



# Future Perspectives with CSP

## **EUMENA/ENERMENA**

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The SEPA-DESERTEC Int. Conference, September 2012, Gießen



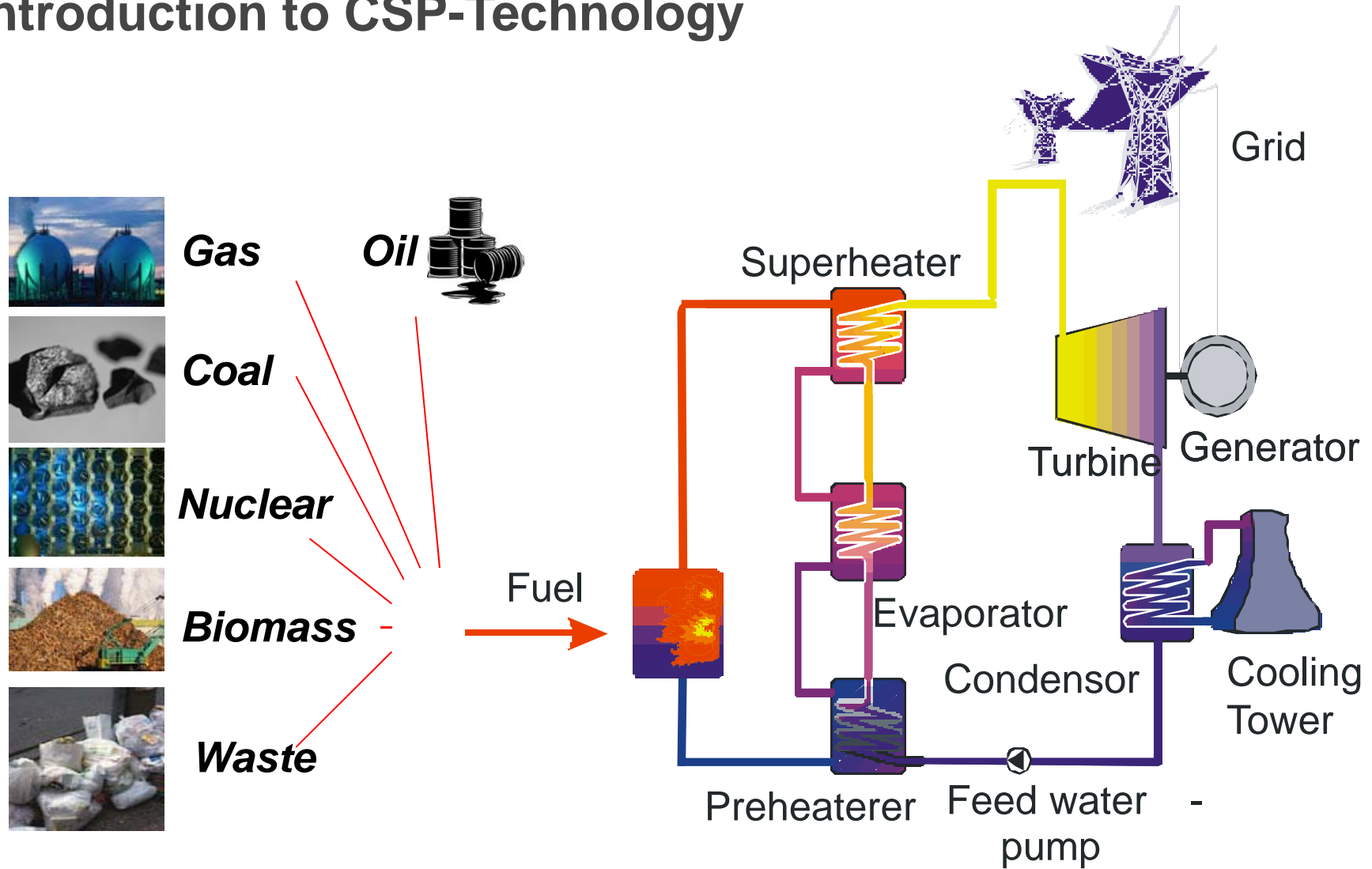
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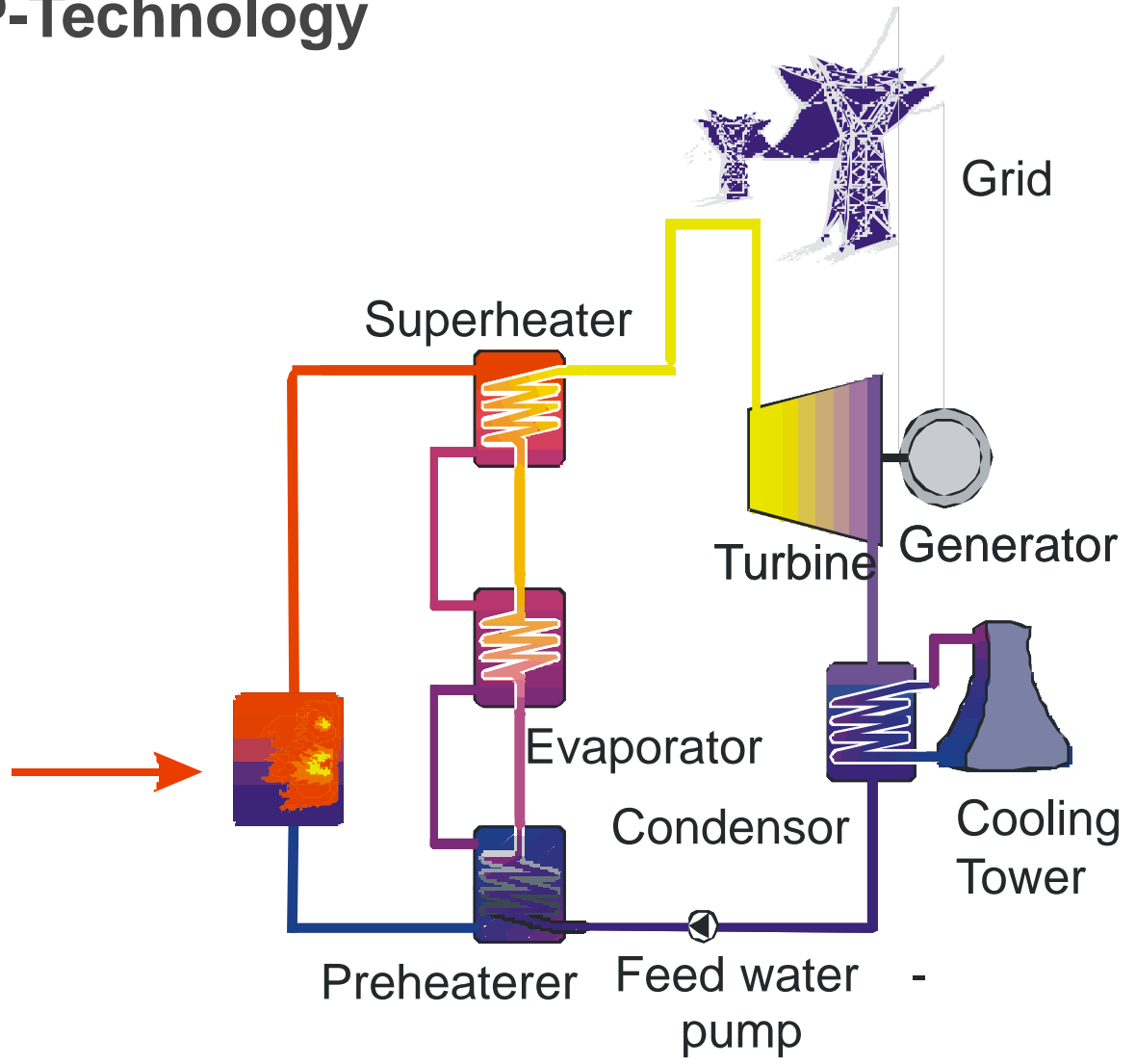
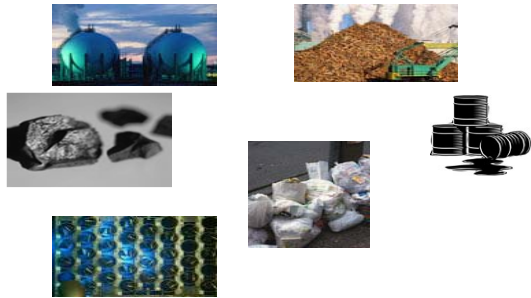
## Outline

- Introduction into CSP-Technology
- Why is CSP important for EU, MENA
- Current CSP-projects
- enerMENA – Support Initiative of the German Government

# Introduction to CSP-Technology

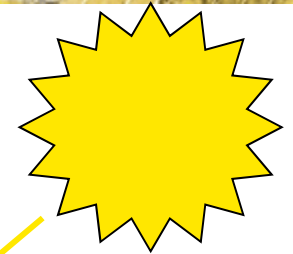


# Introduction to CSP-Technology



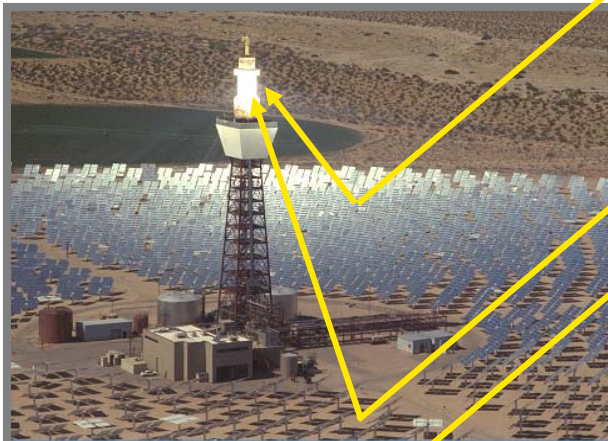


# Introduction to CSP-Technology



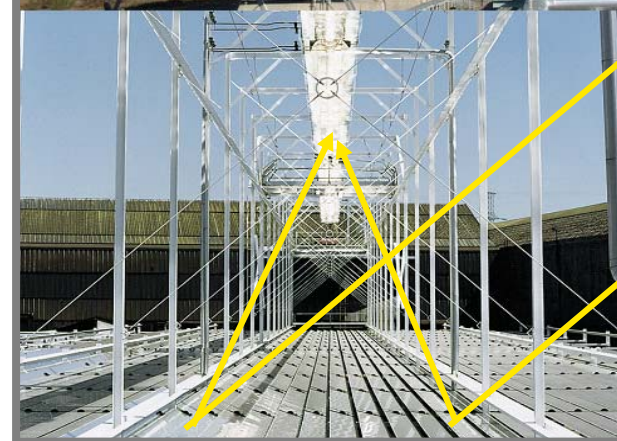
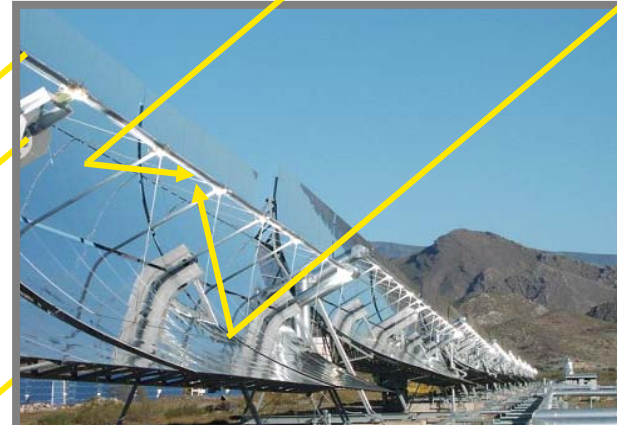
*Up to 1000° C Gas turbines, Motors*

*Solar tower (SNL)*



*Dish-Stirling (SBP)*

*Parabolic trough (PSA)*



*Linear Fresnel (MAN/SPG)*

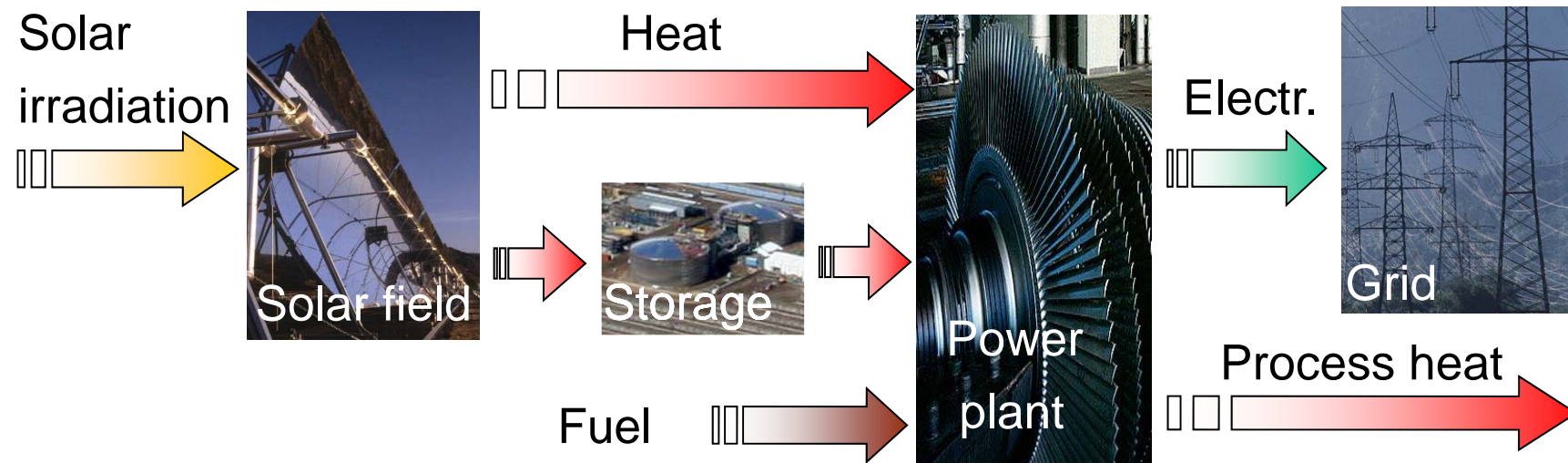
*Up to 550° C steam turbines*



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# Introduction to CSP-Technology



- optional thermal storage or hybrid operation
- heat extraction for process heat, cooling, seawater desalination

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- Introduction into CSP-Technology
  - **Why is CSP important for EUMENA**
  - Current CSP-projects
  - EnerMENA – Support Initiative of the German Government



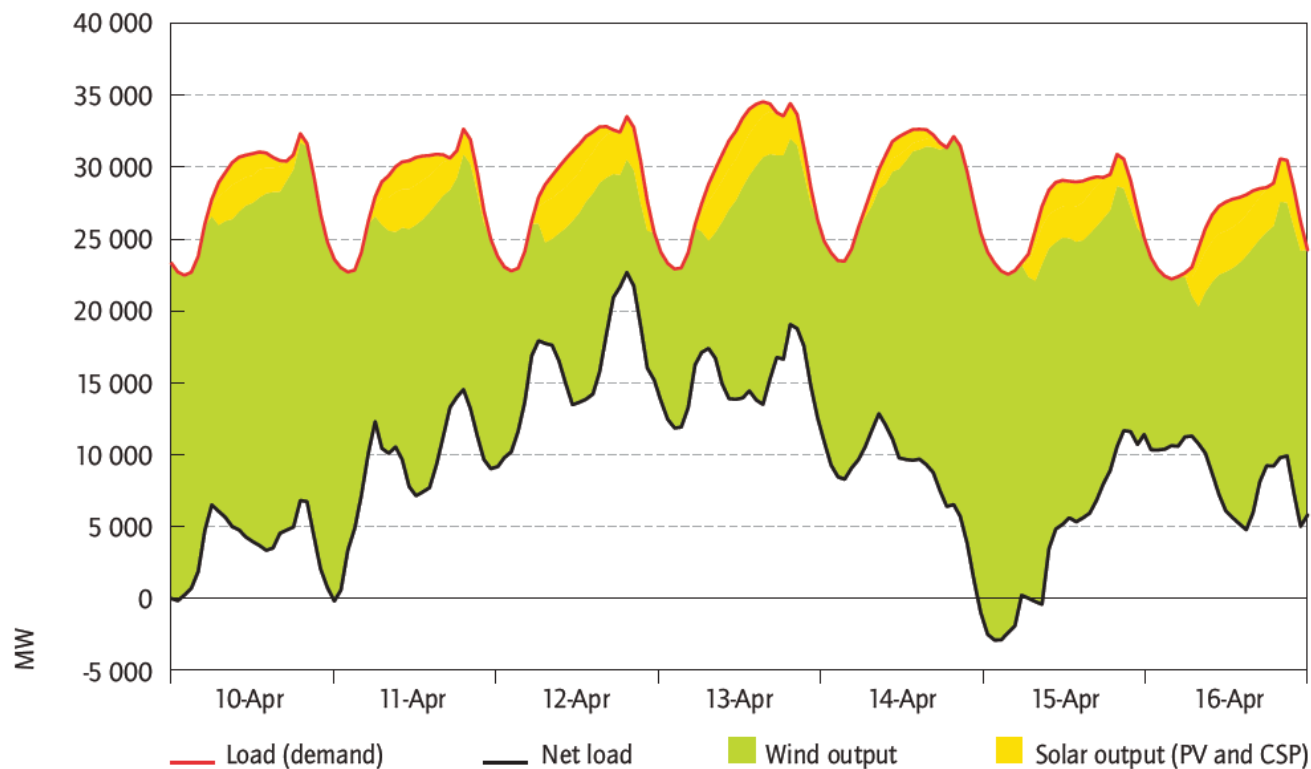
## Why is CSP important for EU and MENA

- The German Nuclear Power Exit Strategy
  - All Nuclear Power Stations will be switched off by 2022
- Energy Concept 2050: 100% Renewable Energy
- partial independence on Weather Conditions



# Why is CSP important for EU and MENA

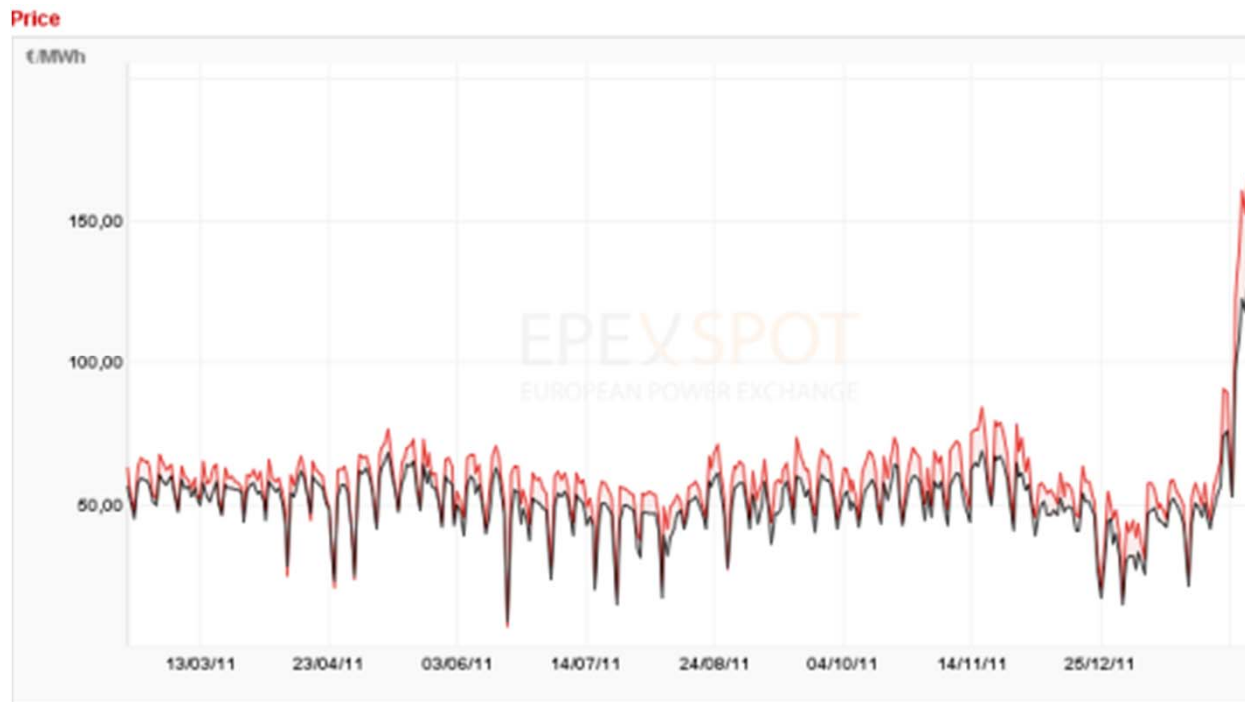
Flexibility problem from 35% wind and solar



Source: GE Energy, 2010.

# Why is CSP important for EU and MENA

Price peaks in the electricity market

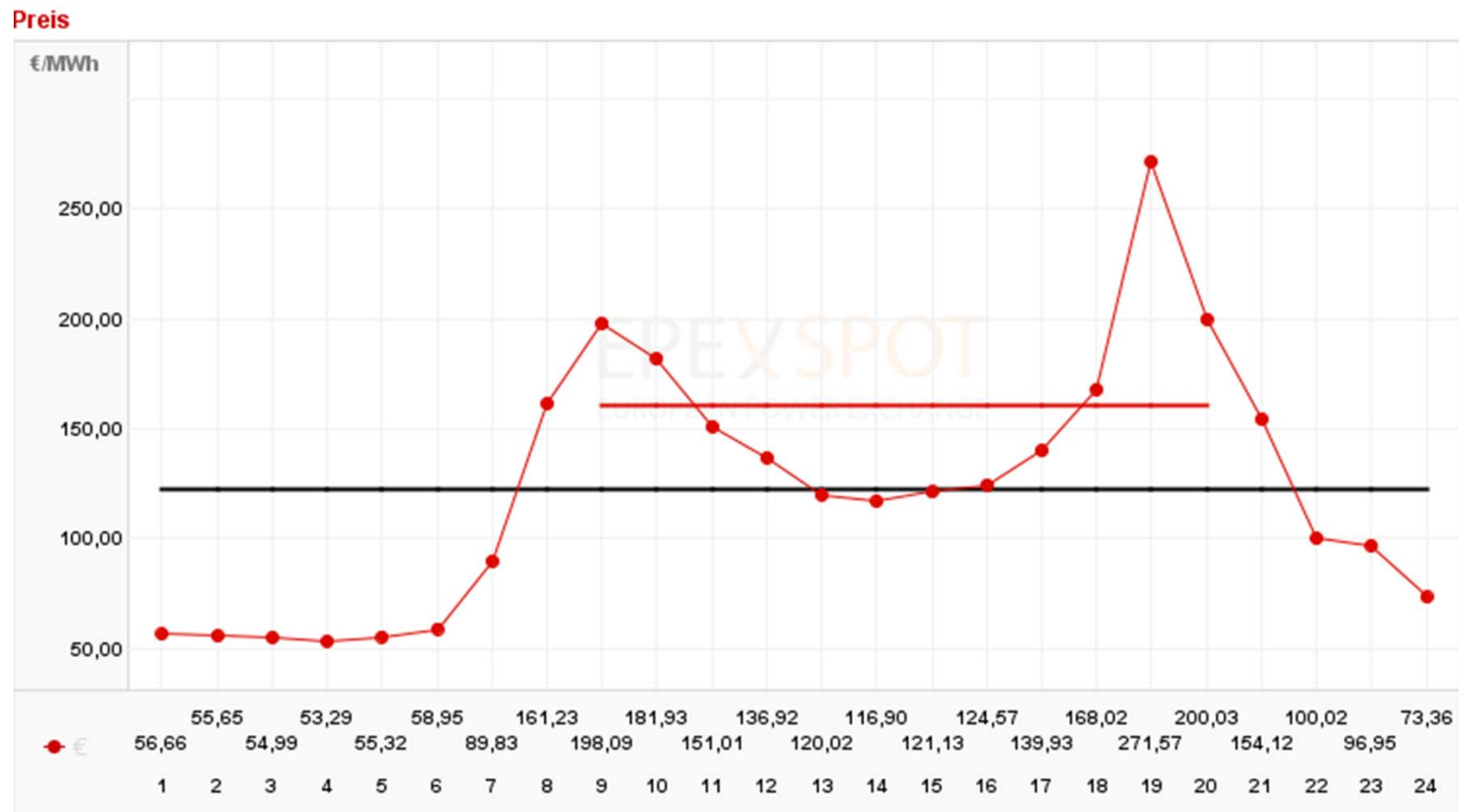


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enerMENA

# Why is CSP important for EU and MENA

Load peak caused by weather conditions, February 2, 2012



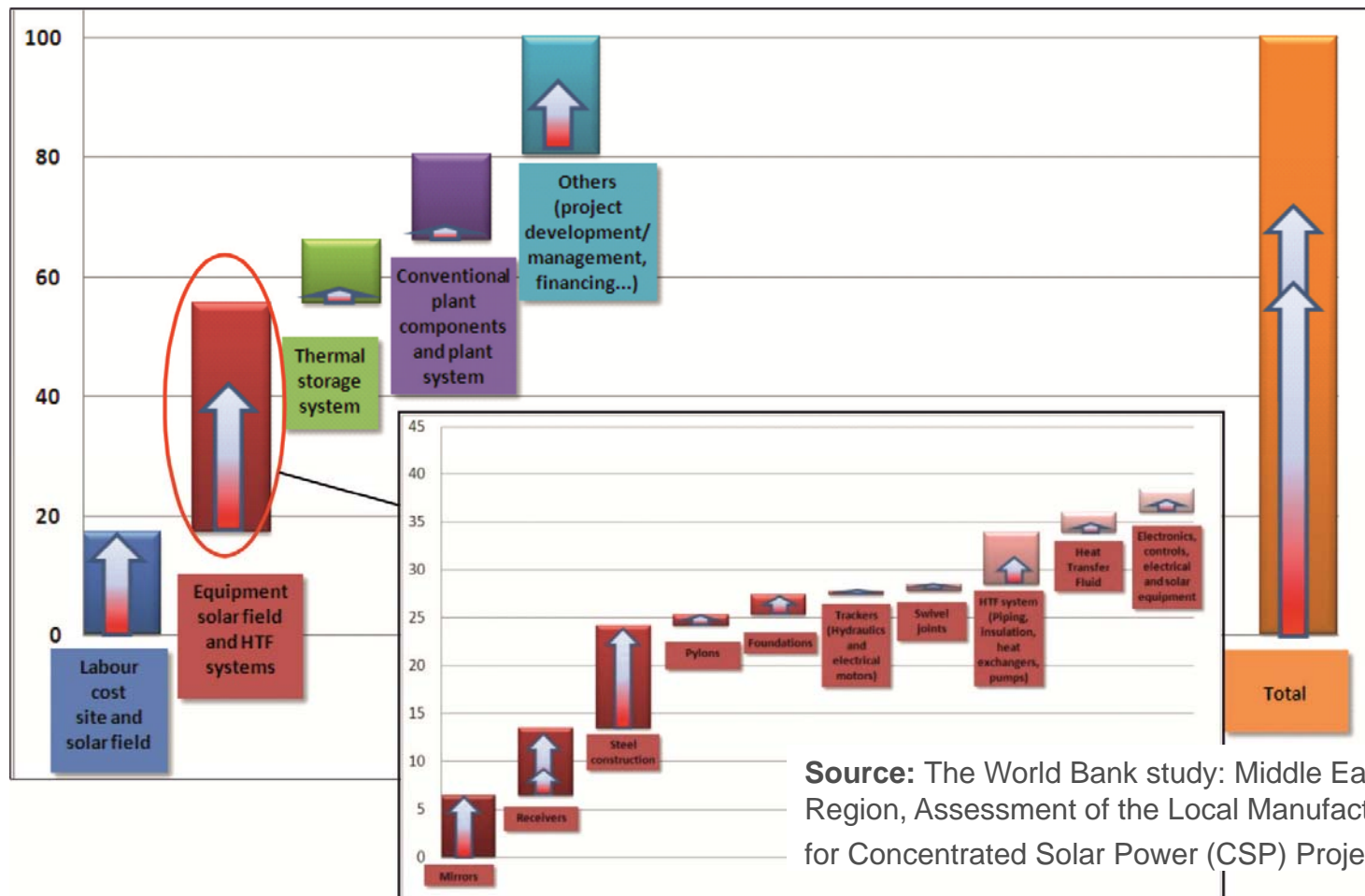


## Why is CSP important for EU and MENA

- Solar Thermal power plants with **thermal storage**
- The DESERTEC Concept
- EU-Mena partnerships
- Improvement of Infrastructure (HVDC lines)

# Why is CSP important for EU and MENA

## Local Manufacturing Potential



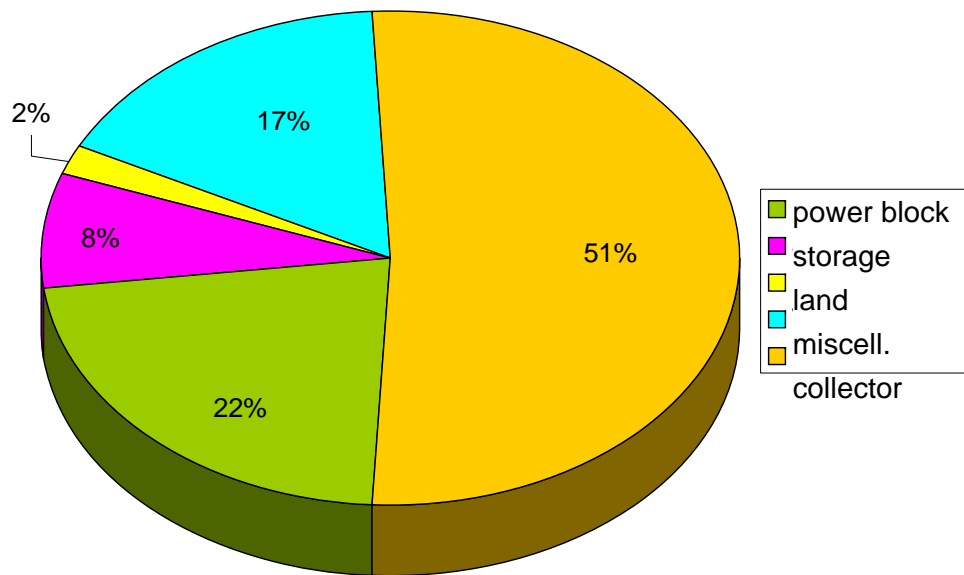
**Source:** The World Bank study: Middle East and North Africa Region, Assessment of the Local Manufacturing Potential for Concentrated Solar Power (CSP) Projects



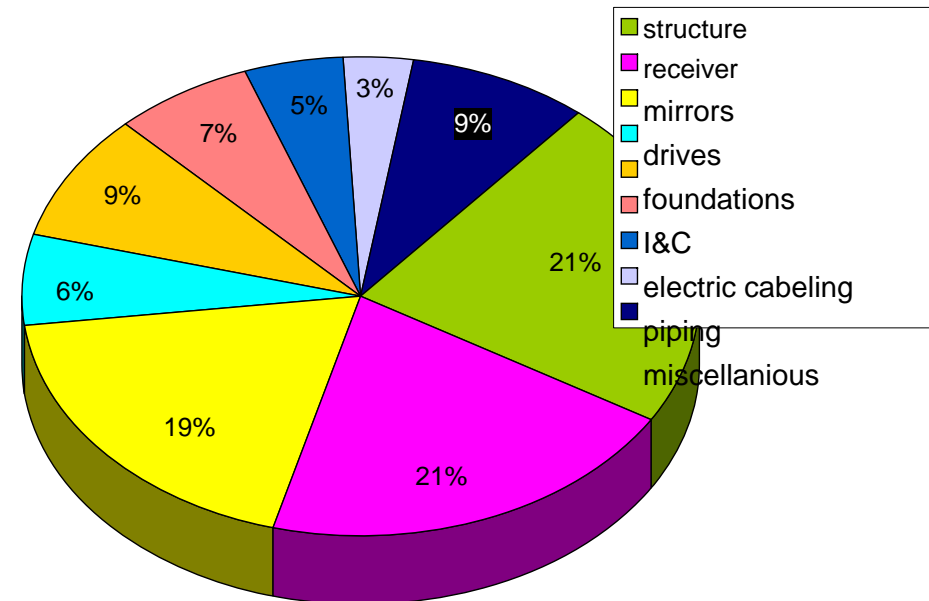
# Why is CSP important for EU and MENA

How can the local value be increased


- Solar thermal power plants feature a high fraction of conventional technologies in the value-added chain



Cost break-down parabolic trough plants

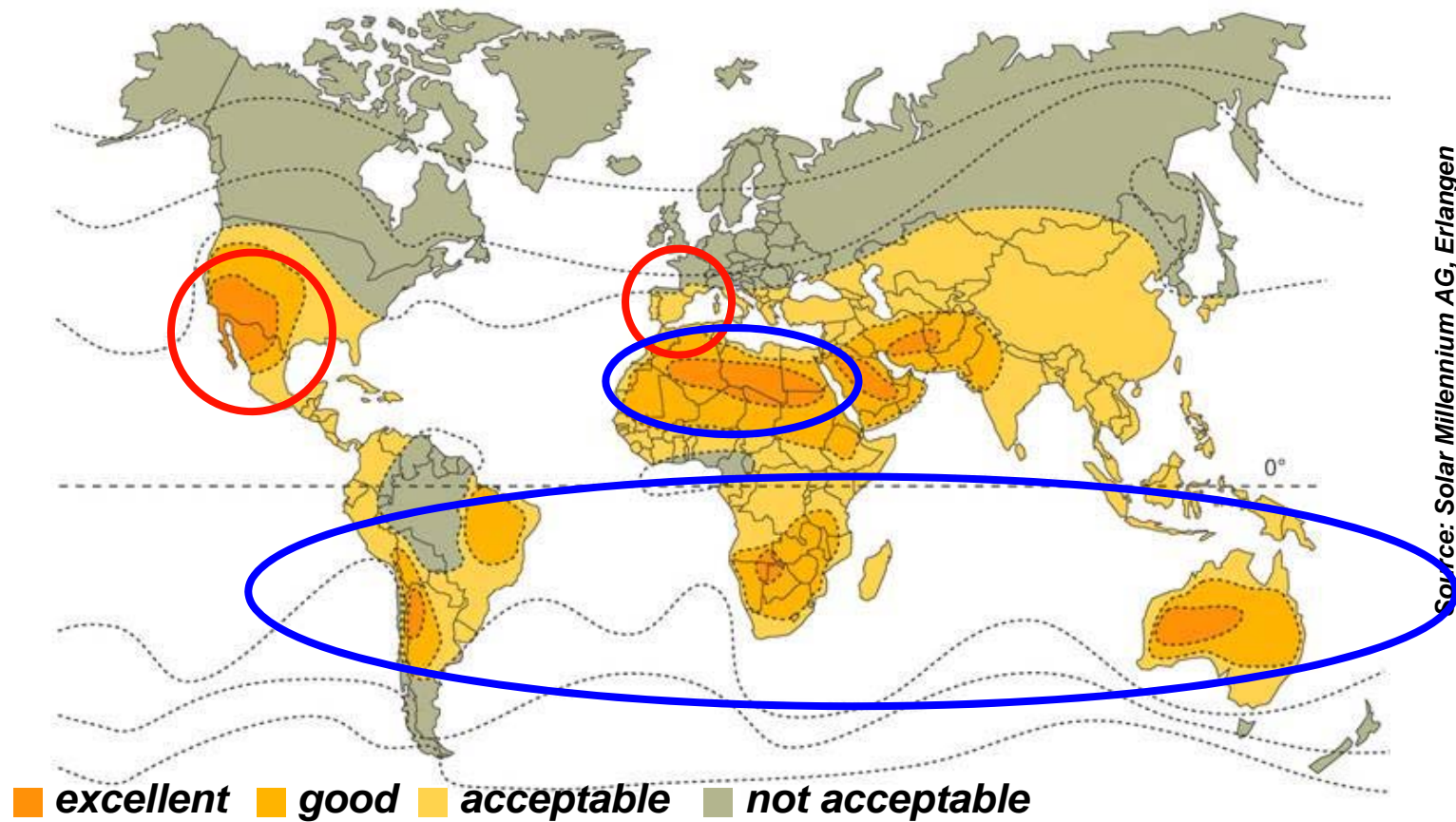


Cost break-down parabolic trough collector

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- Introduction into CSP-Technology
  - Why is CSP important for EU, MENA and Tunisia
  - **Current CSP-projects**
  - EnerMENA – Support Initiative of the German Government

# Current CSP Projects

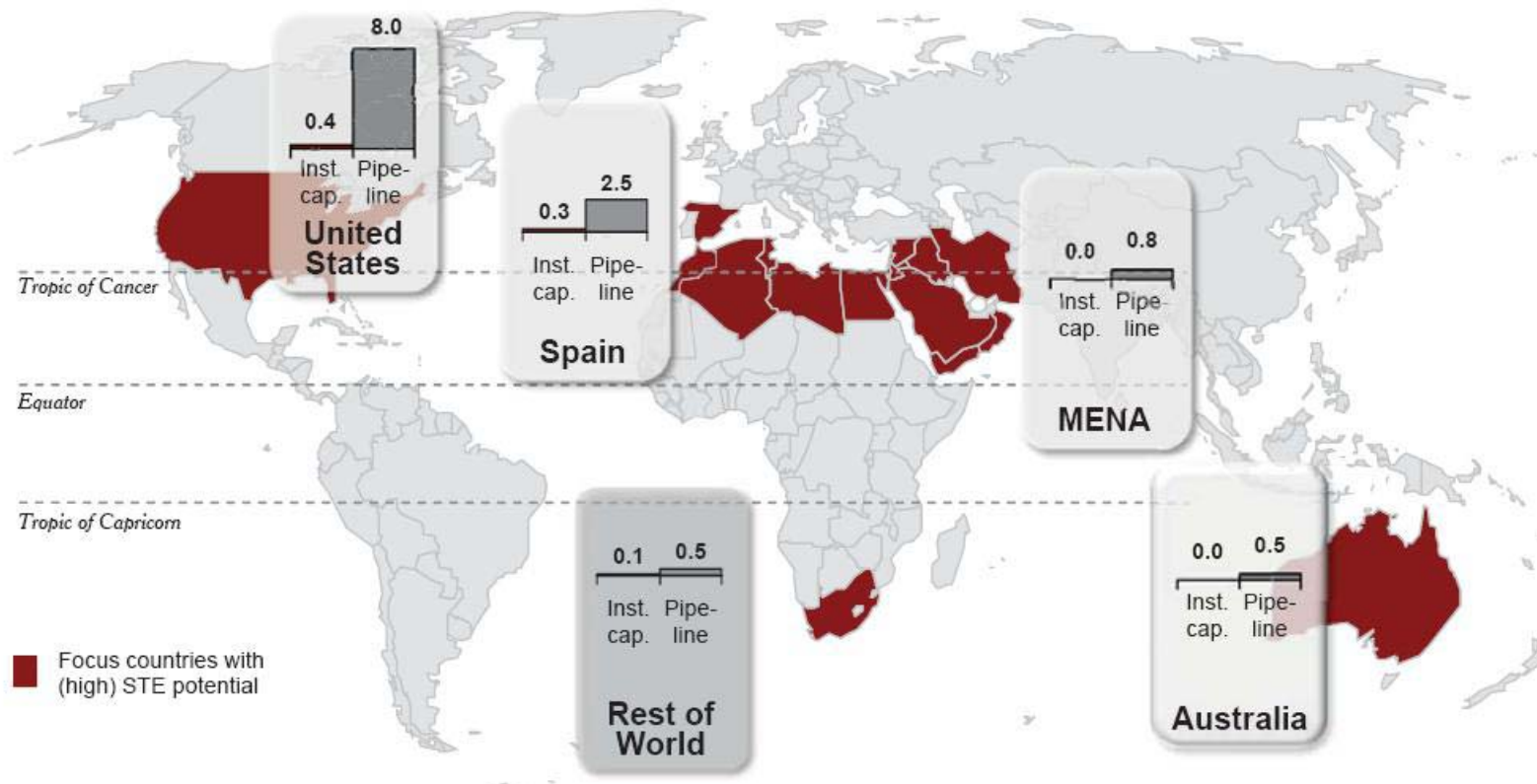
## Global Potential



# Current CSP Projects

## Status Quo Worldwide

Source: for current information see:  
[www.solarpaces.org](http://www.solarpaces.org)



**total**  
**7.000 - 8.500 MW**

Source: The World Bank study: Middle East and North Africa Region, Assessment of the Local Manufacturing Potential for Concentrated Solar Power (CSP) Projects

# Current CSP Projects

Morocco: Ain Beni Matar



- Combined Cycle + Solar field (ISCCS)
- Owner: ONE
- EPC conventional CC-plant: Abener
- EPC solar field + 2 year O&M: Abener
- Groundbreaking: 2008
- Commissioning: 5/2011
- Solar field size: 180.000 m<sup>2</sup>
- Solar share (yearly): 4%



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- Introduction into CSP-Technology
  - Why is CSP important for EU, MENA and Tunisia
  - Current CSP-projects
  - The Potential in Tunisia
  - **EnerMENA – Support Initiative of the German Government**

# Background

## Objective

Support the sustainable implementation of concentrating solar power plant technology in MENA

In-line with the DESERTEC Concept

## Objectives are achieved by permanent

- Support of people
- Improvement of technology
- Support of the dissemination of CSP-Technology



DLR initiative, supported by the German Federal Foreign Office



# Background

Why is a proper implementation of solar power plant construction so important?



## High investment costs of solar plants bear higher risks than conventional plants

- Conventional Power Plant, Low Investment Costs, High Fuel Costs (Payments during the production phase)
- Solar Thermal Power Plant: High Investment Costs, No Fuel Costs (Investment at the beginning of the production phase)



## A low-quality solar field affects project profitability strongly

- 10-15% of solar field efficiency can be easily lost or gained

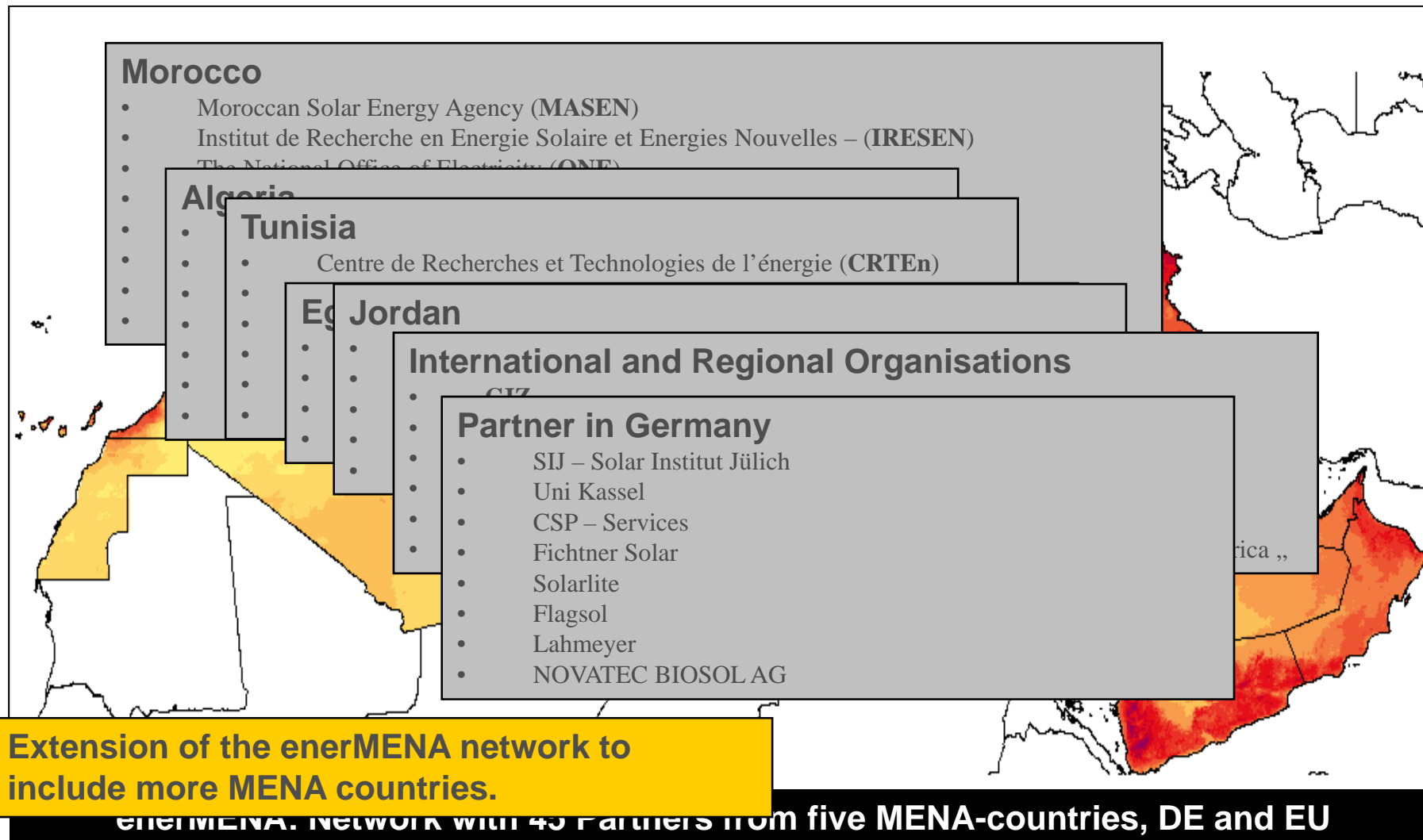
## Solar fields are of big extent

- Correction of assembly errors are expensive

## Solar fields are a long-term investment

- Each percent point contributes to profitability over more than 20 years

# enerMENA Network



# enerMENA structure: Three pillars for implementation

## Targets of Module II:

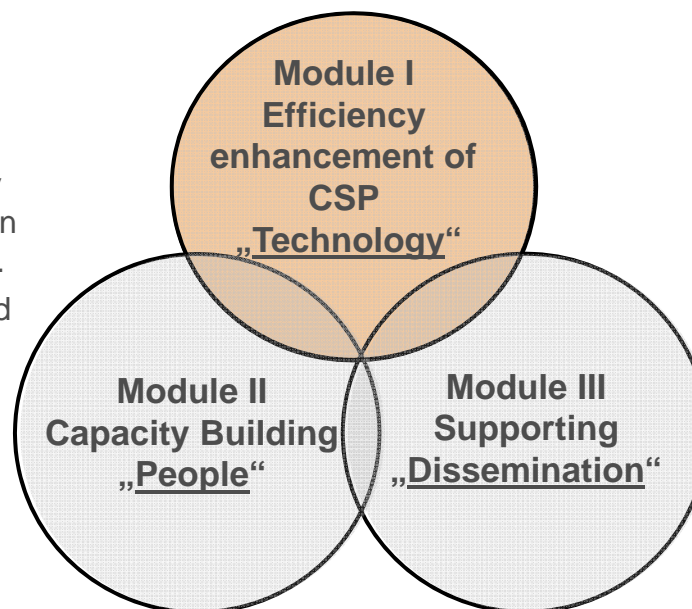
- Preparation of advanced **CSP teaching materials** for MENA-Universities
- **Capacity Building for:**
  - For **engineers**: efficiency optimization and operation tasks of local CSP plants.
  - For **project planners** and managers
  - Establish a capable **CSP technical team** in each partner country

## Targets of Module I:

- Development of Measurement technologies to qualify CSP plants
- Supporting the creation of local test infrastructure

## Targets of Module III:

- Supporting a successful project planning
- Reliable meteorological data for site assessment
- Dissemination of information
- Conjoint research with partners



Project management and coordination

# enerMENA



# Module I: Technology

## “Development of optimization techniques”



### Activities

- Development of optical and thermal measurement technologies to qualify CSP Plants and for **quality control** of plants components.
  - QFly Technology, and
  - The Calibration Bypass Technology
- Provide mobile measurement **laboratories** to MENA partners.

### Planned activities

- Supporting the creation of local **test and R&D infrastructure** at partner institutions.
- Performing thermal and optical measurement campaigns with MENA partners at their CSP power plants,

## Module I: : QFly Technology

### For deflectometry Measurements for optical qualification

- Usage of an autonomous aerial vehicle allows for measurement of whole fields
- Collectors can be measured in operation position

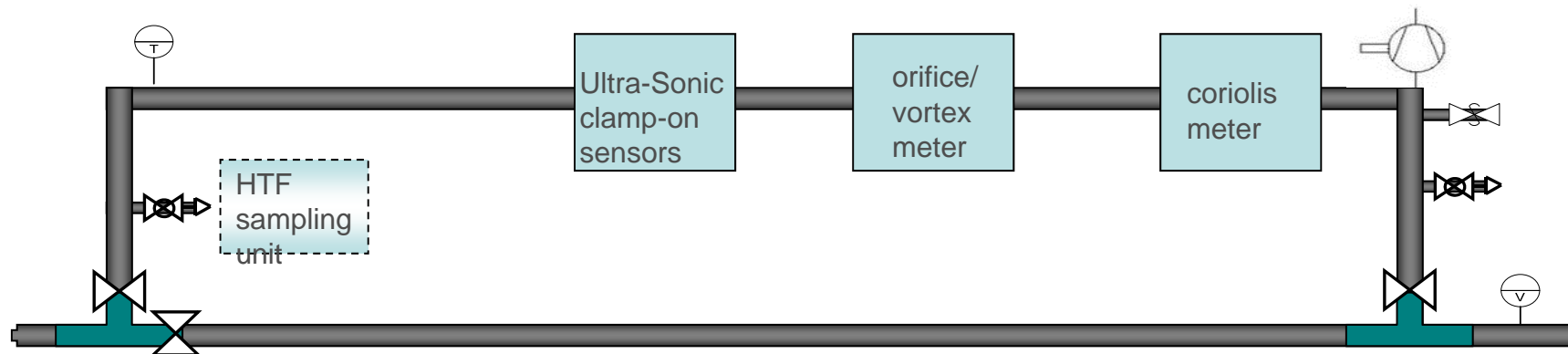


# Module I: Calibration Bypass



## Bypass with High-Precision Coriolis Mass Flow Meter

- Installed as reference in parallel to loop connection piping at inlet
- Unique opportunity for calibration/ qualification/ characterization of flow meters under operation conditions
- Normal operation of loop, but connectors required
- Installed in Kuraymat CSP power plant in Egypt for training and plant optimization purposes



# Module I: Mobile Measurement laboratories

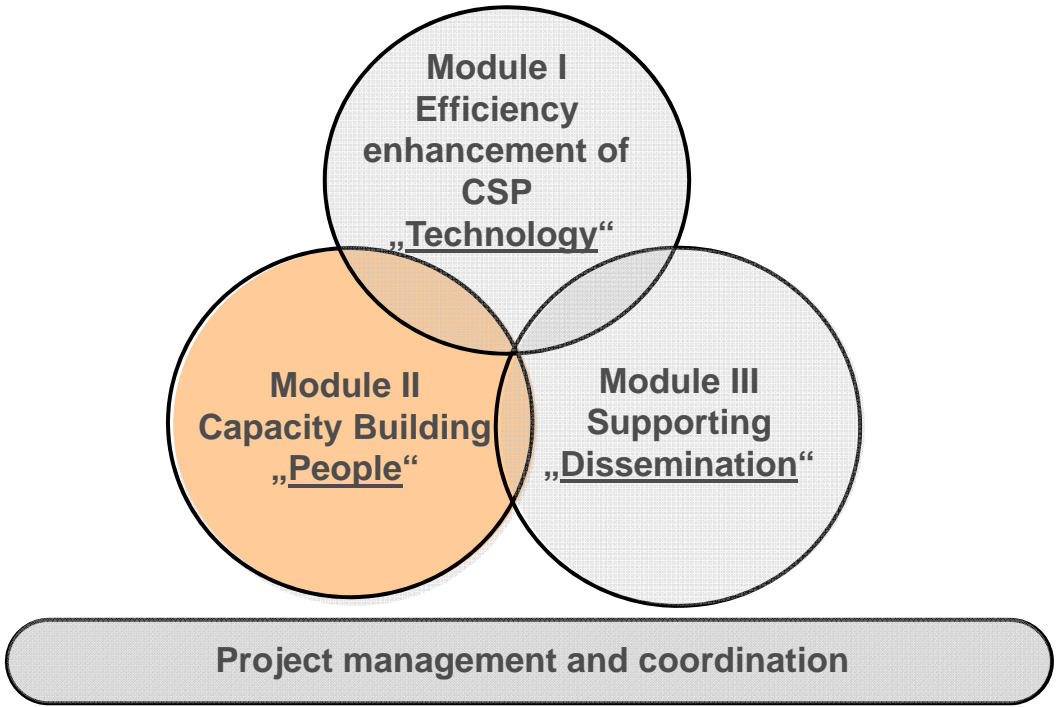


## Each includes

- Mechanical and optical Measurement equipment
- Photogrammetry measurement set for optical qualification of Collectors
- Measurement equipment set for thermal qualification









# Module II: People

“Training program for field engineers and university teaching materials”



## Activities

- Technical **Capacity Building Program** with the aim to establish local technical CSP teams in MENA
  - eM-CB01: PSA in Almeria 11/2010.
  - eM-CB02 at Technopole Tunisia in 11/2011
- Preparation of enerMENA CSP Teaching Materials.
- Prepare expert training materials,
- Organization of CSP expert Training Courses e.g. in Tunis 11/2011, Amman 02/2012

## Planned activities

- enerMENA Students Internship at the PSA, Sep. 2012
- Organize eM-CB03 Kuraymat CSP power plant in Egypt in end of September 2012.
- Organize eM-CB04 course at Cairo University in Egypt in November 2012
- Organization of a CSP expert training course in Casablanca in cooperation with AUE and ONE.
- Prepare **enerMENA Video Tutorials** out of the training materials for faster dissemination.

## Module II: eM-CB series of capacity building courses

- Technical training for engineers and technicians on site on the optimization of CSP power plants.
- Sites: PSA (Almeria, Spain), Technopole (Tunisia), Kuraymat CSP Power Plant (Egypt) and Cairo University (Egypt).
- Each course includes practical and theoretical modules
- Engineers from partner countries will act as “Multipliers”
- Country technical CSP team is established



## Module II: enerMENA CSP Teaching Materials

- May 2010: **Orientation-Workshop** with MENA and German Universities
- June 2010 to June 2011: Multi-phases preparation process of the **enerMENA CSP teaching materials** for universities
- June 2011: **Launching Workshop**: finalize reviewing and start the implementation of the teaching material

Tasks & Activities	2010			2011			
	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Orientation Workshop							
Multi-phase preparation Process							
Review in Germany							
Review in MENA							
Launching Workshop							
Finalization							
Implementation							
- Workshop in Rabat							
- Workshop in Amman							

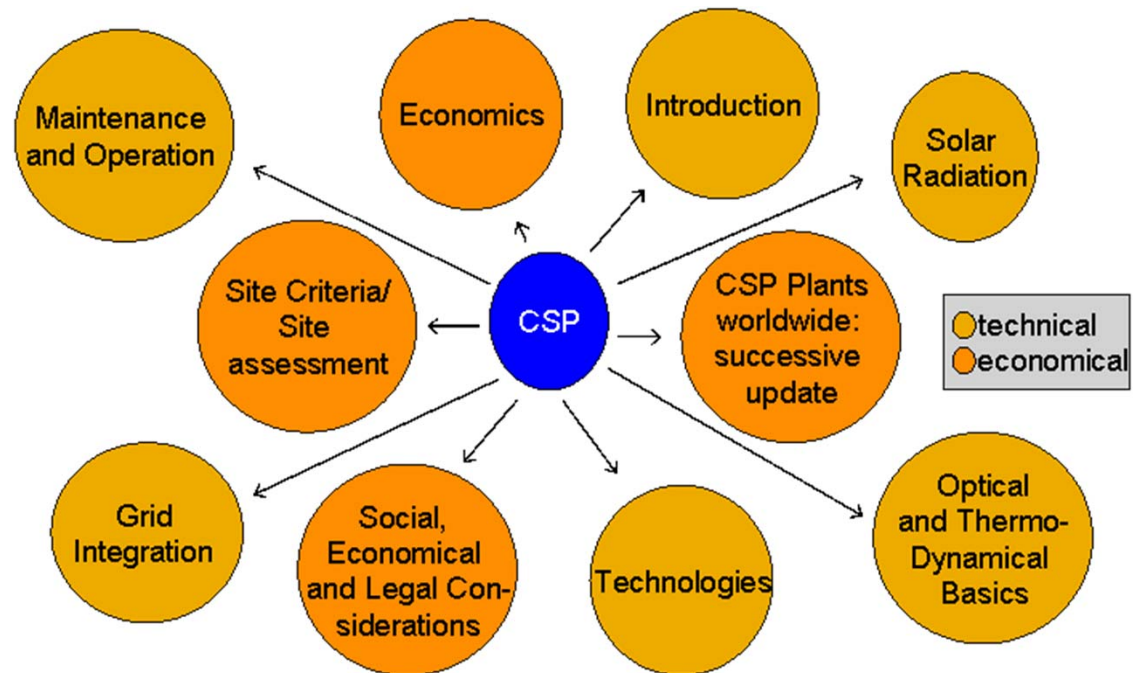
- September 2011: **integration** of the materials in study programs at partner universities.
- Several implementation workshops were organized and are planned in Partner countries

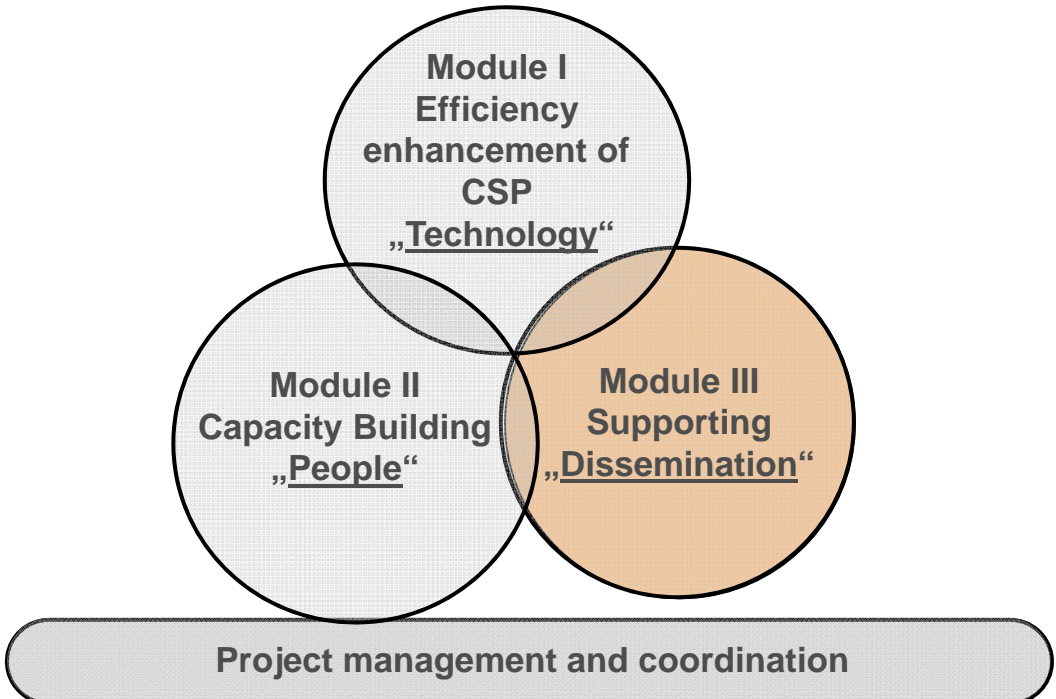
**Partners:** Aachen University of Applied Sciences (SIJ), Kassel University, Cairo University (EG), GUC (EG), Jordan University (JO), JUST (JO), ENIT University (TN), CRTE (TN), CDER (DZ), ENIT University (MA)



## Module II: enerMENA CSP Teaching Materials

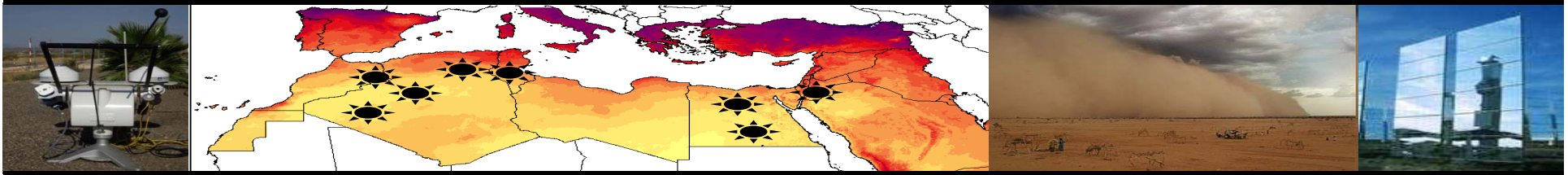
- Wide spectrum of the enerMENA CSP teaching materials that cover all related technical and economic aspects
- **Planned:** Publication of standard CSP reference book





# Module III: Dissemination

## enerMENA Meteo-Network - R&D Activities



### Activities

- Preparation of **coaching material** for yield analysis and project planning methodology
- Installation of the enerMENA-Meteo-Network to provide high quality DNI and Metedata
- Establishment of local contact points for information dissemination at partner institutions.

### Planned activities

- **Conjoint Research** activities with MENA institutions:
  - Soiling of reflectors and extinction of solar irradiance
  - Aging of materials in desert climates
  - Meteorological data assessment
- Organize capacity building courses for project planners and managers.



## Module III: enerMENA Meteorological Network

### Objectives:

Enable the provision of reliable solar data for project planning purpose.

Support network of satellite data



### Network of 10 high-precision meteorological stations for solar resource assessment

- Highly precise measurement of beam, global and diffuse irradiance (cross check is possible through redundancy)
- Uncertainty between 1 and 2%
- Measurement of relative humidity and air temperature
- Measurement of barometric pressure
- Measurement of wind speed and direction at 10m height
- Data logger in temperature-controlled switch box with UPS
- Automatic Data Retrieval (via GSM) and Processing



## Summary

- CSP provides a mature utility scale power technology
- Numerous projects realised worldwide
- Increasing electricity demand from RE in Europe
- Desertec concept may contribute to the RE supply of EU-MENA
- Desertec concept offers chance for sustainable economic growth in MENA
- EnerMENA aims at implementing CSP in MENA
- enerMENA aims at developing successful EU-MENA partnerships





**Thank you for your attention!**

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