

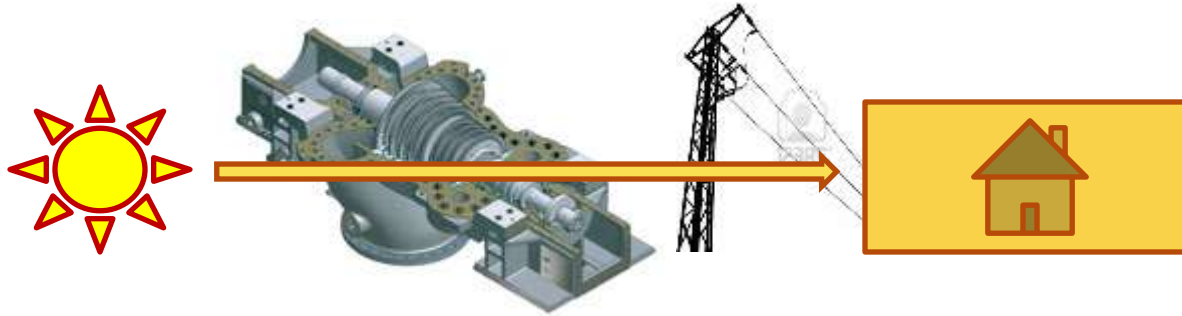


Torresol Energy
re-inventing solar power



OPERATING CENTRAL TOWER PLANTS with MOLTEN SALT STORAGE

What is CSP Technology



A complex 4-step process:

- Light Concentration. Mirrors
- High Temperature Fluid. Oil, molten salts, water, air.
- Heat transformed into Mechanical energy (Turbine, Stirling engine...)
- Rotation converted into electricity (Electrical generator: Alternator)

A complex process, with some advantages.

Advantages:

- Hybridation Solar – Thermal.
- Storage of energy.
- Other forms of hybridation.
- Quality of the wave.

And a result: a reliable and constant (24h) source of electrical energy

The plant is composed of :

- 80 km of internal roads (local)
- 5 Km or paved roads (local)
- 2650 Heliostat Foundations (local)
- 2650 Heliostat columns and metal structure (local)
- 2650 Heliostat assembly (local)
- 300,000 m2 of flat silvered glass (local)
- 1 Reinforced concrete tower (local)
- Carbon steel and SS piping (local)
- Carbon and SS tanks and vessels (local)
- Hundreds of km of cooper wire (local)
- Electrical installation (local)
- 5500 Standard Electrical motors (local)
- Etc.

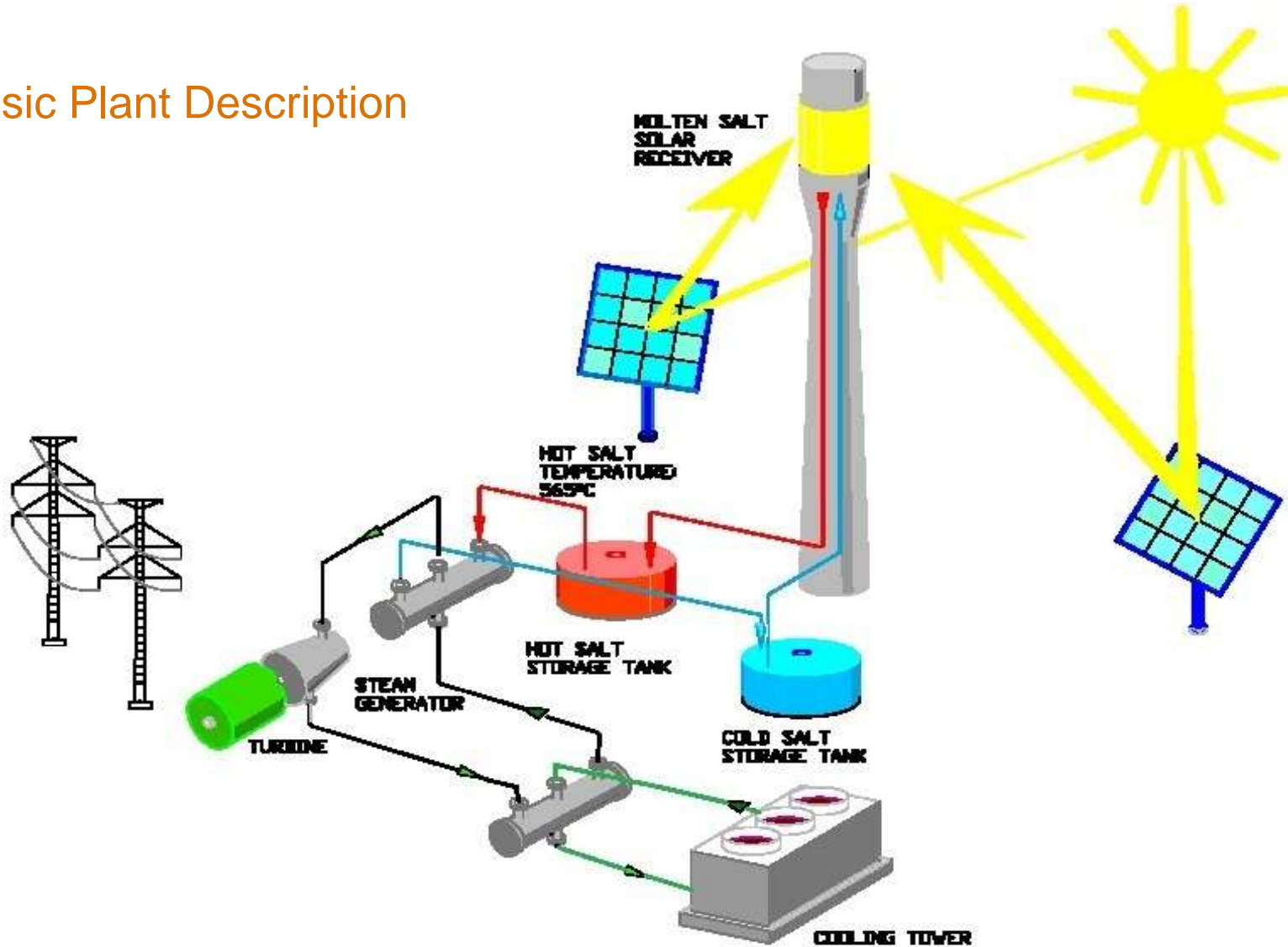
In the case of Gemasolar (Spain):

- 99% of the added value was European
- 90% of the added value was local (Spanish)
- 65% of the added value was local (Andalusia region)



Gemasolar Plant

Basic Plant Description



M. Salt Central Tower

Advantages

- High thermal storage capacity.
 - Due to the storage system, the turbine operation is not immediately affected by a cloud or a sudden high speed wind. A cloud will affect the production 6-15 hours later.
 - The turbine would not stop every night. Longer expected life.
 - The turbine power is manageable. We may choose reduce the output during the night, at valley time, to reach 24 h of continuous operation at lower rate.
 - We maximize the asset utilization. In case of GS will be expecting to produce 6400 h/year, maximizing the profitability
- Lower operational costs
 - All fluids concentrated in a small area. Lower thermal losses and maintenance costs. Self draining piping.
 - The same fluid is used for heat transfer and storage. Less thermal interexchange
- Highest cycle efficiency
 - The molten salts reach highest temperatures maximizing thermodynamic efficiency.

Actual Performance. Gemasolar



Production meets expected values

- Project completed on time and on cost.
- Producing electricity since May 2011.
- Exceeded nominal values:
 - Thermal Power :More than 120MWt
 - Electrical power : 20 MWe
- Improving daily production: Fast learning curve for an innovative project.
- Excellent production predictions





MAX. DIARIO		P. ANUAL 2011	27,59 GWh
26/02/12	404'31 MWh	P. ANUAL 2012	33,5 GWh

23/02/2012 → 398'6 Mwh
 24/02/2012 → 401'7 Mwh
 25/02/2012 → 404'3 Mwh

VARIABLES MAXIMAS

V. SALIDA	A	
DE V. SALIDAS	A	255
VENTILADO DISCO	A	142
DE "MAY. 30"	A	

Q-ON

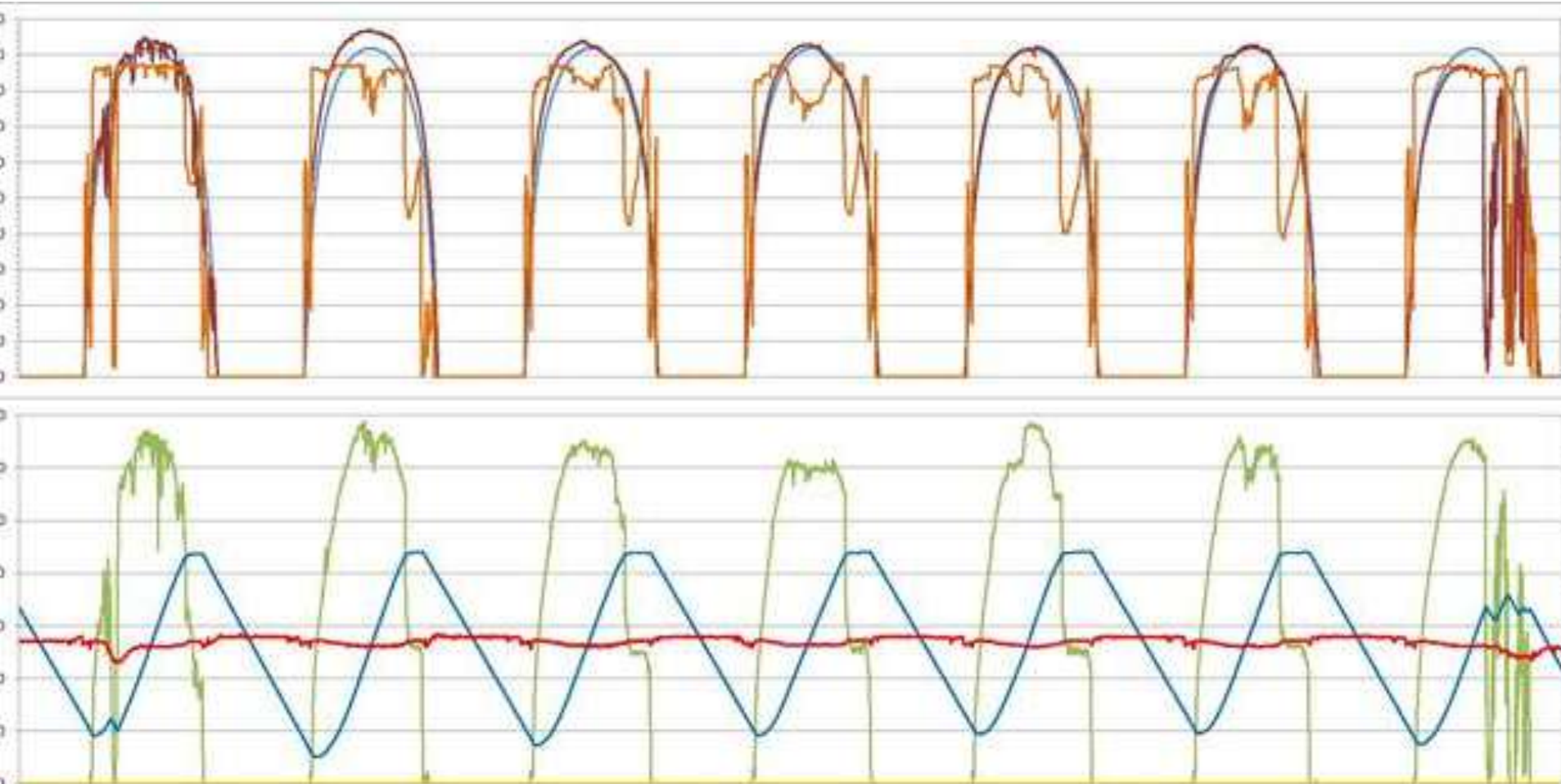
PLANNING
 SISPLAMO
 SOLUCIONES VISUALES

25 HORAS
 PROCESO PARA DE COMUNICACION

Production meets expected values



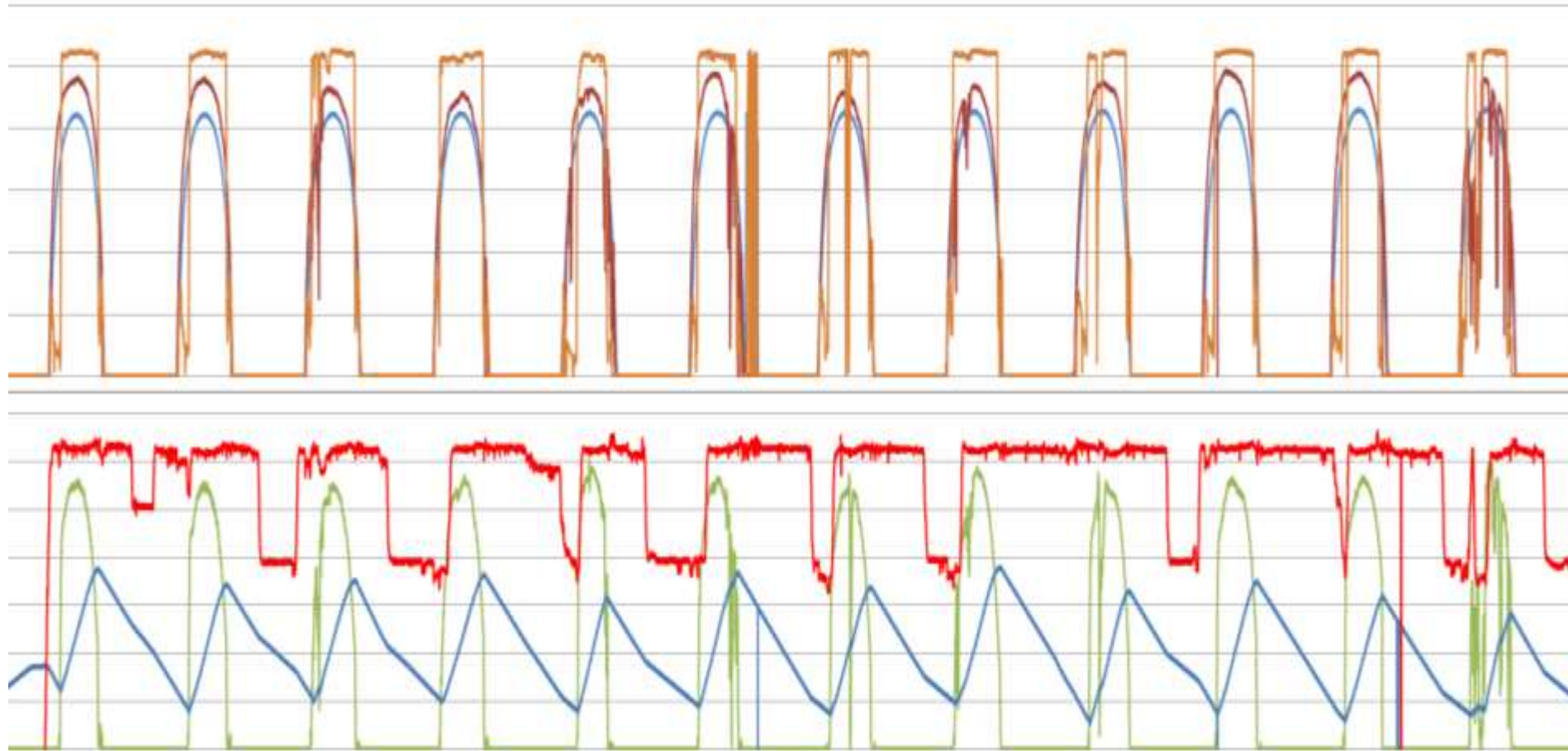
Plant operation : Summer



- Turbine continuously running at nominal power in summer



Plant operation: Winter

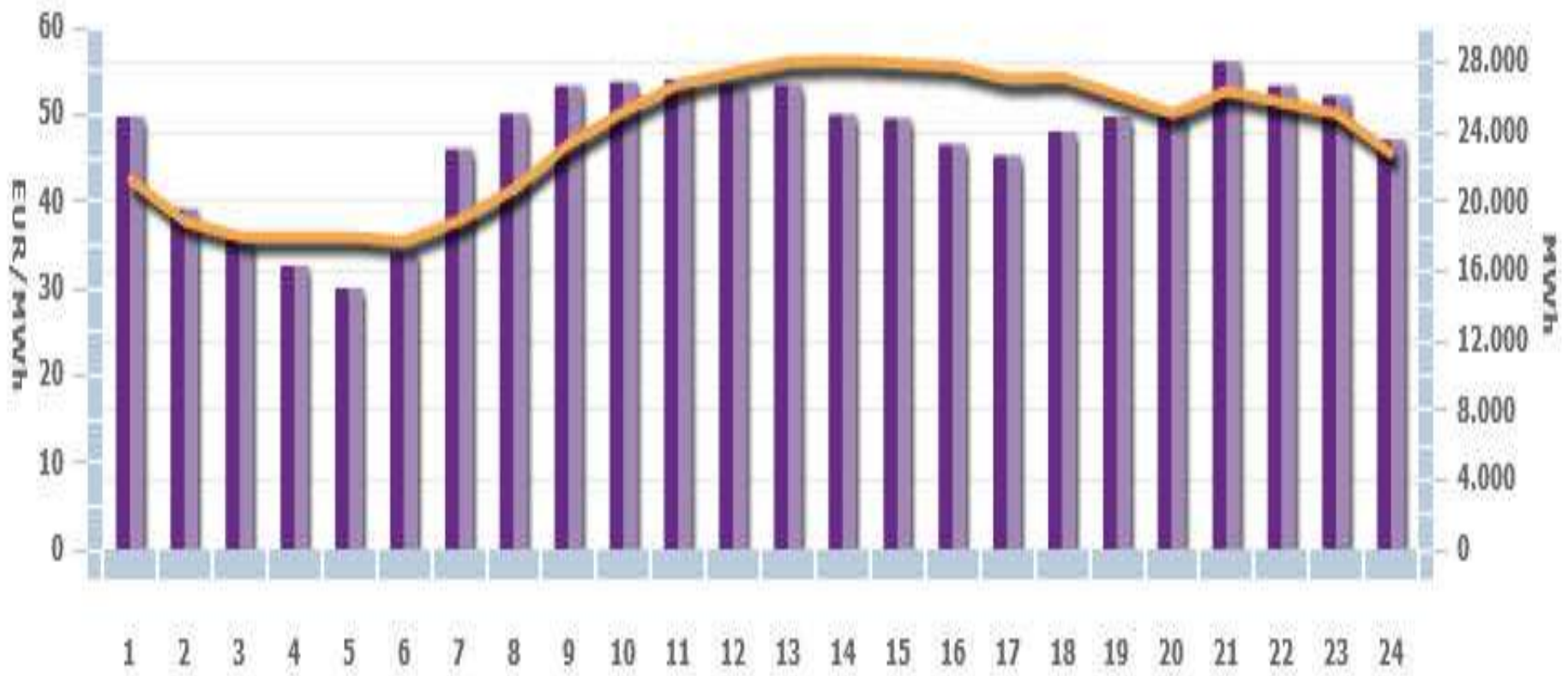


- Non-stop operation in winter time.

Spanish demand



11/10/2012 - Precio horario del mercado diario



- CSP plants with Thermal Storage are already a proven technology.
- CSP plants with Thermal Storage may increase the share of renewable energy, without affecting the grid stability.
- CSP plants with Thermal Storage have a 5 fold effect on the local economy, producing also long term benefits to the country.
- The plants are already in commercial operation meeting or exceeding the theoretical performance.



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