NREL's Trough Workshop

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Need for Regulatory Revisions to Successfully Secure CSP Projects in the US: Lessons from Spain

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A Brief Look Back: the California Success Story in the 1980‘ies

- **Back to the roots:**
- The high oil prices in the early 1980-ies created a boost for renewable technologies
- CSP was capable to respond with firm, dispatchable peaking power
- This energy economic background is back – and the technology is more mature now!

- **The Framework in the 1980-ies:**
- Favorable FERC Regulation
- Investment Tax Credits
- Attractive time-of-use tariffs:
  - 14 US cts. / kWhe on the average
  - up to 36 cts. for summer on-peak

- **The Result:**
- 9 plants with accumulated 354 MWe solar capacity built in only 7 years
- 1.2 billion US $ invested; all private capital (30-40% equity)
- 13 TWhe (9 TWhe pure solar) produced;
- Electricity sales: $ 1.8 billion kWhe until today

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Parabolic Trough Solar Thermal Electric Plants in the California Mojave Desert - German Industry participated in all 9 SEGS plants with 354 MW

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Back in 1988, Pilkington/Flachglas‘ subsidiary FlagSol teamed-up with LUZ for joint project development in Brazil, Morocco, India and Italy. LUZ vanished, Pilkington stepped-out after 8 yrs w/o new projects but Solar Millennium entered the business with private investors in 1999

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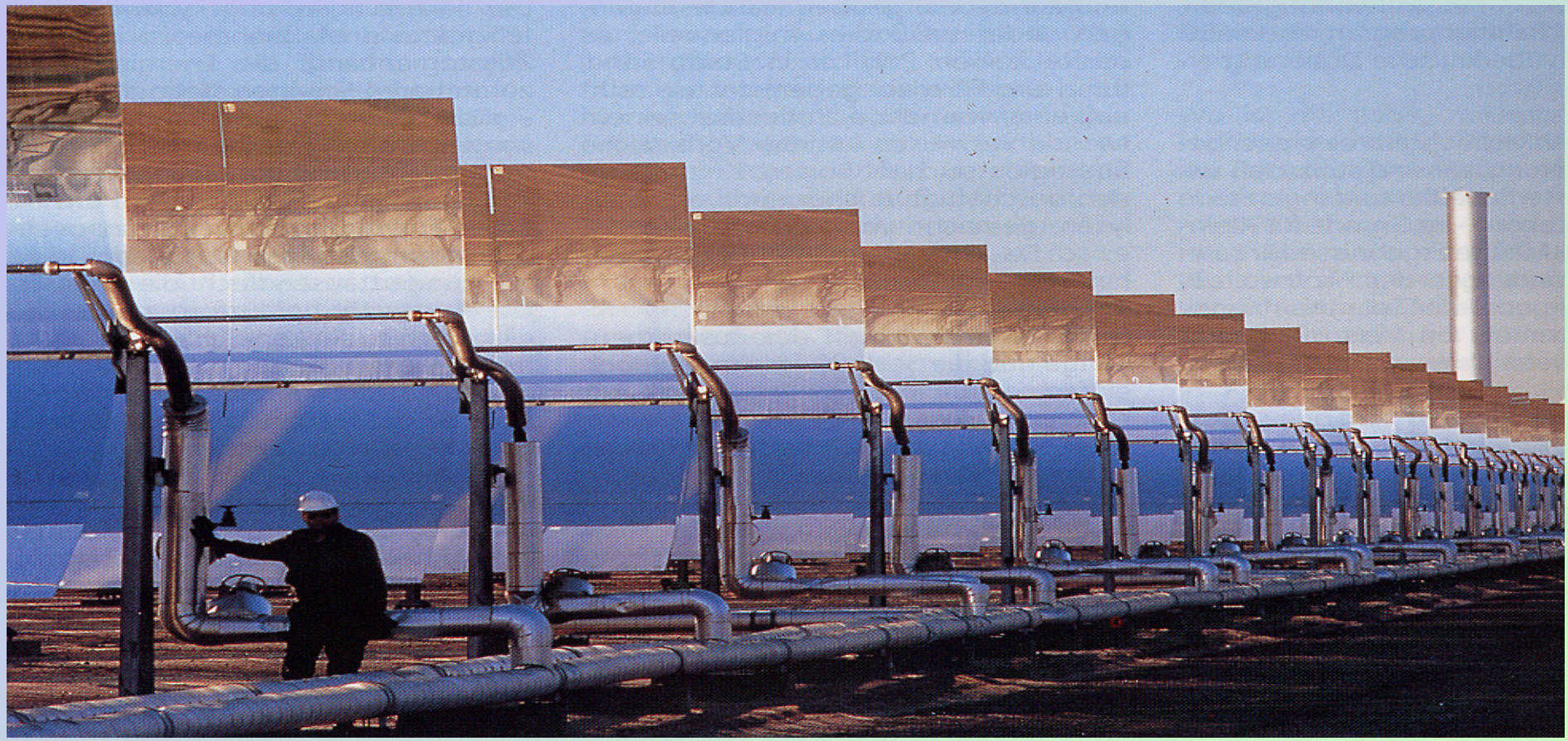

Solar Millennium concentrated on parabolic trough project developments in Spain and Greece and, most importantly, on regulation and technical improvements and qualification

Results: In 2002 the Spanish Feed-in Law passed, further improved in 2004;

2 x 50 MW fully developed, 5 x 50 MW under development, financial closure of first 50 MW plant expected in spring 06, second to follow late 2006

2002/3: Largest new Demo trough since 1990 (1 MWe)

built in full cooperation with KJC in CA

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Erection of 50,000 sqft = 1 MW SKALET Loop at Kramer Jct.

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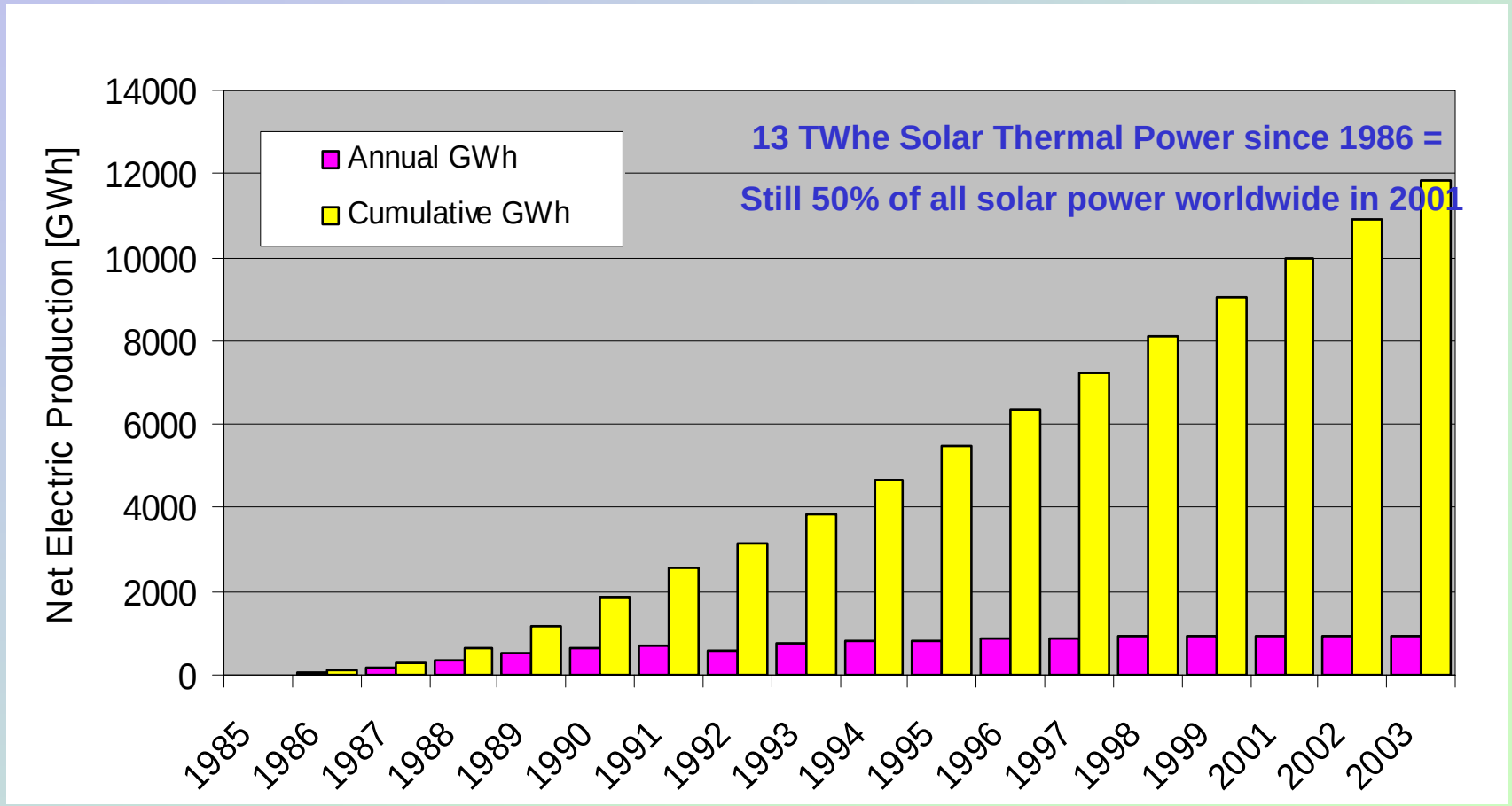
Operating Status of Solar Thermal Power (all Parabolic Trough)



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New Spanish Feed-In Law for CSP: Real Decreto 436/2004

MINISTERIO DE ECONOMÍA

5562 *REAL DECRETO 436/2004, de 12 de marzo, por el que se establece la metodología para la actualización y sistematización del régimen jurídico y económico de la actividad de producción de energía eléctrica en régimen especial.*

2. Resto de instalaciones de energía fotovoltaica del subgrupo b.1.1:

Tarifa: 300 por ciento durante los primeros 25 años desde su puesta en marcha y 240 por ciento a partir de entonces.
Prima: 250 por ciento durante los primeros 25 años desde su puesta en marcha y 200 por ciento a partir de entonces.
Incentivo: 10 por ciento.

3. Instalaciones de energía solar térmica del subgrupo b.1.2:

Tarifa: 300 por ciento durante los primeros 25 años desde su puesta en marcha y 240 por ciento a partir de entonces.
Prima: 250 por ciento durante los primeros 25 años desde su puesta en marcha y 200 por ciento a partir de entonces.
Incentivo: 10 por ciento.

- **Grants same tariffs for PV and CSP from 100kW to 50MW**
- **Cost covering with up to 0.21Euro/kWh**
- **Bankable with 25 year guarantee**
- **Annual adaptation to electricity price escalation**
- **12-15% natural gas backup allowed to grant dispatchability and firm capacity**
- **After implementation of first 500MW tariff will be revised for subsequent plants to achieve further cost reductions**

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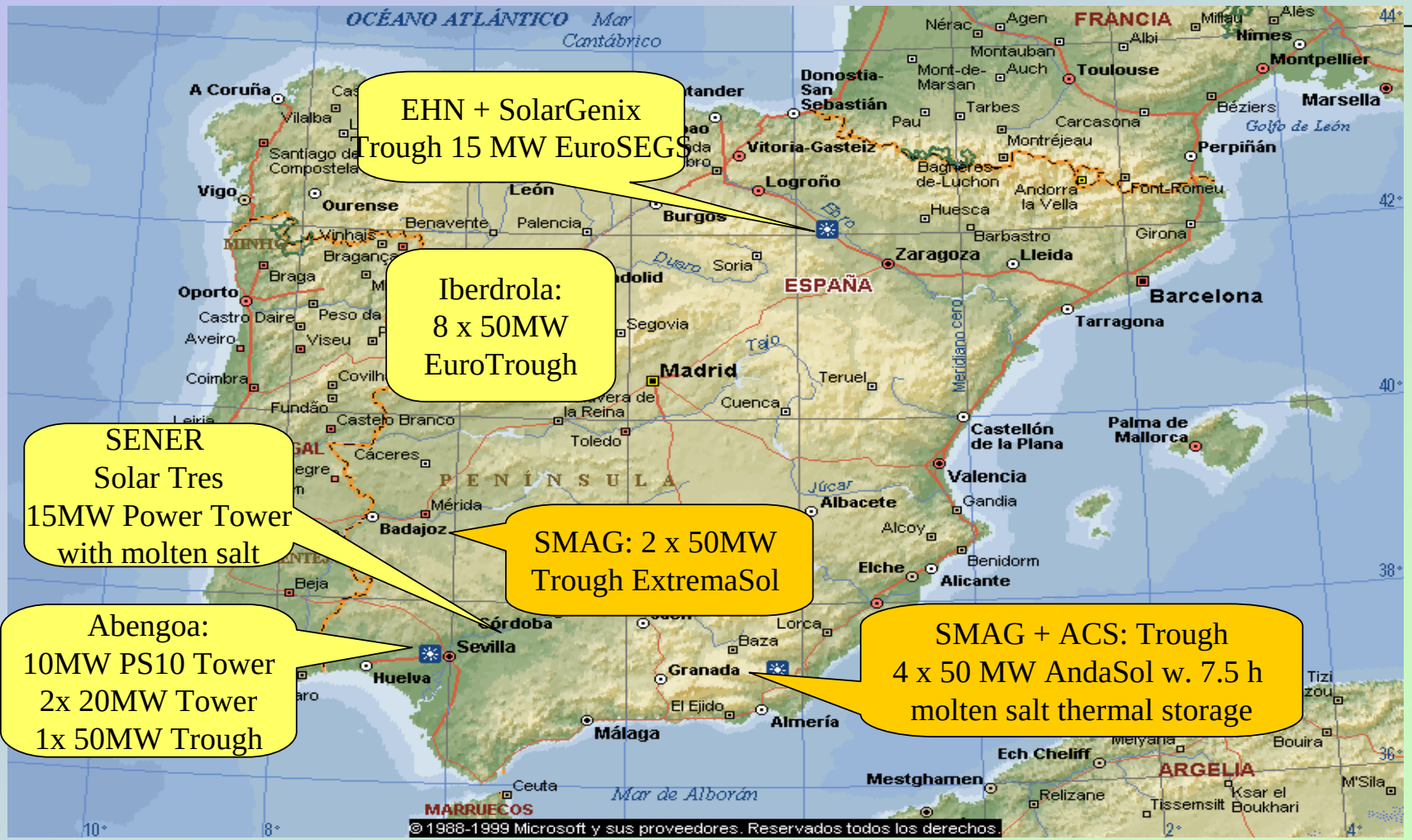
The Spanish Market – Market Pull through Feed-In Law => 800 MWe



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The AndaSol Projects

- Technology: **Parabolic Trough with SKAL ET Design**
- Capacity: **4** x **49.9 MW_{el}**
- Storage: **Molten salt storage** for **7.5 – 12** full load hours **= 3,600 – 5,000 h/yr**
- Project Site: **Plateau of Guadix, Province Granada**
- Net electricity production:
  2 x **180 / 2 x 250 mn kWh/a**
- **Investment: 2** x **€ 250 / 2 x € 320 mn**

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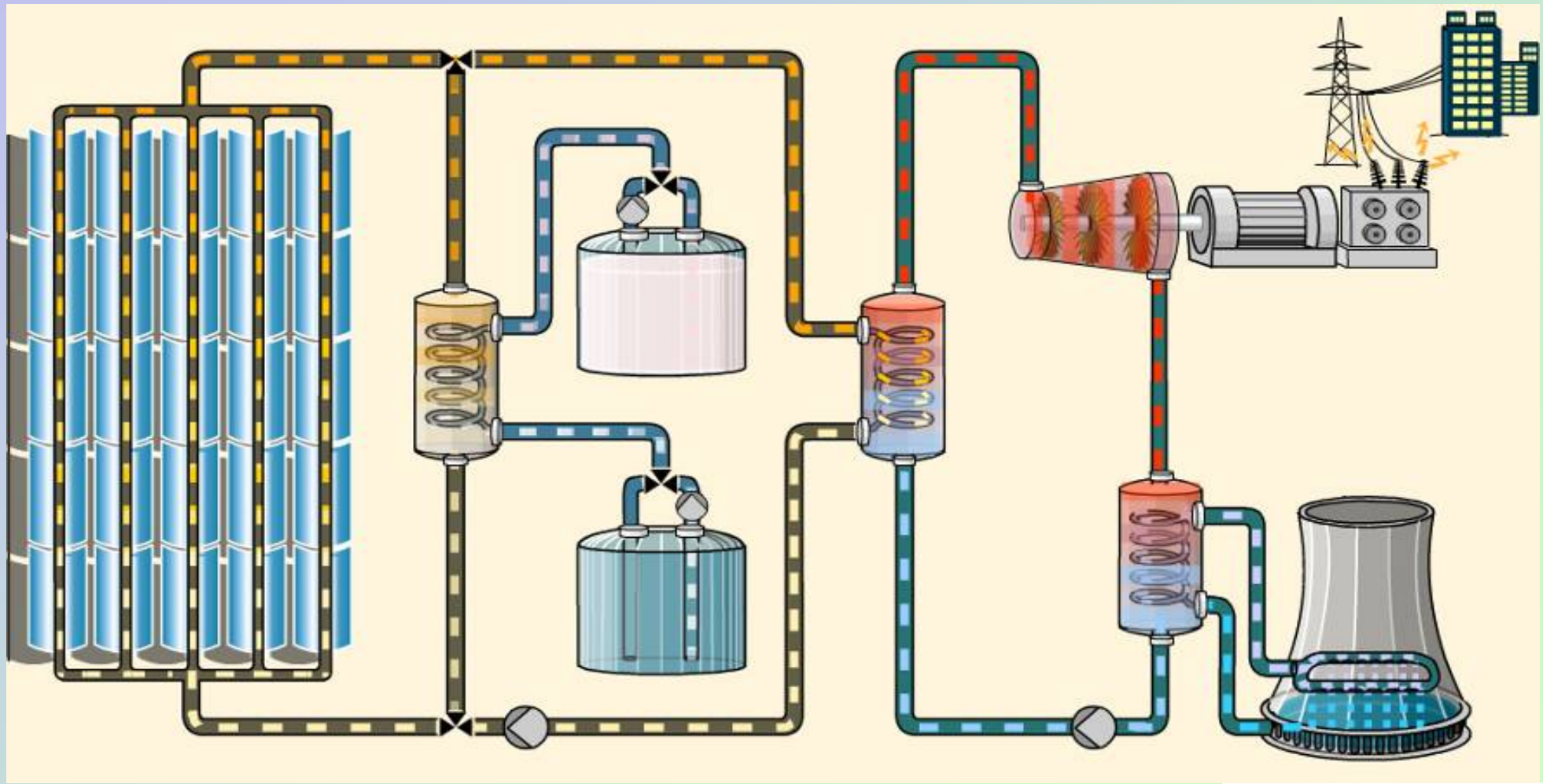
AndaSol Functional Diagram



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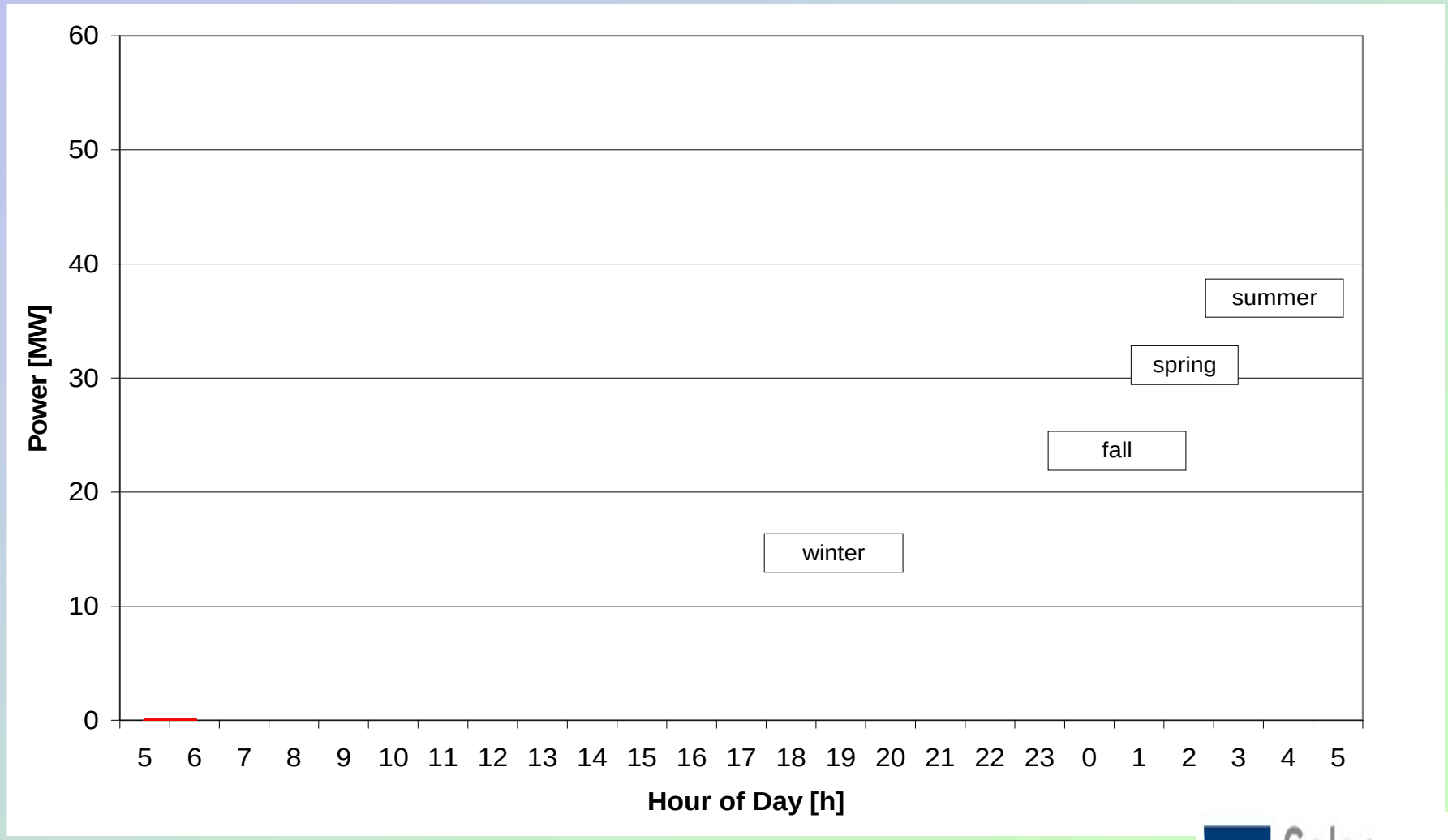
AndaSol Seasonal Operation



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The Absolute „Musts“ for a Successful CSP Market Introduction

- As CSP projects are much bigger in single project size **as most other renewable power projects and, thus, have investment volumes from €/$ 100 to more than €/$ 500 million, even with well - proven technology such as Parabolic trough technology:**
- the project **must be fully guaranteed by one**, single **EPC contractor**
- that **EPC contractor must be bankable, i.e. he is good enough for 20% LD‘s**
- The good message: if this bankability is given**, financing is not at all a problem: In Spain**, there are about **15 internationally operating banks** keen to get a share of the financing cake of **€ 8 billion**!
- **This requires a stable, long-term regulatory framework:** with given long lead times for CSP projects (as with any other big conventional power plant) **ITC‘s and PTC‘s have to consider this longer lead times of at least 4-5 years**
- **These incentives have to be consistent** – as long as one new instrument (e.g. the Federal Solar ITC) is just implemented while others are skipped at the same time, no investor will trust this environment

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The CSP Industry Commitment

- **Today, concentrated solar thermal power (CSP) is competitive with either:**

  - fossil fuel prices of $ 60 per barrel of crude oil or $ 12/mmbtu of gas (if fuel supply contracts are reflecting this level long-term)

  - or with tariffs of $ 0.19/ kWhe in solar - only or, $ 0.15/ kWhe in hybrid mode (25% gas share + Mojave desert solar radiation conditions)
- **CSP Industry doesn‘t need subsidies** beyond a market introduction phase of 2-3GW **if we would get a long-term, fair compensation for clean and dispatchable peaking power!**
- **Regulation should support long-term PPA‘s (25 - 30 years)**
- **This would be a strategic, consistent industry and environmental policy programme – American and European CSP companies are ready to join forces to reduce dependency on oil and gas**
- **What does the CSP industry offer:**

  - Firm, dispatchable peaking power – significantly reducing dependency on gas peaking plants

  - Reliable technology, reducing fossil fuels up to 100% through use of thermal storages w/o need of any back-up capacity

  - Utility-scale and proven technology, perfectly fitting into the utility’s expansion plans

  - Much more jobs than building conventional power stations as solar field investments (50% of total investment) cause labour-intensive construction & erection

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Partners of AndaSol-1 and AndaSol-2

Solar Millennium AG / Milenio Solar Desarollo de Proyectos SL

- Has collected € 15 million private risk capital for solar thermal project development
- Develops solar thermal projects in Spain, Greece (Island of Crete), Southern Mediterranean countries and the Southwest of the USA
- Raises equity for these projects
- Has designed, procured, constructed and operated a 1 MWe test loop of innovative SKAL-ET parabolic trough collectors of 800m length and over 4.300 m² at SEGS V plant
- Its 100% technology subsidiary, Flagsol GmbH, is world leader in design and engineering of parabolic trough solar fields

ACS Group / Cobra Group

Biomass Power Plants
- Planta de 16 MW "Energías de la Mancha (Ciudad Real)
- Planta de 14,2 MW La Loma (Jaen)
- Planta de 5,93 MW Cuellar (Segovia)

Solar Power Plants
- Planta de 98 kW Fotovoltaica en Sa Rapita (Mallorca)
- Planta Fotovoltaica en Tres Cantos(Madrid)

Wind Parks
- TRUCAFORT: 29,85 MW, Provincia de Tarragona
- MONTE DA SERRA: 14,4 MW, Provincia de A Coruña
- MONTE MARBAN: 11,4 MW, Provincia de A Coruña
- VILLALBESA: 22,2 MW, Provincia de A Coruña
- MONTE REDONDO: 49,5 MW, Provincia de A Coruña
- REQUEIXO: 10,5 MW, Provincia de A Coruña
- OUTES: 33,6 MW, provincia de A Coruña
- RAPOSERAS: 39 MW, Provincia de Logroño

Combined Cycles
- Castellon 800MW para IBERDROLA (terminada 2002)
- Castejón 400 MW para IBERDROLA (terminada 2003)
- Santurce 400 MW para IBERDROLA (en construcción)
- Amorebieta 800 MW para ESB (en construcción)
- Escombreras 800 MW para IBERDROLA (Permisos)
- Sabon 400 MW para UNION FENOSA (Permisos)
- Aceca 400 MW para UNION FENOSA (Permisos)

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