CSP Development Around the World: SENER Experience

Mercedes Sierra, CEO SENERUSA
NOOR III is ONLINE
150 MW + 7.5 hours: the LARGEST Molten Salt Power Tower in OPERATION
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SENER ROLE
- TECHNOLOGY PROVIDER
- 50% EPC CONTRACTOR
- O&M CONTRACTOR

MILESTONE in CSP TECHNOLOGY
- LARGEST MS TOWER PLANT in OPERATION
- UTILITY SCALE - 150 MW
- ADAPTED to PEAK DEMAND - 7.5 HOURS

PERFORMANCE FULFILLED
- TARGET PERFORMANCE ACHIEVED in MONTH #1
- AUTOMATIC OPERATION, DIGITALIZATION
- LESSONS LEARNED from GEMASOLAR
SENER, founded in 1956
Strategic business units

AEROSPACE

- Space
- Defense
- Aeronautics

INFRASTRUCTURE & TRANSPORT

- High speed railways
- Freight & mainline railways
- Metro systems
- LRTs & tramways
- Roads & highways
- Airports
- Ports
- Architecture
- Water & environment

RENEWABLES, POWER, OIL & GAS

- Concentrated Solar Power
- Photovoltaic
- Storage
- Biomass
- Hybrid CSP+PV, CSP+Biomass
- Offshore wind
- Waste to energy
- Power & industrial solutions
- Oil & Gas

MARINE

- Marine engineering
- FORAN
SENER experience in solar thermal power (CSP)

SENER PARTICIPATES IN THE DESIGN AND CONSTRUCTION OF 29 PLANTS IN MOROCCO, SOUTH AFRICA, SPAIN AND USA, WITH A TOTAL INSTALLED CAPACITY OF 2,060 MW

DATE OF COMMERCIAL OPERATION
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2018

All the plants are located in Spain except the ones marked with flags.
✓ SHARE of WORLD CSP CAPACITY (MW): 33%

✓ STORAGE development:

**SENER is the company most involved in MOLten SALT STORAGE TECHNOLOGY**
CSP + BIOMASS HYBRID
HIGH CAPACITY FACTOR PLANT

PROVEN TECHNOLOGY

- NOOR III (MOROCCO) CSP PROJECT
- PUERTOLLANO (SPAIN) BIOMASS PROJECT

BENEFITS of CSP+BIOMASS

- LCOE DECREASE:
  - *Only one turbine required, only one common area*
  - *Biomass conversion efficiency increase: molten salt tower cycle is highly efficient (>45%)*
  - *O&M cost decrease: resources optimization*
- MORE FLEXIBLE/DISPATCHABLE PLANT
- NO DAILY STARTUPS of TURBINE
- HIGH CAPACITY FACTOR

BENEFITS of CSP+BIOMASS
CSP + PV HYBRID

PLANT ADAPTED TO PEAK DEMAND. CHEAP ENERGY during DAYTIME

PROVEN SOLAR TECHNOLOGY

- PV during DAYTIME
- CSP focused on PEAK HOURS at the end of day
- SENER proprietary PV TRACKER for UTILITY SCALE plants

BENEFITS of CSP+PV

- LCOE DECREASE:
  - PV is the cheapest renewable energy and provides parasitics for CSP plant
  - CSP is optimized for Peak Hours, where electricity price is higher
  - O&M cost decrease: resources optimization
- MORE FLEXIBLE/DISPATCHABLE PLANT
- CAPACITY FACTOR adaptable on demand
CSP to HEAT HYBRID
CSP CAN PROVIDE HEAT FOR INDUSTRIAL PROCESSES

APPLICATIONS

- DISTRICT HEATING
- WATER DESALINATION
- MINING CHEMICAL PROCESSES
- ORGANIC RANKINE CYCLES

BENEFITS of CSP to HEAT

- DISTRICT HEATING:
  - Surplus heat from cycle is used at a low cost
- WATER DESALINATION:
  - Decrease in desalinated water cost, fuel saving (SENER patent)
- MINING CHEMICAL PROCESSES:
  - Electrolyte heating (lithium...)
- ORGANIC RANKINE CYCLES:
  - Low temperature applications
THANK YOU

www.ingenieriayconstruccion.sener

www.linkedin.com/company/sener

www.youtube.com/user/senerengineering