

CONCENTRATING SOLAR POWER ON THE ROAD TO 2030



Photo Acciona - Palma del Rio II

**How solar thermal electricity
improves energy security
and creates jobs in Europe**

European Solar Thermal
Electricity Association



WHAT IS STE?

Solar Thermal Electricity (STE), also known as Concentrating Solar Power (CSP), is a technology that produces heat by concentrating solar irradiation. This heat can be used to generate electricity with a steam turbine or as process heat for industrial applications. By storing the thermal energy and/or using hybridization, STE is able to firmly deliver electricity on demand without additional cost – even after sunset. STE is grid-friendly not only due to thermal energy storage, but also due to the use of conventional turbine technology to generate electricity.

WHO IS ESTELA?

ESTELA, the European Solar Thermal Electricity Association, is the voice of the European STE/CSP industry. From its office in Brussels, ESTELA provides a single point of contact to stakeholders dealing with energy policy for all matters related to STE.



SUMMARY

STE: A unique combination of advantages

The European industry is a global leader in STE, a technology with a unique set of advantages.

Industry jobs. The STE industry has created manufacturing and engineering jobs throughout Europe, including the southern Member States hit hardest by the economic crisis. The industry will continue doing so as the global STE market is set to reach up to € 130 bn. per year, according to the IEA STE technology roadmap.

Dispatchability. STE with storage provides sustainable (CO₂-free) electricity on demand and makes a further increase of variable renewables in the electricity system possible.

Energy security. STE does not need imported fuels or technologies as backup for ensuring firm balancing services. Hence, STE enhances Europe's energy independence.

Southern Neighbourhood. STE is a key technology to meet rising demand for firm electricity supply in the EU's Southern Neighbourhood in a sustainable way. STE can help stabilize the region economically and politically.

Competitiveness. With only 4GW installed globally, STE technology is relatively new compared to other energy technologies and has a strong potential for further innovation and cost reduction. By 2020, sustainable STE electricity will be the most competitive source of dispatchable electricity in the parts of the world with good Direct Natural Irradiation (DNI).

Seizing the benefits of STE for Europe

Domestic market. To maintain Europe's global leadership for STE and develop the STE industry in particular in southern Europe, it is vital to create a domestic European market of at least 250MW per year. Innovations and cost reductions require projects in this "home market" for the next 5-10 years. This market needs to be supported with long-term financing and other incentives in order to bring innovative projects to the commercial level.

Coordination. STE support should come from a well-coordinated combination of sources: renewable energy support, strategic energy security investments, cohesion funds, as well as resources for development and cooperation.

Grid and regulation. Seizing the advantages of STE for EU energy security requires strengthening the internal electricity market through new transmission lines (especially between the Iberian Peninsula and the rest of Europe, also in Italy and Greece) and an improved regulatory framework (e.g. allowing for long-term transmission rights).

Neighbourhood development. EU support for a program to build several hundred megawatts of STE in its Southern Neighbourhood would create green jobs there, as well as in the EU itself. It would also be a significant and cost-efficient contribution to the global combat against climate change.



Photo ACS Cobra – Extresol



Photo ABENGOA Solar – PS 10-20



Photo Novatec – Puerto Errado 2

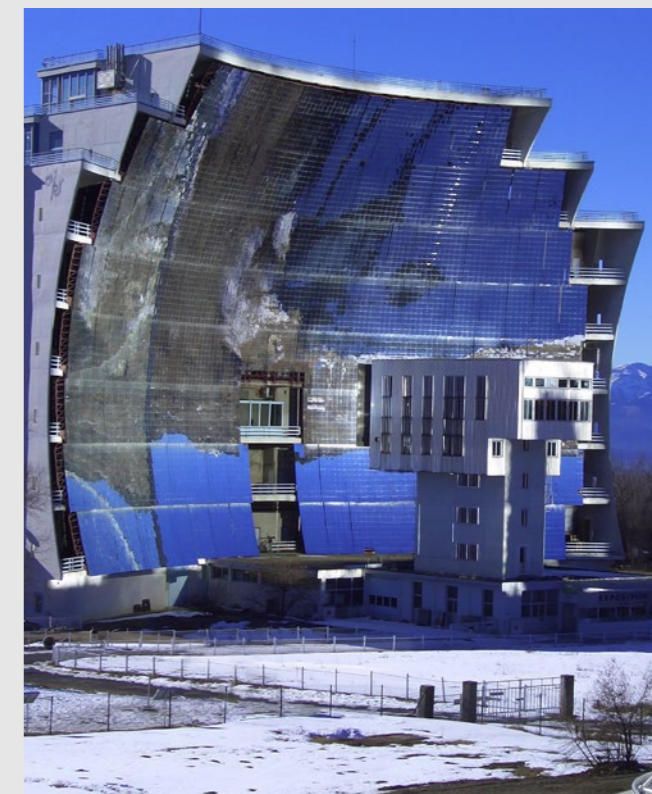


Photo SBP Sonne – EuroDish at Solar Furnace

STE ENABLES A HIGHER SHARE OF RENEWABLES

The EU's 2020 renewable energy targets put Europe on track to increase the share of renewables in its electricity mix.

This will continue with the 2030 target of at least 27%, adopted by the European Council in October 2014. The final goal is an emission-free power sector in Europe by 2050.

Since renewables are no longer a niche market and will contribute 45-60% to the electricity mix in Europe by 2030, the power sector faces new kinds of challenges. In particular, system integration of renewables was found to be a concern by European transmission system operators in their ten-year network development plan (TYNDP 2014).

Due to its storage and its system-friendly thermal generation unit, STE is not only easy to integrate but can also facilitate the integration of more intermittent renewables.

The European Council has set the goal of achieving 15% interconnection capacity and emphasized the need for the full implementation of the internal electricity market. This will make it possible for the whole European continent to profit from sustainable and manageable STE electricity.



Photo Acciona – Palma del Rio II

FACT 1

STE provides proven large-scale storage

To provide solar electricity after sunset with STE, thermal energy is stored in very large quantities. Unlike battery-based solutions, this storage does not increase the cost of electricity generation.

The three 50MW Andasol plants as well as another 14 plants in Spain, have operated with 7.5 hours (h) storage each since 2008. The largest storage system

installed worldwide is part of the 280MW Solana plant in Arizona with 6h storage. The 20MW Gemasolar plant in Spain is able to provide electricity 24h a day with its 15h storage. There is no other commercially available solution to deliver such base load with renewables, except with hydro storage.

STE CONTRIBUTES TO ENERGY SECURITY

In its energy security strategy (May 2014), the EU acknowledges that significant investments in energy infrastructure and a diversification of energy sources are needed to reduce dependency on fossil fuels.

The cost of strategic energy security is not reflected in current wholesale market prices. These prices arise from the short-term balance of supply and demand and are not sufficient to trigger investments in new renewable power plants, which need a long-term business case. STE is a sustainable technology that is able to substitute fossil fuel imports and does not need back-up by other power plants in order to meet electricity demand when it occurs.

Promoting STE technology is therefore in the common interest of the EU Member States striving for energy security.

Dedicated, strategic investments in the form of reliable, long-term contracts for STE are required to help make Europe less dependent on energy imports.

FACT 2

STE creates jobs in Europe

Based on the latest IEA estimates, € 39-57bn will be invested on average every year between 2015 and 2030, creating 275,000 to 520,000 jobs worldwide. With dedicated EU political support, allowing in particular for the installation of 15GW STE in Europe between 2015 and 2030, the European STE industry is well positioned to capture a substantial share of this market and the related jobs. Up to 150,000 qualified jobs are at stake alone in Europe through these 15 years covering a wide spectrum of direct activities related to:

- ▶ Engineering, development and financing
- ▶ Manufacturing of components: reflectors, receivers, etc.
- ▶ Construction, civil, installation and commissioning works
- ▶ Operation and maintenance (O&M)

In addition to such direct activities, the European STE industry will in this case also create numerous indirect jobs: research, training, transport, information and communication (ICT) activities, general maintenance services, etc.

As reward for such a political support by EU, the European STE industry will return to member states more money than received in taxes: revenue taxes, VAT, social charges, corporate taxes, local community's taxes, etc.

SOURCES

1. IEA Technology Roadmap Solar Thermal Electricity, 2014 Edition.
2. Ernst & Young "Etude des retombées économiques potentielles de la filière solaire thermodynamique française", published by Syndicat des Energies Renouvelables France (November 2013)
3. Deloitte "Macroeconomic impact of the Solar Thermal Electricity industry in Spain", edited in by Protermosolar (2010).



Photo ACS Cobra – Andasol 2

STE IS AN OPPORTUNITY FOR ALL OF EUROPE

STE is inherently European: The entire EU will profit from STE's ability to stabilize the grid and increase energy independence. STE from the south and wind power from the north are complementary.

STE brings investments and jobs to the southern regions of the EU that are the focus of EU regional policy since they have been hit hardest by the financial and economic crisis.

These advantages make STE a Technology of Common Interest for the EU. Yet, the fact that STE requires effective cooperation at EU level is slowing down its development. Southern member states suitable for STE plants lack the financial strength to support the development of STE alone. Despite progress in creating the EU internal electricity market, which will allow the north to share

the benefits of STE, support for the development of STE is left to individual countries in the south.

The EU-level 2030 targets and their governance mechanism are an opportunity to address the specifics of STE as a Technology of Common Interest.

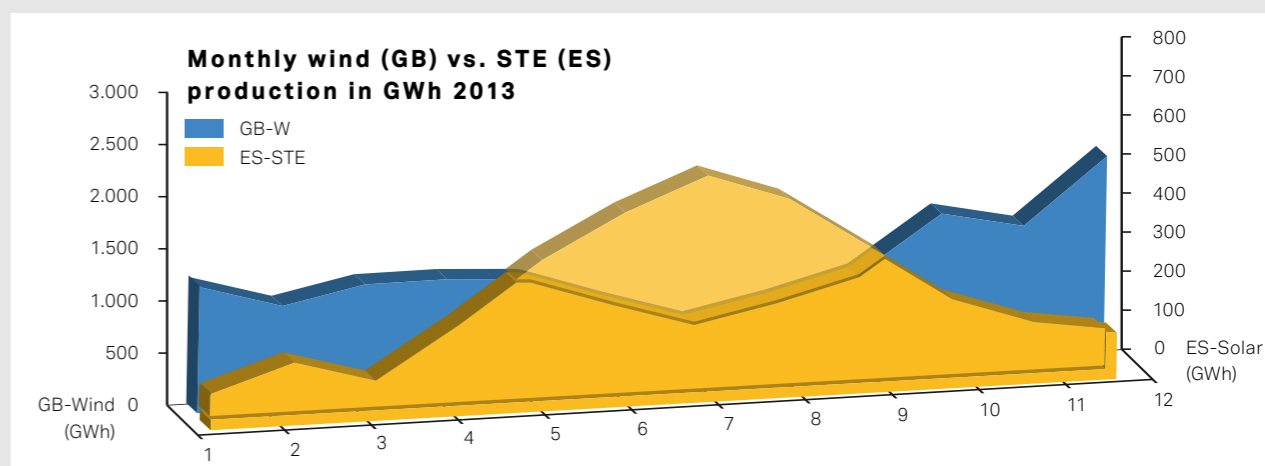
In addition, the umbrella of the energy union is an opportunity for intensified coordination between the EU and Member States, as well as between the involved EU institutions, namely those dealing with energy, research, regional policy and development and cooperation.

FACT 3

STE in the South complements wind in the North

In Northern Europe, winds blow stronger during winter, while the sun shines more in summer.

Therefore, STE in the south of the EU and wind power in its north have a good seasonal fit.



EUROPEAN STE NEEDS A DOMESTIC MARKET

Thanks to the Spanish STE program, the EU is a global leader in STE technology, profiting from a broad base of diverse companies and sectors.

A domestic STE market of at least 250 MW per year is needed to maintain this leadership. Such market development is in line with the IEA estimate that Europe should install 15 GW of STE by 2030.

An EU-level approach to STE as a Technology of Common Interest is required to support reliable off-take options for STE projects. This approach should combine strategic investments in energy security with support for renewable energy, as well as cohesion and research funding. In particular, innovative commercial projects

need support including access to affordable long-term financing.

In addition, STE needs a remuneration mechanism that rewards its system benefits, and long-term transmission rights (15-25 years) to make cross-border projects bankable.

Concrete EU initiatives are required to increase low north-south grid capacities, particularly projects from the Iberian Peninsula, southern Italy and Greece, e.g. using submarine cables.



Photo ABENGOA Solar – PS20

STE IN MENA MATTERS ALSO FOR EUROPE

Solar resources in MENA are among the world's best. The IEA estimates that Africa and the Middle East would need 84 GW of STE by 2030.

Demand doubles every 10 years throughout the MENA region. The result is a constant struggle to cover peak demand, which often occurs after sunset. STE with storage is a recognized, sustainable answer to address this challenge. As a secure electricity supply, STE also provides a prerequisite for economic development and growth, which are essential for political stability in the MENA countries.

Ultimately, increasing the standard of living and stability in the EU's Southern Neighbourhood is crucial for European cooperation policy and security.

With the upcoming Paris climate conference, the EU also has a responsibility to live up to its leading role in global climate policy. Supporting renewables in the MENA countries is an opportunity to do so.

A market for STE in the neighbouring MENA region would be an opportunity for the European industry to create green jobs there and at home in Europe.



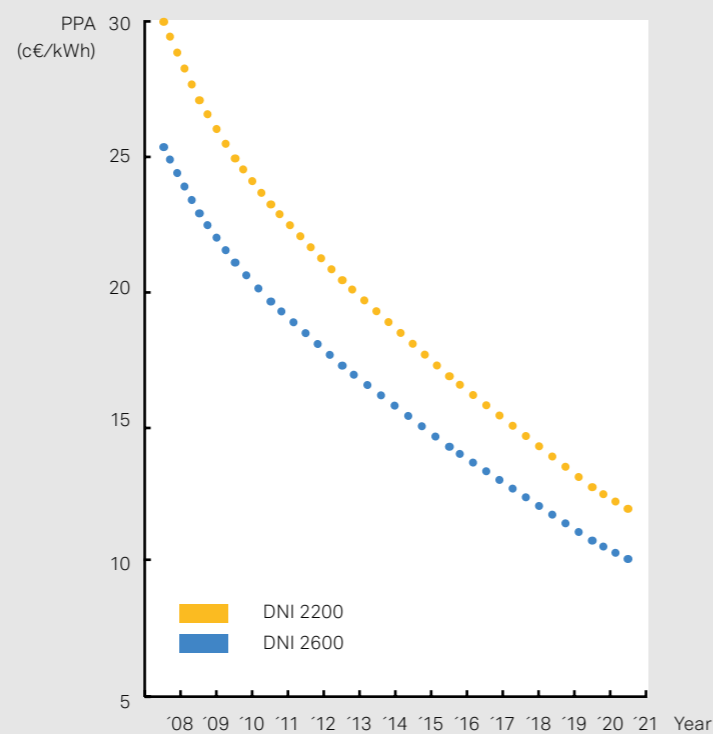
Photo Shams Power Company – Shams 1



Photo ACS Cobra – Andasol 1-2

FACT 4**STE is affordable**

As for all renewables, STE cost of electricity depends on the quality of the resource, i.e. irradiation in the case of STE, and the cost of capital. The lines in the graph show cost developments depending on these factors and based on the STE industry's innovation roadmap. Values for a 25-year PPA for a 150MW, 4h storage STE plant, under usual commercial terms for the loans without any public financial aids and no escalation. By the end of 2014, prices for plants in Morocco went slightly below 12 c€/kWh due to subsidies on the granted loans.

COST REDUCTION ESTIMATIONS FOR STE POWER PLANTS UNDER STANDARD CONDITIONS

EFFECTIVE SUPPORT FOR STE IN THE EU'S SOUTHERN NEIGHBOURHOOD

First gas-STE hybrid plants exist in Egypt and Algeria, as well as Morocco. In Morocco, a 500 MW STE complex (Noor) is also currently under construction.



Photo NOOR I, Courtesy of TSK

Europe has supported these projects with development finance and technical cooperation. This experience provides a good basis for further cooperation with the EU's Southern Neighbourhood.

With a coordinated effort, the EU can support the creation of a self-sustaining STE market in its Southern Neighbourhood. A market of several hundred MW new STE per year for a period of 5-10 years is required to reach this ambitious but realistic objective.

Beyond development finance, priority instruments to incentivize a STE market in the Southern Neighbourhood include guarantees to mitigate off-taker risks and financial support for electricity payments, e.g. from climate funds.

To establish a stable STE market in MENA that also creates jobs in Europe, EU development cooperation needs to be coordinated with industrial and climate policy.

This coordination is particularly needed since the European STE industry is facing an aggressive industrial policy by other countries supporting their STE industries in MENA.

- #1 STE enhances EU energy security and grid integration of renewables.
- #2 The EU's STE industry creates jobs in Europe.
- #3 To maintain its global leadership position, the European STE industry needs a domestic market.
- #4 The EU will get the most out of STE via an intensified coordination of its energy, research, regional and development policies.
- #5 A sizeable market for STE in the MENA countries benefits both the local and the EU economies.
- #6 The EU must coordinate its development, climate and industrial policies regarding its Southern Neighbours.

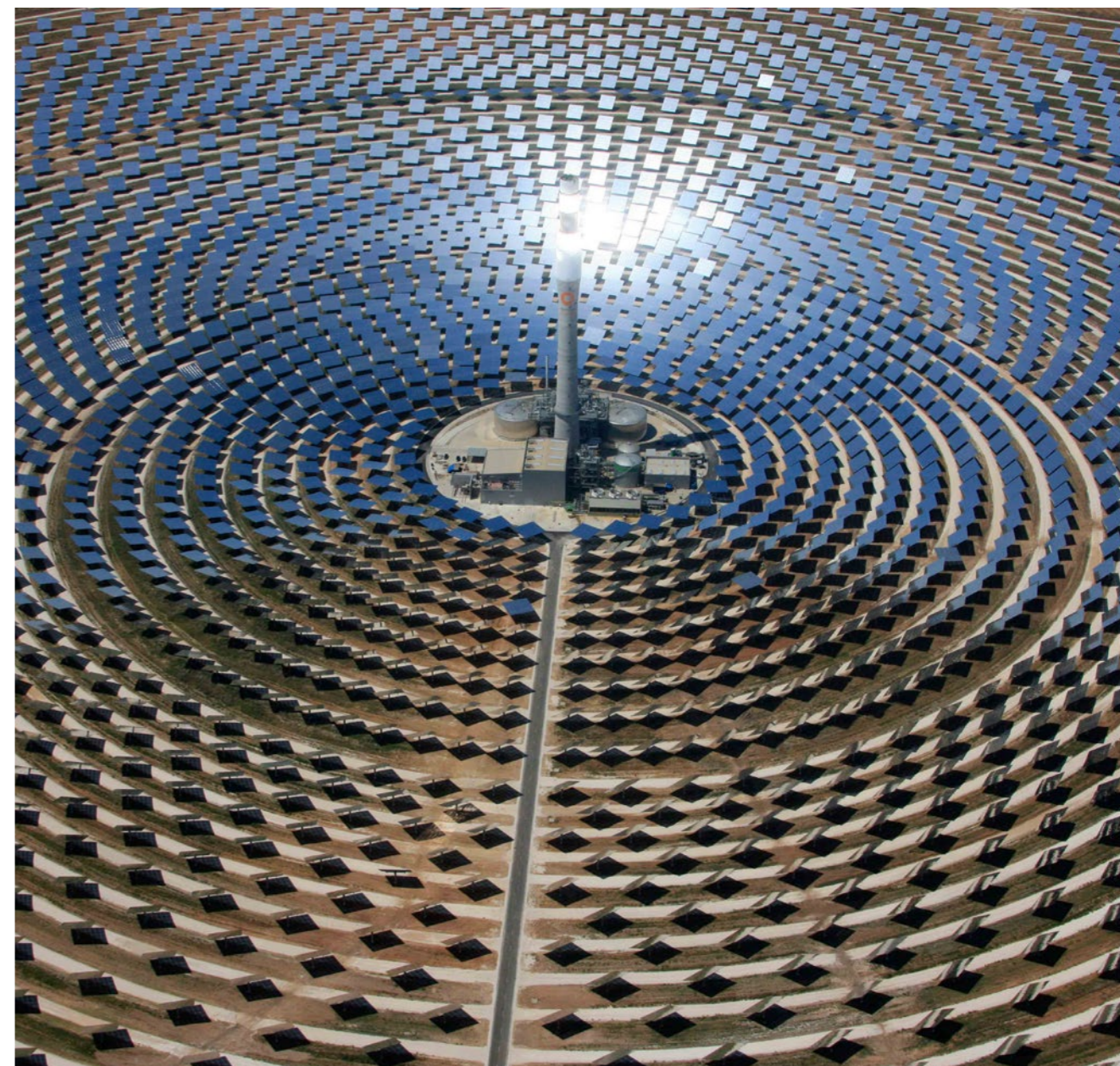


Photo SENER/Torresol – Gemasolar

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