# CSP Technologies
# Projects in EUMENA

**European Solar Thermal Electricity Association**

**Dr. Nikolaus Benz**

**EUROMED Solar Workshop**
***October 12, 2008***

European Solar Thermal Electricity Association

ESTELA

# What's ESTELA ?

- A European Industry Association
- Constituted in June 2007
- Created to support the emerging European industry for the construction of solar thermoelectric power plants in Europe and abroad, mainly in the Mediterranean region (EUMENA)
- Involves all main actors in Europe
- Is based in Brussels in EREC house

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# CSP is Utility Scale Power

| | | |
|---|---|---|
| **Solar use** | **direct radiation** | **direct and diffuse radiation** |
| **Size** | **10 MW ... 250MW** | **1 W .. 10 MW** |
| **Installation** | **flat rural land** | **everywhere** |
| **Capacity** | **2000 – 7000 h/year (storage)** | **700 - 2000 h/year** |
| **Back up** | **internal, fuel (gas, bio mass)** | **grid (external)** |
| **Life time** | **> 20 years** | **> 20 years** |
| **Generation cost (today)** | **0.15 .. 0.25 €/kWh** | **0.25 .. 0.50 €/kWh** |

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# CSP Technology

## provides sustainable, clean and reliable Power from 10 MW to 250 MW

**Parabolic Trough:**
- Size: 50 - 250 MW
- proven utility scale technology
- commercial operation since 1984
- preferred technology for new plants in USA/Spain/MENA

**Solar Tower:**
- Size: 50 - 100 MW
- Demo plants built in 80‘s
- First commercial 10 MW plant in operation in Spain
- New 20 MW almost completed
- Larger projects announced in USA

**Linear Fresnel:**
- Size 50 - 200 MW
- in development

**Dish Stirling:**
- Size 25 kW (modular)
- few installations operating
- applications competing with PV

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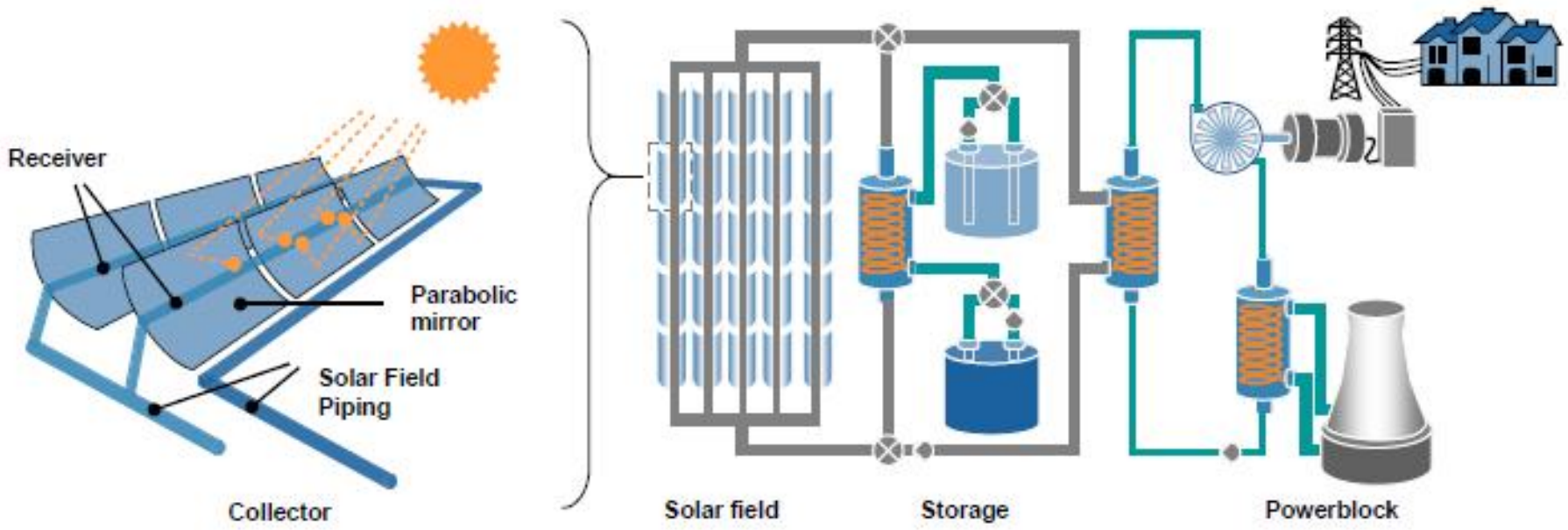
# Todays leading technology: Parabolic Trough

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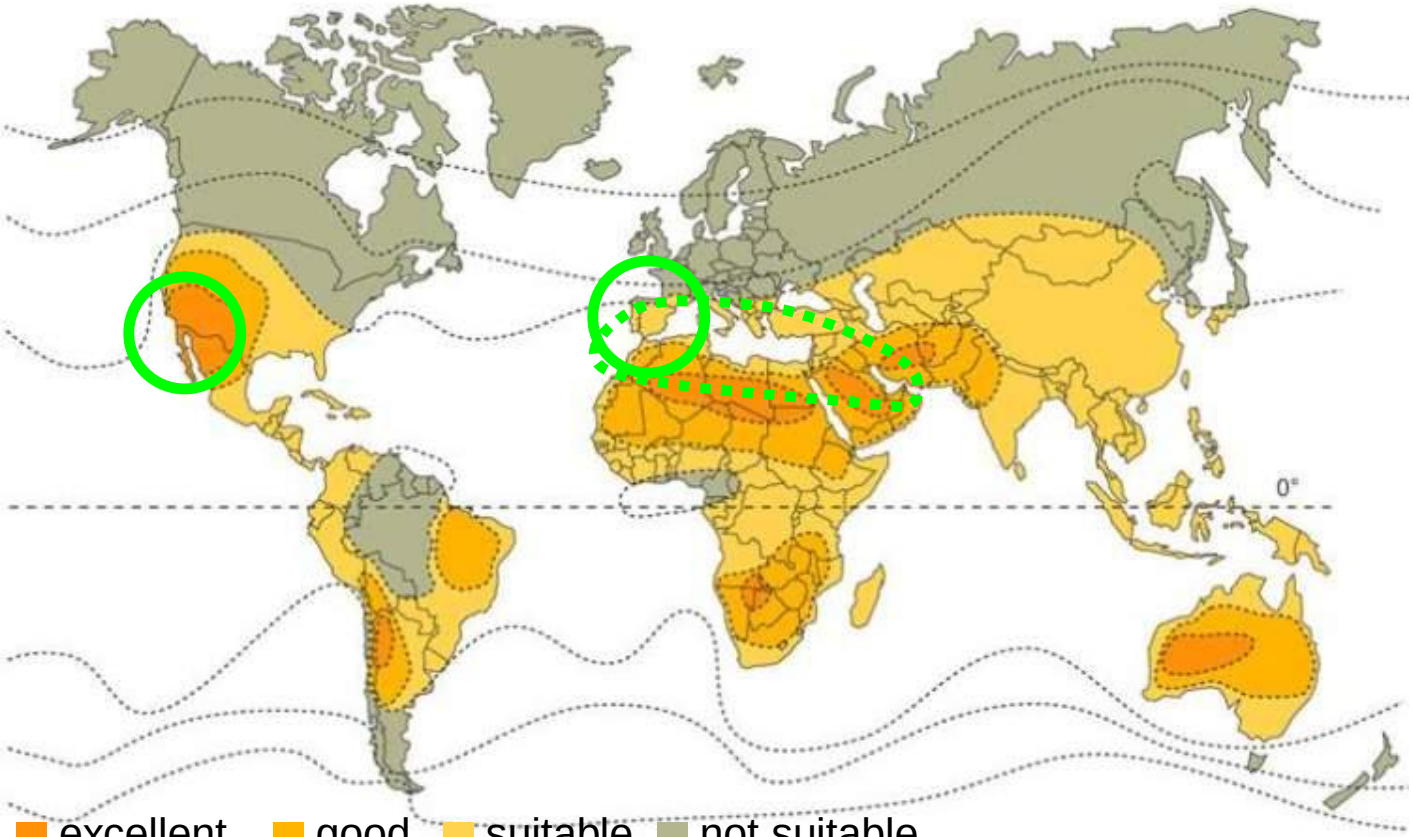
# Current and Future Markets




excellent good suitable not suitable

Source: Solar Millennium AG, Erlangen

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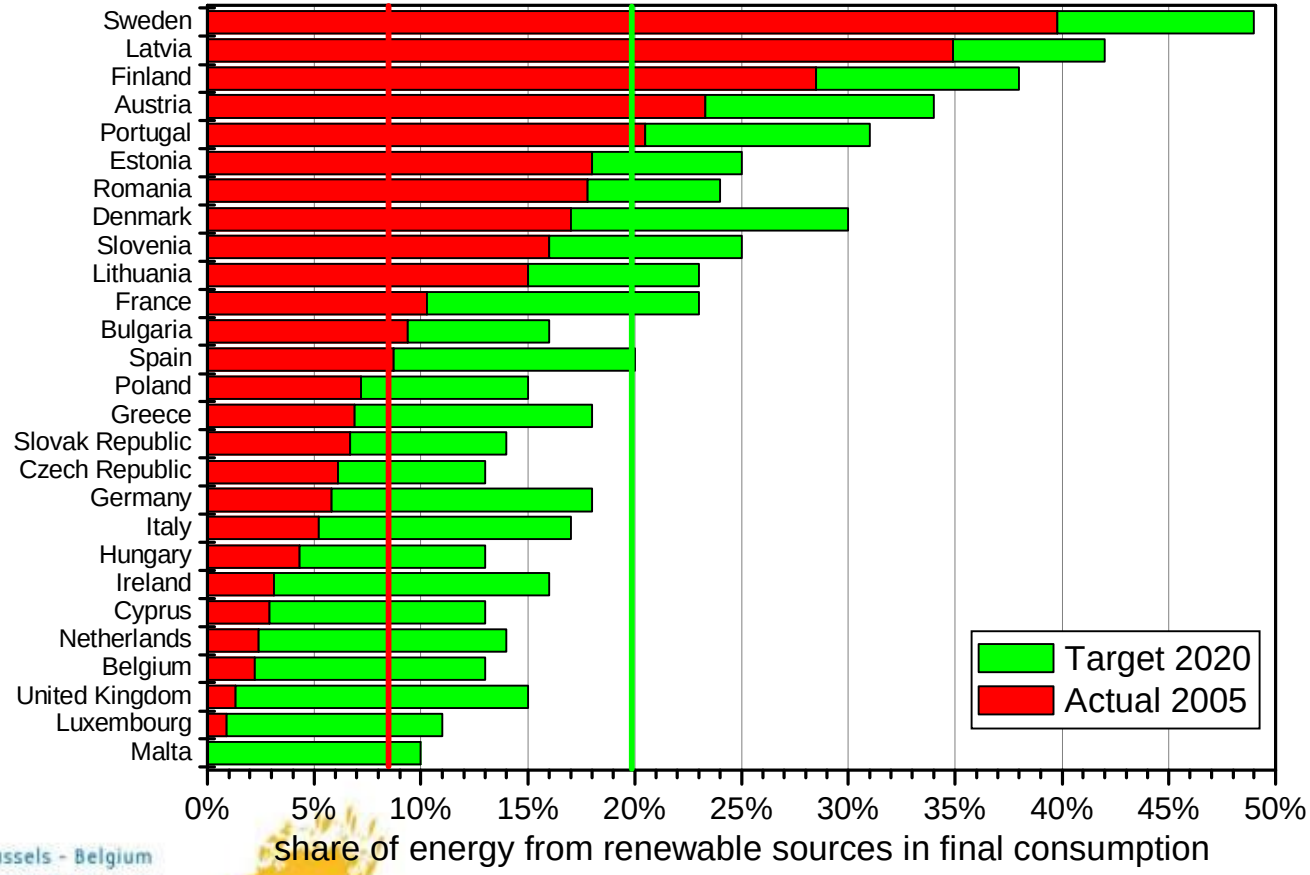
# Renewable Energy goals in Europe

**EU-Draft Directive 2008**: Renewable Energy 2020:

- 20% of final energy
- 34% of electricity (05: 15%) = 1200 TWh in 2020

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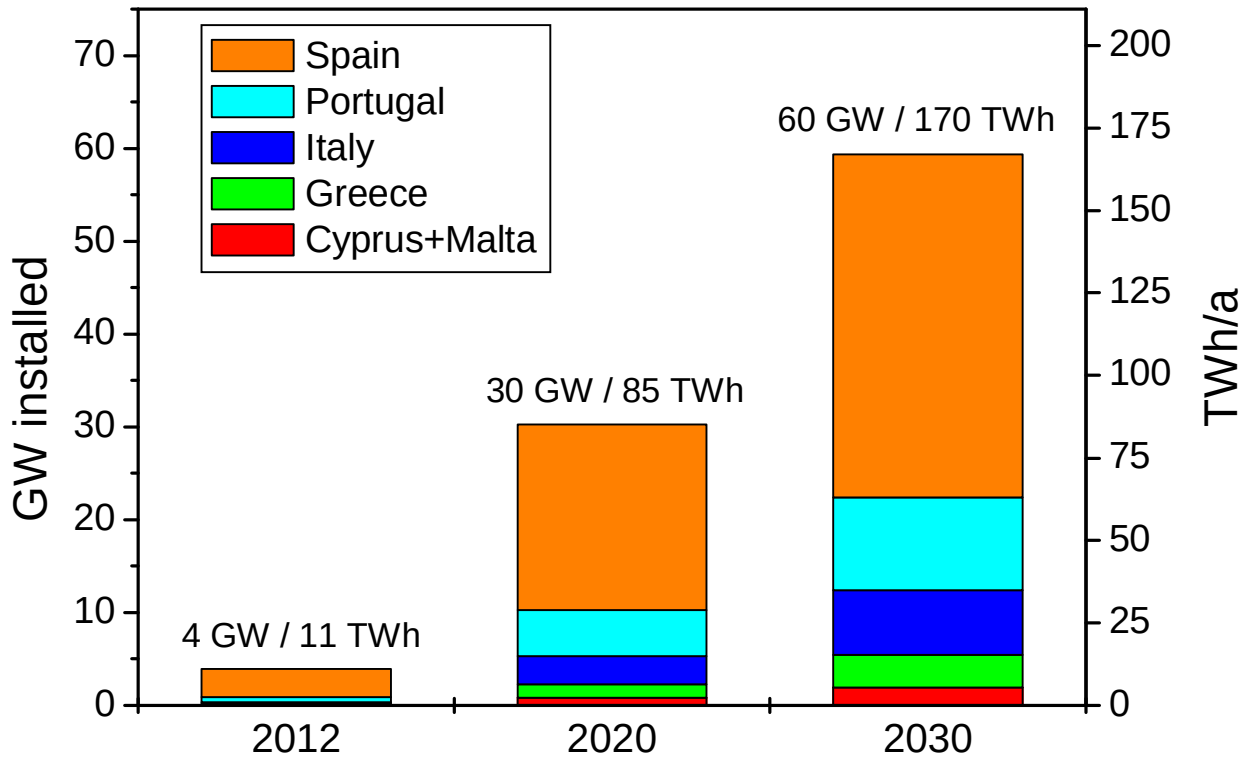
# Roadmap for CSP Plants

Potential of CSP in Europe:
installed capacity and annual energy production

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# Spain: feed-in law is driver

## CSP projects in Spain

| Loc | Central | Emplazamiento | Potencia | Estado |
|---|---|---|---|---|
| 1 | PS10 | Sanlúcar la Mayor (Sevilla) | 11 MW | En operación |
| 2 | Aznalcollar TH | Sanlúcar la Mayor (Sevilla) | 0,08 MW | En operación |
| 3 | PS20 | Sanlúcar la Mayor (Sevilla) | 20 MW | En construcción |
| 4 | Solnova 1 y 3 | Sanlúcar la Mayor (Sevilla) | 50+50 MW | En construcción |
| 5 | ESI | (Sevilla) | 0,01 MW | En operación |
| 6 | Lebrija | Lebrija (Sevilla) | 50 MW | En construcción |
| 7 | Andasol 1 y 2 | Aldeire-LaCalahorra (Granada) | 50+50 MW | En construcción |
| 8 | Palma del Rio I | Palma del Rio (Córdoba) | 50 MW | En construcción |
| 9 | Puertollano | Puertollano (Ciudad Real) | 50 MW | En construcción |
| 10 | Manchasol 1 | Alcázar de San Juan (Ciudad Real) | 50 MW | En construcción |
| 11 | Alvarado | Alvarado (Badajoz) | 50 MW | En construcción |
| 12 | Extresol 1 y 2 | Torre de Miguel Sesmero (Badajoz) | 50+50 MW | En construcción |
| 13 | Gemasolar | Fuentes de Andalucía (Sevilla) | 17 MW | En construcción |

- 3 plants in operation
- 10 under construction
- about 100 in development

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# Spain: Towers of Abengoa Solar

PS 10 (11MW) and
PS 20 (20 MW)

- in total 1878 heliostats (120 m² each)
- towers height 100 m and 160 m
- 73 GWh/y to feed about 16.000 spanish households
- 19.000 to/y $CO_2$ saved

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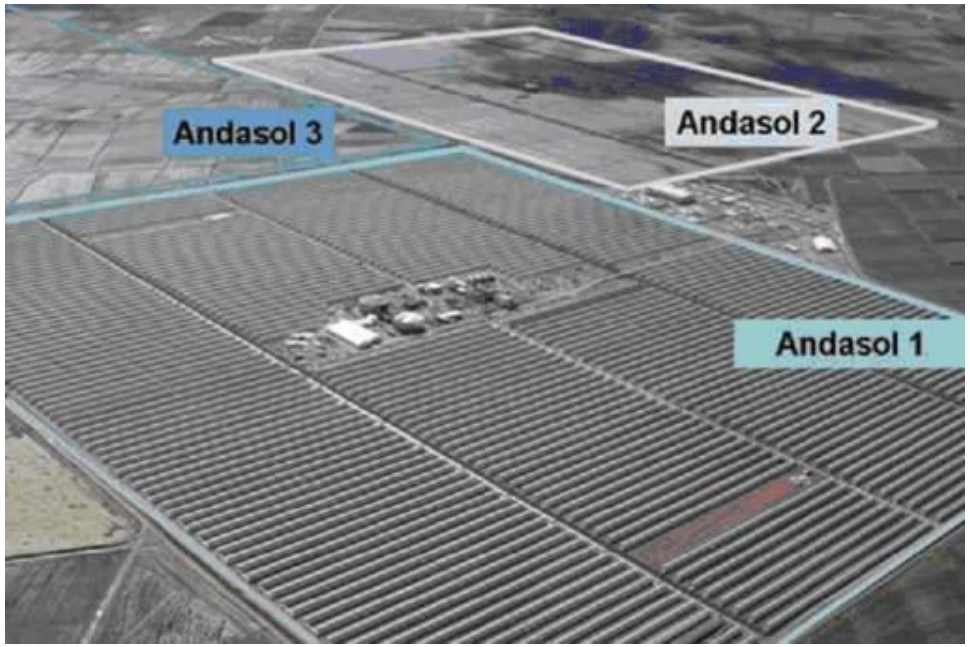
# Spain: Andasol 1-2-3




- Promoted by ACS-Cobra and SolarMillennium
- largest parabolic trough plant
- 3x 50 MW with 7.5 h storage
- ~ 1.5 Mio m² mirror area
- 3 x 180 GWh/year
- 450.000 to/y $CO_2$ saved

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# MENA

## First Projects in a Promising Future Market

- ISCCS Plants in Morocco, Egypt and Algeria with small solar share
- Morocco and Egypt funded by GEF
- Project in Abu Dhabi in development

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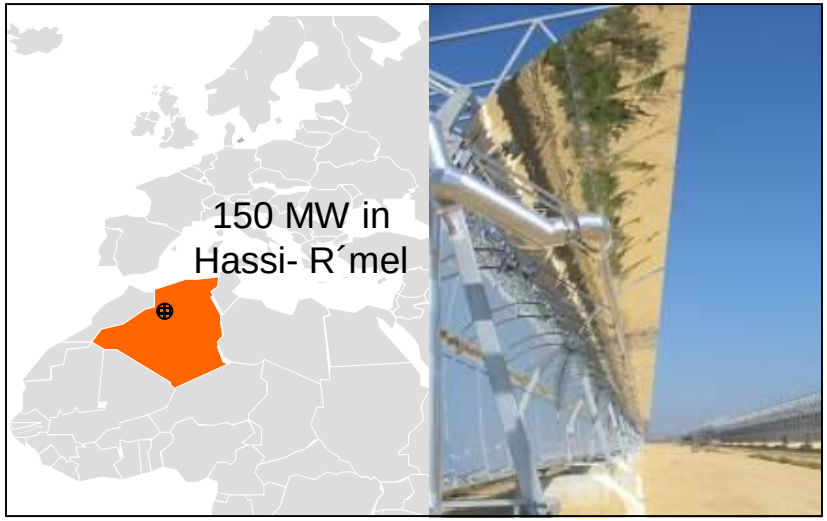
# ISCC plants in Algeria and Morocco




## ISCC in Algeria 150 MWe

- First combined cycle with solar trough field under construction
- 20 MW solar, rest from natural gas
- 180,000 $m^2$ of reflective surface
- Promoted by Abengoa Solar and NEAL

## ISCC in Morocco 470 MWe

- Largest combined cycle with solar trough field
- 20 MW solar, rest from natural gas
- 183,000 $m^2$ of reflective surface
- Project sponsored by World Bank
- Promoted by Abengoa Solar

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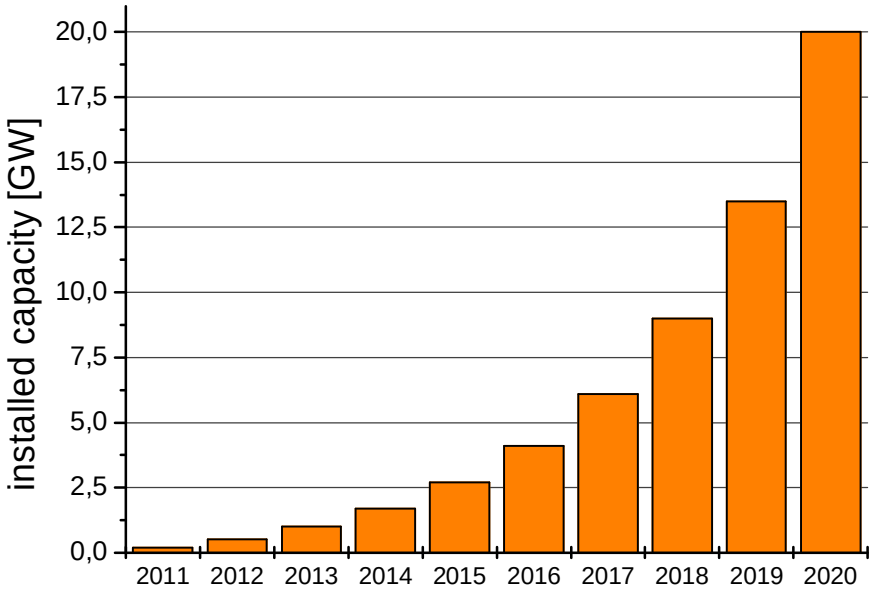
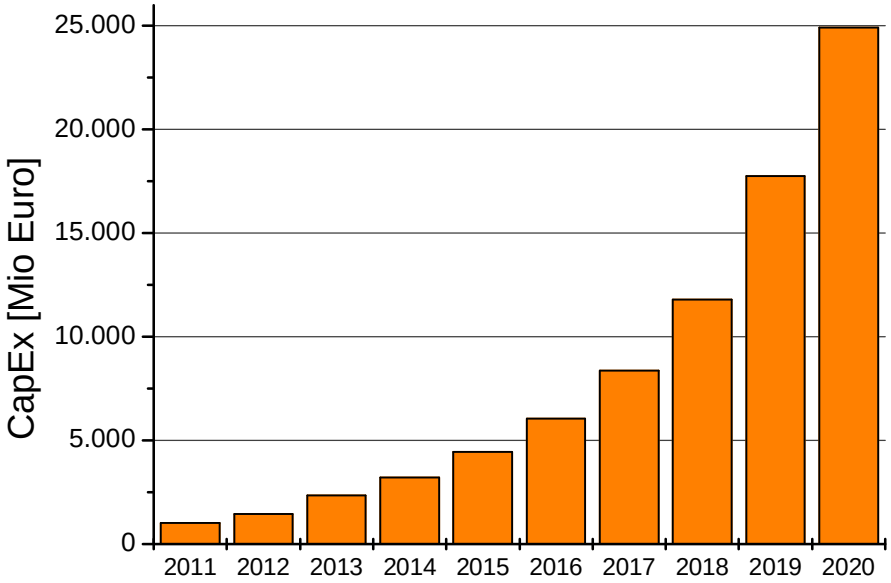
# Mediterranian Solar Power Initiative

## 20 GW until 2020




- total investment: 82.000 Mio Euro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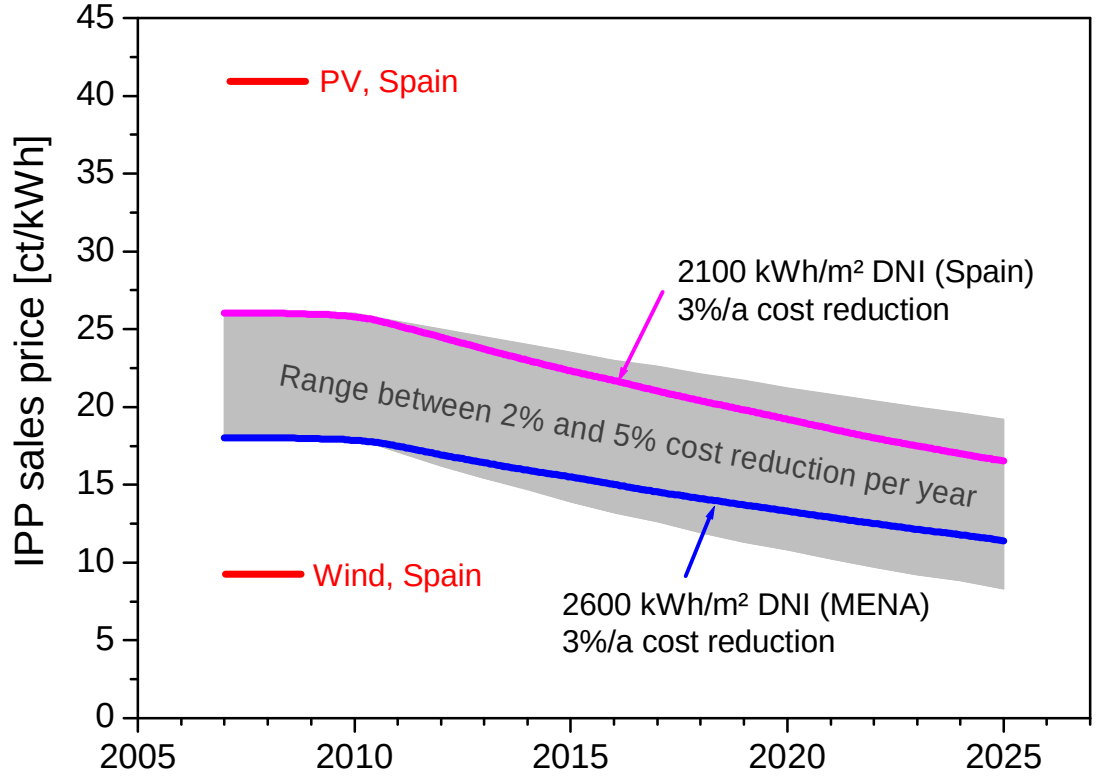
# Roadmap for CSP Plants

Estimated IPP baseline sales price for CSP in Europe and MENA.




**What brings the cost down?**

- Innovation in systems and components
- Improving production technology
- Increasing the overall efficiency
- Enlarging the number of operation hours
- Bigger power blocks
- Reducing the O & M costs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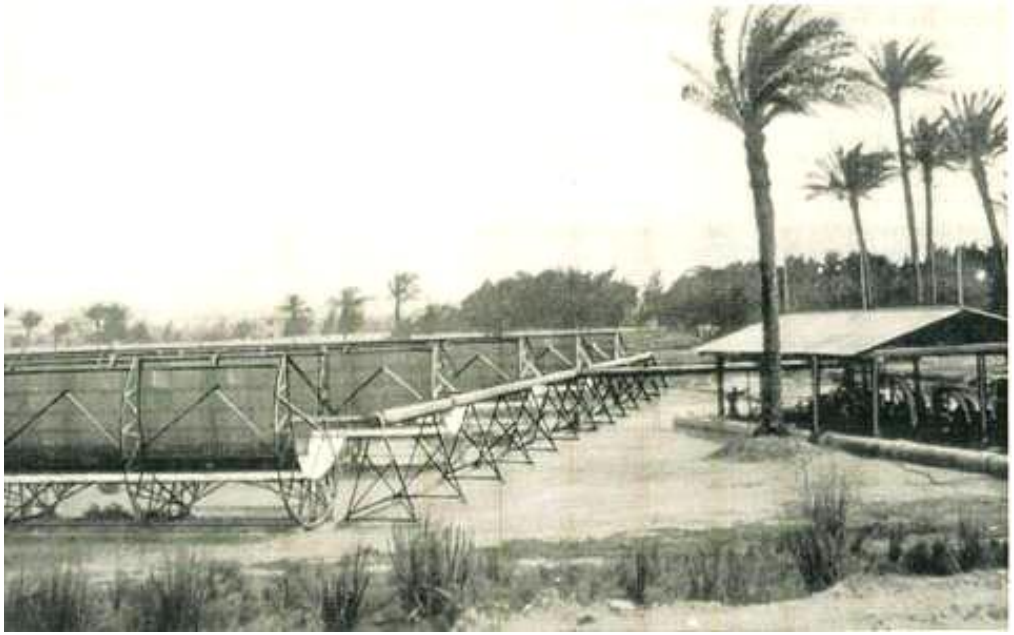
# Let's work on the return of CSP to MENA…



First Parabolic Trough plant of Shuman in Meadi near Cairo (1914)
5 rows 62 m each, steam turbine 120 HP

(technisches Archiv des Deutschen Museums)

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