Solar Thermal Power Generation
- A Spanish Success Story

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FERIA INTERNACIONAL DE ENERGIA Y MEDIO AMBIENTE

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Introduction to COBRA and ACS

Cobra Group is responsible for the development of renewable energy project inside the ACS group

cobra GRUPO

Dragados Industrial

- **A global leading player of applied engineering services and EPC contractor**
- **Development of Renewable Energy Projects**

ACS ACTIVIDADES DE CONSTRUCCIÓN Y SERVICIOS

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Highlights

- **Parabolic-trough and solar tower plants are the most developed concentrating solar power (CSP) technologies realized up to date, with more than 420 MW of commercial plants operating**
- **Spain has one of the most favorable feed-in tariffs for CSP plants paying at least 39 cents US$ per kWh**
- **At the end of 2007 more than 50 CSP projects with about 2150 MW have been registered by the Ministry of Industry making Spain the leading country in CSP development worldwide**
- **ACS/Cobra is building three plants and has the objective to operate eight CSP plants with a total capacity of 400 MW within five years**
- **At this moment ACS/Cobra is the only turn-key contractor with experience in constructing parabolic-trough power plants which combine solar fields with molten salt storage tanks**

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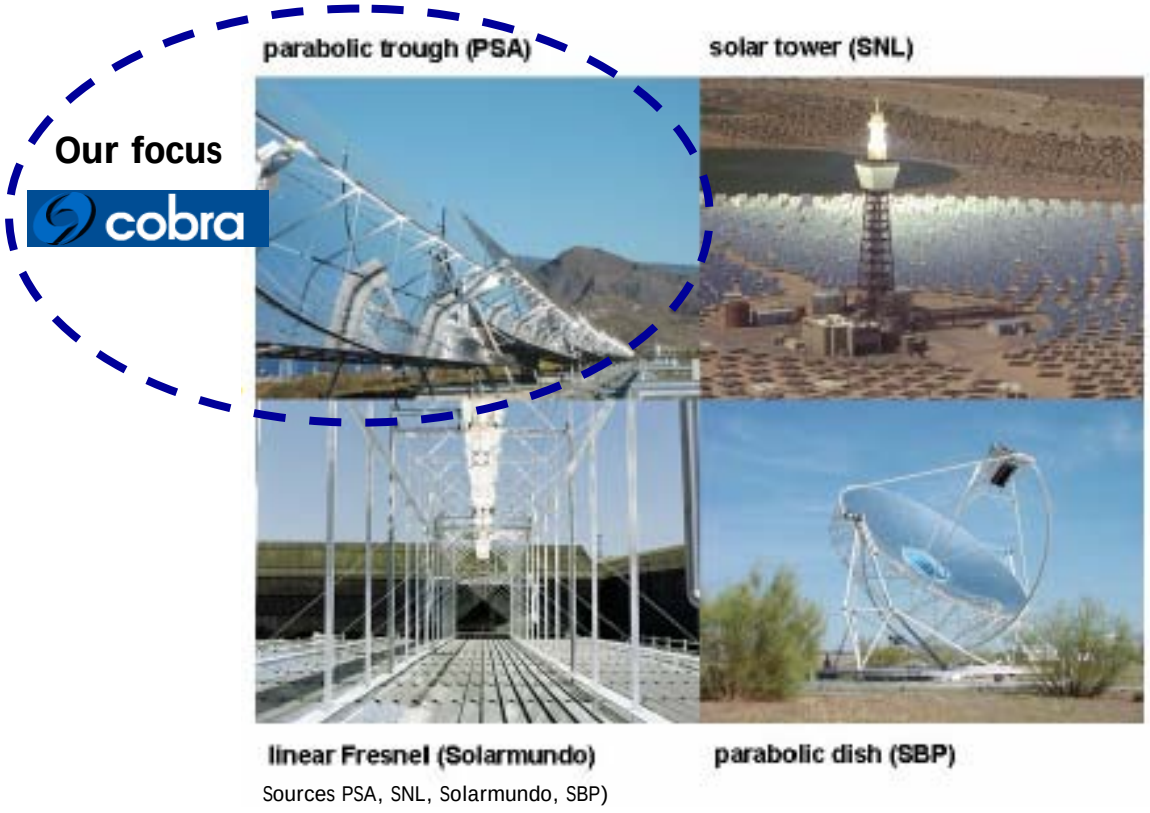
Technology overview

Parabolic-trough and solar tower plants are the most developed concentrating solar power (CSP) technologies realized up to date, with more than 420 MW of commercial plants operating



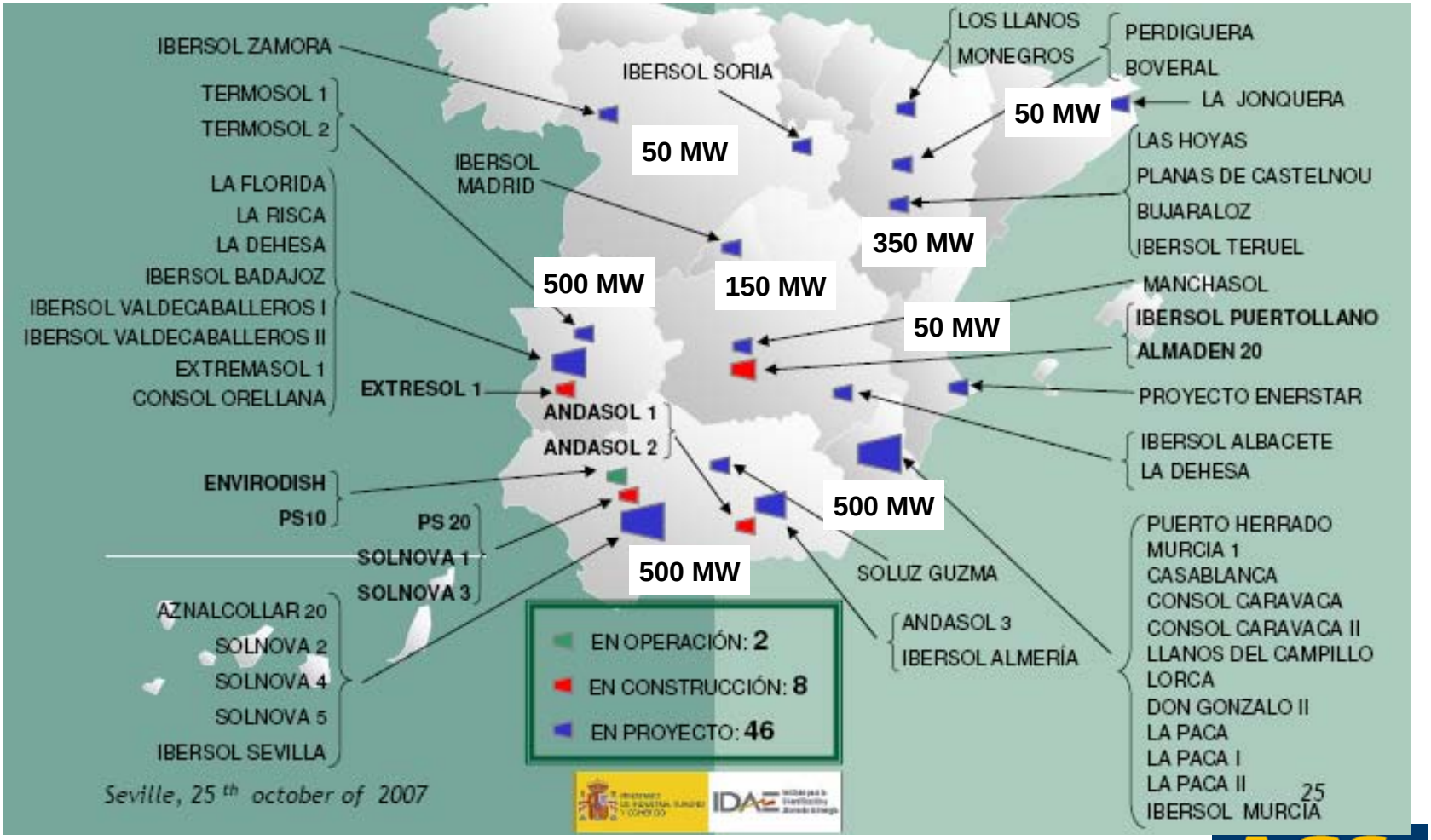
Sources PSA, SNL, Solarmundo, SBP)

Commercials plants:

- 354 MW SEGS (California)
- 64 MW Nevada Solar One
- 10 MW PS 10 (Seville, Spain)

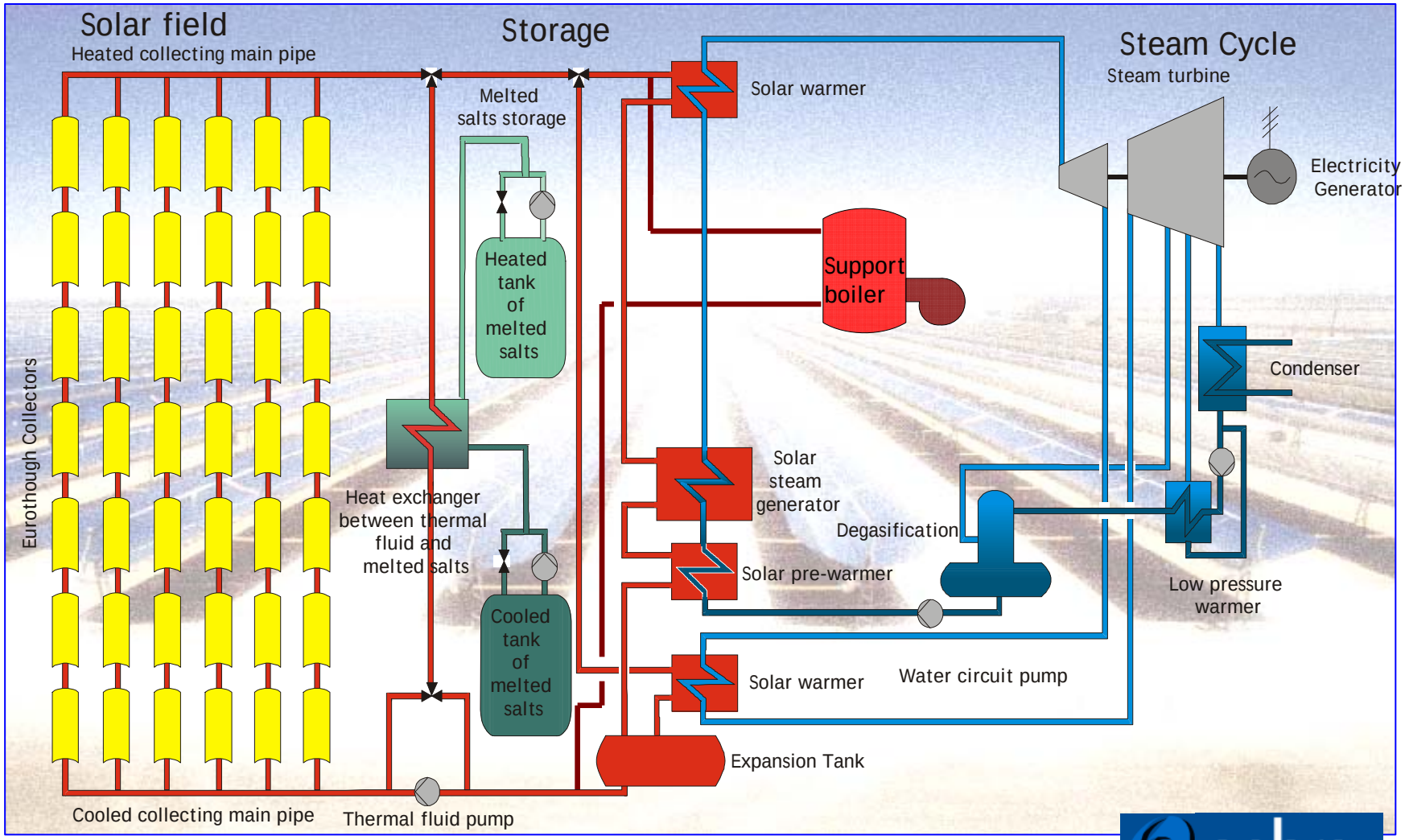
Current Situation in Spain

At the end of 2007 more than 50 CSP projects with about 2150 MW have been registered by the Ministry of Industry



Andasol: Simplified Scheme

Our 50 MW_{el} CSP plants consists of three parts: Solar field, storage tanks and power generation

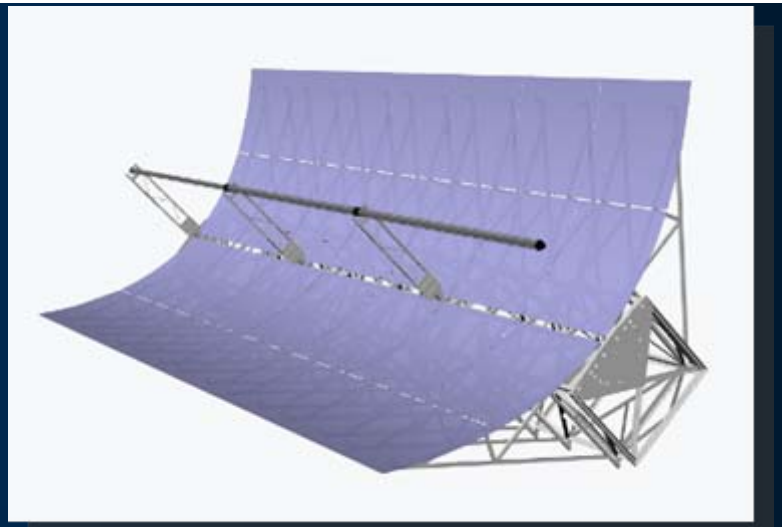


Andasol: Solar field

More than 500,000 m² of mirrors have been lined up to build the solar field

Characteristics

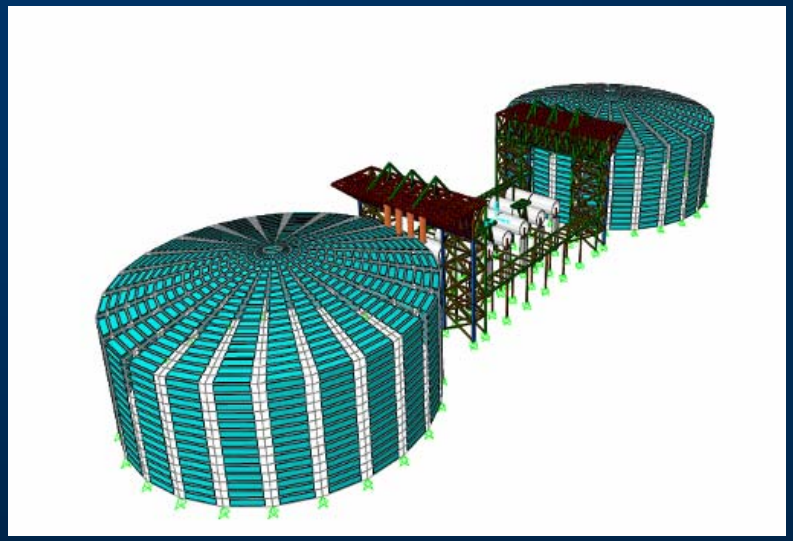
- **Parabolic trough collectors**
  - **Metal structure.**
  - **Parabolic reflecting surface**
  - **Absorbing pipes**



- 156 loops in 200 Ha
- 500,000 m² of mirrors
- Thermal fluid 292ºC – 392ªC

Andasol: Thermal storage

The molten salt storage tank system increases the running time of the CSP plant up to 3.500 hours/per year



Two storage tanks (ø= 36 m, h=14 m)

- **Storage capacity (h): 7,5h @ 50 MW**
- **Molten salts: 28.000 Metric Tons/**
- **Melting temperature: 221º C**
- **Allowance range: 291º C - 384º C**

IMPROVED MANAGEABILITY

Projects pipeline

Cobra is building three plants and has the objective to operate eight CSP plants with a total capacity of 400 MW within five years

ANDALUCIA

- ANDASOL-1
- ANDASOL-2
- ANDASOL-4
- ANDASOL-3
- ANDASOL-5
- ANDASOL-6
- ANDASOL-7

EXTREMADURA

- EXTRESOL-1
- EXTRESOL-2
- EXTRESOL-3

CASTILLA-LA MANCHA

- MANCHASOL-1
- MANCHASOL-2

- Three plants being built
- Objective 2012: 400 MW on operation

ACS ACTIVIDADES DE CONSTRUCCIÓN Y SERVICIOS

Andasol 1 - Under construction

- Municipality of Aldeire (Granada).
- Under construction.
- Start Date: 3Q 2008.
- Infrastructures of evacuation: October 2007.
- Line and SE 66 kV: October 2007.
- Satellite Plant of Gas: October 2007.

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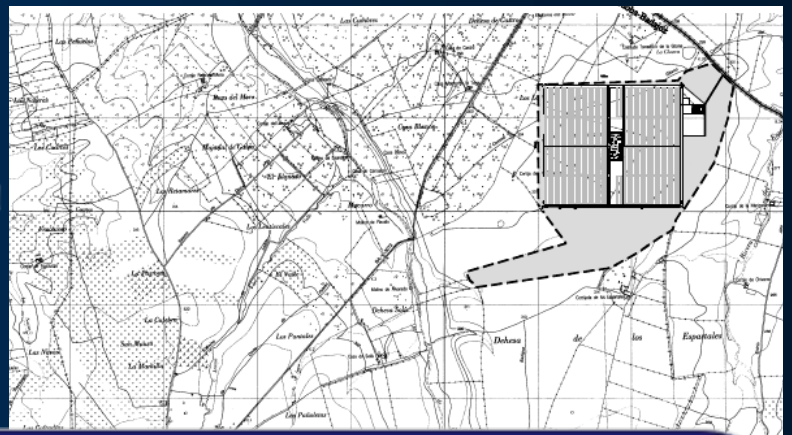
Andasol 2 - Under construction

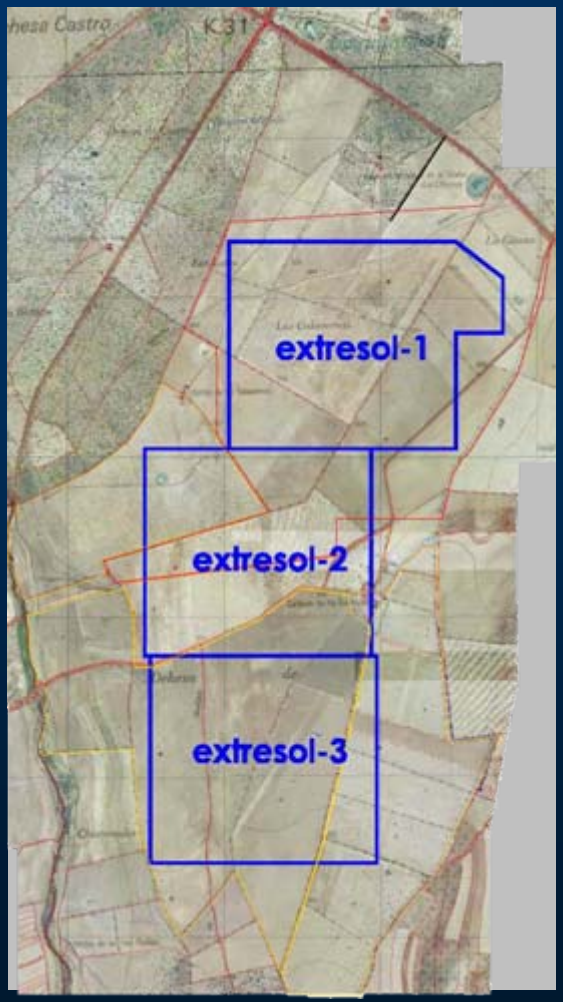
- Municipality of Aldeire and La Calahorra (Granada).
- Under construction. Movement of lands.
- Start Date: 1Q 2008.
- Infrastructures of evacuation: October 2007.
- Line and SE 66 kV: October 2007.
- Satellite Plan of Gas: October 2007.

Extresol 1 - Under construction



- Municipality of Torre de Miguel Sesmero (Badajoz).
- Under construction. Engineering Development and contracting of main supplies.
- Start Date: August 2007.
- Infrastructures of evacuation: October 2008.
- Satellite Plan of gas: October 2008.

Extresol-2 and Extresol-3



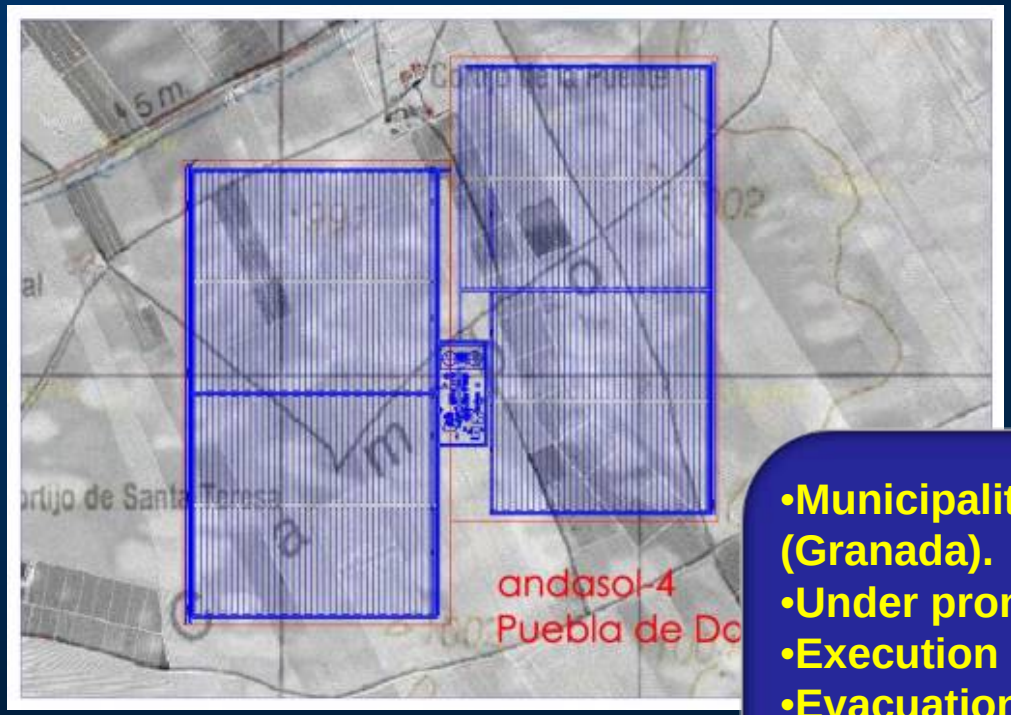
- Municipality of Torre de Miguel Sesmero (Badajoz).
- Under promotion. Condition of Generator in Special Regime.
- Permitting Projects: 11/07
- Evacuation:
  - Extresol 2: Sevillana Endesa. Granted point of evacuation.
  - Extresol 3: REE. Granted point of evacuation.
- Extresol 2:
  - Start of construction: 08/08
  - Start Date: 08/10
- Extresol 3:
  - Start of construction: 02/09
  - Satart Date: 02/11

Manchasol-1 and Manchasol-2

Manchasol 1 and 2 - Under promotion

- Municipality of Alcázar de San Juan (Ciudad Real).
- Under promotion. Condition of Generator in Special Regime.
- Permitting Projects: 10/07
- Evacuation: REE. Granted point of evacuation
- Start of construction: 09/08
- Start Date: 09/10

Andasol 4 - Under promotion



- Municipality of Puebla de Don Fadrique (Granada).
- Under promotion.
- Execution Projects: 06/07
- Evacuation: Requested point of connection to Sevillana-Endesa.
- Start of construction: 11/09
- Start Date: 11/11

Development Plan

At this moment Cobra is the only turn-key contractor with experience in constructing parabolic-trough power plants which combine solar fields with molten salt storage tanks