



Solar Power International 2008

German Renewable Energy Day Coming home to where it all started: A Developer's View of Current California CSP Opportunities

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

Back to the roots:

- 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 Successful Framework in the 1980-ies:

- Favorable FERC Regulation
- Investment Tax Credits (Federal & State)
- Attractive time-of-use tariffs:
 - **14 US cts. / kWh 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)
- 20 TWhe (15 TWhe pure solar) produced;
- Electricity sales: \$ 2.5 billion kWh until today



**Luz / FPLE's Kramer Jct. SEGS III – VII
Parabolic Trough Plants (5 x 30 MWe)**

Solar Millennium's CSP History

SEGS I – IX Plants in California Mojave Desert (9 plants with 354 MWe total cap)

- ☞ Solar Millennium's subsidiary company **FlagSol** & strategic German industry partners, such as Schott & Flabeg participated in all 9 SEGS plants with 354 MWe since 1984
- ☞ FlagSol, as only CSP company, had a knowhow transfer program with **LUZ** back in 1987 and jointly developed projects in Brazil, Israel, Italy, Jordan and Morocco



Solar Millennium's 1 MWe Skal-ET Collectors & Demo Loop at SEGS V in Kramer Jct., CA

- ☞ **ET 1 & 2:** R & D at Plataforma Solar de Almeria) 1996-2002: EU co-funded
- ☞ **SKAL-ET:** full demo loop at Kramer Junction, erected in 2002-2003; continuous commercial operation until to day (supported by German Fed Min for the Environment - BMU)
- ☞ this ~2.3 MWt 5,000 m² SKALET loop exceeds last-built LS-3 collector thermal performance by >10%
- ☞ This was demo basis for **AndaSol 1-2**
2 x €300+ bank financing



Solar Millennium's CSP Achievements

Solar Millennium concentrated on parabolic trough project development in Spain, particularly on regulation. In 2002, the

- ➔ **Spanish Real Decreto for CSP passed, further improved in 2004**

Solar Millennium also focused on technical Improvements

- ➔ **Largest new trough system installed since 1990 (~2.3 MWt) built in full cooperation with KJC and, since 2005, FPLE in Kramer Jct., CA**

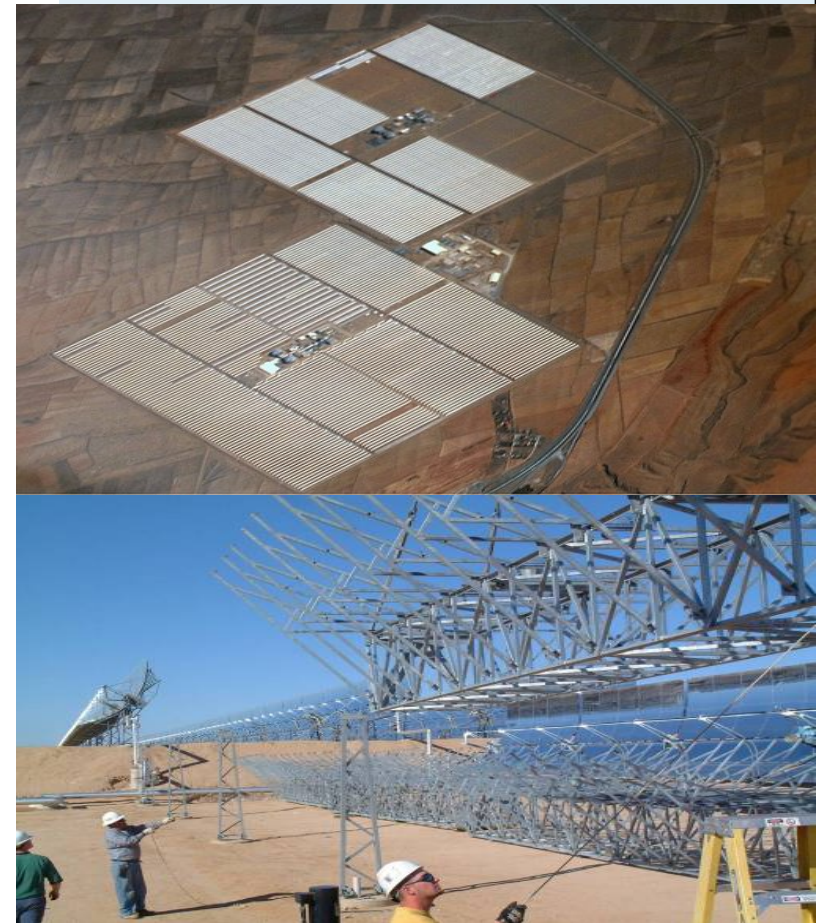
Solar Millennium qualified Engineering & Construction Team (ACS-Cobra/Sener)

- ➔ **Successful development (2002 – 2006) and implementation (since 2006) of the first parabolic trough power plants in Southern Spain**

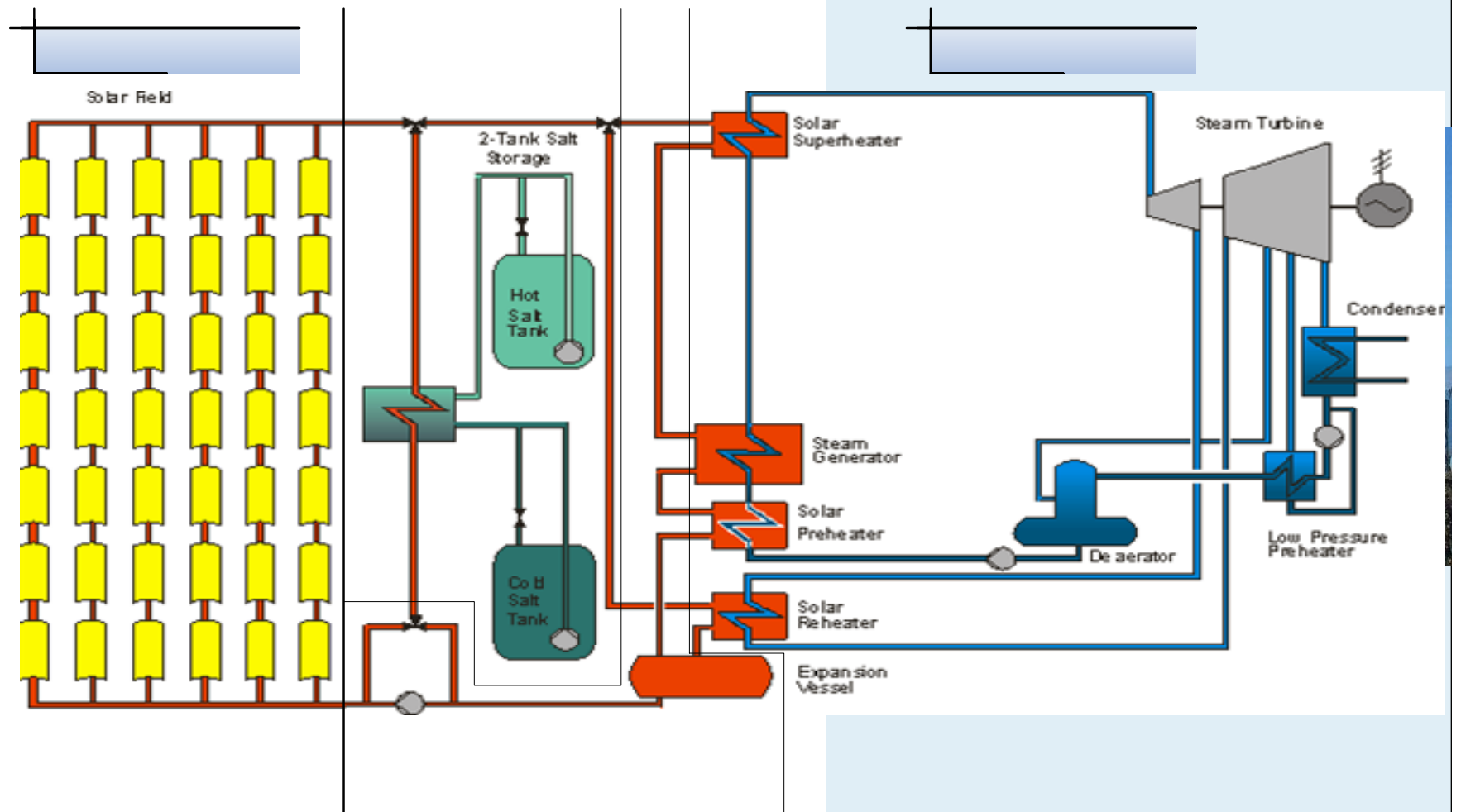


The Andasol 1- 3 Projects

- ✂ Technology: Parabolic Trough with Solar Millennium's SKAL ET Design
- ✂ Capacity: 3 x 49.9 MWe1
- ✂ Storage: Molten salt storage for 7.5 full load hours = 3,600 h/yr
- ✂ Project Site: Plateau of Guadix, Province Granada, Spain
- ✂ Net electricity production: 3 x 180 million kWh/a
- ✂ Investment: 3 x € 300 million EPC volume
- ✂ Industry/Development Partners:
 - ✂ for the first 2 plants: ACS / Cobra
 - ✂ for subsequent plants: MSM – JV with MAN Ferrostaal



Plant Schematic



Solar Field

The AndaSol 1-3 Projects: Convoy Planning

- ❏ **Andasol 1:** construction started June 2006, right now in start-up & commissioning
- ❏ **Andasol 2:** in construction since February 07 – start-up expected in spring 09
- ❏ **Andasol 3:** financial closure expected this Oct 08 – start-up fall 2010
- ❏ each project features a 510,000 m² solar field 1,020 MWh thermal storage, € 300 million EPC volume – 80% debt financed
- ❏ **Best practice for convoy planning:** saves costs on permitting and work force mobilization, shares infrastructural costs



The Spanish Market

Market Pull through Feed-In Law => 800 MWe



North American Market

Solar Millennium's Development Strategy

- ⑩ Seeks utility customer base and high quality sites that enable large developments at each site (200 MW to 600 MW Sites)
 - ⌘ Take advantage of logistics and economies-of-scale
 - ⌘ Site infrastructure
 - ⌘ Procurement Logistics
 - ⌘ Utilize the Solar Field construction force for large, multi year effort
 - ⌘ Maximize Efficiencies of Operation and Maintenance and Spare Parts Inventory

- ⑩ Offers turn-key supply of solar boilers (collectors + HTF system) w. or w/o thermal storage (with full wrap-up warranty & guarantee) or complete CSP plants through Joint Venture with MAN Ferrostaal Power Group of Essen

- ⑩ Offers and helps building-up strong EPC consortia with US partners – including formation and training of O&M entities

- ⑩ Offers joint project development and ownership with US partners



**It could be easier: If Southwestern States really want dispatchable renewable power to fulfill their RPS w/o threats to their grid:
Set an attracting regulatory and legislative framework and build CSP plants – like these 11 million sq-ft trough fields of AndaSol-1 &-2!**

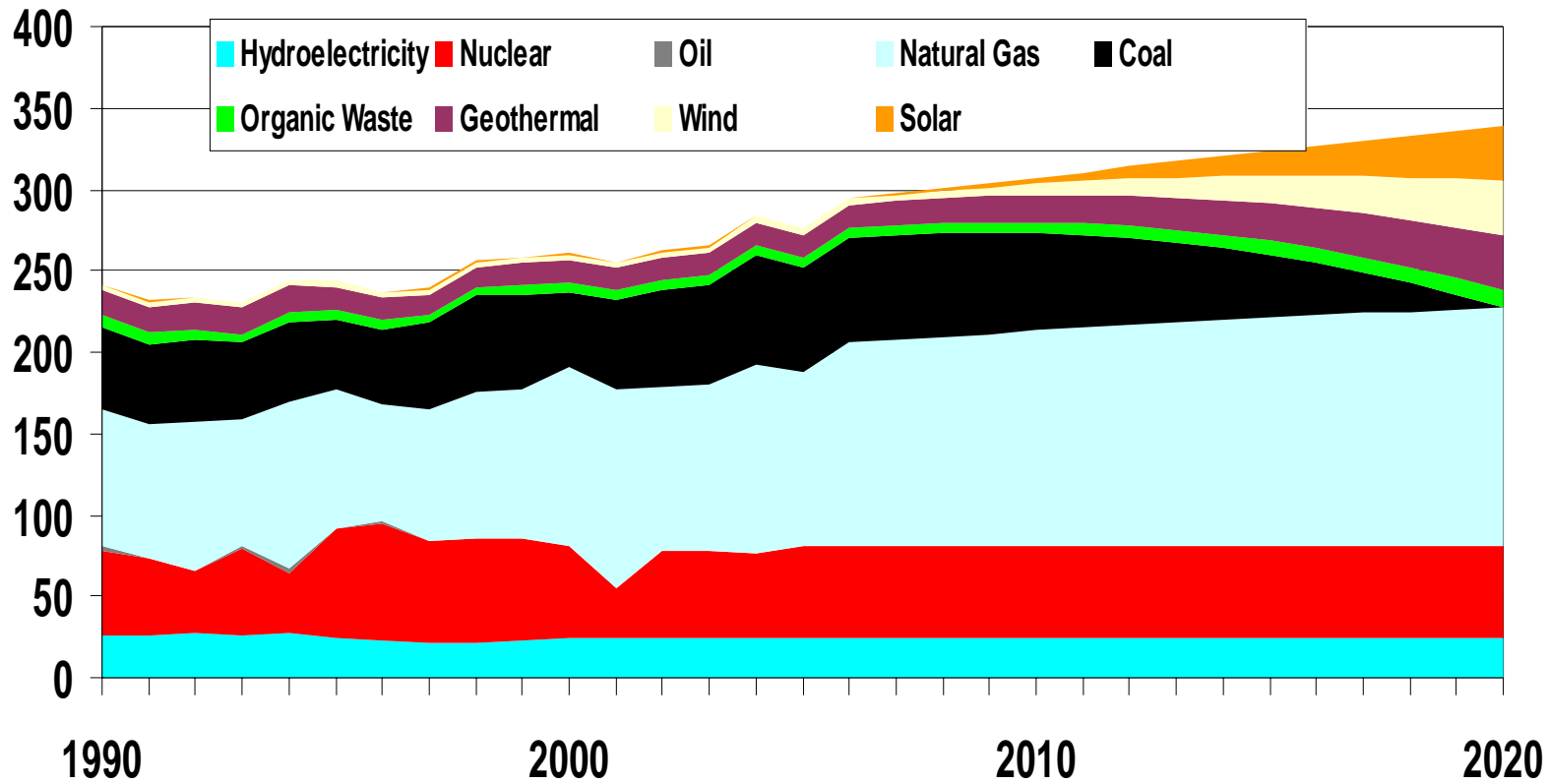


CEERT Scenario on AB 32

California Electric Energy Resources

Scenario - 33%_ZeroCoal

(Terawatt-hours)



California needs about 800 MW of CSP every year from now on until 2020 to secure its AB 32 goal assuming that CSP takes a 30% share of the 75 TWhe RE power needed. This 30% share grants grid stability in critical summer months.

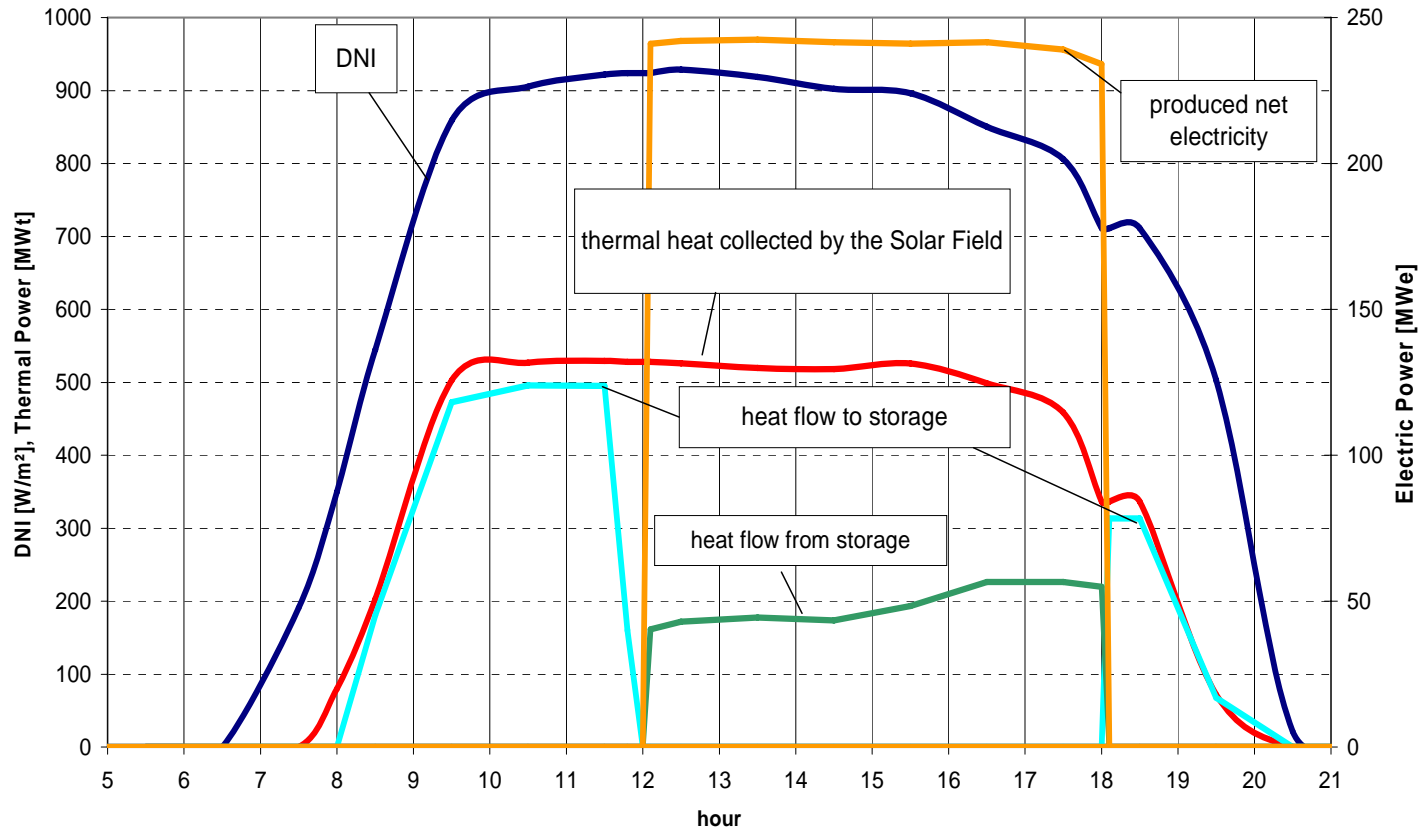


To secure grid stability under such bold RE build-out scenario, dispatchable CSP plants with thermal storage are needed at least for critical summer on-peak



AndaSol-1 &- 2 plants in Spain: 1,020 MWh, 7.5 full load hrs, 31,000 tons of molten salt

SOLAR BOOSTER : Shift solar power from morning/ evening hours to critical summer afternoon hours



- Charge of storage until noon (without any electricity production)
- Electricity production from 12 – 17:59 using heat of solar field AND storage
- Charge the storage after 18

Anticipated Market for CSP Solar in US Southwest

California:

- 2,000 MW by 2013
- 8,000 MW by 2020
 - mostly peaking demand

Arizona: 1.5 – 3 GW by 2020

Nevada: 1 - 1.5 GW by 2020

New Mexico and – mostly –

West Texas: 1 - 2 GW by 2020

Colorado: 0.5 - 1 GW after 2012

Utah: 0.5 – 1 GW after 2012



Obstacles that hinder bold CSP build-out

- ❏ 30% commercial Solar ITC was on and off: thanks God, the financial crisis and SEIA's great job its now available until end 2016!
- ❏ Transmission clog: LGIP and FERC rules don't work any more – 5,000 MW RE awaiting transmission system upgrades
- ❏ Increasing concern about extensive use of public land in fragile desert habitat – 900,000 acres applied just at BLM CA field offices
- ❏ West Mojave Plan basically hinders any CSP development in highest solar resource area, the West Mojave High Desert
- ❏ Mojave Desert is already vastly distributed amongst Military, large wildlife areas and real estate – nobody thought of renewables in the past



The 3 big „battlefields“ to rescue a CSP built-out

Tariffing and Market Rules:

- MPR Reform vs. Feed in Tariff
- Compliance Milestones (steel-in the ground – not just PPAs) + ACP
- Same Rules for all: IOUs, POUs, LSEs

Transmission:

- FERC & CAISO: weed out & clear the queue
- RETI: Define transmission corridors by end of 08 / Get initial main trunk planning done by 2009
- consider state funds for priority infrastructure investments

Land use

- create land use corridors along main transmission trunks throughout the entire Western System



Potential California CSP Build-out Plan

=> Build 8-10 GW CSP peaking power by 2020

800 MW / yr from 2009 on

- ½ Mojave High Desert
- ½ Mojave Low Desert along I-10 to AZ & Imperial Valley

=> Labor effects:

- ⌘ About 3,000 local construction jobs in CA for 12 years
- ⌘ 1,000 manufacturing jobs in CA/SW
- ⌘ 2,000 permanent operating jobs in CA

Secure property tax exemption: done!

Secure ITC extension for 8 yrs: done!

=> Secure / enforce grid system

- ⌘ 3 GW west of Highway 395
 - => Antelope/Mojave subs
- ⌘ 3 GW east of 395
 - => Kramer/Lugo subs
- ⌘ 2 GW along I-15 to NV Border
 - => Lugo
- ⌘ 2 GW from Imperial Valley south to SD and north to LA Basin

=> Streamline environmental permitting (NEPA/CEQA) BLM – CEC

=> Compromise with enviros on build-out plan, spatial planning & zoning: reduced footprint by using best solar radiation area, preferably on disturbed land

=> Land corridors for clean power

Business Model

Solar Millennium AG				
Project development	Project financing	Power plant investment	Technology	EPC-Contractor
<p>Phase 1: Basic development & site selection</p> <p>Phase 2: On-site project development with regional project development companies</p> <p>Phase 3: Independent on-site project development by the project company</p>	<p>Financing of power plant projects</p> <p>Sales of power plant investments</p> <p>Cooperation with institutional investors for sharing equity positions</p>	<p>Revenues from operation of solar thermal power plants</p> <p>Optimization of the remaining business sectors based on the experience of present operation</p>	<p>Technology provider throughout the planning and construction phases of solar power plants</p>	<p>Complete solar systems supplier of parabolic trough solar fields, HTF+ thermal storage sub systems in strategic cooperation with MAN Ferrostaal Group as EPC partner</p>

Solar Millenium Group Structure

