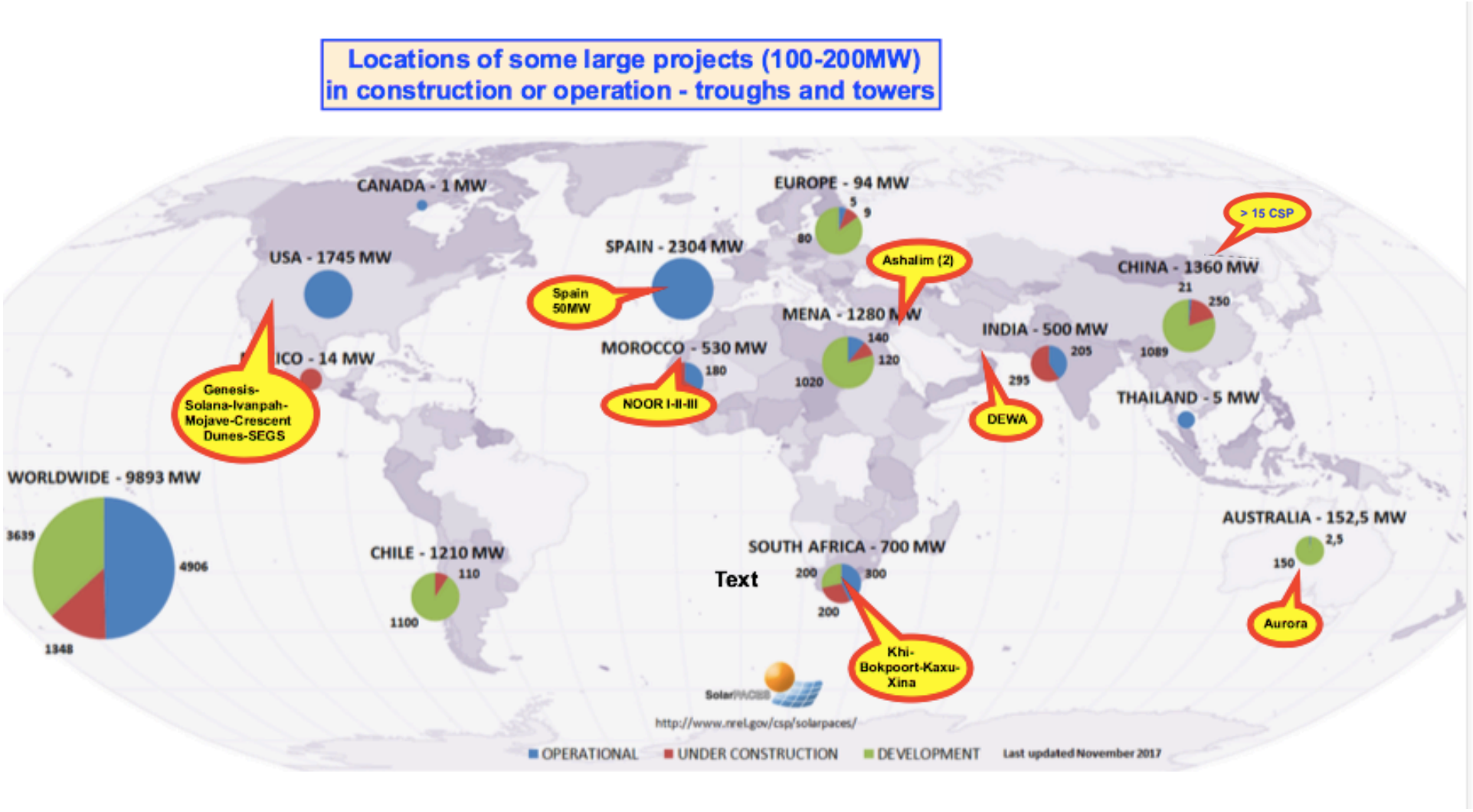


Turbine operates continuously day and night

Source: SENER



International CSP (Nov 2017)

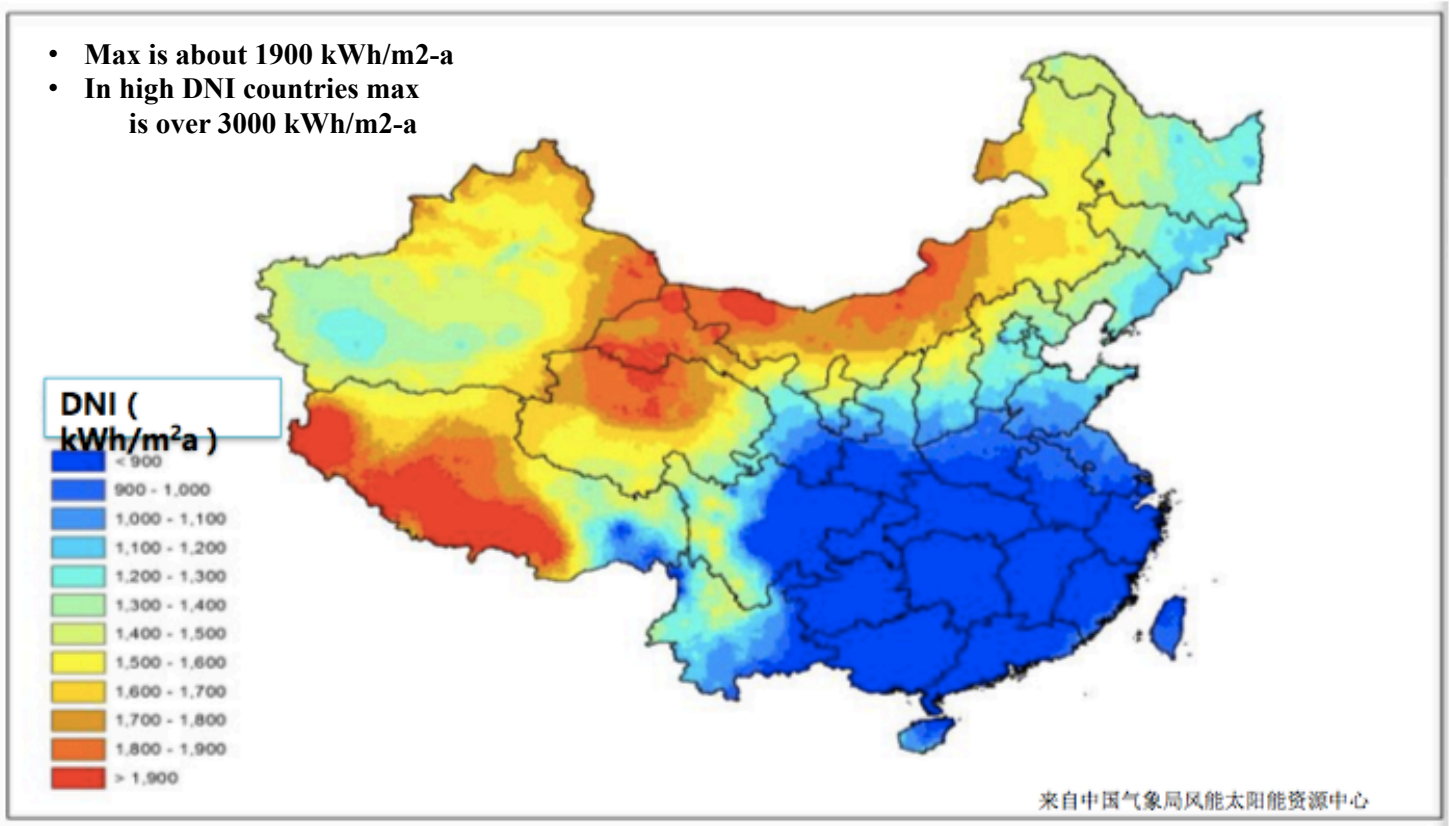

Locations of some large projects (100-200MW)
in construction or operation - troughs and towers
CANADA - 1 MW
USA - 1745 MW
ICO - 14 MW
Genesis-Solana-Ivanpah-Mojave-Crescent Dunes-SEGS
WORLDWIDE - 9893 MW
3639
4906
1348
CHILE - 1210 MW
110
1100
EUROPE - 94 MW
5
9
80
SPAIN - 2304 MW
Spain 50MW
MOROCCO - 530 MW
180
NOOR I-II-III
MENA - 1280 MW
140
120
1020
Ashalim (2)
INDIA - 500 MW
205
295
DEWA
> 15 CSP
CHINA - 1360 MW
21
250
1089
THAILAND - 5 MW
AUSTRALIA - 152,5 MW
2,5
150
Aurora
SOUTH AFRICA - 700 MW
200
300
200
Khi-Bokpoort-Kaxu-Xina
Text
SolarPACES
http://www.nrel.gov/csp/solarpaces/
OPERATIONAL
UNDER CONSTRUCTION
DEVELOPMENT
Last updated November 2017

Thank you

blank

4.1 DNI Resource in China

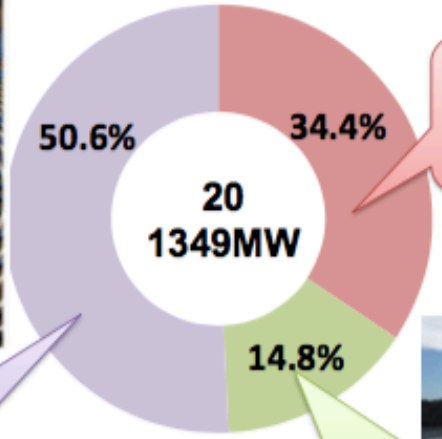
- **Max is about 1900 kWh/m2-a**
- **In high DNI countries max is over 3000 kWh/m2-a**



DNI Distribution in China

2 Technical Development Situation of CSP

2.3 First Batch of CSP Demonstration Projects



7 Trough, 464MW
(5 Thermal Oil
+ 2 Molten Salt)

9 Tower , 685MW
(7 Molten Salt
+ 2 Water)

4 Linear Fresnel,
200MW
(2 Water + 1 Molten Salt
+ 1 Thermal Oil)

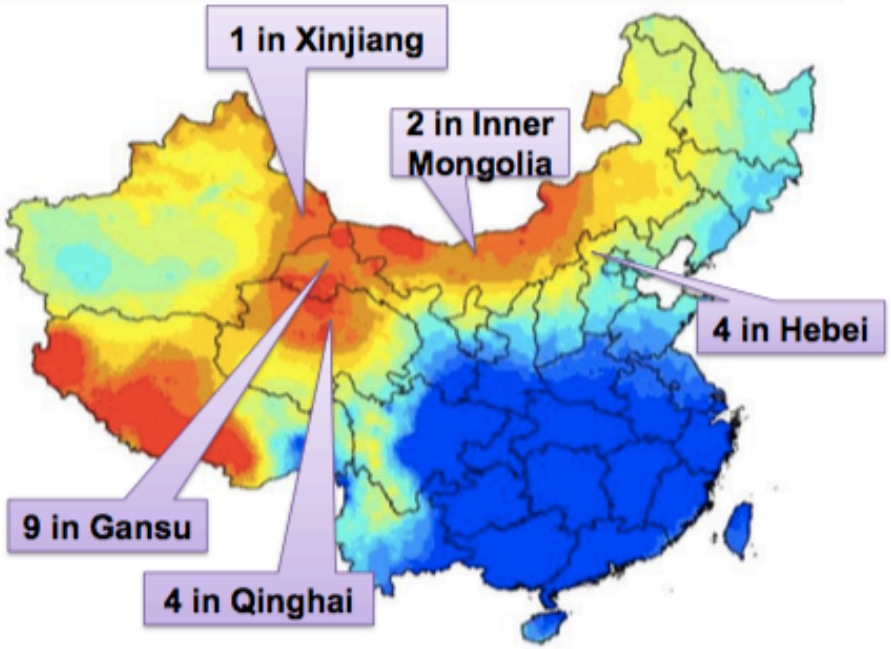
- Some projects have adjusted the solutions in application document. For example, 2 water tower projects have be changed to molten salt tower.

2 Technical Development Situation of CSP

电力规划设计总院

2.3 First Batch of CSP Demonstration Projects

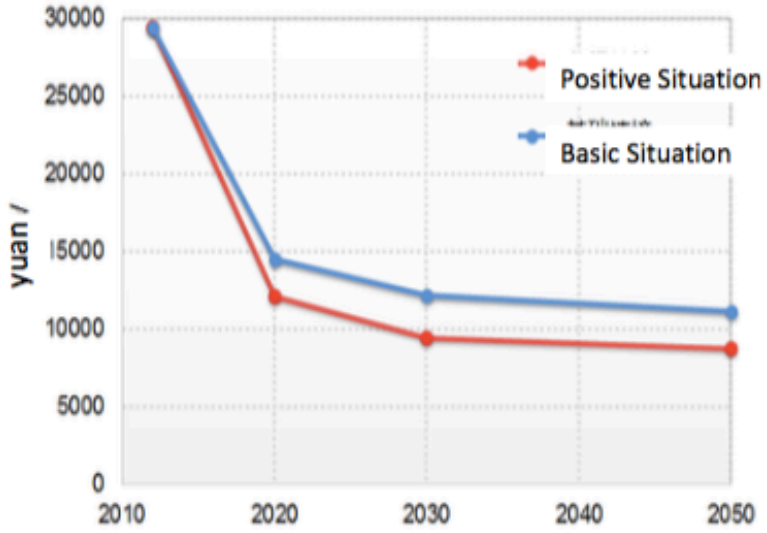
- 20 projects in total capacity with 1.349 GW distributing five province regions.
- Grid purchase price is ¥ 1.15/kWh.
- Such price can only be applied to the projects put into operation by the end of 2018 . Most projects are expected to complete construction by then.
- Most projects adopt China's self-developed collecting technology
- The power plant engineering work is undertaken by domestic design institutes.



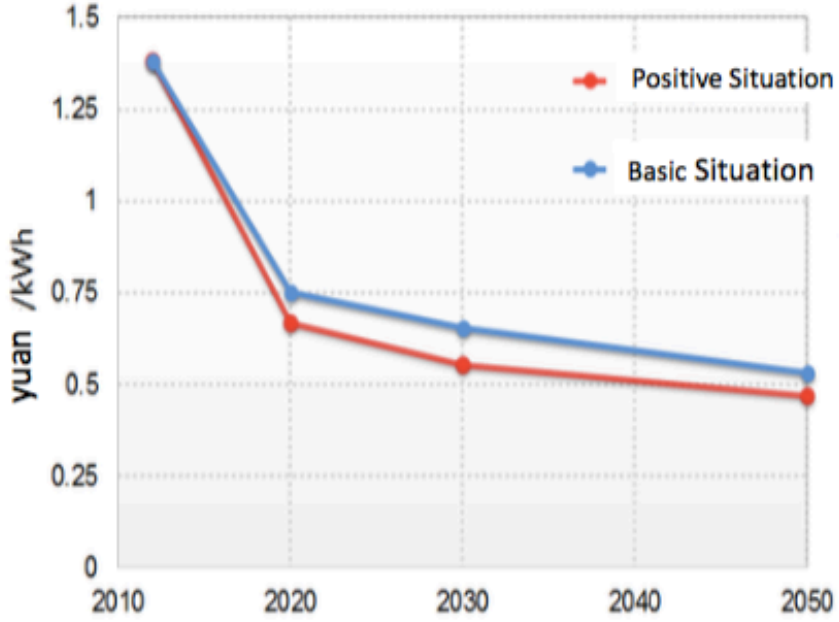
Distribution of 20 Demo Projects

4.4 Estimation of Investment Cost & LCOE

- Current investment cost for CSP plant is ¥25,000-30,000 /kW. By the end of 2020, It is expected that the investment cost will be reduced to ¥15,000/kW, and the LCOE will be lowered to ¥0.75/kWh.



CSP Investment Cost Prediction in China



CSP LCOE Prediction in China