

“Production of Electricity with RES & CHP for Homeowners”

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Innovation on CPV in

Portugal



www.ws-energia.com

Photovoltaic Energy

Photovoltaic Energy

Why is PV important?

PV in Portugal

Why Concentration?

Concentration system

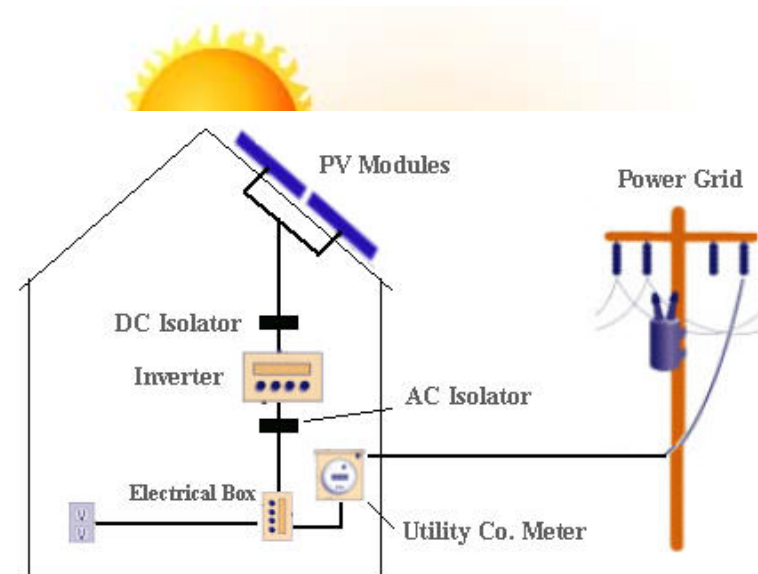
DoubleSun®

References



Photovoltaic (PV) Energy

- ▶ Conversion of sunlight into electricity
- ▶ Energy produced by solar cells which are packaged in solar modules
- ▶ PV systems produces DC current which can be transformed in AC current by an inverter



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Why is PV important?

- ▶ **Environment**
- ▶ **Economy**
- ▶ **Technology**

Why is PV important?

▶ **Environment**

- ▶ Clean (no gas emissions)
- ▶ Inexhaustible
- ▶ No material waste during their use

▶ **Technology**

▶ **Economy**

Why is PV important?

▶ Environment

▶ Technology

▶ Economy

- ▶ Exploitable in each corner of the world (isolated zones)
- ▶ Accessibility to a variety of users (many applications)
- ▶ Long life time
- ▶ Low maintenance costs
- ▶ Reliable technology

Why is PV important?

▶ Environment

▶ Technology

▶ Economy

- ▶ Creation of jobs and strengthen the economy
- ▶ Development of many different sectors
- ▶ As efficiency is improved and production costs decreases it becomes more affordable and available

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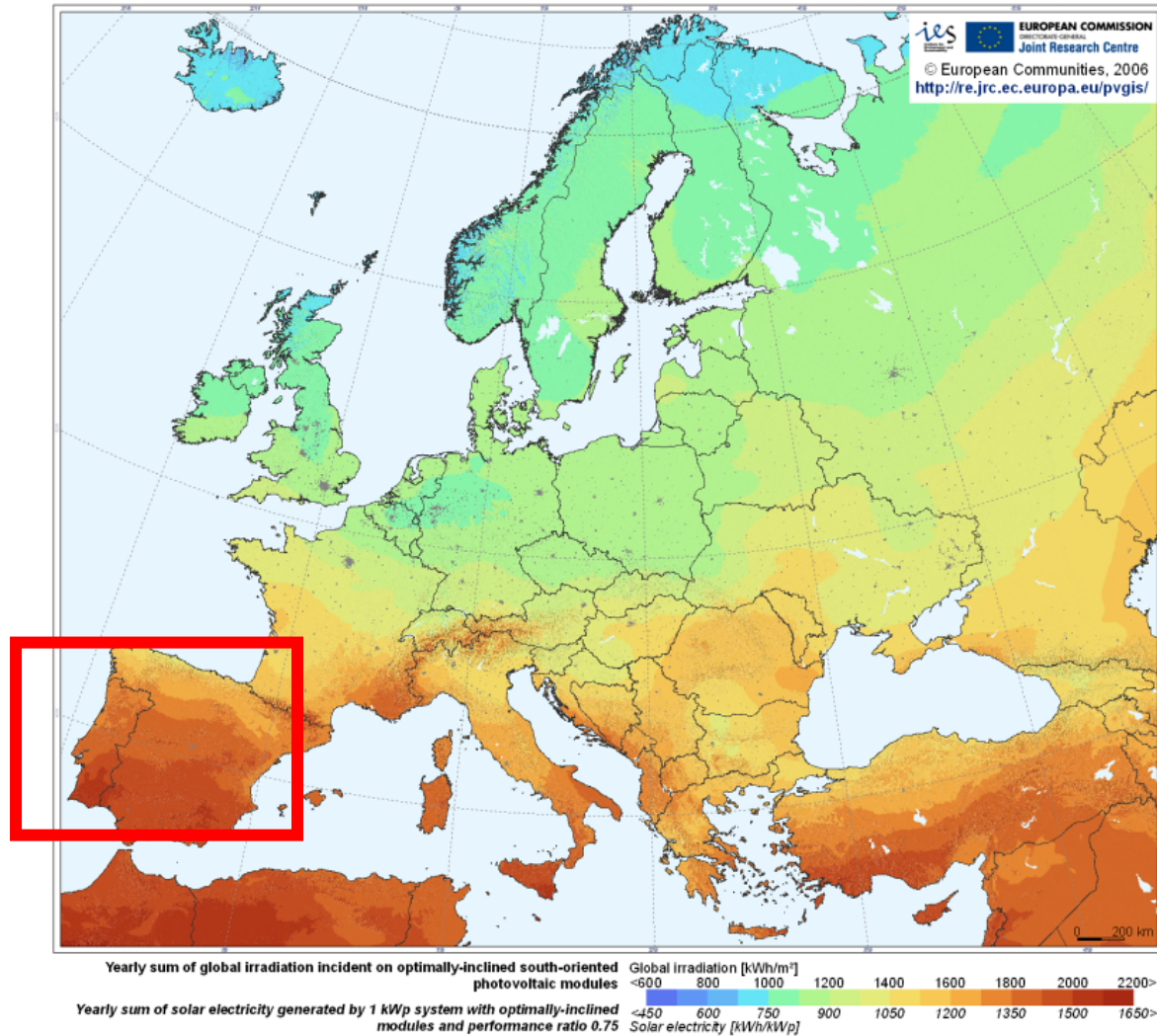
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Photovoltaic Solar Electricity Potential in European Countries

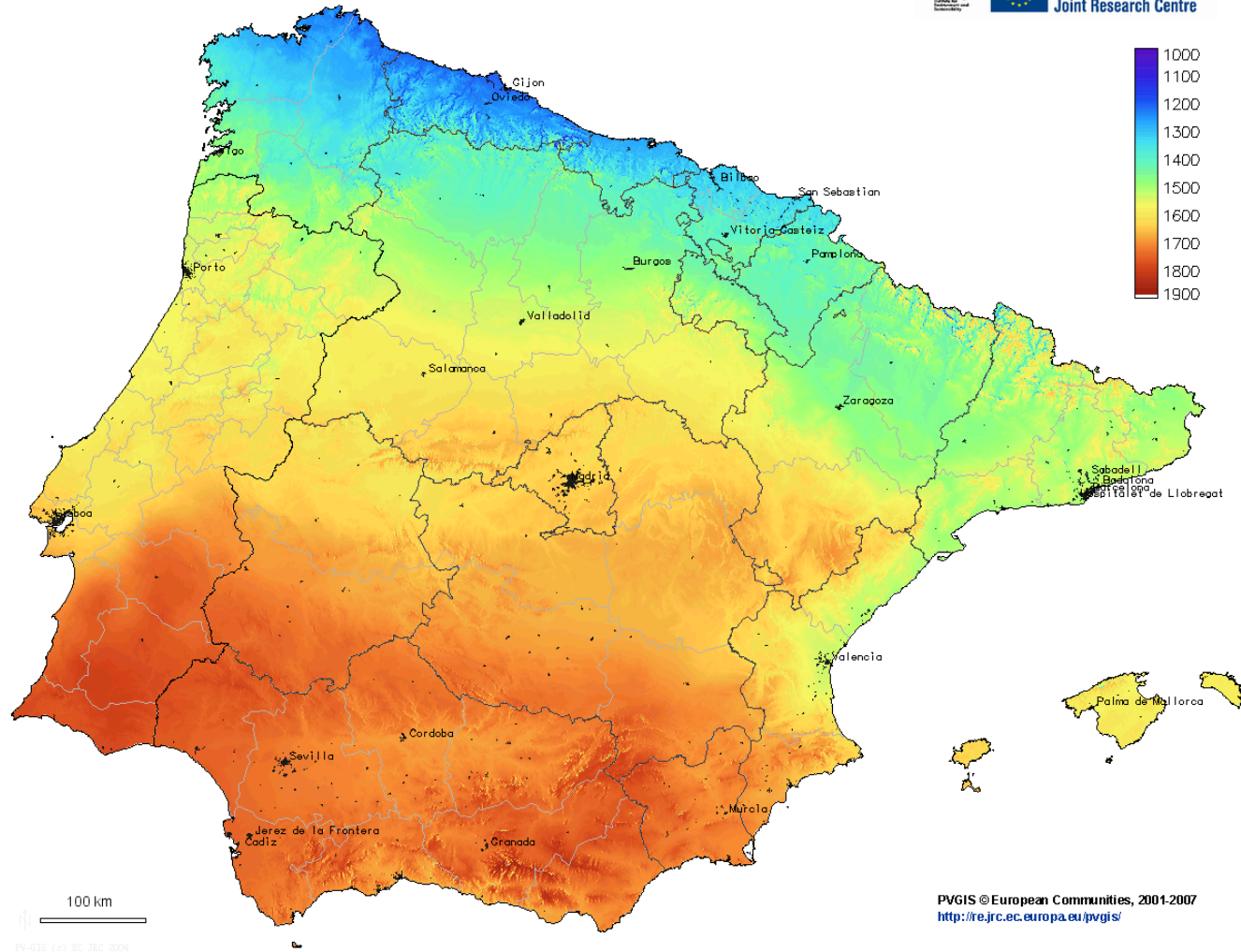


PV in Portugal

Yearly sum of global irradiation on a horizontal surface - Spain and Portugal



EUROPEAN COMMISSION
DIRECCION GENERAL
Joint Research Centre



PVGIS © European Communities, 2001-2007
<http://re.jrc.ec.europa.eu/pvgis/>

PV in Portugal

Cumulative installed PV power (MW) in Portugal



PV in Portugal

- ▶ **IPP (Independent Power Producer)**
 - ▶ 0.32 €/kWh for systems > 5kWp
 - ▶ 0.44 €/kWh for systems < 5kWp
(applicable during 15 years or until reach a production of 21 GWh/MW)

- ▶ **Micro-Generation (Renewables on Demand)**
 - ▶ Under the specific law that applies to PV the installations of solar water heating is mandatory.
 - ▶ Maximum power installed: 3.68 kW
 - ▶ 0.65 €/kWh initially
 - ▶ It requires that all the energy produced to be sold to the electricity supplier

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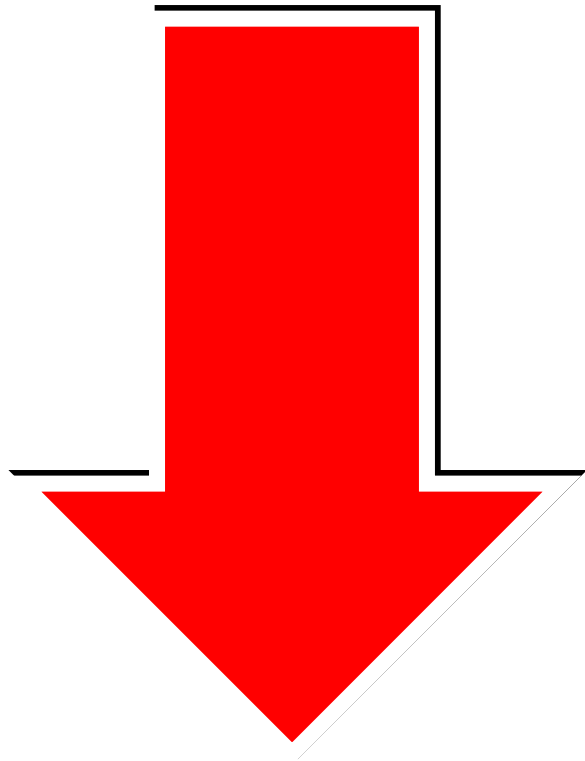
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Why concentration?



Drawbacks of PV technology

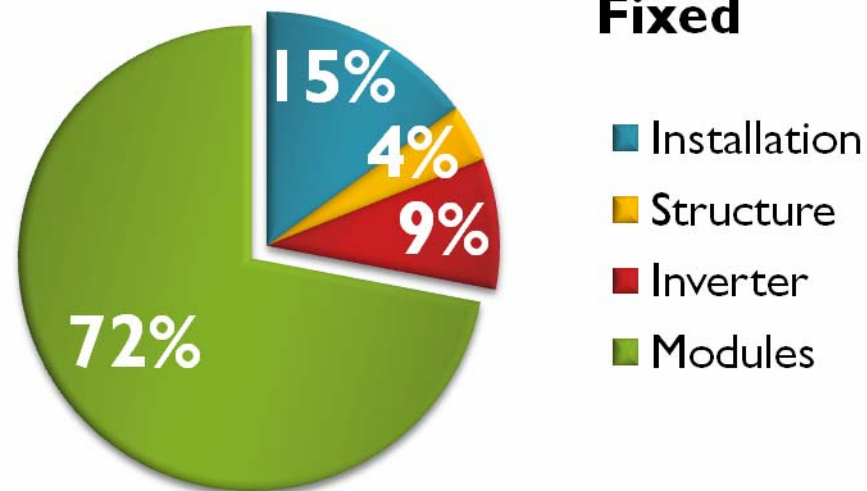


- ▶ Silicon scarcity (high prices)
- ▶ Low conversion efficiency

Why concentration?

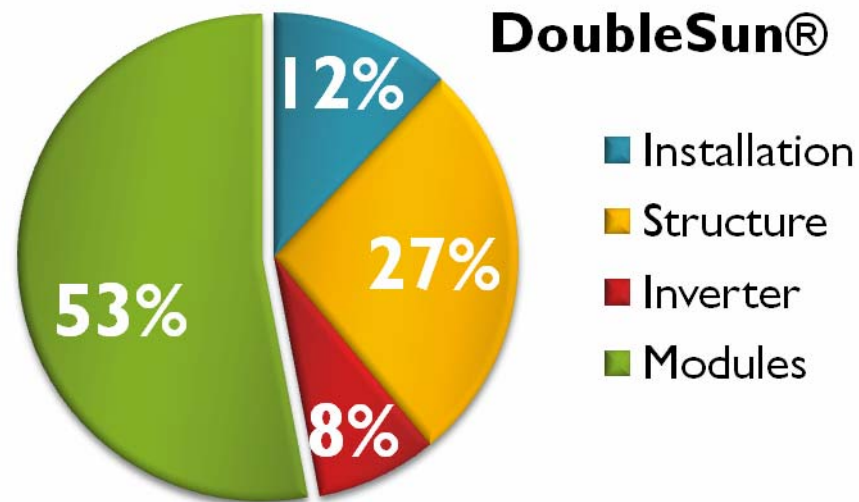
CONCENTRATION

Allows the reduction of area of expensive solar cells and modules



Challenges:

- Cells should be homogeneously illuminated
- Market penetration
- Credibility and qualification standards



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Why Concentration?

Concentration systems

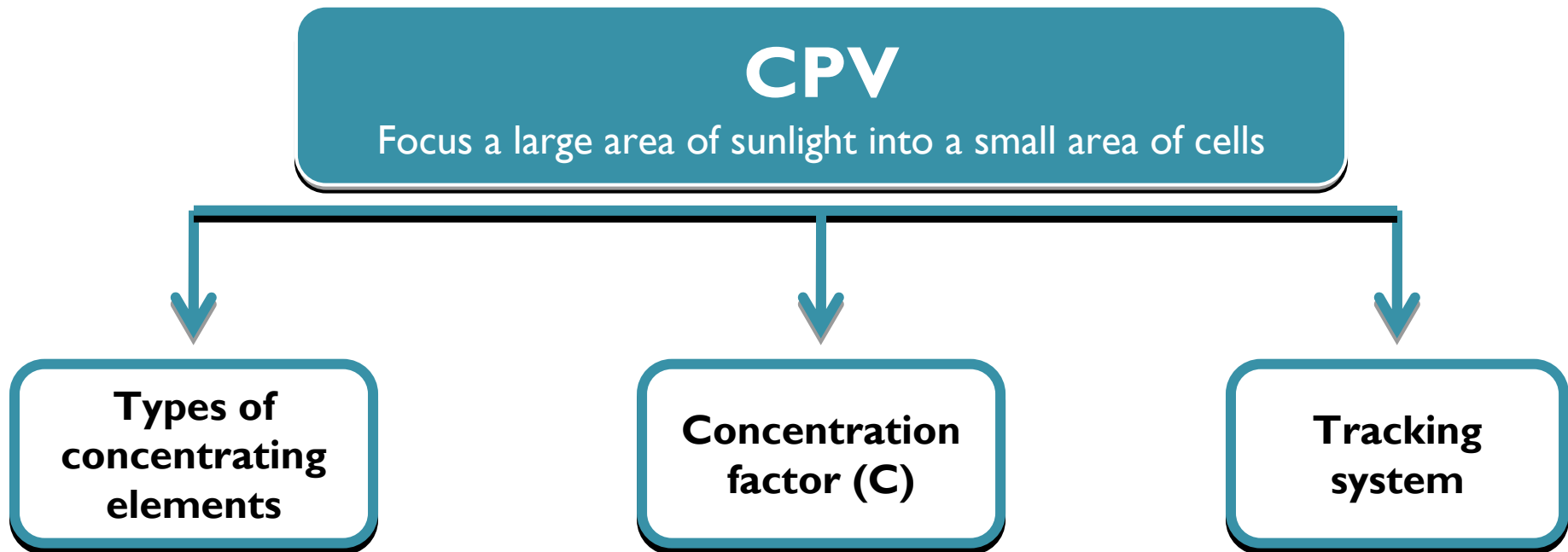
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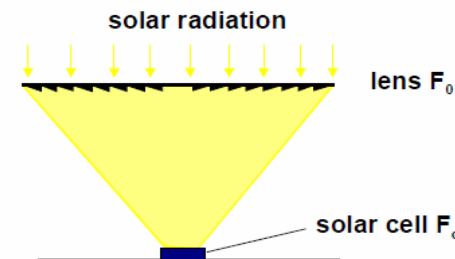
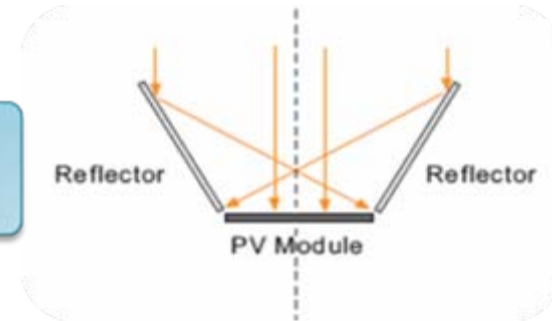
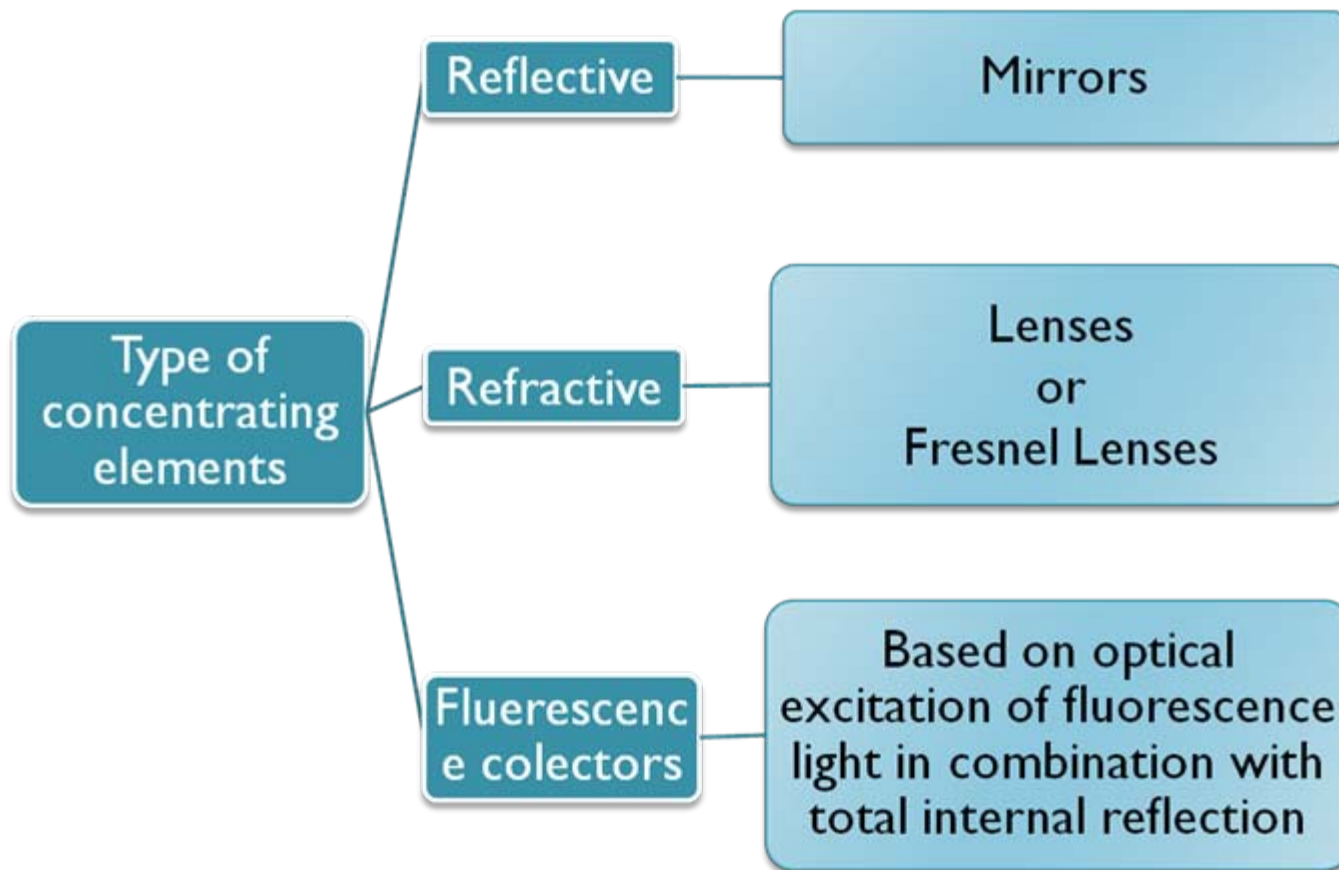
Concentration Systems



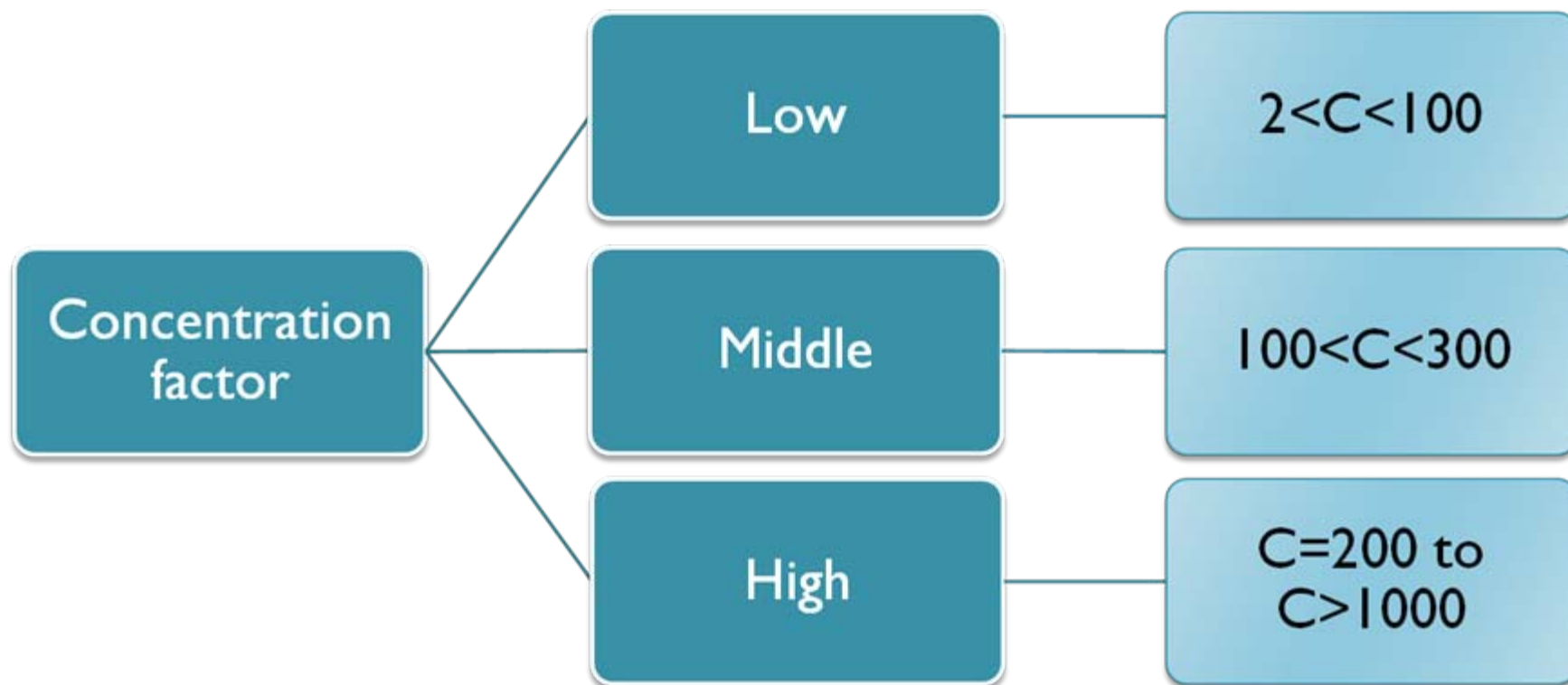
Objective



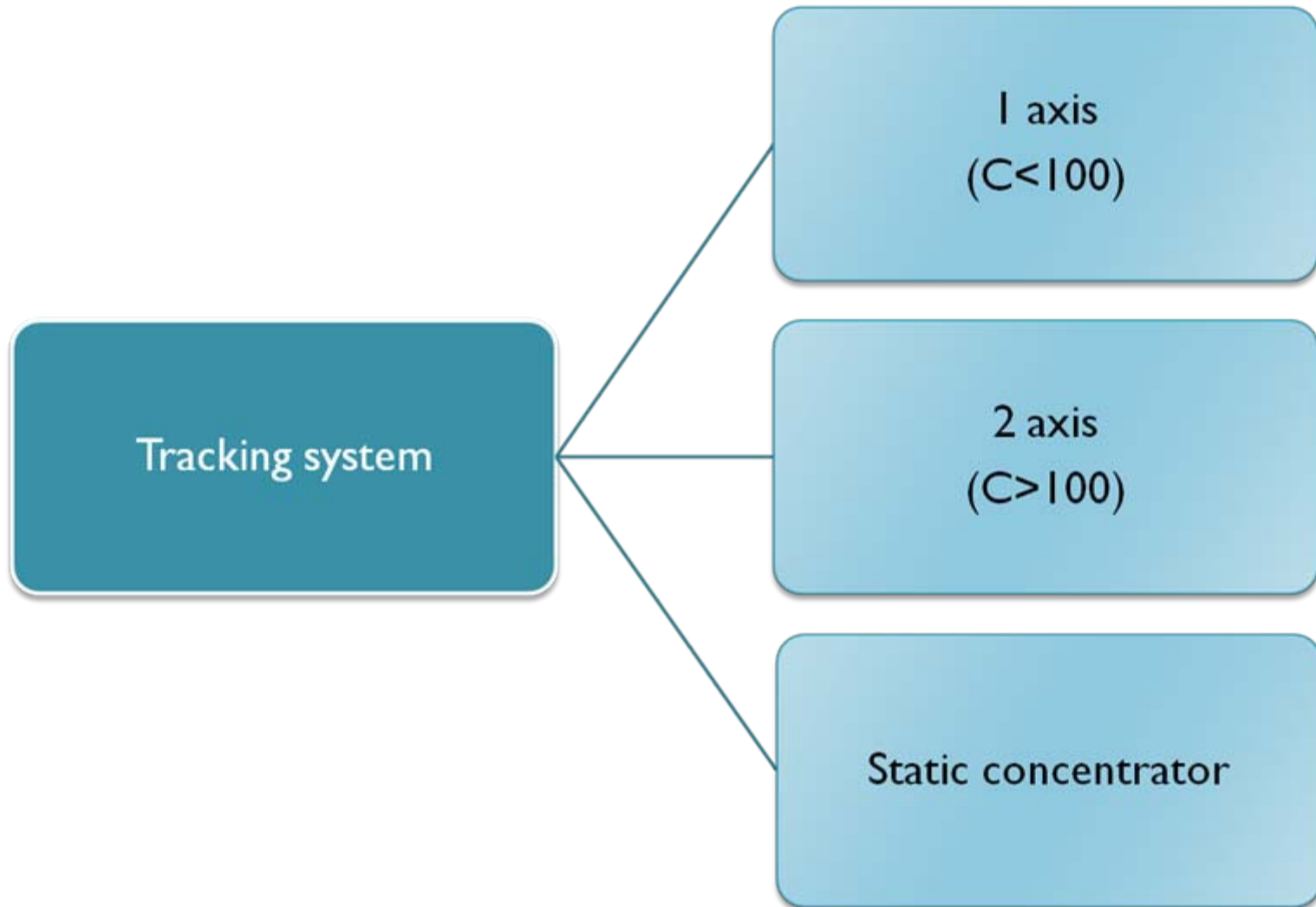
Design of CPV systems – Concentrating Elements



Design of CPV systems – Concentration factor



Design of CPV systems – Tracking Systems



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What is the DoubleSun® technology?

- ▶ It is a patented CPV technology
- ▶ **WS Energia** is one of the Top 3 leading European Company in producing optical components for low concentration PV applications
- ▶ Number of CPV installations >50 (Portugal, Spain, Italy...)



DoubleSun® Characteristics

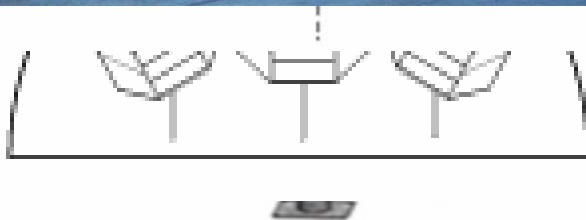
- **CONCENTRATION** (low, $C=2$)

- **OPTICAL ELEMENTS**(2 reflective mirrors)

- **TRACKING**(2 axes)

- **MODULES** (available in the market)

- **APPLICATIONS** (medium and large: solar parks)

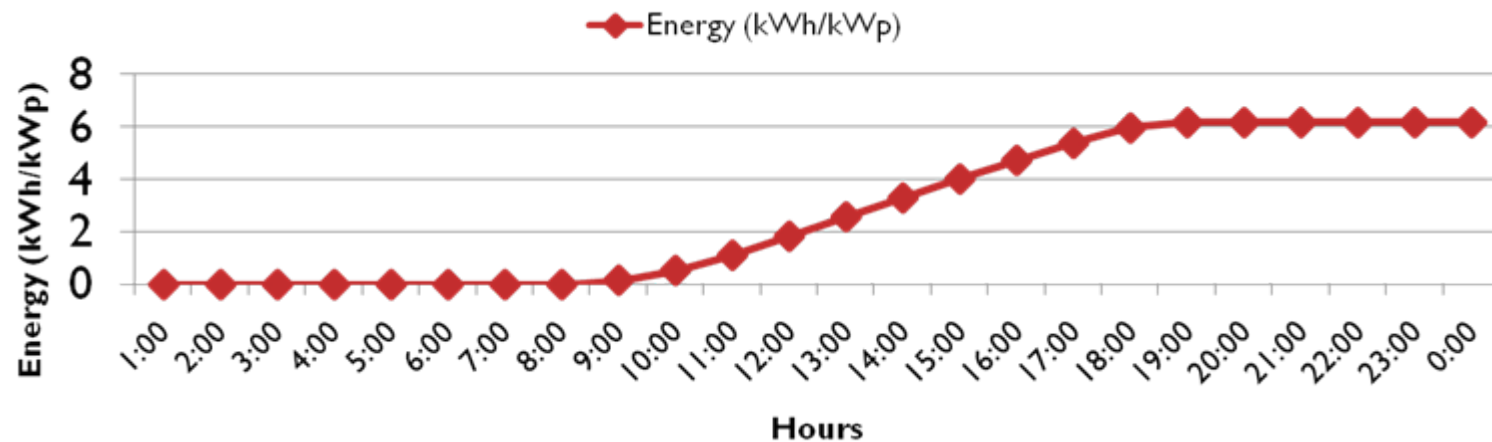
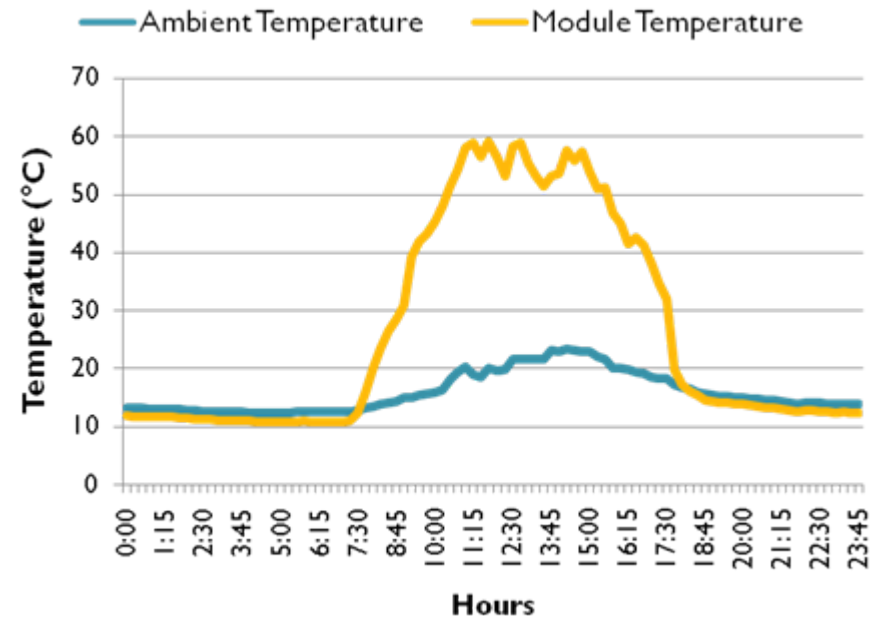
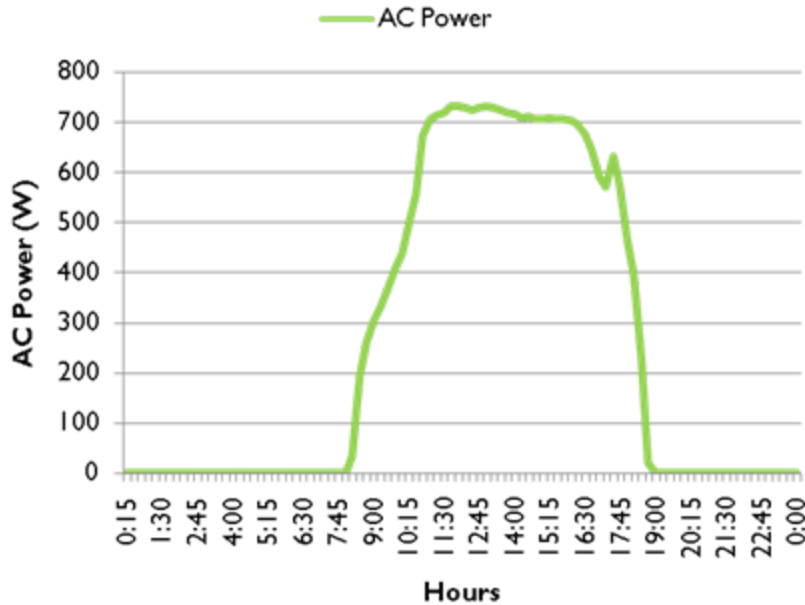


DoubleSun® Characteristics

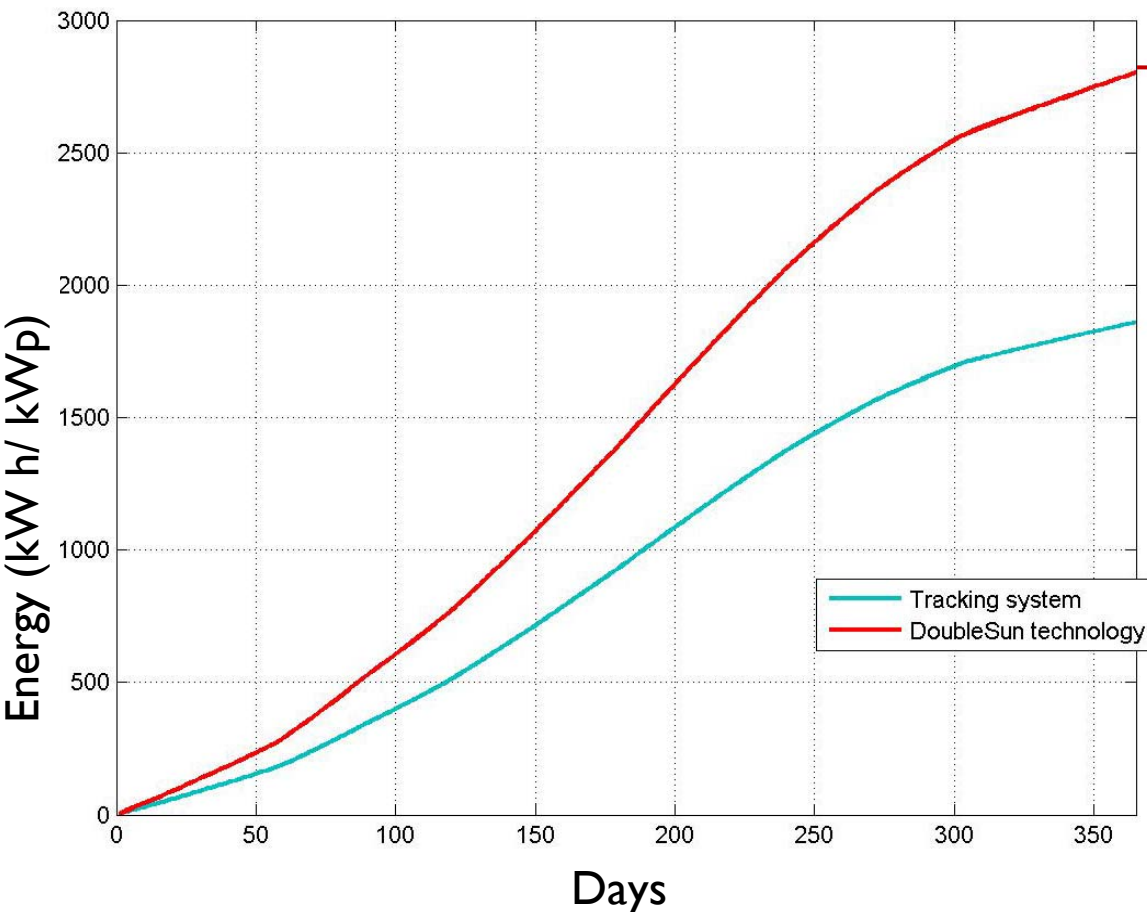
- ▶ The solid structure design was tested in high wind conditions (withstand wind speed up to 150 km/h)

- ▶ The critical module temperature (95°C) is only reached when the ambient temperature overtakes 40°C

AC Power for September 22 (2007)



Energy produced by the DoubleSun® technology



System	Annual Energy (kWh/kWp)	Comparison
Fixed*	1420	31 %
Tracking (2-axes)	1860	
DoubleSun®	2802	97.3 %

* The values presented for the fixed system were collected from the data base of the Joint Research Community (JRC)

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- ▶ <http://electricratelock.com/solar.aspx>
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- ▶ Šúri M., Huld T.A., Dunlop E.D. Ossenbrink H.A., 2007. Potential of solar electricity generation in the European Union member states and candidate countries. *Solar Energy*, 81, 1295–1305, <http://re.jrc.ec.europa.eu/pvgis/>
- ▶ Report: EU Photovoltaic Technology Platform, The Strategic Research Agenda (SRA), Concentration Photovoltaics (CPV), October 2006
- ▶ Report IEA-PVPS T1-14:2005
- ▶ Filipa Reis, Development of Solar concentrators for Large Photovoltaic Plants, Setembro 2008

Thank you.