First Summer School

Part A: Line-focus Solar Thermal Technologies

September 20-24, 2021

Lecture 2:

Socio-economic benefits and potential market for CST Technologies

Lecturer: Eduardo Zarza Moya

Plataforma Solar de Almería – CIEMAT

(e-mail: eduardo.zarza@psa.es)

Socio-economic Benefits and Potential Market for Concentrating Solar Thermal Technologies

Content

- Socio-economic benefits of CST Technologies
- Potential market for CST Technologies
- Summary

Benefits of Concentrating Solar Thermal Systems

Both, *Solar Heat for Industrial Processes* (SHIP) applications and *Solar Thermal Electricity* (STE) plants have significant benefits:

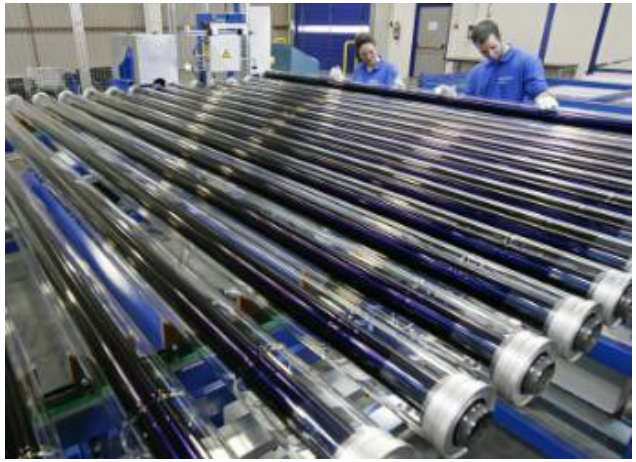
- Due to their good dispatchability, STE plants make possible a higher share of other renewable energies that are not dispatchable (e.g., PV plants)
- CST plants improve the local, regional and national economies because a significant fraction of the total investment stays in the country where the plants are implemented (high local content) for on-site assembly and to manufacture mirrors, receiver tubes, steel structures, etc..

Benefits of Concentrating Solar Thermal Systems

New factories devoted to CST plants

Parabolic mirrors

Receiver tubes for line-focus collectors



Metallic structures

Benefits of Concentrating Solar Thermal Systems

Other benefits for the industrial sector

New business lines for existing companies:

- Engineering, construction and civil work
- Electrical Infrastructures and power lines
- Galvanic industries

Reinforcement of some industrial sectors:

- Piping and big vessels
- Heat exchangers
- Boilers
- Telecommunication and control systems

Significant incomes for the sector of Auxiliary Services

- Industrial cleaning and washing
- Quality control laboratories
- Transport sector
- Training and qualification

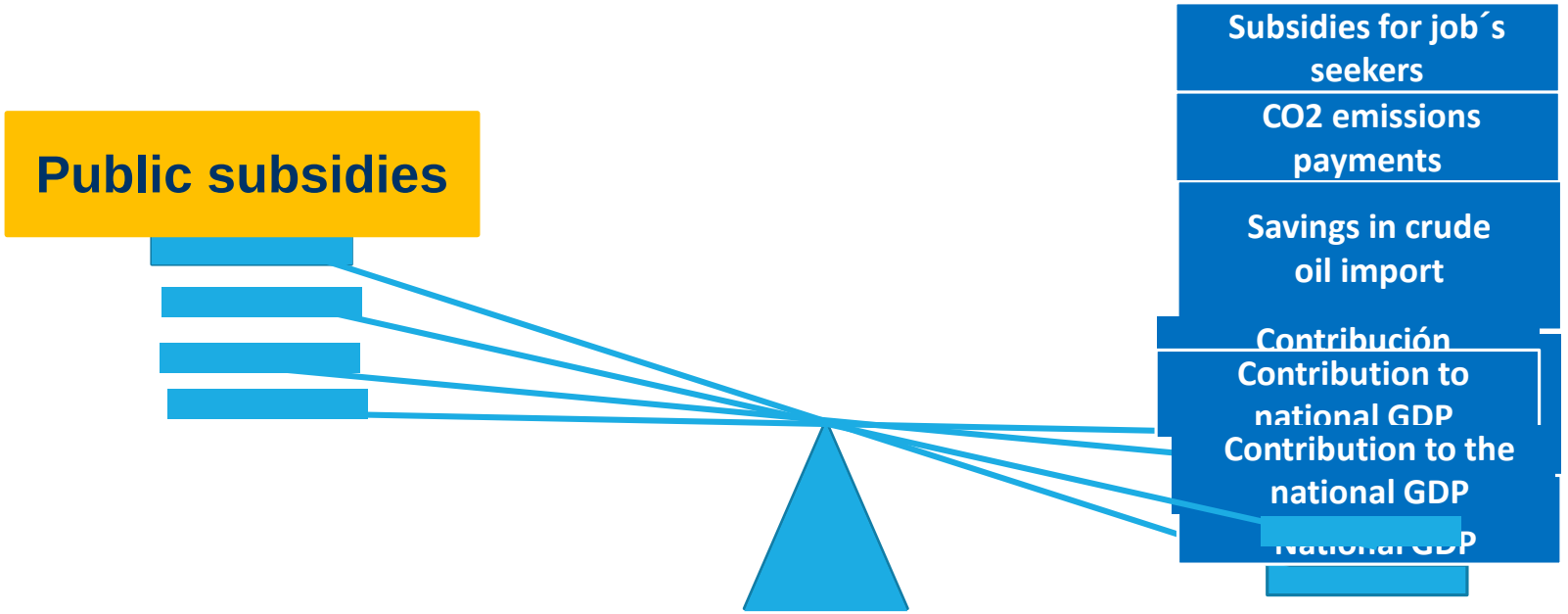
Benefits of Concentrating Solar Thermal Systems

- Due to their good dispatchability, STE plants make possible a higher share of other renewable energies that are not dispatchable (e.g., PV plants)
- STE plants improve the local, regional and national economies because a significant fraction of the total investment stays in the country where the plants are implemented (high local content) for on-site assembly and to manufacture mirrors, receiver tubes, steel structures, etc..
- Implementation of STE plants requires a lot of manpower, thus injecting money in the local economy or the region where the plants are built
- The net economic balance for the country is clearly positive

Benefits of Concentrating Solar Thermal Systems

Macro-economic results at national level

Public subsidies to STE plants are very beneficial for the country where they are implemented



Socio-economic Benefits and Potential Market for Concentrating Solar Thermal Technologies

Content

- Socio-economic benefits of CST Technologies
- Potential market for CST Technologies
- Summary

The Energy Market: Global Context

The current situation of the *energy market* can be summarized with three sentences:

- The *Primary Energy* demand will significantly increase in the future
- Currently, most of the *Primary Energy* demand is supplied with fossil fuels, which have limited resources
- The share of *Renewable Energies* must be significantly increase

The Energy Market: Global Context

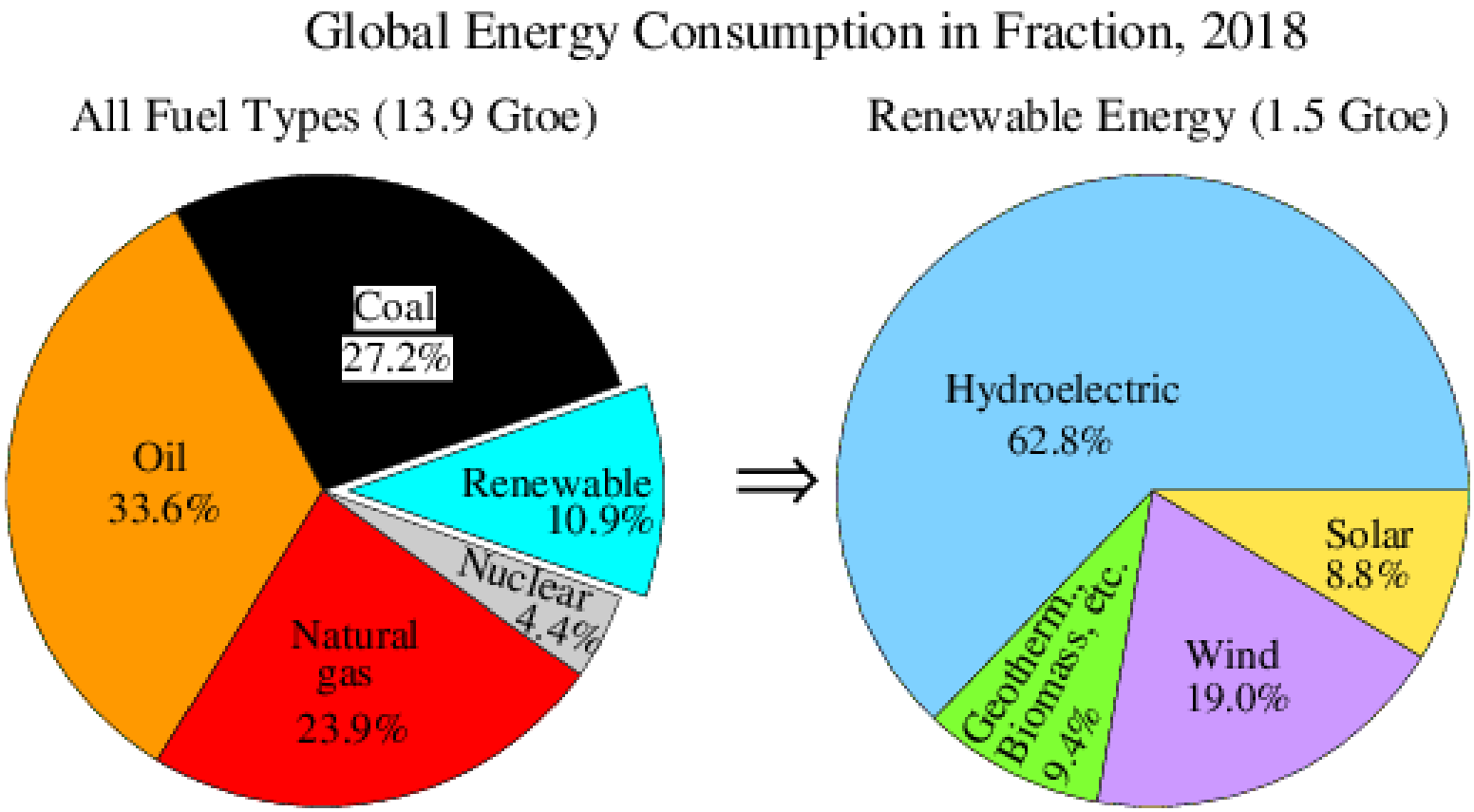
➢ The *Primary Energy* demand will significantly increase in the future

- At present, 20% of the World population do not have Access to electricity (1400 Millions out of about 7000 Millions

- The economic, social and technological growth of the countries is directly linked to their energy consumption. A 36% increase in the World Primary Energy consumption is expected between 2004 and 2035, up to 12.300 Mtoe (WEO, 2010). Most of this increment will take place in India and China

The Energy Market: Global Context

- Currently, most of the *Primary Energy* demand is supplied with fossil fuels, which have limited resources



The Energy Market: Global Context

➢ The share of *Renewable Energies* must be significantly increase

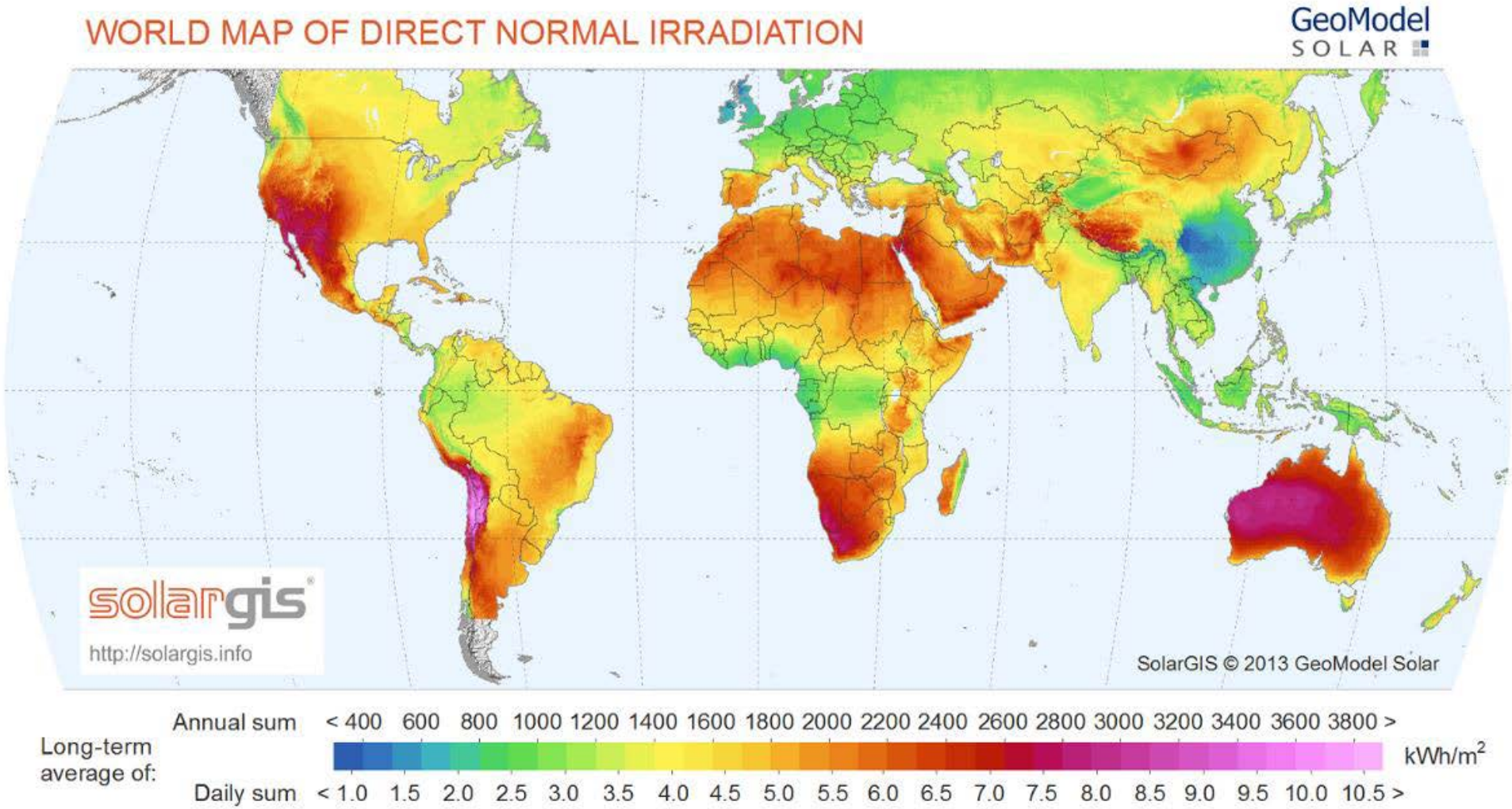
- There is and increasing social concern about pollution and the environmental degradation
- Current concentration of Green House Gases in the atmosphere is 400 ppm. It must be kept under 450 ppm to avoid irreversible environmental damages (2ºC global warming)
- There is a wide portfolio of renewable energies at present already available for their commercial use. Many different scenarios have been analyzed by the IPCC and the conclusion has been that a significant increase in the use of Renewable Energies is required (17% in 2030 and 27% in 2050). With these percentages the concentration of green houses gases in the atmosphere will not increase. The overall investment required to achieve this goal is of about 1% of the GDP, only.

Potential Market for CST Systems

CST Plants have a huge potential market, because:

- The primary source of energy (solar radiation) is practically unlimited and it is available in many countries

Potential Market for CST Systems



Potential Market for CST Systems

CST Plants have a huge potential market, because:

- The primary source of energy (solar radiation) is practically unlimited and it is available in many countries
- Solar thermal electricity is a clean energy with a high potential for cost reduction

Potential Market for CST Systems

- Solar thermal electricity has a great cost reduction potential

Cost forecast of the IEA (International Energy Agency)

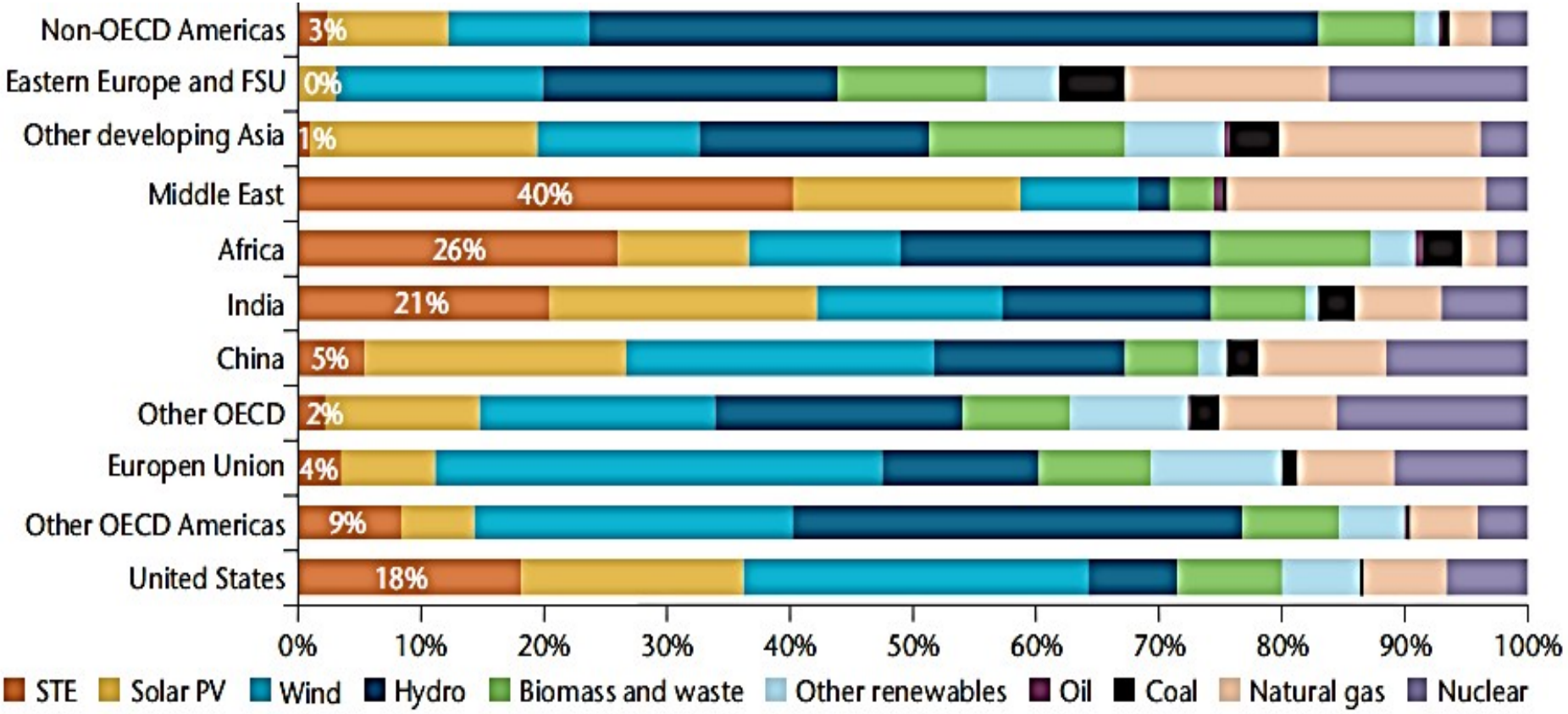
Table 4: Projections of LCOE for new-built CSP plants with storage in the hi-Ren Scenario

USD/MWh	2015	2020	2025	2030	2035	2040	2045	2050
Minimum	146	116	96	86	72	69	66	64
Average	**168**	**130**	**109**	**98**	**80**	**77**	**72**	**71**
Maximum	213	169	124	112	105	101	96	94

Note: All LCOE calculations in this table are based on 8% real discount rates as in *ETP 2014* (IEA, 2014b).

Potential Market for CST Systems

International Energy Agency Forecast for Electricity Sources in 2050



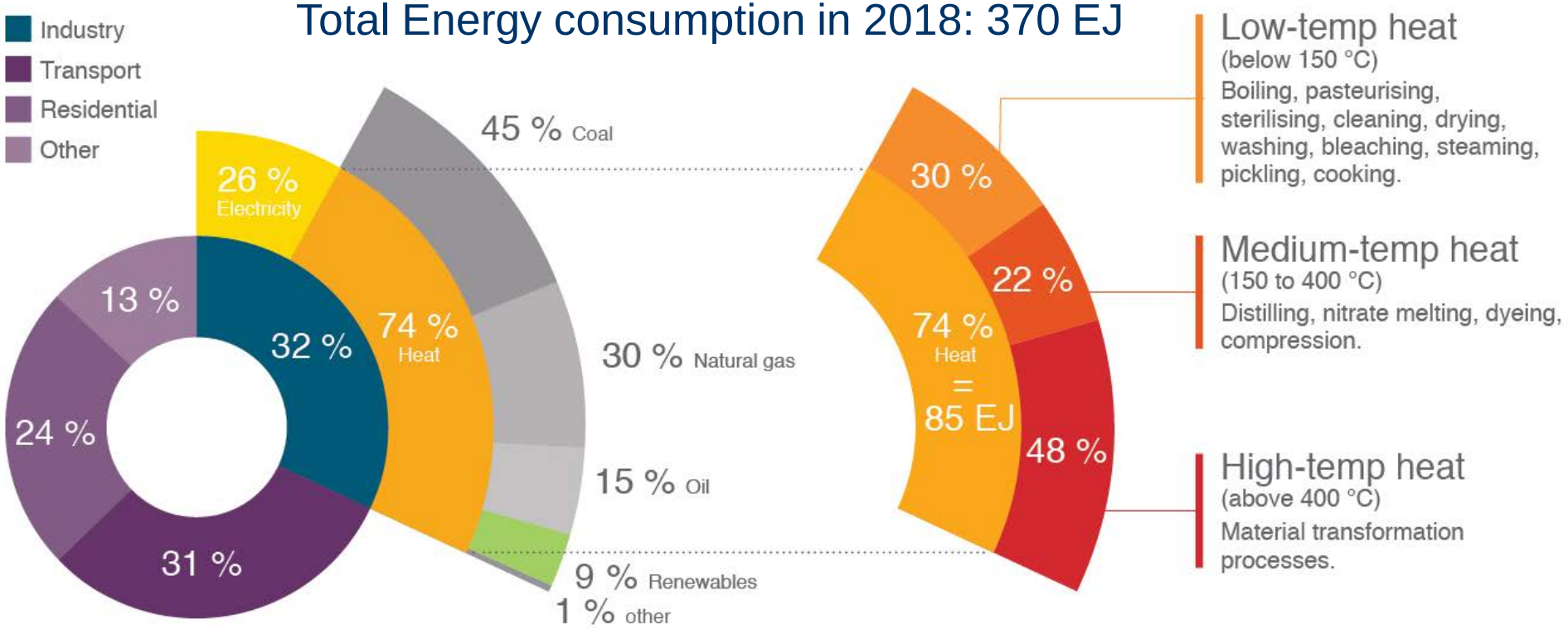
Potential Market for CST Systems

CST Plants have a huge potential market, because:

- The primary source of energy (solar radiation) is practically unlimited and it is available in many countries
- Solar thermal electricity is a clean energy with a high potential for cost reduction
- The industrial sector consumes a lot of thermal energy (heat)

Solar heat for industrial processes (SHIP)

Total World energy consumption by sectors in 2018



- Heat represents three quarters of the total energy demand of industries world-wide, and 70% of it is medium to high temperature heat, more easily supplied by concentrating solar thermal systems

Solar heat for industrial processes (SHIP)

Industry	Process (es)	Temperature (ºC)	Medium
Food processing, beverages production, milk processing	Cooking, pasteurization, sterilization, tempering drying, heat treatment…	40 - 150	Steam, water, air
Textile	Blanching-dying, Drying, Pressing, Fixing, printing	40 - 180	Water, steam
Pulp and paper	Bleaching, de-linking, drying, pulp preparation…	60 - 200	Water, pressurized water, steam, air
Chemical and pharmaceutical	Distillation, evaporation, drying…	100 - 170	Water, steam, air
Leather products, rubber, plastic and glass manufacturing	Pre-tanning, drying and finishing, preheating, preparation, distillation, lamination…	50 - 200	Water, air, steam
…	…	…	…

Potential Market for CST Systems

CST Plants have a huge potential market, because:

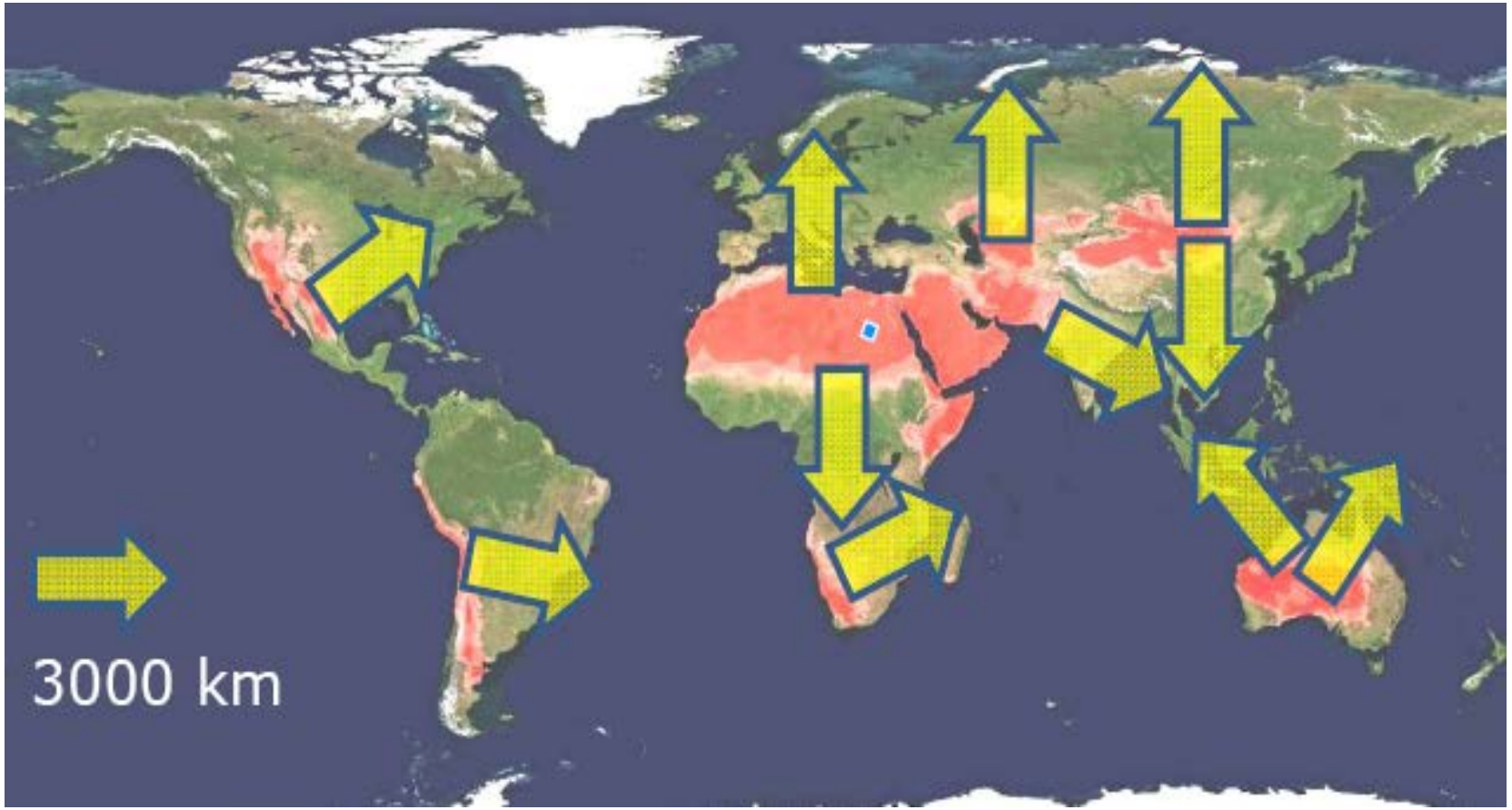
- The primary source of energy (solar radiation) is practically unlimited and it is available in many countries
- Solar thermal electricity is a clean energy with a high potential for cost reduction
- The industrial sector consumes a lot of thermal energy (heat)
- Electricity can be transported to a long distance with an affordable cost (10% overall)

Potential Market for CST Systems

- Electricity can be transported to a long distance with an affordable cost
  - ✓ Electricity can be transported over 3000 km using high voltage (800 kV) DC power lines (HVDC). The extra cost due to this transport would be affordable (< 15 €/MWh). 90% of the World population lives within a distance of less tan 3000 km from a sunny place with high level of direct solar radiation. Overall transport losses are less than 10% for a distance of 3000 km

Potential Market for CST Systems

3000 km distance to sunny places



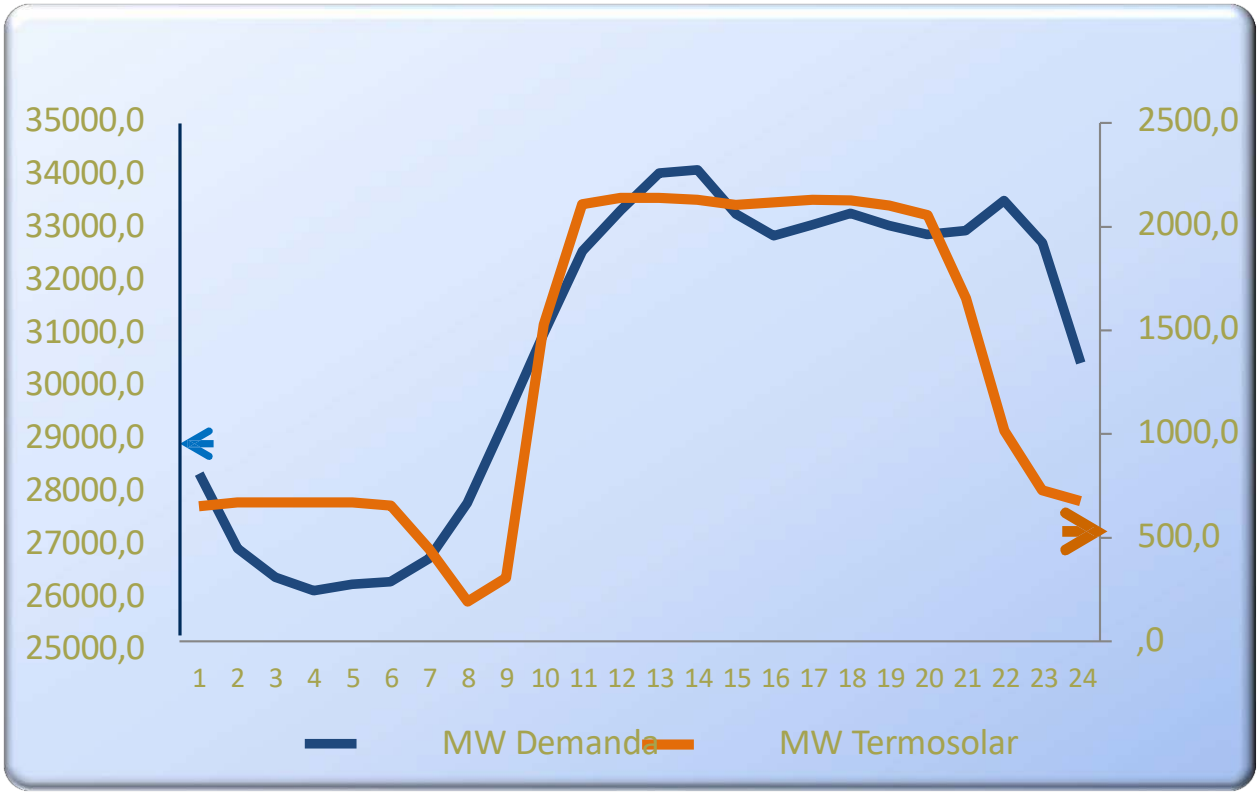
Potential Market for CST Systems

CST Plants have a huge potential market, because:

- The primary source of energy (solar radiation) is practically unlimited and it is available in many countries
- Solar thermal electricity is a clean energy with a high potential for cost reduction
- The industrial sector consumes a lot of thermal energy (heat)
- Electricity can be transported to a long distance with an affordable cost (10% overall)
- Solar thermal power plants can meet the demand due to their high dispatchability (possibility to produce electricity when it is demanded, even if there is not direct solar radiation at that time)

Potential Market for CST Systems

- Solar thermal electricity plants can meet the demand very well (good dispatchability)



Source REE

Daily production curve of solar termal electricity in Spain and typical demand curve

Socio-economic Benefits and Potential Market for Concentrating Solar Thermal Technologies

Content

- Socio-economic benefits of CST Technologies
- Potential market for CST Technologies
- Summary

Socio-economic Benefits and Potential Market for Concentrating Solar Thermal Technologies

Summary Remarks

- Solar radiation is a practically unlimited energy source
- The two main applications of concentrating solar thermal systems (i.e. SHIP and STE) have a large potential market for commercial deployment
- CST plants improve the local, regional and national economies because of their high local content.
- Solar Thermal Power plants may contribute in a significant way to achieve a more sustainable energy market

First Summer School

Part A: Line-focus Solar Thermal Technologies

September 20-21, 2021

Lecture 2:

Socio-economic benefits and potential market for CST Technologies

- **Thank you very much for your attention**
- **Questions?**

Lecturer: Eduardo Zarza Moya

Plataforma Solar de Almería – CIEMAT

(e-mail: eduardo.zarza@psa.es)