Review Of Solar Thermal Technologies And Experiences In The Area Of Southern Spain

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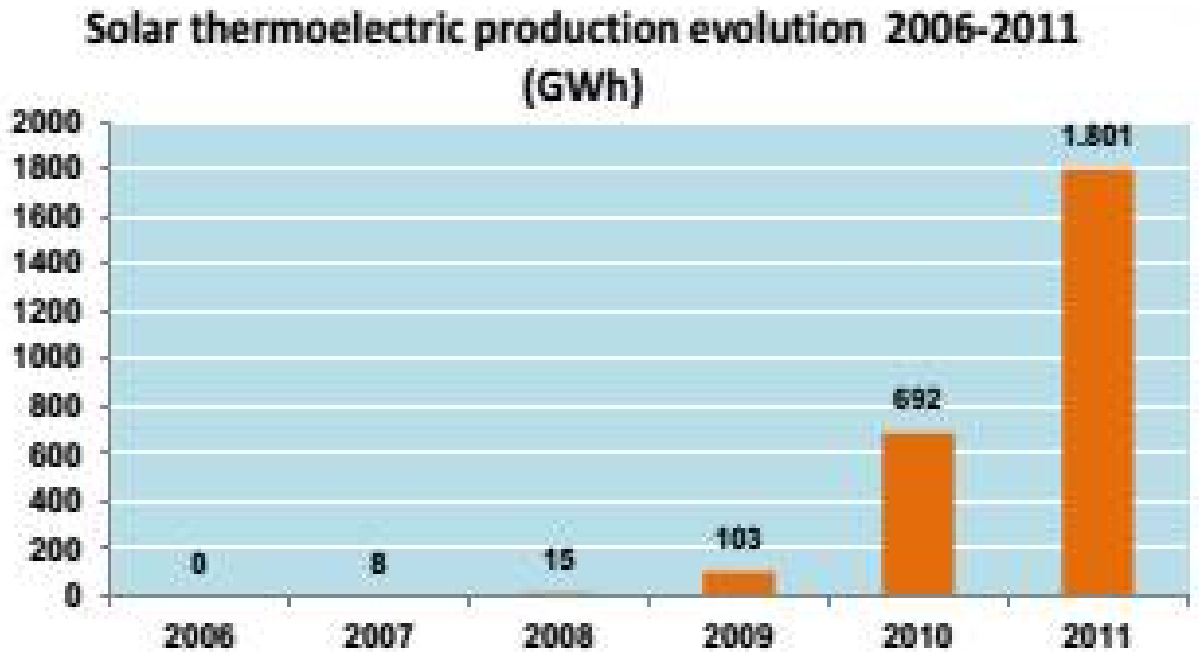
Outline

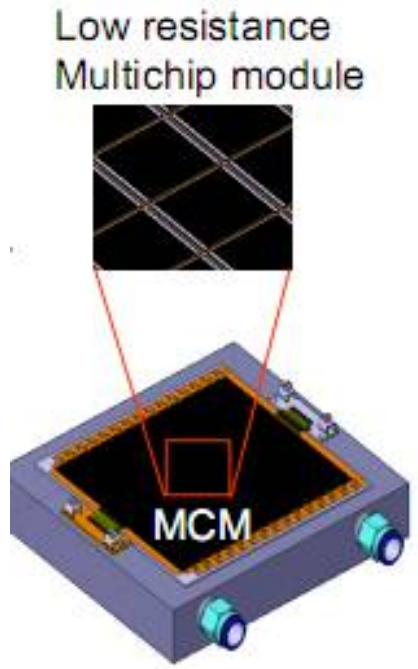
- Solar Thermal Electricity
- Solar Thermal Technologies
  - HCPVT system
  - Dish-Stirling-System
  - Parabolic Trough Technology
  - FRESNEL Collector Technology
  - Commercial CSP-Biomass
- Central Tower Plants
  - GEMASOLAR
  - ABENGOA SOLAR
- Impact on environment, maintenance and forecasting processes

STE production evolution in Spain from 2006-2011



Solar Thermal Technologies -HCPVT system-

- High Concentration Photovoltaic Thermal System
- Photovoltaic thermal system with high electrical AND thermal efficiencies
- Over 75% of solar irradiance converted to valuable output
- Combines advantages of CSP, PV and CPV
- System energy efficiencies over 35%
- Low thermal resistance multichip module package



Solar Thermal Electricity - Dish-stirling system-

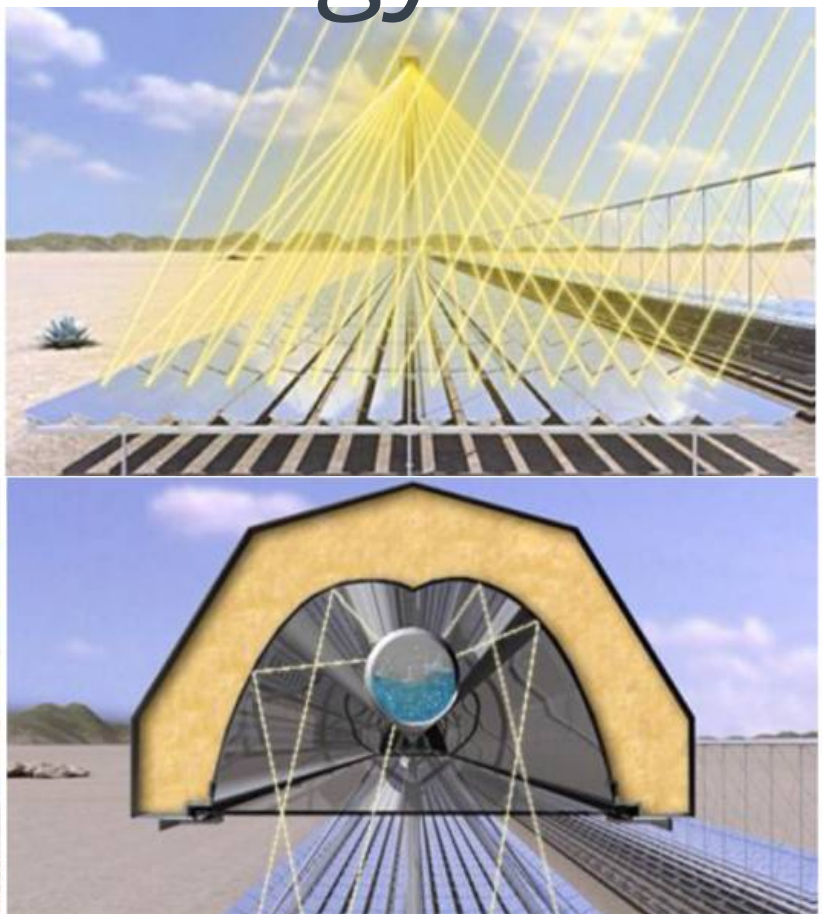
- Power generation by stirling engine, Efficiency 40%
- Concentrator, Stirlingpackage, Tracking System and Control System
- Tracking system - fully automatic with azimuth/elevation and polar drive
- Stirling engine based on isothermal compression/expansion
- Kinematic engine with 4-cylinders using Hydrogen at 720°C, 12MPa

Solar Thermal Electricity - Parabolic Trough technology-

- Parabolic mirrors focusing solar irradiation on vacuum absorber tube
- Thermal oil transmission (up to 385°C) to the water/steam cycle
- ANDASOL-I plant Granada

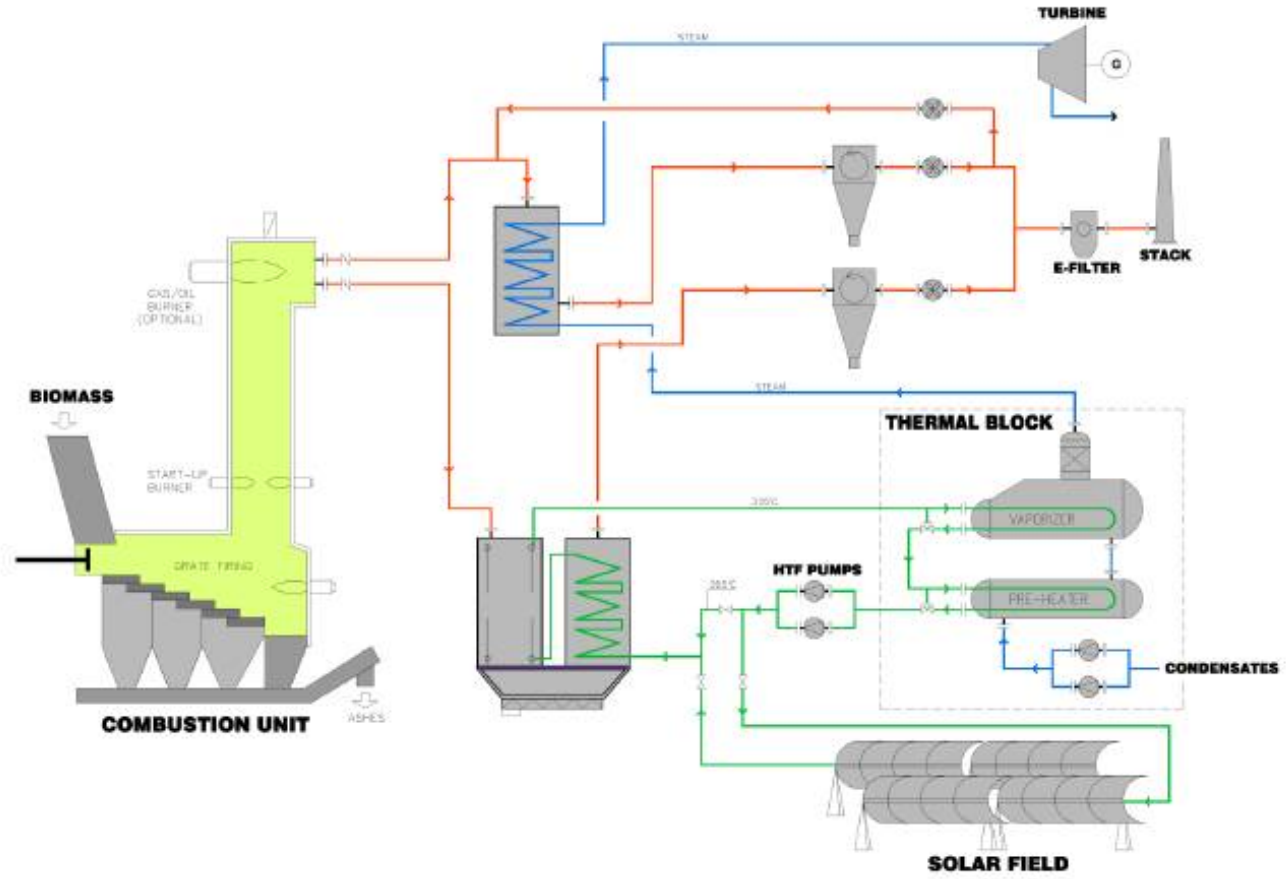
Solar Thermal Electricity - Fresnel Collector technology-

- Parallel flat rows of mirrors
- Continuous tracking of primary reflectors
- Receiver water 270°C/55 bars
- Solar generated steam directed to steam turbine to generate electricity
- Considerable reduction of materials in the construction of the solar field and water consumption

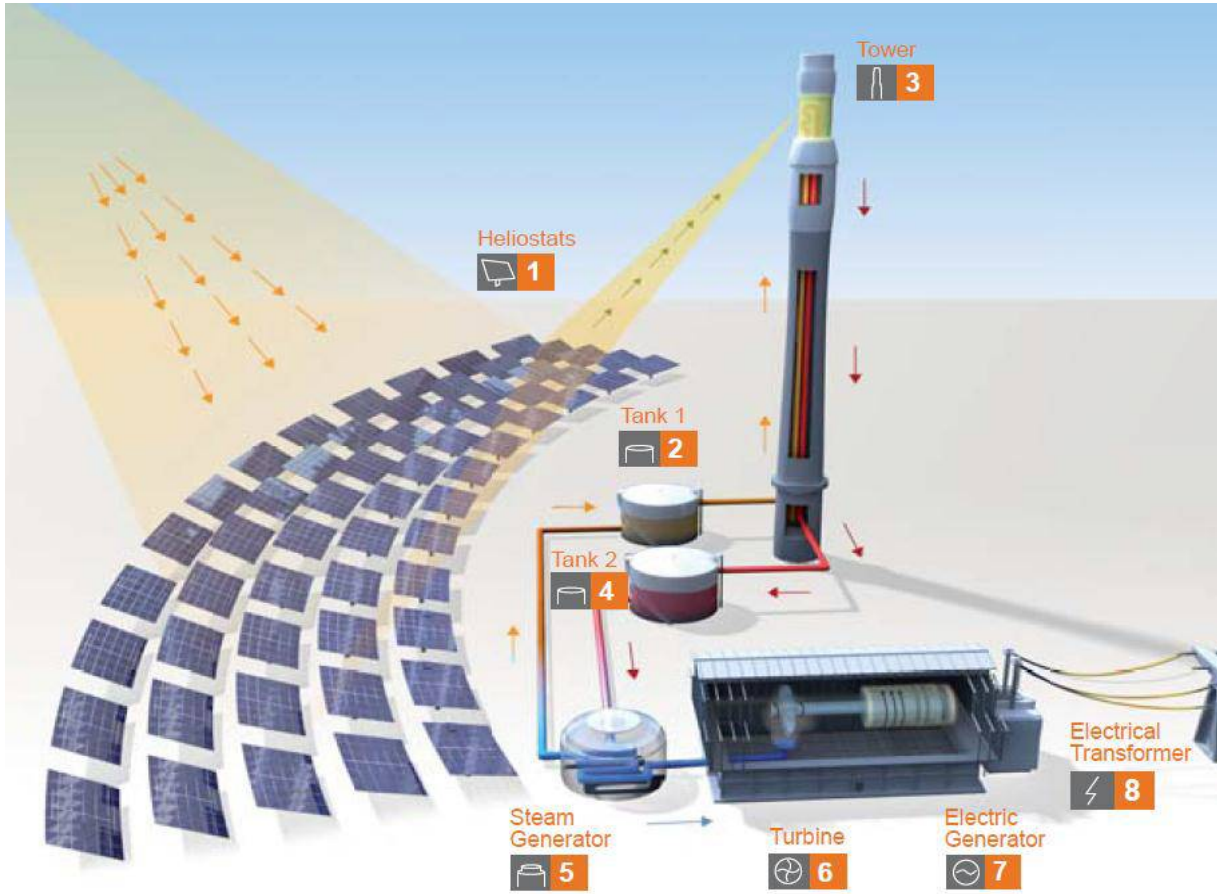


Solar Thermal Electricity - Commercial CSP-Biomass -

- 22,5 MW electrical output power
- Parabolic trough collectors hybridized with biomass
- 40% solar, 10% Fossil fuel a 50% biomass
- Continuous operation
- Available biomass mix of forest and other sources



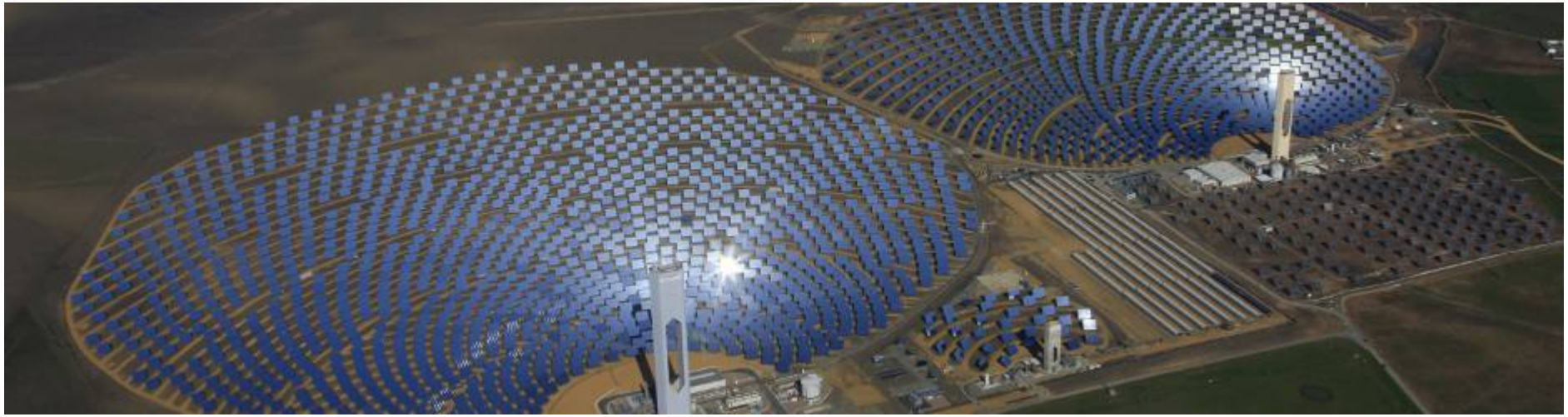
Central Tower Plants
-GEMASOLAR-



Central Tower Plants -GEMASOLAR-

- High thermal storage capacity (24 hours)
- Same fluid is used for heat transfer and storage
- Molten salts at 565ºC maximizing thermodynamic efficiency
- Piping system is contained in small area, reducing the heat losses, the maintenance costs and minimizing the possibility of leaks
- 19.9 MWe GEMASOLAR first commercial–scale plant generate 110 GWh/year
- Heliostats in the solar field 2.650, height of the tower is 140m

Abengoa Solar

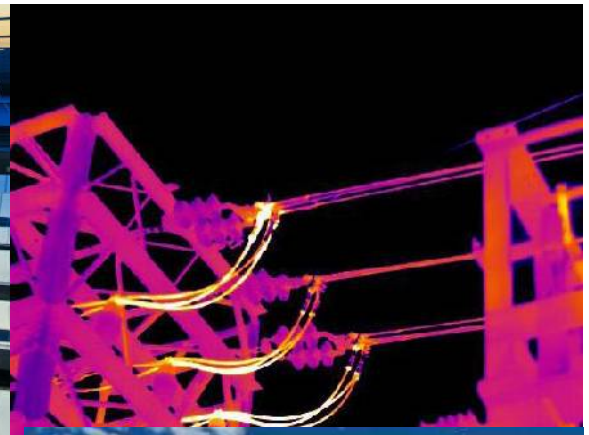


Central Tower Plants -ABENGOA SOLAR-

- Solar PS10 (11MW) and PS20 (20MW) first commercial power towers in the world
- One-hour storage system
- PS20 solar plant: 210-acre solar field with 1,255 Sanlucar 120 heliostats
- Receiver located at the top of a 541-foot tower
- Each heliostat reflects the solar radiation captured onto receiver to produce steam which is generated into electricity inside a turbine

Impact on environment, maintenance and forecasting processes

- Support processes of the CSP plants problems of electricity storage, solar radiation measurement, evaluation and forecasting, construction, operation and maintenance
- Main problems of maintaining are mirrors (heliostats) and heating elements



MODE 1 ↓ MODE 2 ↓ MODE 3 ↓ MODE 4	MODE 1 ↓ MODE 2 ↓ MODE 5	MODE 8 — MODE 6 — MODE 7	MODE 8 — MODE 6 — MODE 7

Conclusion

- STE technologies high level of efficiency
- Experiences from Spain opened new opportunities for other countries
- Costs of implementing are decreasing
- Concentrated solar power plants can adapt production to the demand necessities
- Facilities grouped in control centers, less time to do the needed things, less strict limitations could be planned and placed, therefore increasing production and installation


Thank you for
your attention!!!