



EUROPEAN SOLAR THERMAL ELECTRICITY ASSOCIATION

SOLAR THERMAL ELECTRICITY EUROPEAN INDUSTRIAL INITIATIVE (STE-EII)

IMPLEMENTING PLAN 2010-2012

BRUSSELS, MAY 2010



IMPLEMENTING PLAN OF THE EUROPEAN SOLAR THERMAL ELECTRICITY INDUSTRIAL INITIATIVE (STE-EII)

INTRODUCTION

From the European industry perspective, the EU SET Plan is a very visible and effective contribution to fill in the traditional enormous gap between lab and field, which has been delaying the industry actual development for decades.

Thanks to the efforts done by some Member States on both the research (Germany, Italy, Spain, etc.) and regulatory (feed-in-tariff in Spain, etc.) fields, a number of commercial plants are now being operated and under constructions in Europe. Consequently, today the European Industry is the world leader in the sector of Solar Thermal Electricity (STE), also known as Concentrated Solar Power (CSP). STE current trends demonstrate that STE technologies will be major contributors to a low carbon economy in a relatively close future.

The European leadership has been reached by building on: a) the encouraging feed-in tariffs established by the Spanish Government, b) the past research and innovation efforts made by the EU Institutions and some Member States, in particular Spain and Germany, and c) the previous (80s) experience of the US (SEGS plants). The European industry is actually investing around 10 billion € in the 2007-2014 period. European institutions, especially the Directorates for Energy and Research and the EIB, are significantly contributing to such a success.

In order to maintain this leadership, efforts in innovation should be enhanced and fostered as the only way to move towards Solar Thermal Electricity capable of providing an affordable and dispatchable energy with a low environmental impact. To this purpose the European Industry identified Technology Objectives, developed in the document presented to the European Commission in July 2009, the European Solar Thermal Electricity Industrial Initiative in the framework of the SET-Plan.¹

In October 2009 the European Commission in its Communication COM(2009) 519/3 and more precisely in its staff working document SEC(2009) 1295 "A technology Roadmap" has grouped the technology objectives for CSP in four categories.

ESTELA's proposal for implementing the STE-EII is made accordingly to these four reformulated technology objectives as the innovative items are the same as in our STEII proposal for the SET-Plan. The present document focuses on the implementing plan for the period 2010-2013.

¹ (http://www.estelasolar.eu/fileadmin/ESTELAdocs/documents/2009 - ESTELA - STEII SET-Plan_06 - 09_07_03_FINAL - NO_LIST .pdf).

To be successful such an Implementing Plan, should match with the real conditions of the STE sector, mainly, status of the plants, supporting schemes frequently applied in STE projects, regulatory frameworks, etc.

Therefore, ESTELA's current proposal builds on the idea that the Implementing Plan of the STE-EII for the period 2010-2012 should take into account the possibilities of fostering the market penetration of innovation by coupling innovation and commercial operation – in the most adequate and suitable plants already operating and planned – in addition to the innovative demonstration action that could be launched in new brand plants paving the way for a second phase to 2013-2020.

THE EUROPEAN VALUE OF STE

The great dynamism of the STE industry, its high potential, operational reliability and current production capacity makes Solar Thermal Electricity a strategic resource for planning the European electricity scheme for 2020 and beyond. The good characteristics of solar thermal power make the difference with other renewable sectors: STE plants are fully dispatchable, perfectly meet the demand curve and can additionally provide other fluent renewable conversion technologies with the necessary back-up.

The installed capacity in Europe is expected to be of 2 GW by 2012 and around 30 GW by 2020. For the EU long-term renewable energy supply regional approaches are of paramount importance. Focusing on STE, the EU and its Member States should take advantage of the fact that the largest potential of the world is in Southern Europe and the Union's neighbour countries of the Mediterranean, today partners in the Union for the Mediterranean.

In the medium-term, while a target of 30 GW for 2020 in the EU is feasible a much larger contribution could be obtained in a longer-term if the potentials of the Northern Africa countries are developed. A target of 20 GW for 2020, 85 GW for 2030 and 430 GW for 2050 is feasible taking into account the grid infrastructure to be developed in the region.

Regarding job creation, for every megawatt installed 10 jobs will be created, via manufacture, component supply, solar field development, installation and indirect employment.

STE DEPLOYMENT THROUGH THE SET-PLAN

The SET-Plan offers an enormous opportunity to develop Solar Thermal Electricity sector. ESTELA's STE-EII has been developed for the purpose of contributing to achieve two main EU goals:

- To contribute to achieve the EU 2020 targets and beyond by implementing large-scale demonstration projects carried out by the industry aimed at increasing the competitiveness of the STE sector.
- To enhance market penetration and to consolidate the European global industry leadership throughout medium-term R&D activities aimed at achieve costs reduction in Solar Thermal Electricity generation plants.

The successful development of STE can be only carried out through a coordinated action at European level. STE is the most promising clean technology, with the hugest potential, however, research is needed for achieve the fully deployment of this technology. The STE industry needs long-term R&D support schemes, financial and political support, both at national and European level.

I - FIRST STEPS TO IMPLEMENT THE STE-EII: 2010-2012

The European Commission Technology Roadmap 2010-2020 established **four Technology Objectives** for Concentrated Solar Power:

1.- REDUCTION OF GENERATION, OPERATION AND MAINTENANCE COSTS

- To improve the conversion efficiency at system level as the reliability and efficiency of individual components.
- To develop advanced plant monitoring and control technologies.

2.- IMPROVEMENT OF OPERATIONAL FLEXIBILITY AND ENERGY DISPATCHABILITY

- To develop and improve thermal energy storage, as well as hybridization of the power plants

3.- IMPROVEMENT IN THE ENVIRONMENTAL AND WATER-USE FOOTPRINT

- To reduce the cooling water consumption through innovative cycles, by developing dry cooling systems and optimising land use through new and innovative designs

4.- ADVANCED CONCEPTS & DESIGNS

- To work on advanced components, concepts and systems.

As a first step, during the first phase of the Implementing Plan, 2010-2012, the European industry considers that top priority should be given to Innovation Objectives:

- 1) Reduction of generation, operation and maintenance costs, and*
- 2) Improvement of operational flexibility and energy dispatchability.*

II - PROPOSED STRUCTURE FOR STE-EII DEMONSTRATION PROJECTS IMPLEMENTATION

Support to the STE-EII for the period 2010-2012, should take into account the current status of the national plans in the EU Member States and in those countries within the EU Neighboring Policy eligible in the framework of innovation in Solar Thermal power plants. The implementation of the SET-Plan, through EU and national financial support schemes, is needed for incorporating R&D in the already existing and planned plants in the short-term. Only by investing in R&D at European level the STE will reach competitive levels in the energy market. The implementation of the STE-EII should boost and support innovation.

STRUCTURE ACCORDING TO THE STATUS OF STE PLANTS

ESTELA's current proposal takes into account the impact of the new scenario created by the authorization procedure recently adopted in Spain focusing on the short term innovation (2010-2012) that could be incorporated in the existing plants, allowing for results in a much more reduced period of time, making this technology more competitive. The support of the SET-Plan would provide a wider penetration and coordination of any future support scheme.

The SET-Plan can also help to incorporate innovation in some plants in Spain which have been approved and that construction will start in 2011 and 2012.

REGARDING THE STATUS OF THE PLANTS, THE PROPOSED STRUCTURE CONSISTS IN THREE TYPES OF PROJECTS WITH SPECIFIC SUPPORTING MECHANISMS:

TYPE A) PLANTS IN OPERATION OR UNDER CONSTRUCTION

Projects to be inserted as a new appendix in spare room of plants already built or being built.

There are 8 STE plants in operation or commissioning status, while around another 20 plants are under construction.

Due to the characteristics of the STE technology, these plants can be an excellent opportunity to build and test full-size components or systems at lower cost and in shorter time than any other alternative.

These projects would be financed by the interested parties, possibly with some financial help, mainly in terms of grants and soft loans. Unfortunately, unless there is a strong reinforcement of the funds allocated by the EU through the SET-Plan that will further encourage the plants owners and the interested industry partners, the rate of progress through this mechanism will remain very slow.

Supporting mechanisms for projects type a): The promoters of these projects expect to demonstrate the performance, duration, degradation, costs of selected innovative systems or components. If the trial is successful, they expect to implement it on a fully commercial scale in future plants. The most effective way of encouraging this kind of innovation is by means of grants and/or soft loans:

National

Regional

EU Support Programmes and Funds – FP7th – SET Plan

TYPE B) AUTHORISED NEW PLANTS

New plants expected to start either construction or operation in Spain along the period 2010-2013 in the framework of the current national regulation. 48 plants, around 28 of which are already authorized with certain general technical characteristics and their construction will start from 2010 until 2013.

While the administrative and financial situation of these 28 plants prevents the introduction of major breakthrough innovation, it does allow the prudent introduction of innovative components or systems, provided that additional costs and technological risks are shared among the parties who benefit from the potential success of such innovations: the plant owner, the EPC Contractor, the system or component supplier and the public entities, at regional, national or EU level, who may participate.

A balanced combination of grants, soft loans and some kind of risk-sharing guarantee will be a good solution to strongly encourage the introduction of innovations in this type of projects which, again, would considerably shorten the lab to market-time and cost of new components or systems.

<u>Authorized plants in Spain</u>	<u>Number of plants</u>	<u>MW</u>
<i>Operating or in commissioning in 2009</i>	8	332
<i>Completion 2010</i>	11	548
<i>Completion 2011</i>	11	516
<i>Completion 2012</i>	11	500
<i>Completion 2013</i>	15	443
Total 2010-2013	48	2007

From the Supporting mechanism for projects type b): The innovative systems or components are to be installed in plants already financed on other basis than grant scheme. Installing an innovative system or component may encompass additional investment or O&M costs and some risk of complete failure. Therefore, a combination of grants, soft loans and risk sharing loans/guarantees, adapted to the nature of the risks taken, will be preferred:

National

EU Support Programmes and Funds – FP7th - SET Plan

TYPE C) BRAND NEW PROJECTS

Brand new projects where the plants permitting process has not started, or at least has not been completed, and where consequently new concepts or designs could be tested and demonstrated at a commercial stage. The context is much more open, as the promoters are free to implement any kind of innovative features, for instance:

- New components or systems within already demonstrated plant configuration.
- New configurations, using existing or new components, i.e. mixing-up troughs and tower, different HTF's or storage systems, different hybridization approaches, more or less integrated desalination system.
- Totally new concepts, still at the lab level, i.e. direct steam, gas turbine.

For these projects, and depending on the combination of additional costs involved (including possible delays due to the need to adjust the new configuration or concept) and the risk of partial (final performance below expected) or total failure, the best combination of the supporting mechanism should be defined on a case by case basis.

Supporting mechanism for projects type c): If a regular project finance scheme could encounter finance difficulties due to the technological risk, the risk-sharing mechanism will be part of the preferred solution, provided that it covers the reimbursement of the project finance loans in case of technological failure. Obviously, the income of the project must be assured through feed-in tariffs or any other support scheme, related or not to the innovative aspects of the project.

STRUCTURE ACCORDING TO THE INNOVATIVE CONCEPTS

The following categories of innovative actions have been prioritised in accordance with the Innovative Objectives of the STE-EII:

I) DEMONSTRATION OF INNOVATIVE COMPONENTS.

The projects should demonstrate that the component is reliable and performs as intended for commercial application on STE plants. Areas in which innovative concepts could be tested include:

- linear receiving tubes
- tower receivers
- Stirling engines
- supporting structures
- mirrors
- driving devices
- control valves/special valves
- special pumps
- new heat transfer fluids
- storage media material

II) DEMONSTRATION OF INNOVATIVE SYSTEMS:

The projects should demonstrate innovative systems: Storage systems, HTF systems, receiving/capturing systems, dry cooling systems, hybrid cooling systems, desalination systems, etc.

III) DEMONSTRATION OF INNOVATIVE CONFIGURATIONS OF PLANTS:

The projects should demonstrate innovative configuration of plants: New hybridization concepts, new storage concepts, dual electricity-water plants, trough and tower plants, etc.

IV) DEMONSTRATION OF INNOVATIVE CONCEPTS:

The projects should demonstrate new innovative concepts: Direct steam, hot air to gas turbine, dual fuelled Stirling or Brayton Parabolic Dish.

Please note that demonstration of new components and systems can be carried out in any situation of the plant, either a), b) or c) above, while new configurations or new concepts will likely require to be performed in new plants (projects type c).

III - IMPLEMENTATION PHASE OF THE STE-EII DEMONSTRATION PROJECTS: FINANCING AND TIMETABLE

SCHEME OF THE STE-EII IMPLEMENTATION PLAN 2010-2012 IN ANNEX I

DEMONSTRATION PROJECTS: OBJECTIVES, FINANCING AND TIMETABLE IN ANNEX II

SUMMARY TABLE BY TYPE OF PROJECTS

Status of plants	Total Investment	Public Invst. Grants	Private Invst. Soft Loans - Risk Sharing	Private Invst. Capital
a) In operation or under construction	225	111	54	60
b) Authorised new plants	160	59	60	41
c) Brand new projects	3220	400	2266	554
TOTAL	3605	570	2380	655

SUMMARY TABLE BY OBJECTIVES

Objectives	2010-2012 Total Investment	2010-2012 Public Invst. Grants	2010-2012 Private Invst. Soft Loan or Risk Sharing	2010-2012 Private Invest. Capital
1) Reduction of cost and increase efficiency	2596	270	1850	476
2) Operational flexibility and dispatchability	1009	300	530	179
TOTAL	3605	570 (15%)	2380 (66%)	655 (18%)

SUMMARY TABLE BY FINANCING INSTRUMENTS

Innovative Actions	EC/MS Grants	Soft Loans	EIB - Risk Sharing
I. Demonstration of innovative components (projects type a) and b).	X	X	
II. Demonstration of innovative systems (projects type a) and b).	X	X	
III. Demonstration of innovative configurations of plants (projects type b) and c)	X	X	X
IV. Demonstration of innovative concepts (projects type c).	X	X	X

IV - KEY ELEMENTS FOR SUCCESS

The full success of the STE-EII requires a strong integrated effort at the EU, national and regional levels, as well as the industry commitment. The role of each administration level is different and can be outlined as follows:

EU LEVEL

- Grants – European Commission.
- Soft loans – EIB.
- Risk sharing mechanism (guarantees to cover technological risk) – EIB.

MS NATIONAL LEVEL: COUNTRIES WITH A GOOD SOLAR RADIATION LEVEL

- Expand the present feed-in tariff contingents to accommodate a certain amount of new SET Plan selected plants.
- Promote flexibility criteria in already approved plants (but still not under construction) to accommodate innovative features.
- Proactively work with the EC and other interested Member States and/or Mediterranean Partner Countries (MPCs) in the development of the flexibility/cooperation mechanisms of Art. 6-9 of the RES Directive through the harmonised transposition of such Directive.
- Give priority to projects selected within the SET Plan.
- Allocate a certain amount of funds from the proceeds of the CO₂ allowances auctions to the supporting mechanisms of plants built under the cooperation mechanisms containing innovative features.

MS NATIONAL LEVEL: COUNTRIES WITH POOR SOLAR RADIATION LEVEL

MS can take advantage of solar power by co-promoting Joint projects and/or purchasing “Statistical Transfer”, applying to RES Directive, rights from plants under the SET Plan SII, for instance:

- Give priority to projects selected within the SET Plan.
- Allocate a certain amount of funds from the proceeds of the CO₂ allowances auctions to the supporting mechanisms of plants built under the cooperation mechanisms containing innovative features.

REGIONAL LEVEL PLANTS

- Provide authorisations / permitting / grid connections for SET Plan plants.

- Expand the benefits of regional R&D support mechanisms to SET Plan plants.
- Use the regional public R&D centres to help the design.

WORLD BANK AND OTHER MULTILATERAL

- Encourage SET Plan endorsed projects within the MSP, regardless of additional technological risks, encouraging the participation of host countries engineering and R&D institutions.

UFM INSTITUTIONS / SECRETARIAT

- Support the development of present and future mechanisms to joint efforts between the SET Plan and the MSP.

THE ROLE OF THE INDUSTRY

The European STE Industry is presently investing more than 10 billion €. Promoters have taken a quite significant technological risk, as the first plants' technology had no previous commercial experience – i.e. plants with molten salts storage, saturated steam tower plants and tower plants with molten salts receiver and storage.

Other actors, such as components manufacturers are making significant contribution to the technological innovation by investing in production process and facilities.

The European Industry, represented by ESTELA and the Spanish Association, Protermosolar – their 60 and 90 members, respectively, representing the almost 90% of the sector – is hereby expressing its strong determination to support the efforts that the present document is outlining.

V - MONITORING: KEY PERFORMANCE INDICATORS (KPI)

The KPIs which will monitor the improvements in the achievement of these two objectives during this first phase (2010-2012) are the following:

KPIS 2010-2012	
Activity	Key Performance Indicators
1) Increase efficiency & Reduce cost	<p>Increase efficiency:</p> <ul style="list-style-type: none"> Increased solar to electricity conversion efficiency by at least 5% (relative). Increase Heat Collecting Fluid Steam Temperature. <p>Reduce costs:</p> <ul style="list-style-type: none"> Reduce cost of installed products and O&M by at least 10% compared with state of the art in commercial plants in 2009. Life-time Levelized Electricity Cost €/MWh. Number of "down-time" hours per year (plant reliability).
2) Increase dispatchability	<ul style="list-style-type: none"> Increased performance of storage and hybridisation by at least 5%. Investment cost of storage, €/MWht of stored energy. Increase efficiency of storage, %, as well as time dependency. Decrease size of storage, m³/MWht. Increase number of operating hours, based on maximum storage capacity. Decrease the cost of produced energy (compared with a similar plant without storage).

For the purpose of Monitoring, at a first stage, reference Solar Thermal Electricity plants and their respective LCOEs will be considered as 50 MW plants with and without storage and located in the South of Europe – DNI around 2050 kW/h m².

VI – FURTHER STEPS TO IMPLEMENT THE STE-EII: 2013-2020

Meanwhile in the STE Implementing Plan, 2010-2012, priority has been given to the Innovation Objectives 1 and 2, developed in the present proposal. STE Implementing Plan for the period 2013-2020 will develop all the four Innovation Objectives, including Objectives 3 and 4 as proposed in the STE-EII 2010-2020.

For the period 2013-2020, the European STE Industry, based on main research and innovation actor's advice, estimates that efforts will, therefore, focus on:

- *The design of advanced concepts to reduce costs and improve dispatchability, and*
- *Improving the environmental footprint through mid-term R&D programmes addressing dry cooling, desalination and innovative use of land.*

INTEGRATION WITH THE GRID INITIATIVE FOR THE SET-PLAN

Solar Thermal Electricity plants are fully dispatchable, perfectly meet the demand curve and can additionally provide other fluent renewable conversion technologies with the necessary back-up.

STE generation is highly predictable, and it can be coupled with thermal storage or hybridization, with gas or biogas, providing stability factors for the electricity networks. Solar thermo-electric plants have favourable inertial responses as well as the capacity for primary, secondary and tertiary electrical regulation in both ways, up and down, can meet the demand needs at any time, day and night, and can supply electricity at peak hours if previously planned.

The presence of STE plants in any grid knot allows increased amount of intermittent, low inertia sources, such other RES.

To increase dispatchability is one of the four Innovative Objectives of the STE-EII "Improvement of operational flexibility and energy dispatchability".

New and smarter grid infrastructures are needed within the North and South of Europe and, in the longer-term, grid infrastructures will be needed to transmit the STE electricity from Northern Africa countries to the Europe.