SolarPACES

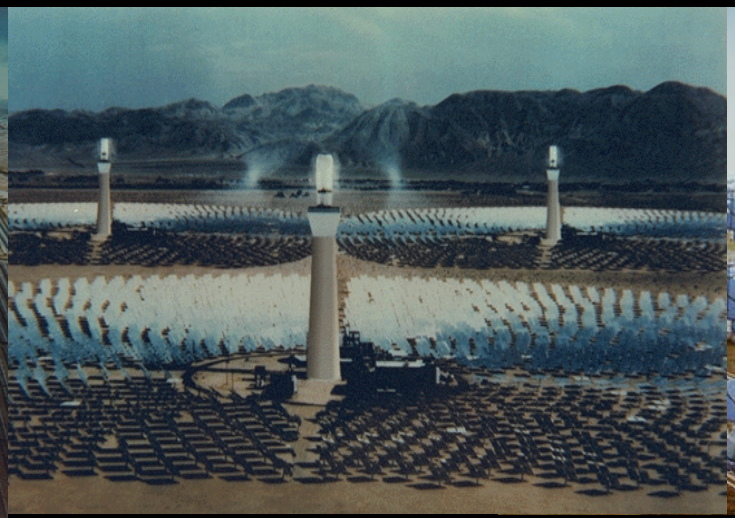
From Research to CSP Market Introduction

Progress and Advances of Concentrating Solar Power Technologies

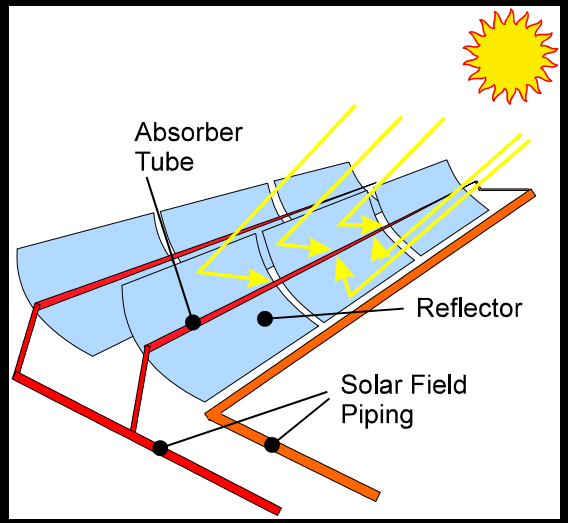
Dr. Michael Geyer, Executive Secretary

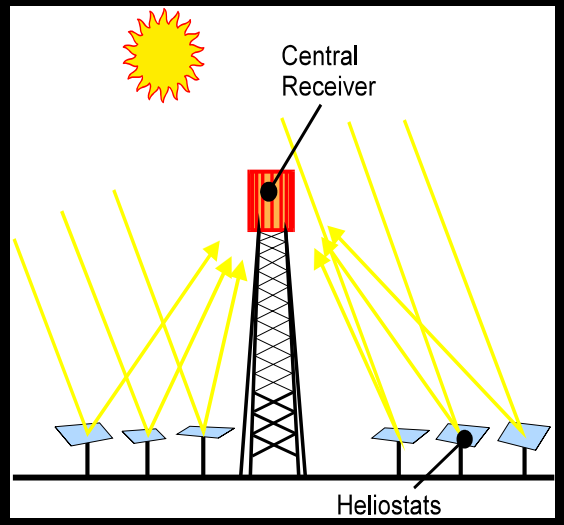
Dr. Thomas Mancini, Chair

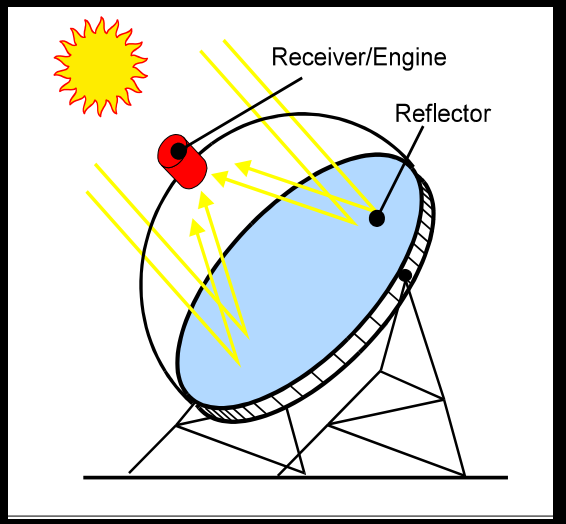
of the IEA SolarPACES Implementing Agreement

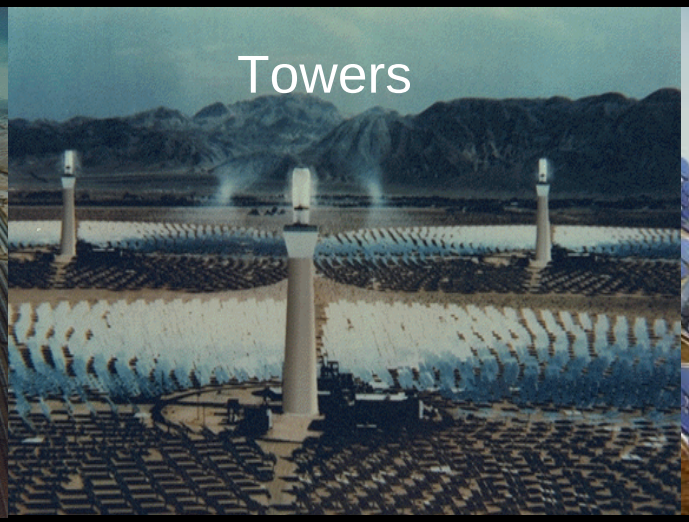


The CSP Technologies









Five Years Ago CSP and SolarPACES were almost Declared Dead


27 DIE ZEIT Nr. 26 22. Juni 2006

WISSEN

Mehr


REPORT

Solar Millennium AG

Es geht voran

EL MUNDO

ANDALUCIA


Singleton Argus

Solar generation

Harnessing sun's heat in power process


Nace en Granada la mayor planta termosolar europea

El pueblo de Aldeire asiste a la colocación de la 'primera piedra' del proyecto hispano-alemán Aldesol, que dará electricidad a 45.000 hogares


ECONOMÍA

Diario de Sevilla

Abengoa aspira a liderar en Europa la producción de energía solar

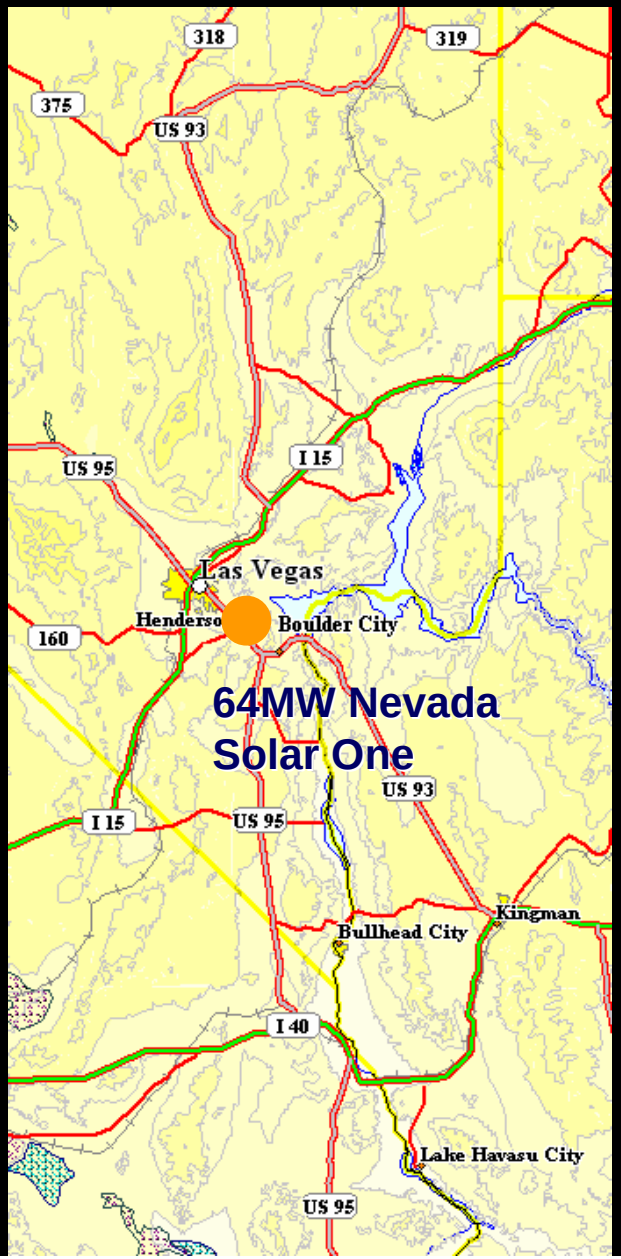
Today CSP makes Headlines on National Newspaper Cover Pages

SolarPACES

In a few days the first commercial Power Tower, Abengoa‘s PS10 will start operation near Seville, Spain

SPAIN: 11 MW PS10

- 75.700m² Heliostat Field, 30 Minutes Storage
- 12-15% fossil fuel
- 23GWh annual production
- EPC Cost 35Mio Euro
- 5Mio EU Grant and 1.2 Mio Andalusian Grant
- 1st STARTUP SCHEDULED IN 2006
- PS20 Construction started



USA: 64MW Nevada Solar One

- 357.200m² Solar Field, 30 Minutes Storage
- No fossil fuel
- Long term Power Purchase Agreement signed with Nevada Power and Sierra Pacific
- EPC Notice to Proceed – January 2006
- 1st STARTUP SCHEDULED FOR DEC 2006

United States: Construction 64MW Nevada Solar One

SPAIN: 3x 50MW AndaSol

- 510.120m² Solar Field and 7.5hours Storage
- 176 GWh annual production, 12% gas
- EPC Cost 260Mio Euro first Plant
- 5Mio EU Grant for AndaSol-1
- Financial Closure 31.5.2006, NTP 1.7.2006
- 1st STARTUP SCHEDULED 1.7. 2008

AndaSol-1 Construction Progress





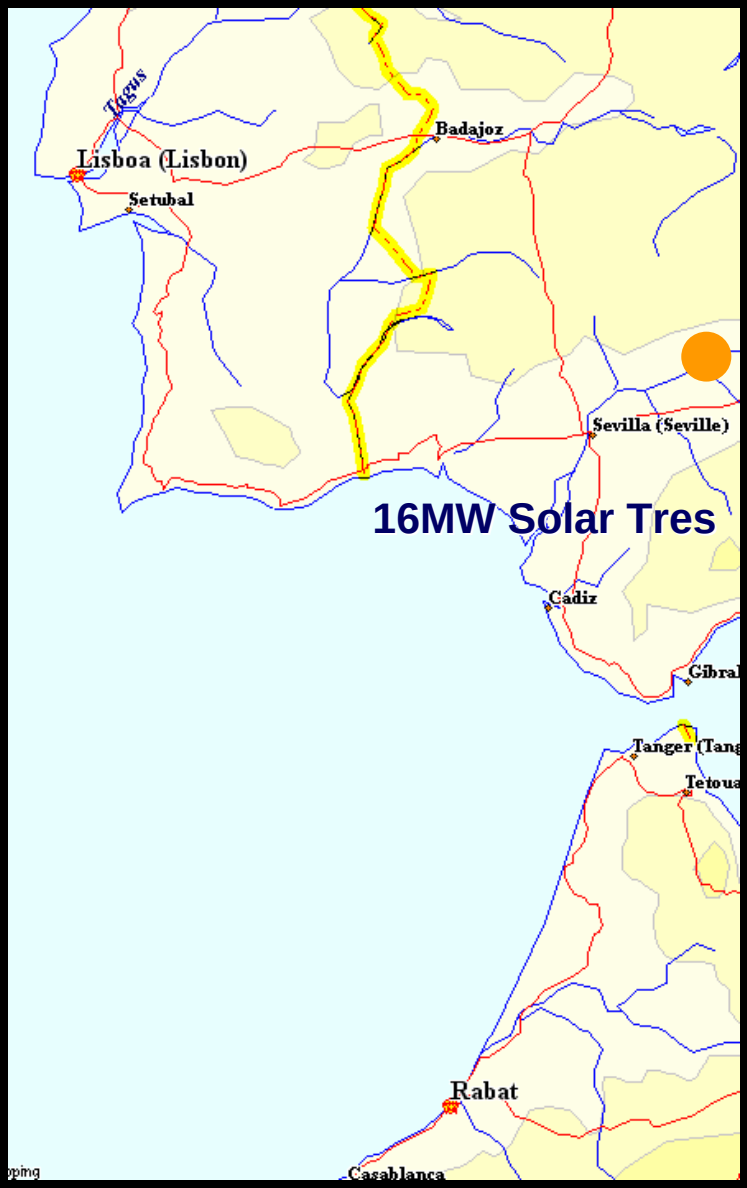

AndaSol-1 and AndaSol-2:

Owner: 75% ACS-Cobra and 25% Solar Millennium

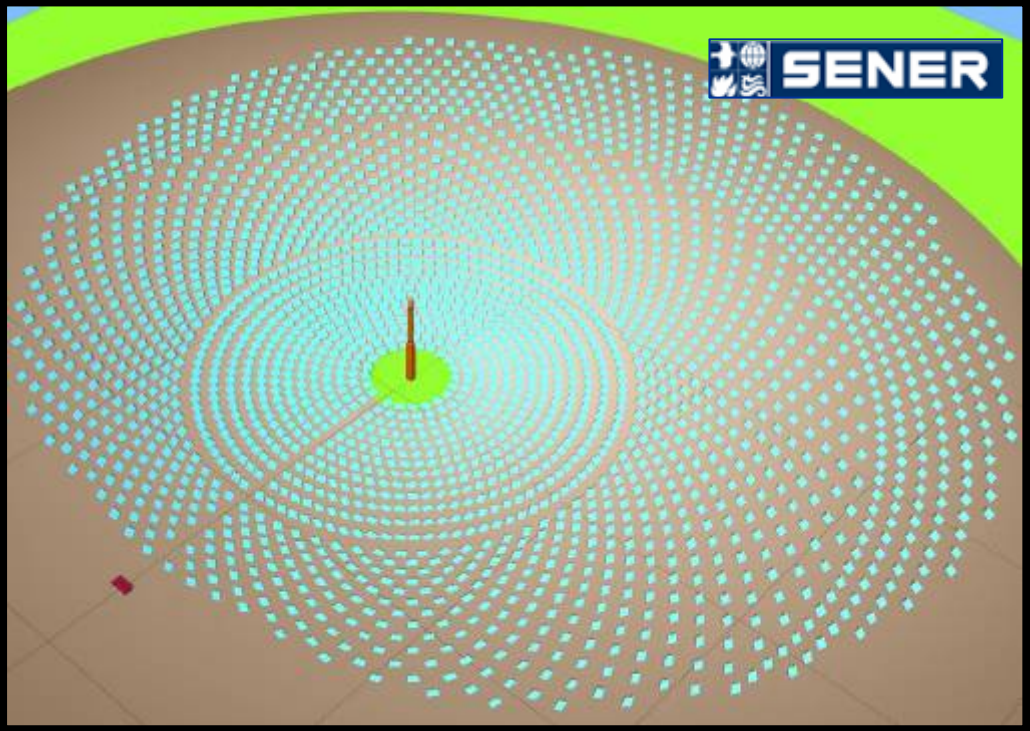
EPC Contractor: UTE of ACS-Cobra and SENER with Engineering from FLAGSOL

SDG&E and SCE announced a 500MW PPA with SES

SES Stirling Energy Systems



SPAIN: 16 MW SOLAR TRES



- 285.500m² Heliostat Field, 15 Hours Storage
- 12-15% fossil fuel
- 96GWh annual production
- Receiver now under tests at PSA
- Promoted by SENER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Concentrating Solar Power (CSP) R&D&D started 2000 years ago under a Defense Program …

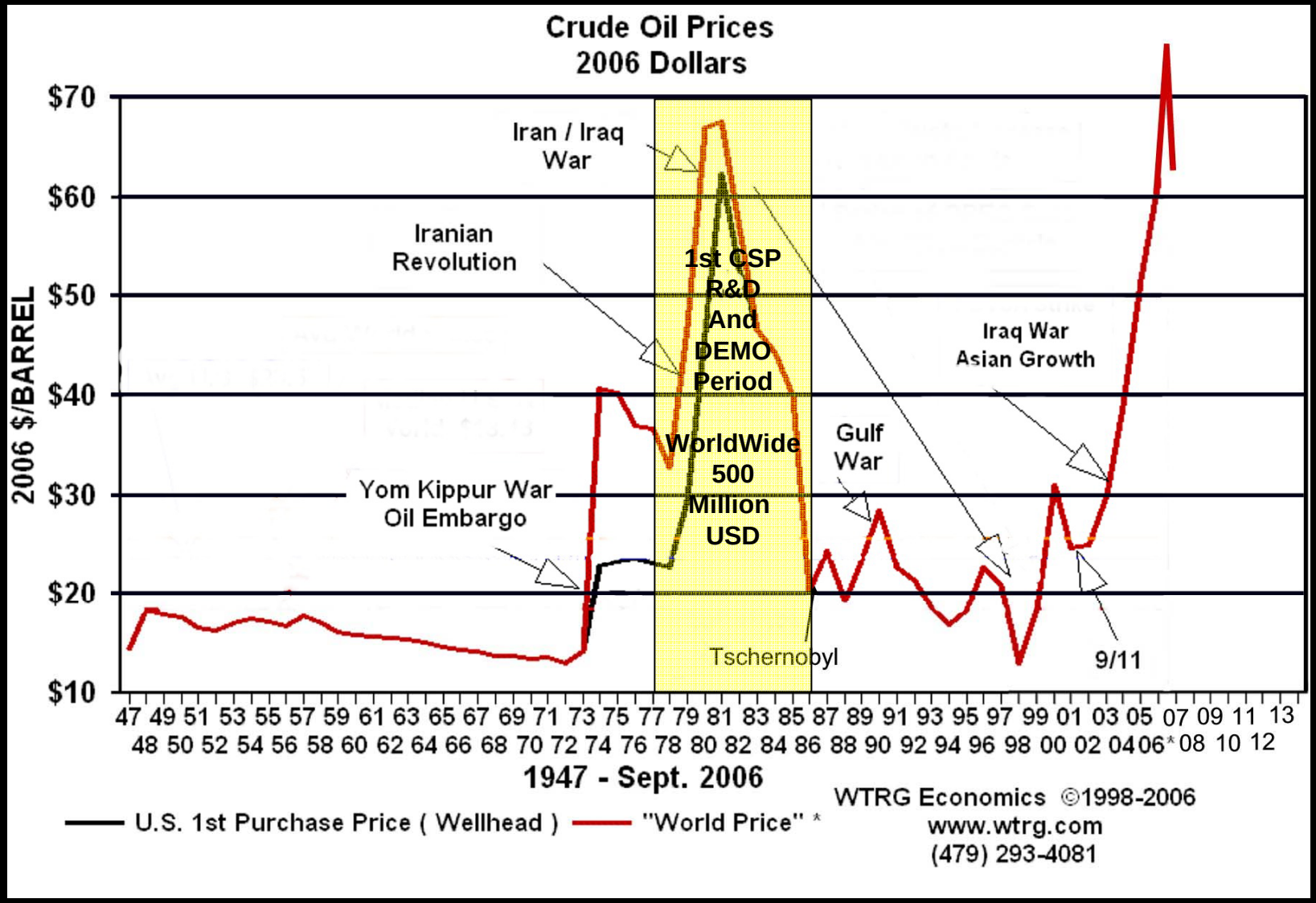
1912 first parabolic trough collector by Shuman in Cairo
62m length x 4m aperture

100 years ago the first parabolic trough produced direct solar steam near Cairo, when coal was shipped from England to Egypt

1918 the curtain
fall over the further collector development


Until the first Oil Crisis in the late 70s
gives rebirth to CSP Research

The Pork Cycles of R&D and Plant Construction in CSP

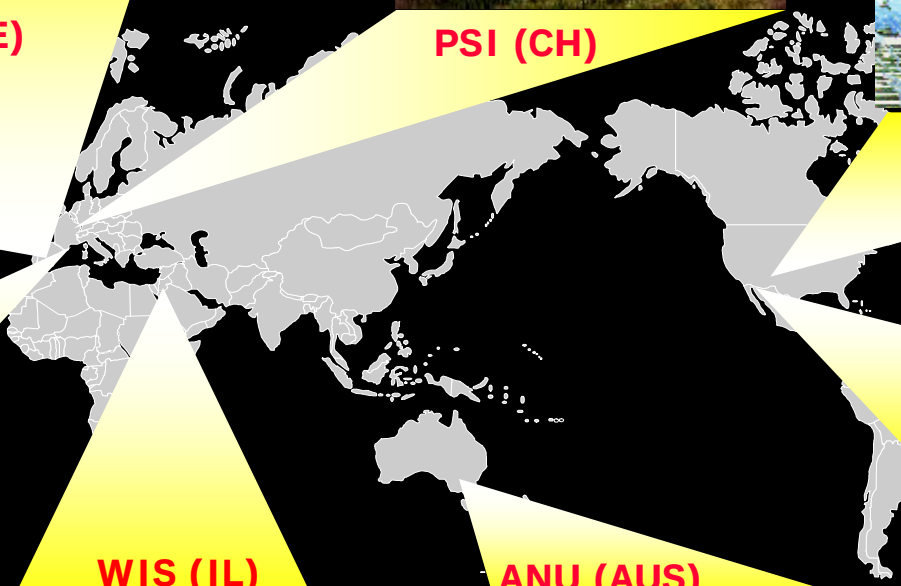


Solar Thermal Power Facilities Worldwide

PSA (E)

PSI (CH)

Solar One (US)



CNRS (F)

WIS (IL)

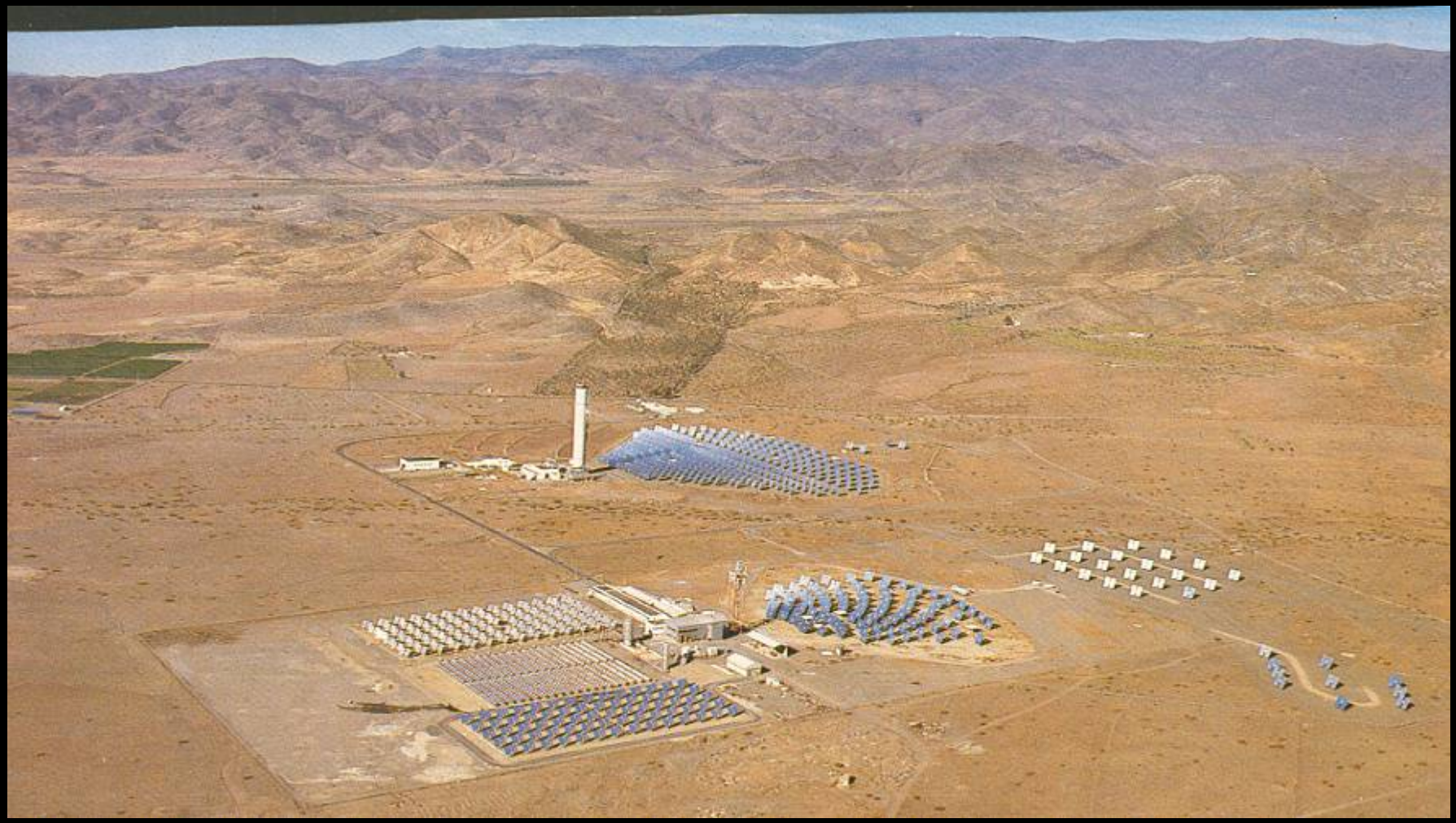
ANU (AUS)

CRTF Sandia (US)

ACUREX Troughs for Process Heat and Power

Shenandoah Dishes for Process Steam Generation

1.2MW CESA-1 and IEA SSPS Project



1978-1985

2MW Themis Molten Salt Power Tower in the French Pyrenees

1978-1985
5MW Saturated Steam Power Tower at Crimea Developed by USSR

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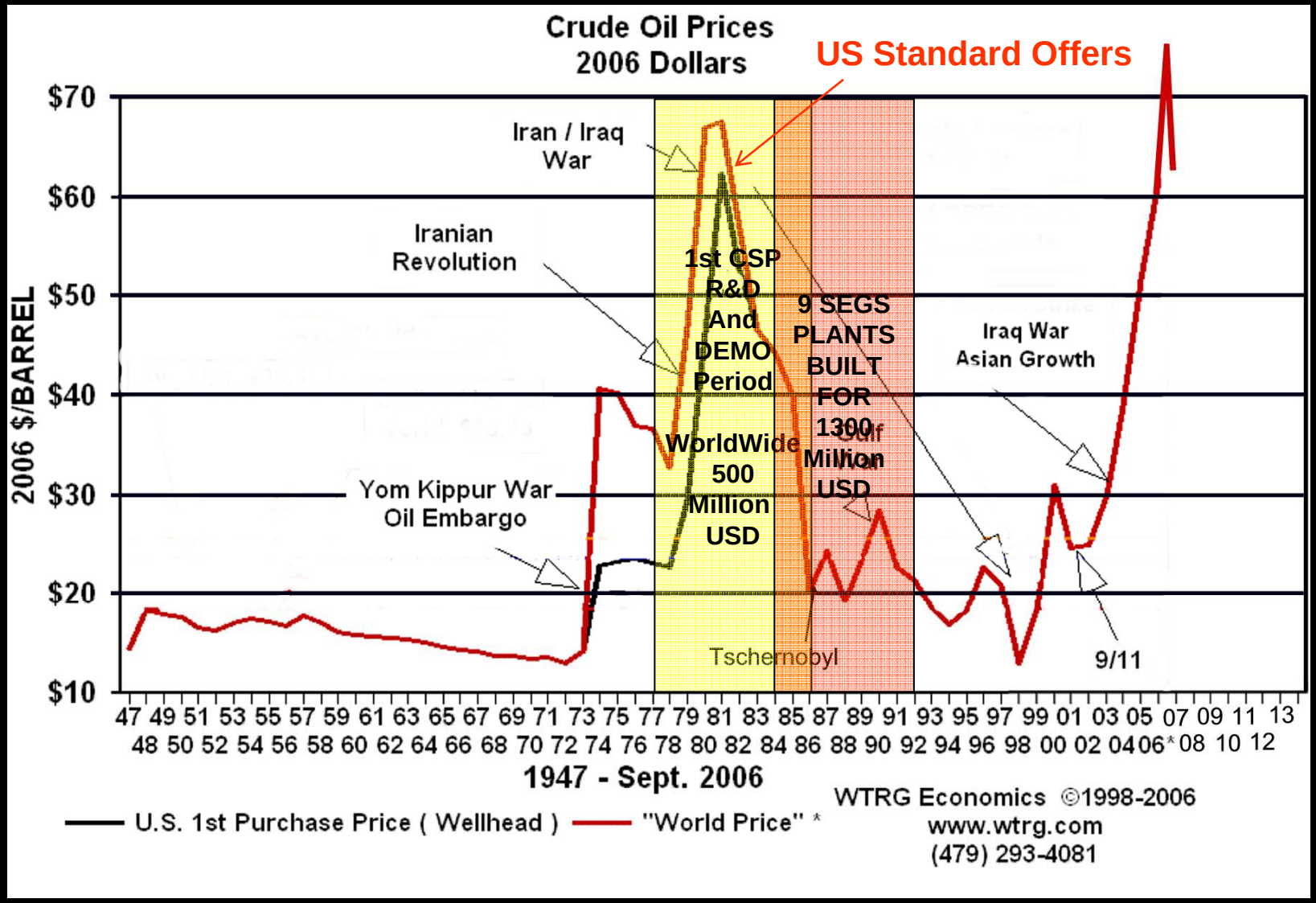
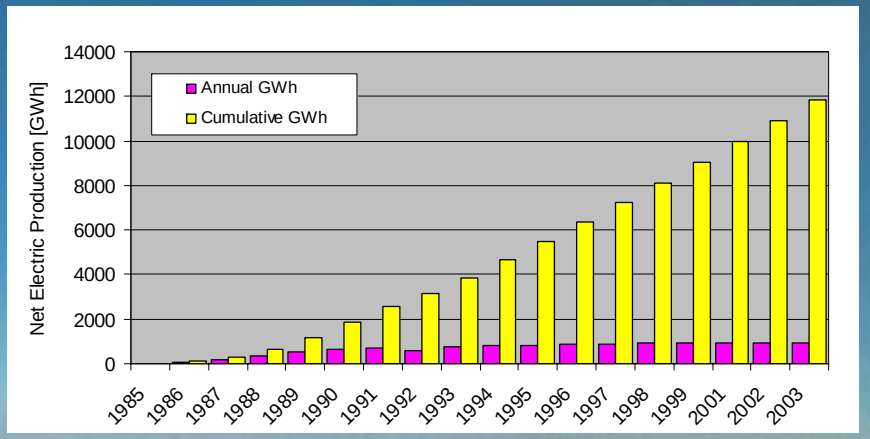
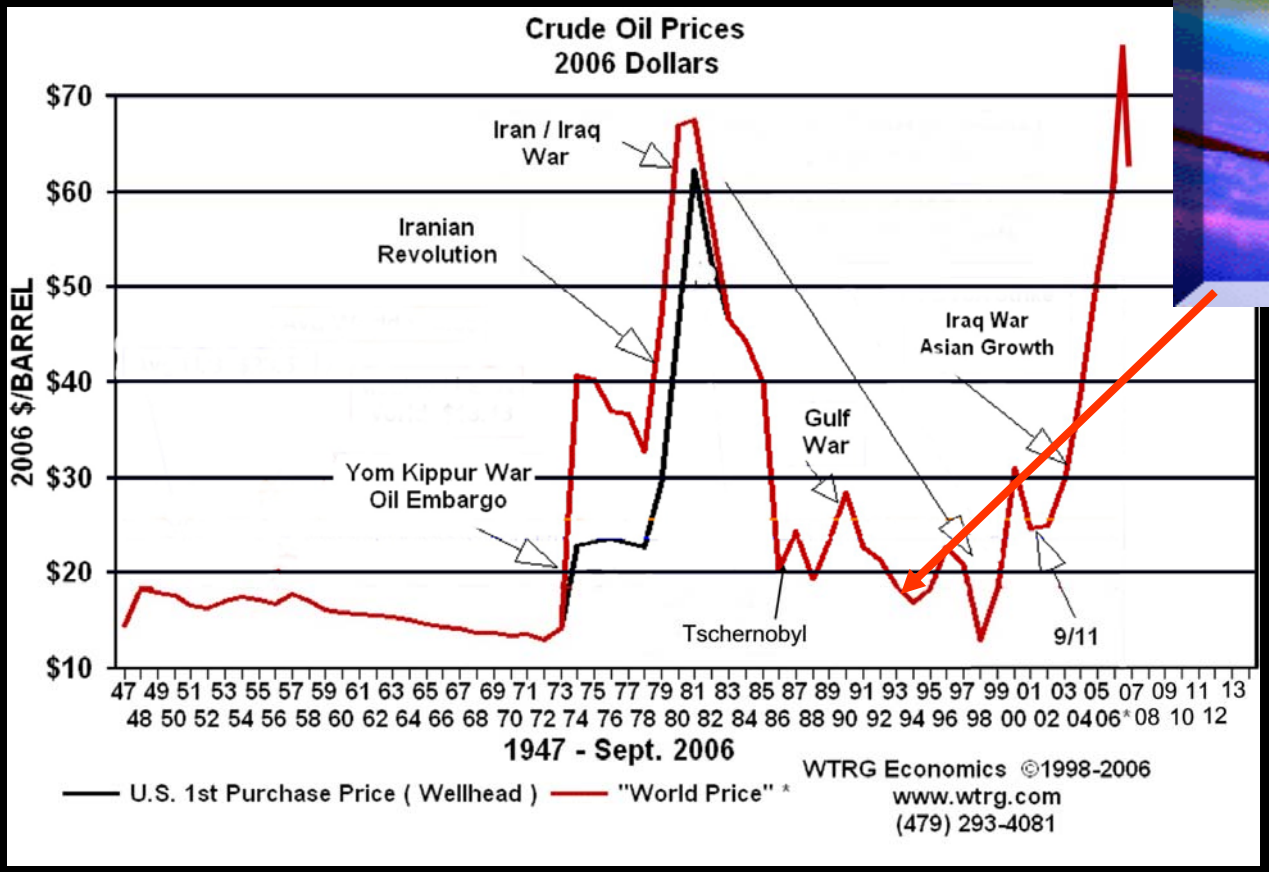
1978-1985
10MW Superheated Steam
Solar One at Daggett

First Worldwide Market Opportunity: US Standard Offers No.4



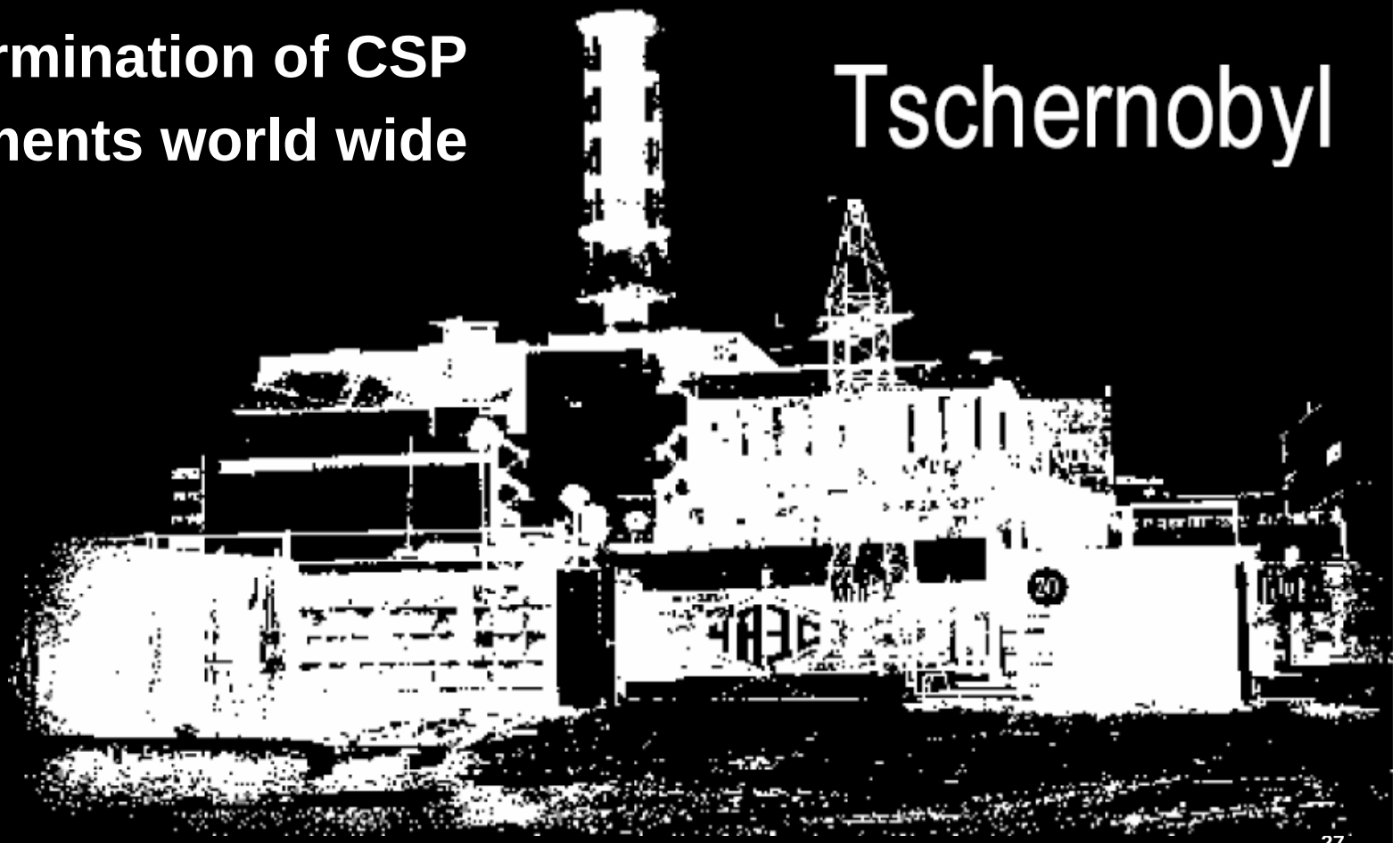


In this first market window, 354MW of 600MW PPA are built

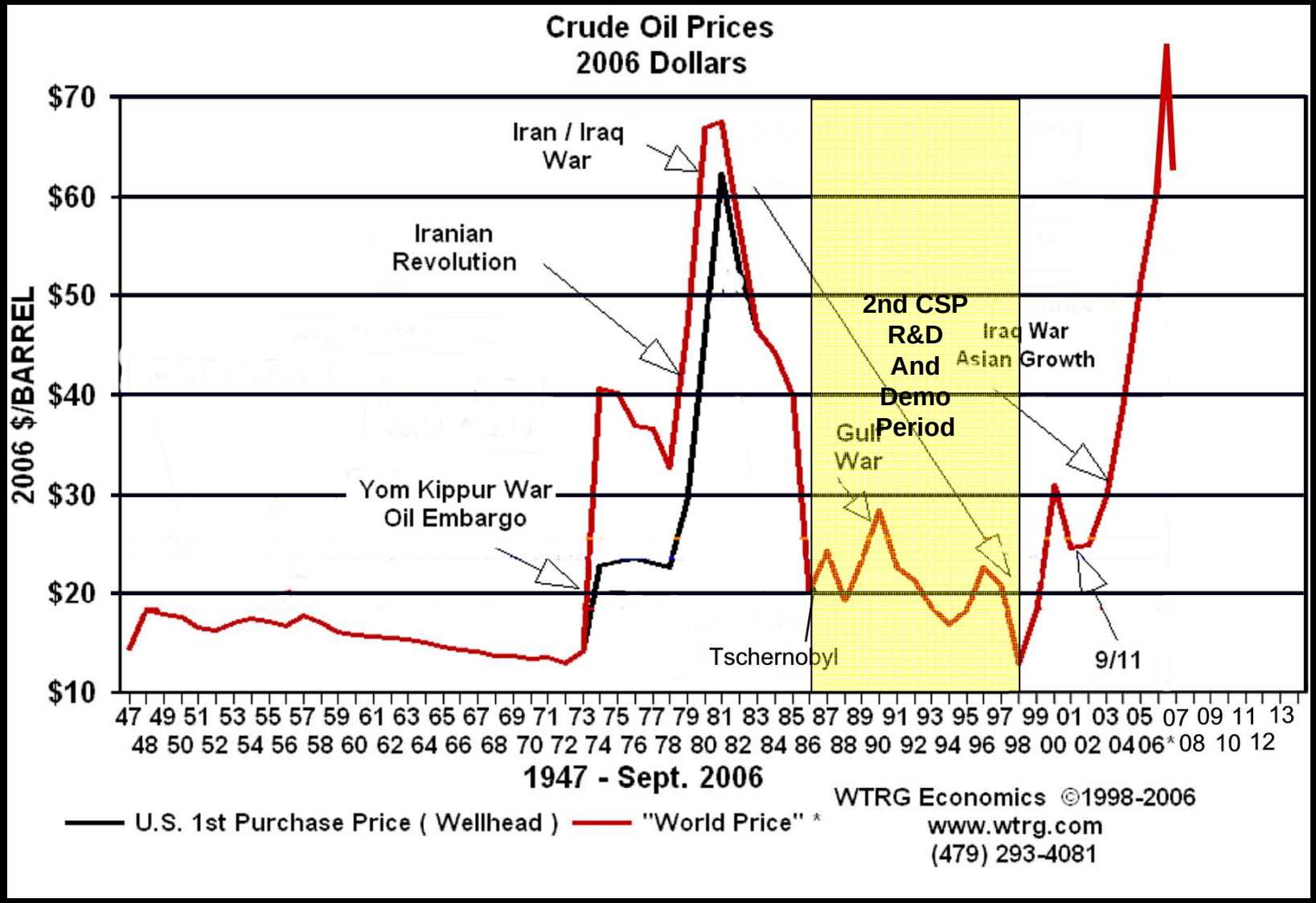


Demise of Luz after Fall of Energy Prices in 1991/92

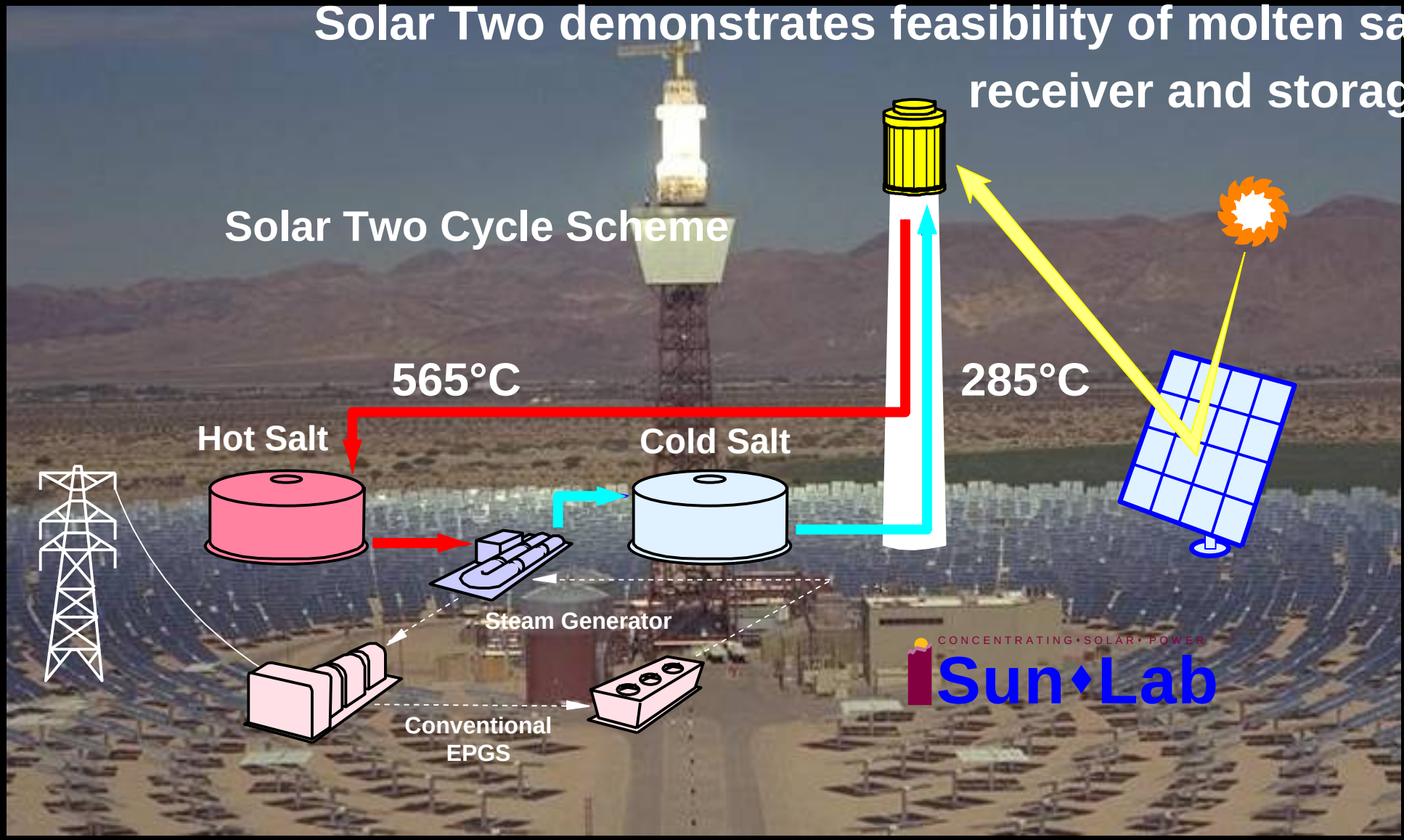
With Oil & Gas at it‘s minimum, the 90s would have been the termination of CSP developments world wide



1986: Tschernobyl saves CSP R&D Budgets in Europe



Solar Two demonstrates feasibility of molten salt receiver and storage



Open Volumetric Air Receiver (formerly PHOEBUS)

Achievable Steam Parameters:

700°C
100 bar

Primary Heat Transfer Medium:

Air

Backup Options:

Thermal Storage
Duct Burners

Backup Fuels:

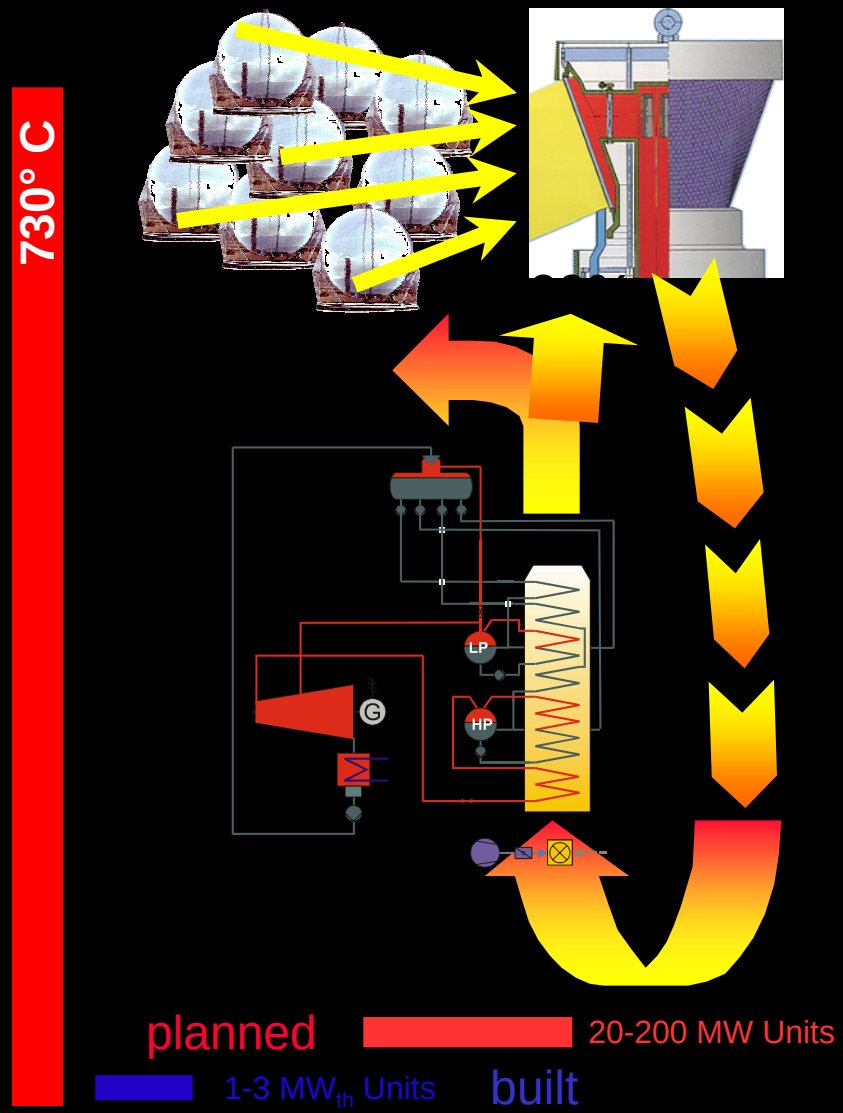
Natural Gas
Fuel Oil

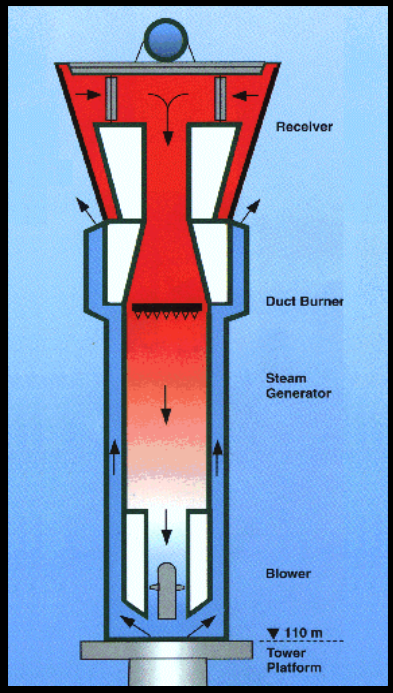
Technology Status

Successful 3 MW Thermal System Demonstration at Plataforma Solar

Turnkey System Supplier:

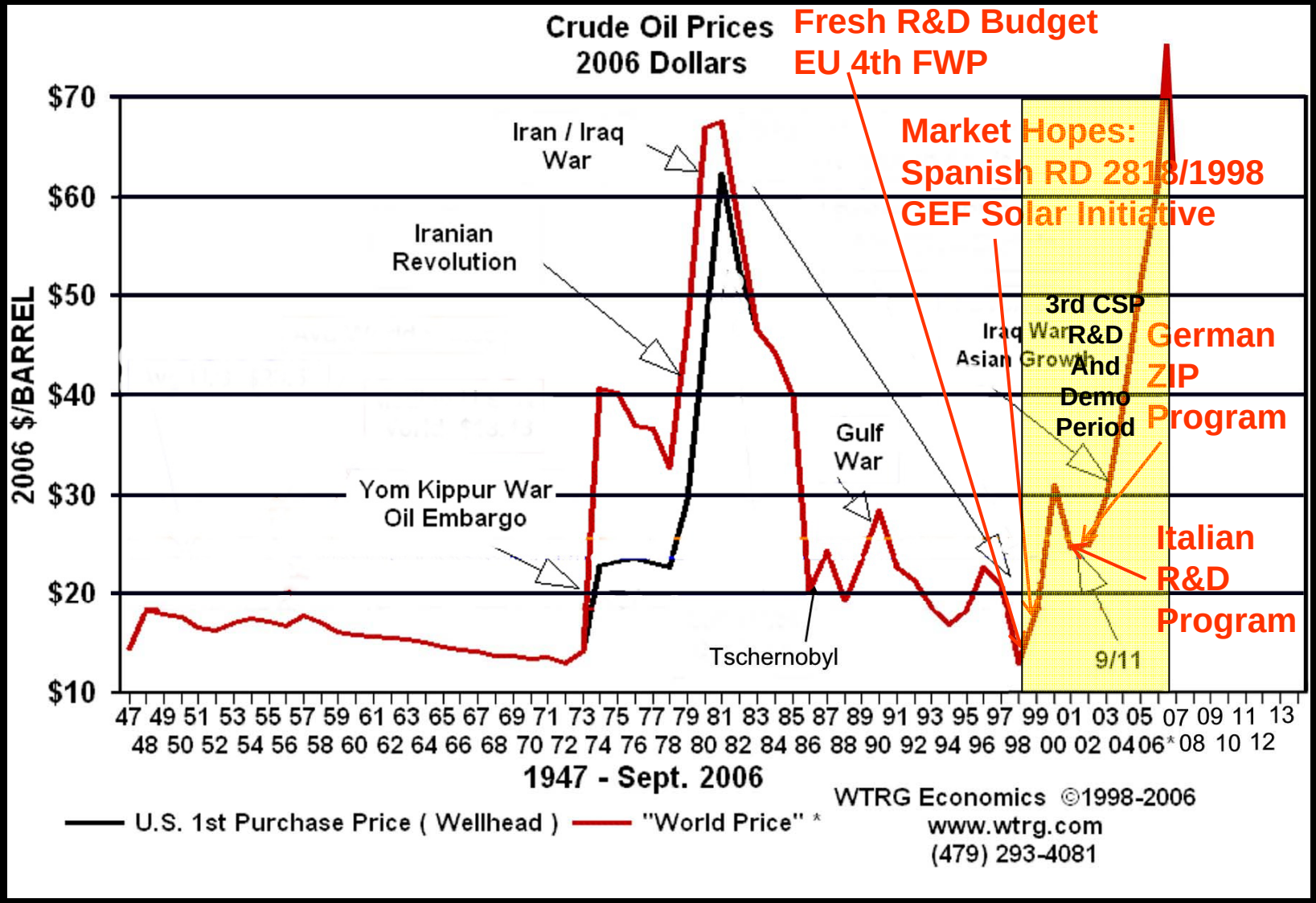
Kraftanlagen München





25kW SES Dish Stirling System

1998 EU saves CSP R&D, while US and Germany almost give up



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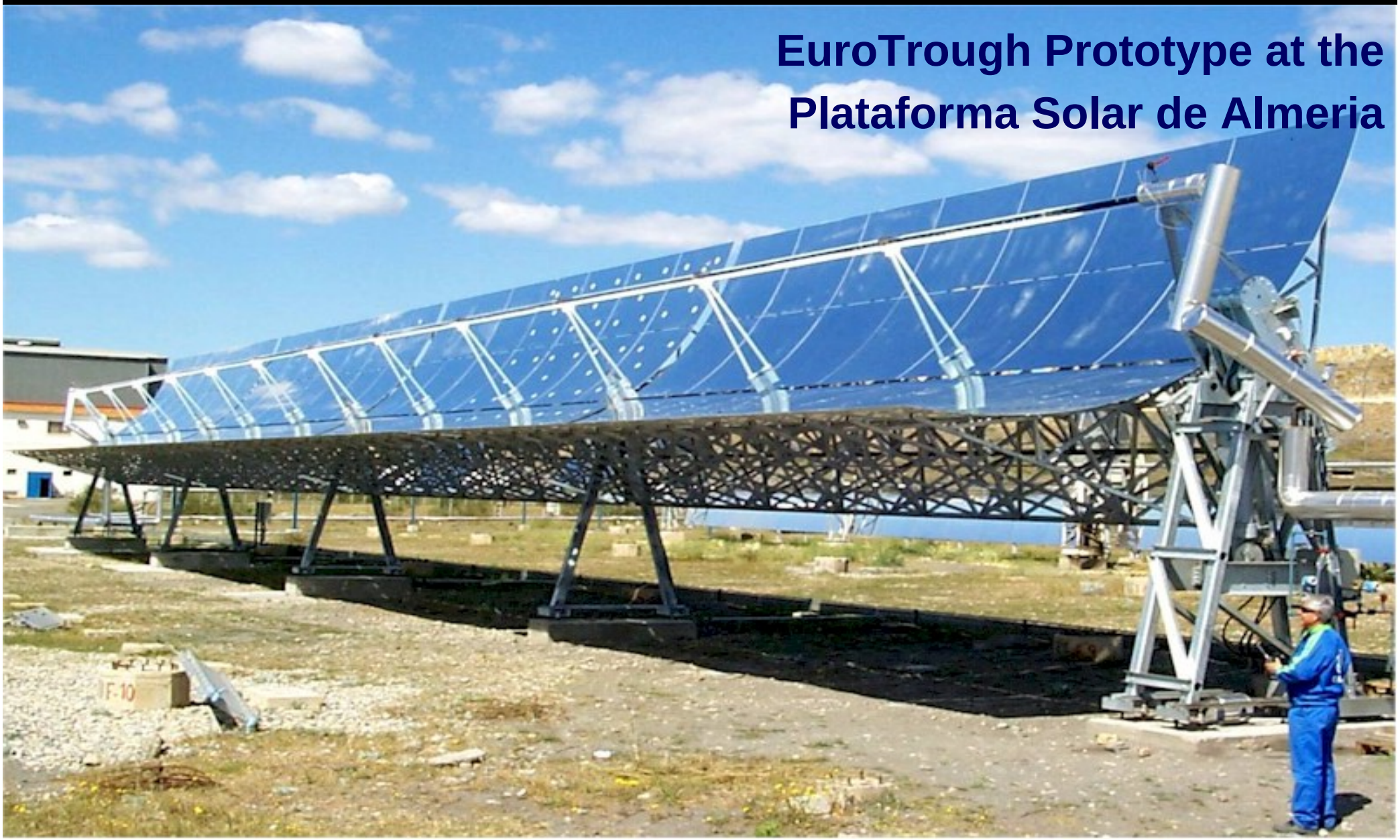
1996-2000 DISS Direct Solar Steam from Troughs at the Plataforma Solar de Almeria

Ciemat

SolarPACES

EuroTrough Prototype at the Plataforma Solar de Almeria



4500m² SKAL-ET Testloop at Kramer Junction

1 MW ORC plant at Saguaro Power Plant south of Phoenix, AZ. Solargenix, APS

Archimide

Grande Progetto Solare Termodinamico

molten salts
parabolic trough
ISCC power plants

ENEA

ENEA's Molten Salts Test Facility at Casaccia, Rome

ENEA proved feasibility of 550°C/290°C Molten Salt Trough

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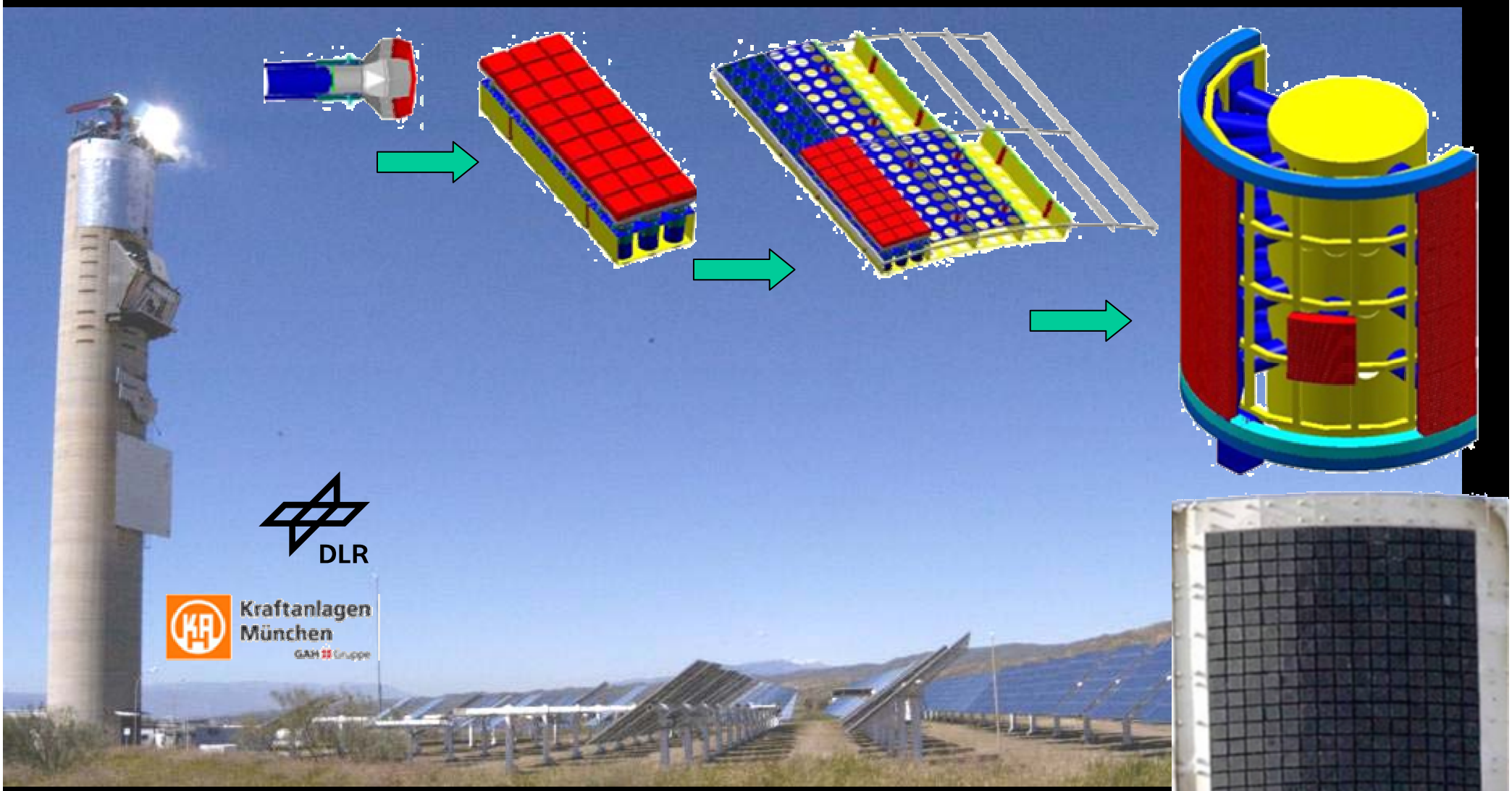
Fresnel Collectors

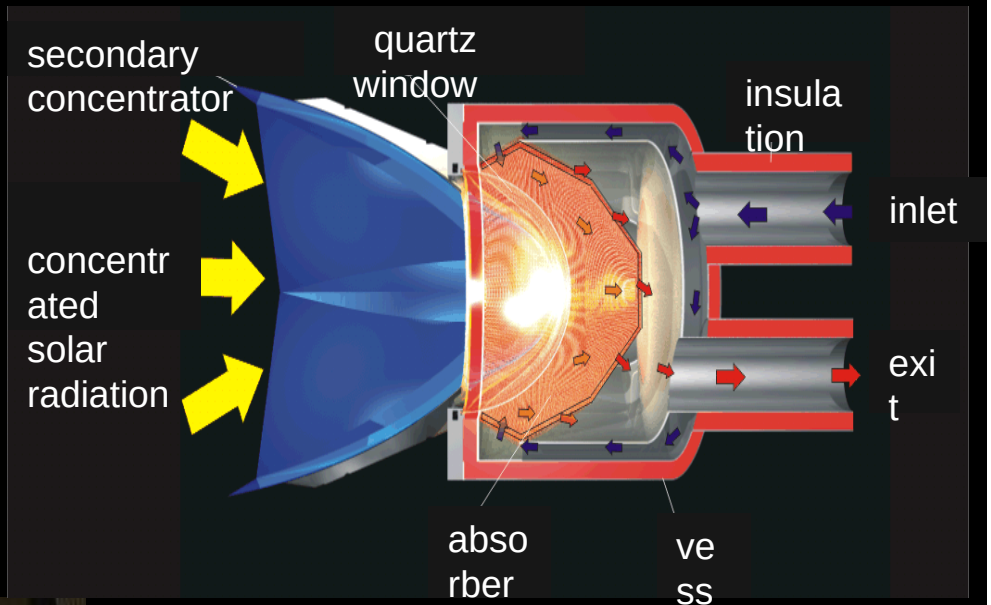
John Marcheff Solar Project at Lidell Coal Power Station, Australia

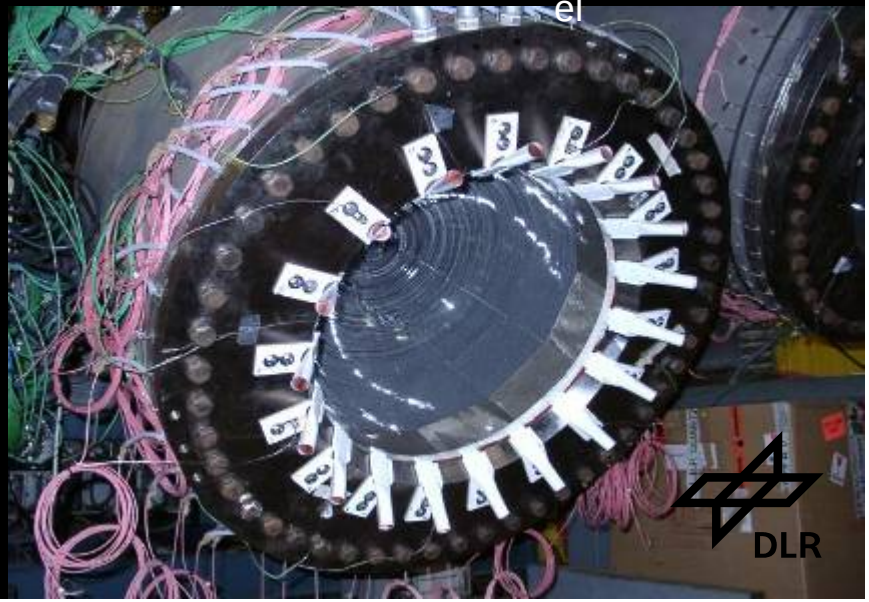


SOLAIR Open Air Receiver at Plataforma Solar

SolarPACES

SOLGATE
250kW Solar Gas Turbine
Plataforma Solar





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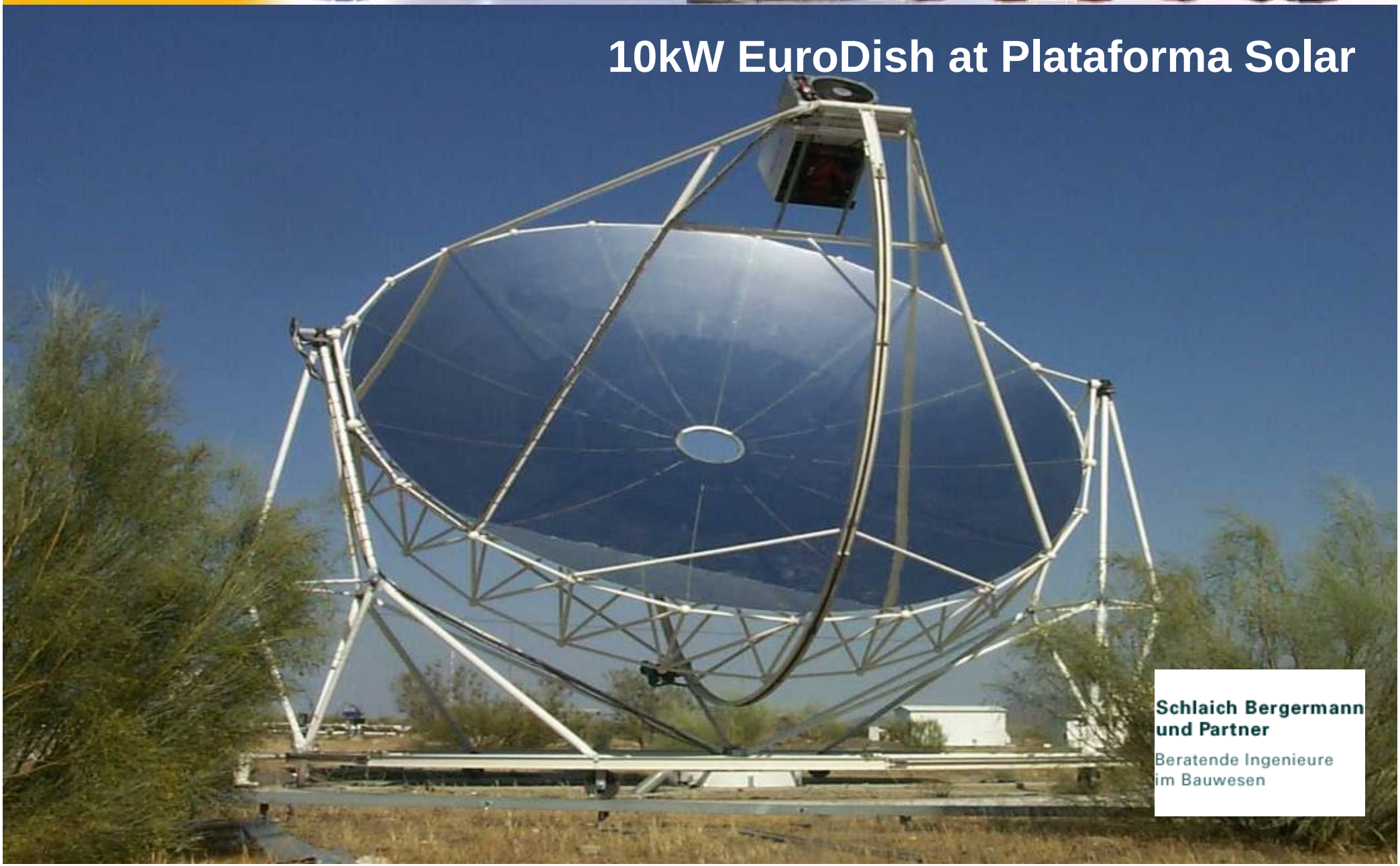
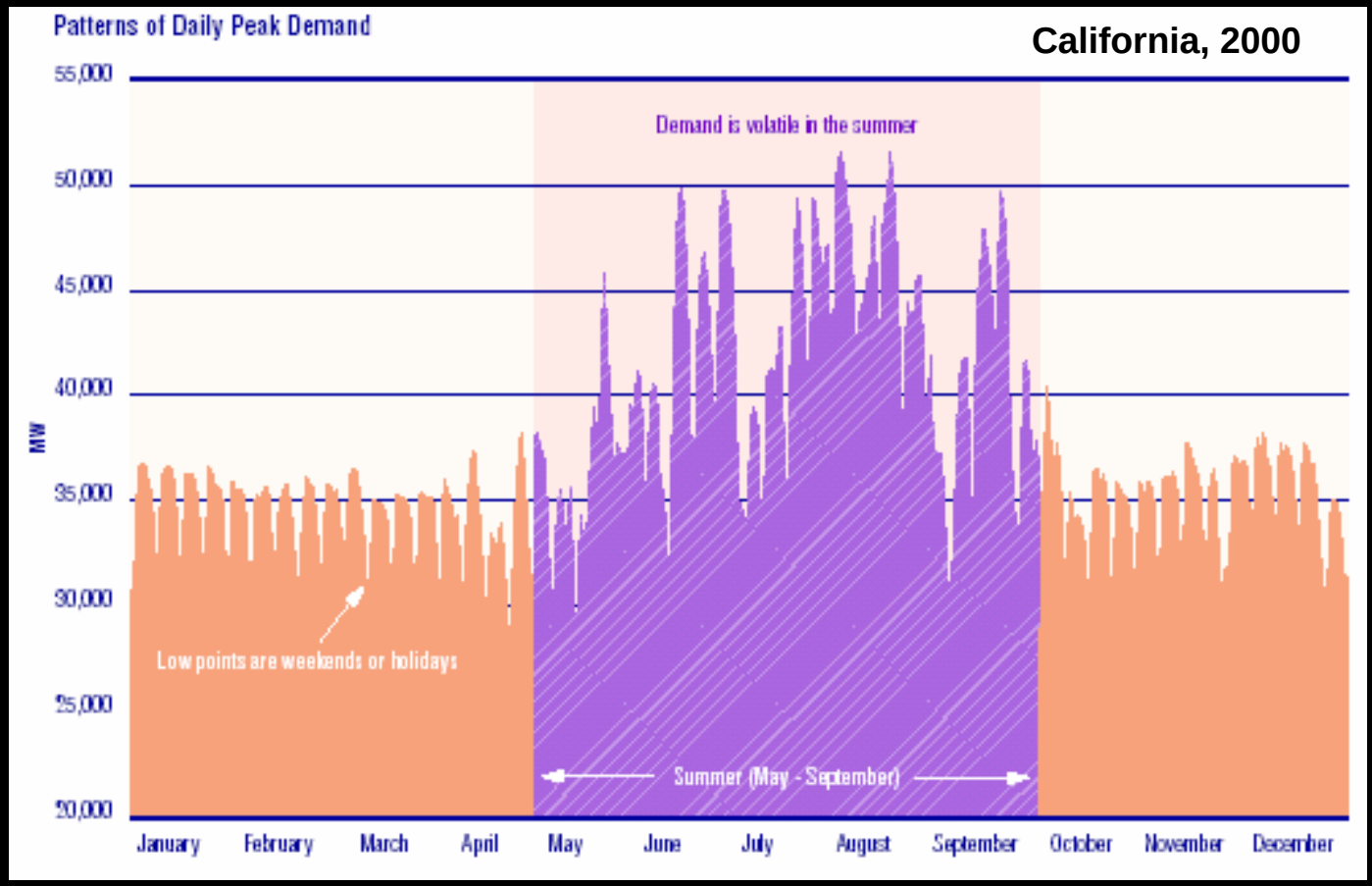
10kW EuroDish at Plataforma Solar



Schlaich Bergermann und Partner

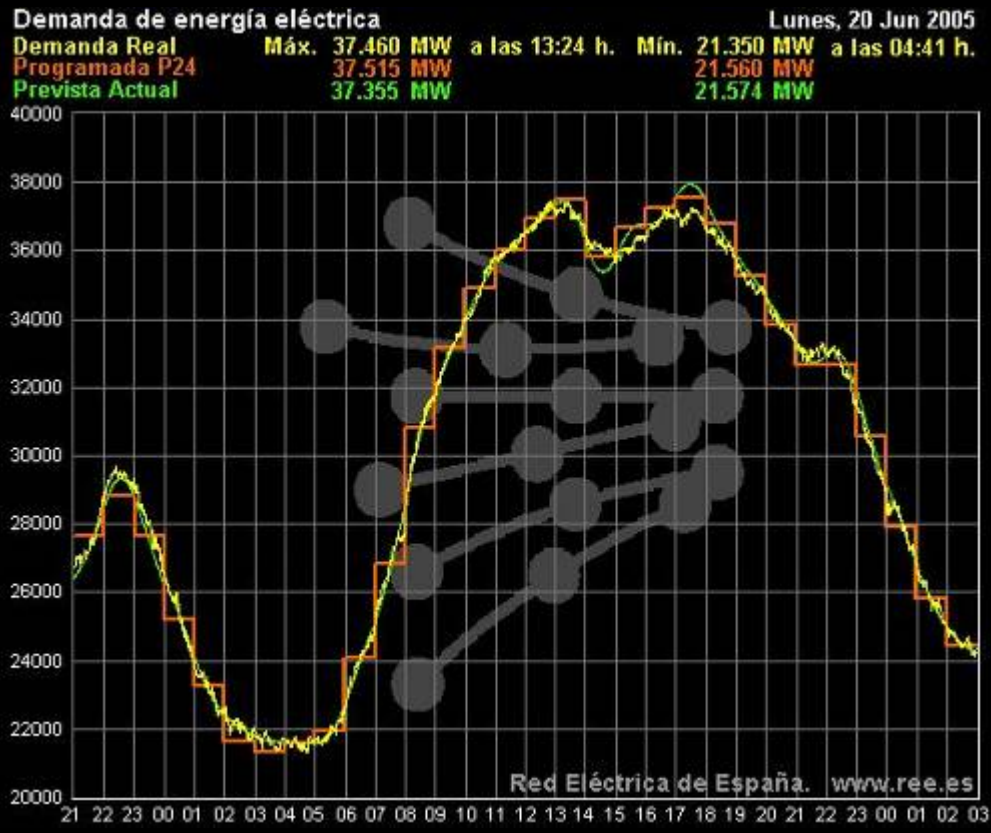
Beratende Ingenieure im Bauwesen

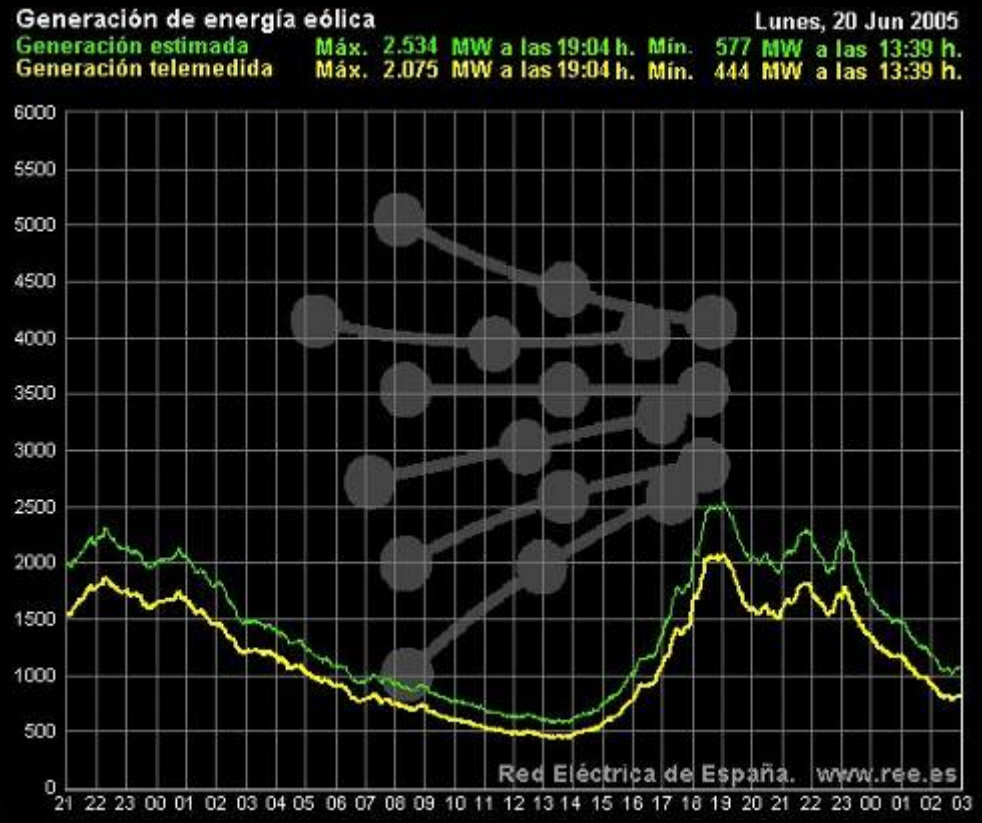
2000: Summerly airconditioning demand starts rocketing world wide, linked with housing construction boom



Solar thermal can supply peak power in summerly heat periods when hydro and wind are scarce

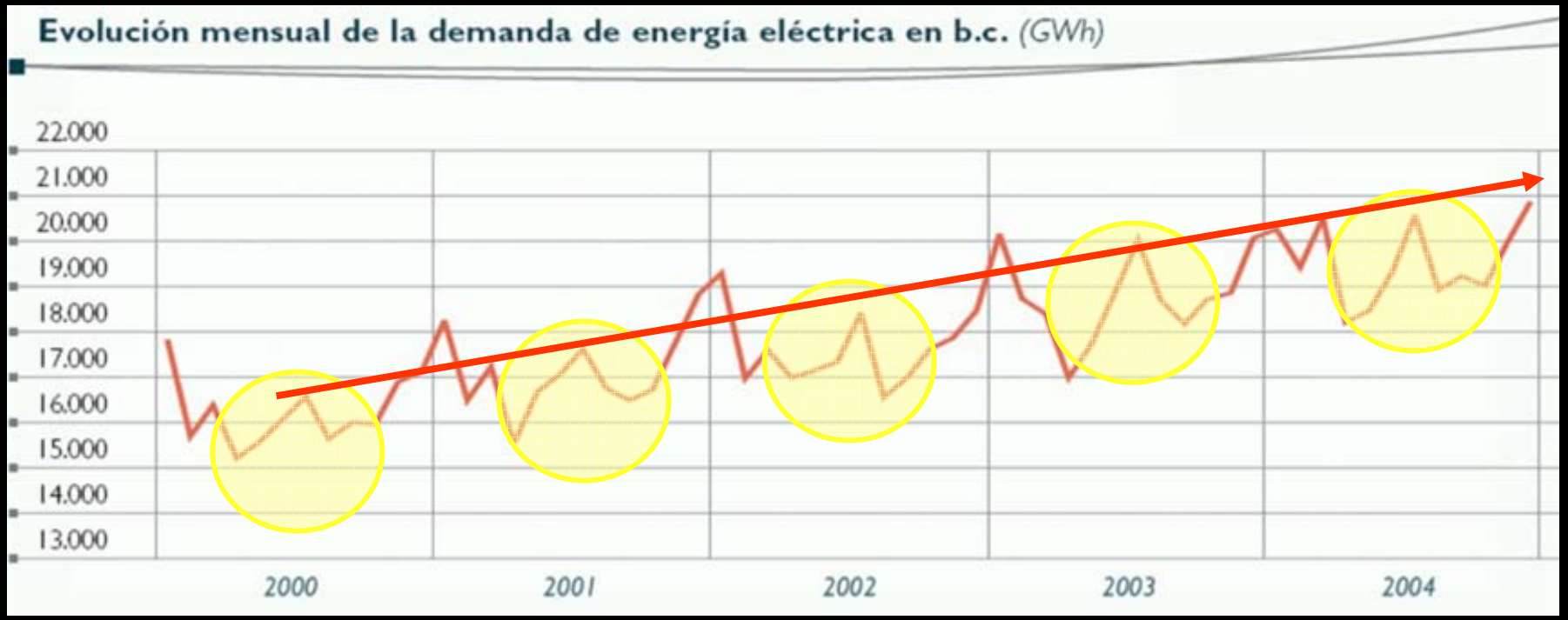
Record Summer Peak in Spain 2005



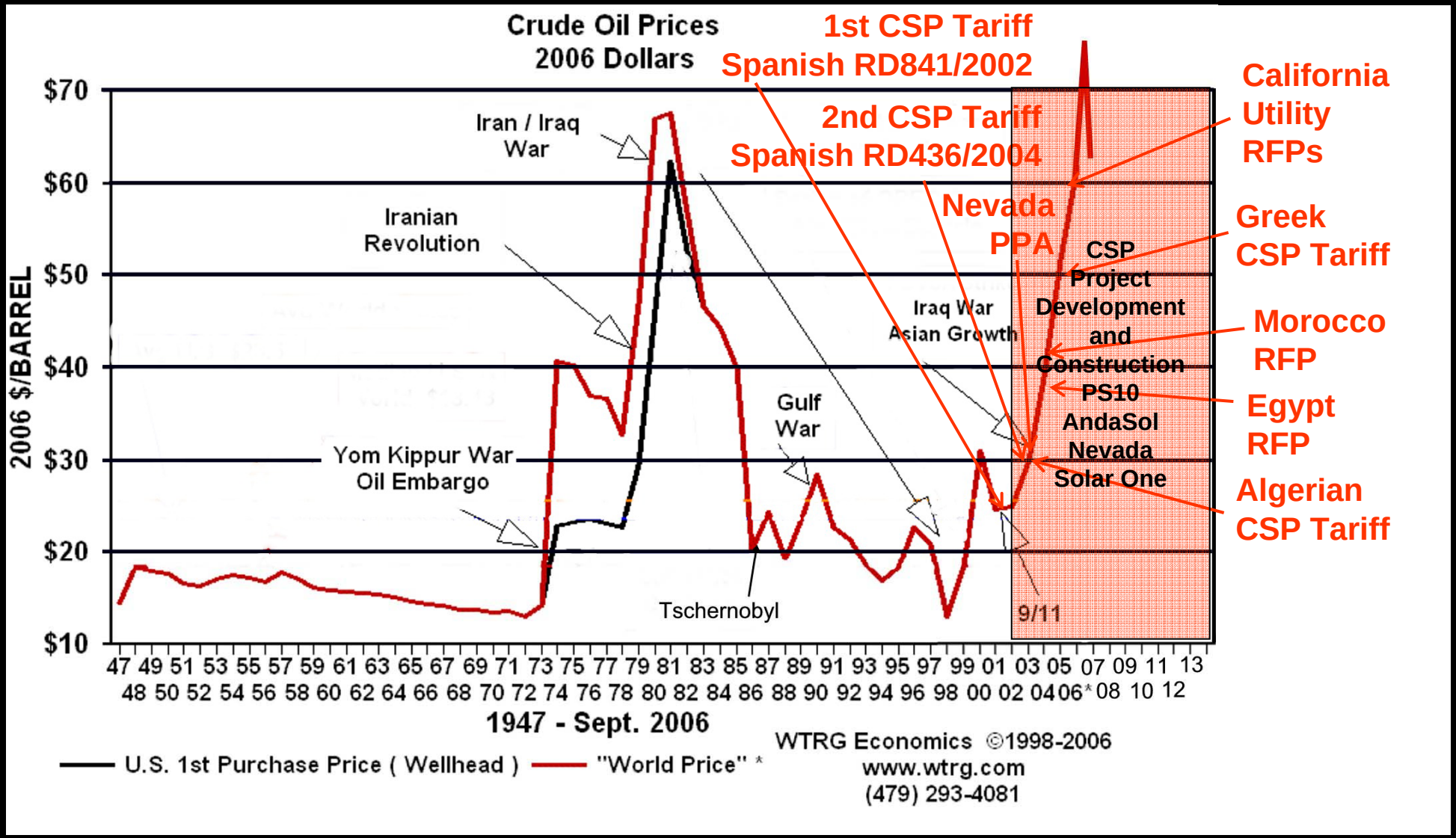


- Solar thermal can supply firm and dispatchable peak power in summerly heat periods when hydro and wind are scarce

Growth of Spanish Peak Demand 2000-2004



Second Market Chance for CSP



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:

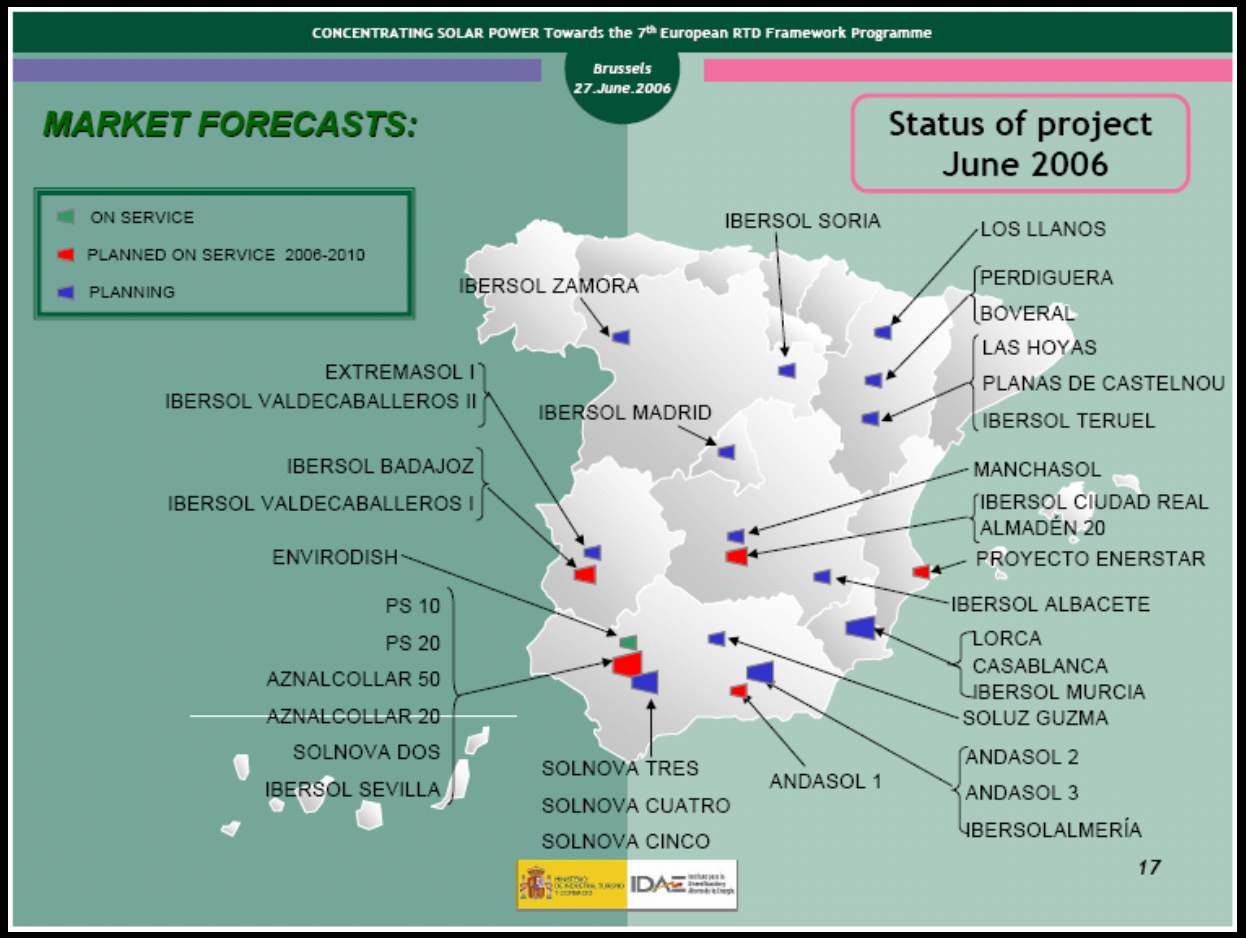
Tarifa: 300 por ciento durante los primeros 25 años desde su puesta en marcha y 240 por ciento a partir de entonces.
Prima: 250 por ciento durante los primeros 25 años desde su puesta en marcha y 200 por ciento a partir de entonces.
Incentivo: 10 por ciento.

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 200MW tariff will be revised for subsequent plants to achieve cost reduction

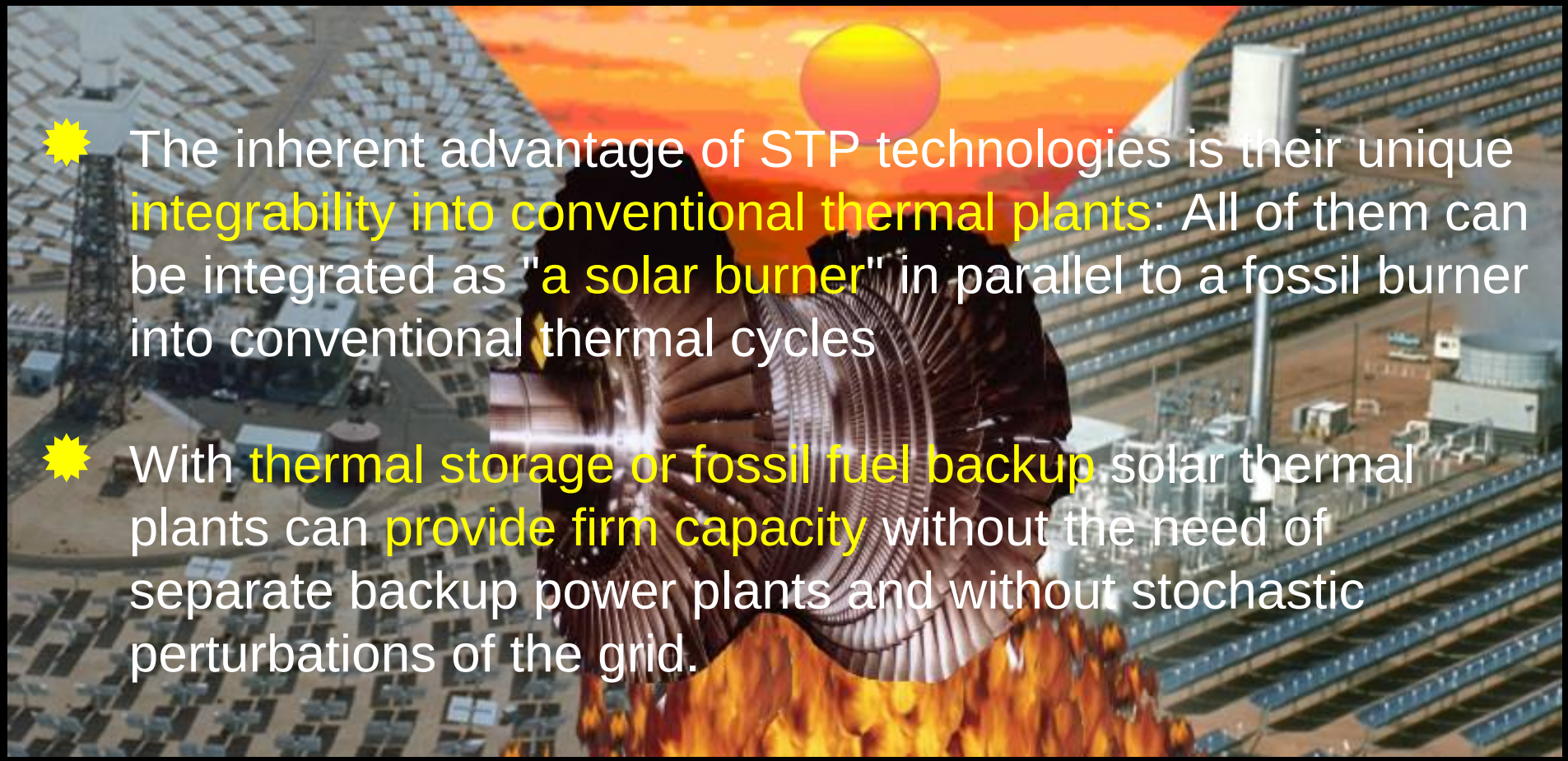
Spanish CSP Feed-In Law Boosts CSP Projects



- Within 3 months after publication of RD436, half a dozen new CSP projects started development
- The new contractors are willing to take the risk of full EPC guarantees
- High interest of investors from utility sector to participate in equity
- Competition of commercial banks for financing
- New players ready to offer in GEF projects, since now they see a home market

International CSP Project Developments

Key Advantages of CSP?



- The inherent advantage of STP technologies is their unique integrability into conventional thermal plants: All of them can be integrated as "a solar burner" in parallel to a fossil burner into conventional thermal cycles
- With thermal storage or fossil fuel backup solar thermal plants can provide firm capacity without the need of separate backup power plants and without stochastic perturbations of the grid.

Looking into the Glass Ball for the Future CSP Developments

- Support and Monitor CSP Plants
- Improve and Reduce Costs of CSP Components
- Build Global DNI Database
- Advance CSP Technology for Output Improvement and Cost Reduction
- Reduce Cooling Water Needs
- Develop Solar Water Treatment Technologies
- Develop Solar Hydrogen Technologies
- Develop Markets, Financing, Regulations in the Global Market Initiative
- Make CSP Known Globally

.

THANK YOU!

More Information at

www.solarpaces.org