SolarPaces 2010 Opening, 21 September

CSP/STE in the IEA Perspectives

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International Energy Agency
The IEA and SolarPaces

- SolarPaces is one out of 40 Implementing Agreements within the framework of the IEA
  - Co-operation amongst voluntary countries
  - Open to non-Member countries
  - 9 Ias devoted to renewable energy technologies

- SolarPaces one of the most successful of all IEA Implement Agreements
  - Possibly the largest participation by non-Members
  - At the origin of the technology in the 80s as well as the current deployment
  - SolarPaces annual symposium the largest scientific and industry conference

- The IEA is proud of SolarPaces!
Renewables enter the mainstream

The use of renewable energy triples between 2008 & 2035, driven by the power sector where their share in electricity supply rises from 19% in 2008 to 32% in 2035.
Renewables are the second most important contributors to CO2 emissions reduction.
Growing shares of renewables in all sectors, for all scenarios

All scenarios point out a large growth of renewables
The primary role of renewables in the BLUE scenarios

Renewables provide from almost half to three quarters of the global electricity mix in 2050
RE generation in 2050 for key countries/regions

The mix varies according to resources
PV & CSP technology roadmaps

• Launched by IEA’s Executive Director Nobuo Tanaka in Valencia, 11 May 2010 (MSP Conf.)
• PV and CSP complementary to each other
• Solar electricity could represent up to 20% to 25% of global electricity production by 2050
  • Roughly half CSP, half PV
  • Producing up to 9000 TWh per year
  • Saving almost 6 billion tonnes CO₂ per year
• This decade crucial for effective policies to enable the development of solar electricity
• Need to plan and invest in grid infrastructure
PV & CSP complementarities

- PV takes all light
- PV almost everywhere
- Mostly at end-users’
- Variable
- Peak & mid-peak
- Grid parity (retail prices) by 2020
- Smart grids for integration

- CSP takes direct light
- CSP semi-arid countries
- Mostly for utilities
- Firm, dispatchable backup
- Peak to base-load storage
- Competitive peak power by 2020
- HVDC lines for transport

Firm & flexible CSP capacities can help integrate more PV
CSP costs and global output

- Competition for peak and mid-peak loads
- Competition for base load

Graph showing trends in CSP costs and global output from 2010 to 2050, with different regions and DNI levels.
The CSP Roadmap: 2050

Repartition of the solar resource for CSP plants in kWh/m²/y, and of the production and consumption of CSP electricity (in TWh) by world region in 2050 as foreseen in this roadmap. Arrows represent transfers of CSP electricity from sunniest regions or countries to large electricity demand centres.

Sources: Breyer & Knies, 2009 based on DNI data from DLR-ISIS and IEA Analysis.

More on it on Wednesday 23/09 in the morning!
How accurate are our DNI Data?

The case of Morocco

SWERA:
NASA
NREL

Ain Béni Mathar

Ouarzazate

Concentrating Solar Collectors: Direct Normal Irradiance (DNI)

Boujdour

Concentrating Solar Collectors: Direct Normal Irradiance (DNI)

Foum Al Oued

Sabkhat Tah

Concentrating Solar Collectors: Direct Normal Irradiance (DNI)
Uses of storage

Intermediate load

Delayed intermediate load
Base load

Extreme peak load

Uses of storage
Morocco 2017: load curve & merit order
Morocco 2017: load curve & merit order with PV
Morocco 2017: load curve & merit order with CSP
Time of use payments are key

### SCE

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<th>Off-Peak</th>
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### PG&E

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### SDG&E

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Solar assisted steam reforming of natural gas
Hydrogen in natural gas grids
Direct de-sulfuration of H2S in refineries
Solar-enhanced biofuels (gasification)
Liquid fuels (with CO₂ footprint) for security
Metal oxydes and fuel cells
Scheffler dishes

Steam cooking at Shiridi for 20 000 meals per day
Scheffler Reflector for Community-Kitchens

flexible parabolic reflector (rotates synchronous with the sun)

winter sun

kitchen-building

cooking-pot

door of fireplace

secondary reflector

entrance of light
Forthcoming

**RE Roadmaps**
- Geothermal
- Biofuels
- Hydro Power
- Solar Heating & Cooling
- Bioenergy for Heat & Power

**Books**
- Harnessing Variable Renewables
- Deploying Renewables
  - Worldwide Prospects and Challenges
  - March
- Solar Publication
Solar publication: a primer

- Publication in September
- All technologies, all sectors, all countries, all timescales

**Markets and Outlook**
- Resource
- Electricity
- Buildings
- Industry
- Transport
- Costs and Benefits
- Policies

**Technologies**
- Photovoltaics
- Heat
- Solar thermal electricity
- Solar fuels
Non-concentrating STE?

- Improvements in collectors allow considering non-concentrating solar thermal electricity
- Includes advanced flat-plates, evacuated tubes and... “concentrating compound collectors”
- Takes diffuse light, needs no sun-tracking
- At 160 C, solar-to-electricity ratio of <10%
- Relatively cheap storage (but volumes?)
- Could complement PV and shift load
- Possibly combined with solar heating & cooling
- Pre-heated water feed for fossil power plants
- One of several options to push the limits up
Conclusion: A considerable potential

- Solar energy has the potential to become the largest source of electricity, and contribute to heating, cooling, process heat, transport fuels – could become the primary energy source.
- Solar may also change million lives with access to modern energy services.
- Efforts to bring solar energy technologies to maturity and competitiveness must be broadly shared on global scale.