THE FIRST 5 YEARS OF ESTELA

SOLAR POWER FROM EUROPE'S SUN BELT

European Solar Thermal Electricity Association

ESTELA

SOLAR THERMAL ELECTRICITY SECTOR 2007-2011: THE REAL UPTAKE

Credits

A report by the European Solar Thermal Electricity Association

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Design: www.acg-bxl.be

Photos: courtesy of Members of ESTELA and Protermosolar

Published in February 2012

INTRODUCTION

European Solar Thermal Electricity Association

ESTELA

In February 2007 the 11-MW PS10 power plant in Seville, Spain, was first connected to the grid. In May 2007 the 64-MW Nevada Solar One power plant was connected to the grid. These two important milestones represent the renaissance of the Solar Thermal Electricity technologies following the long and dark STE night since the last SEGS plant was commissioned in California in 1991.

The European Solar Thermal Electricity Association, ESTELA, was constituted in July 2007 and since then has been devoted to promote the deployment of STE plants in Europe.

In the last 5 years, more than 1,000 MW have been connected to the grid, mainly in Spain. According to National Action Plans on Renewable Energy from Portugal, Spain, France, Italy Greece and Cyprus, around 7,000 MW will be installed by 2020.

ESTELA has actively contributed to the current European Union's regulatory framework which set the targets for 2020 and the flexible mechanisms to achieve national targets by opening the internal market to green electricity exchanges among Members States and with Third countries. Therefore, solar power generated in STE plants located in the southern European regions would reach northern and central Europe and solar electricity generated in the northern African countries would be imported if EU's standards are applied.

This important step forward to a future renewable electricity generation system should be supported by European research programmes and allocations of emission rights to foster technological development and the quick cost reduction.

ESTELA commitments and activities in these 5 years focused on helping to build the legal framework that will be applied until 2020. Besides its assisting role to the European legislative and executive Institutions - Parliament, Council, Commission, Committee of the Regions, European Investment Bank, ESTELA has provided assessment to national authorities and public institutions in Europe and in other regions of the world. ESTELA was also one of the main contributors in building and shaping the Solar Mediterranean Plan and still continues its contribution and suggesting ways for making it happen.

ESTELA has today 60 direct members representing more than 200 companies and institutes. Three national associations are members of ESTELA: the Spanish association Protermosolar with more than 100 members, the Italian ANEST with more than 30 and the French SER with around 30. ESTELA is considered the authorised voice of the STE Industry sector at European level. ESTELA has recently promoted - along with the South African SASTELA and the Australian AUSTELA - a world level federation of STE associations, STELA World, to have a proper platform to bring our messages to multinational institutions such as UN, IPCC, IEA, IRENA, among others.

In the following pages, progress made in these 5 years is described. ESTELA is a service oriented association: services to Members, services to institutions and decision makers and services to research and innovation institutes. Dissemination of the work carried out is the purpose of this brochure reflecting ESTELA's activities in its first 5 years of life.

Mariàngels Pérez Latorre
Secretary General

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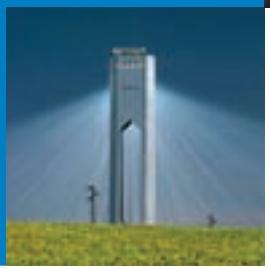

FOREWORD

Message from President José Alfonso Nebrera (2007-2010)

When in July 2007 Valeriano Ruiz, representing Protermosolar, Nikolaus Benz for Schott and myself for ACS joined Mariàngels Pérez Latorre to incorporate ESTELA, none of us could imagine how incredibly successful our just born industry association would become. In these years the solar thermal electricity industry has evolved from virtually inexistent to a fast-growing business with new plants operating or being built in every continent.

With fast reducing investment cost, improving efficiency (thanks to higher temperatures and better materials and components), improved storage and hybrid configurations, and, last but not least, operational experience adding further improvements on a daily basis, solar-thermal technologies are today proven, but at the same time still have a tremendous potential for further costs reduction as well as for better efficiency, dispatchability and firmness.

None of this would have been possible without the effort and the continued enthusiasm of a growing number of governments, companies and individuals. Today, thousands of people, working for business or for innovation entities, are accelerating the progress. Despite the crisis in most of the world's economies, today's in-power politicians must understand that accelerating the pace of innovation is their best contribution to the way out of the crisis and for the future benefit of the people and the environment.

Message from President Luis Crespo (since 2011)

Electricity generation free of greenhouse gas emissions is nowadays technically possible. To make this scenario happen, solar thermal electricity power plants must be considered as an essential piece of the puzzle. Thanks to its high effectiveness and hybridization capability of storage, solar power plants contribute to the stability of the grid. For these specific characteristics, solar thermal electricity power plants will be the core of the electrical generation system in the World's Sunbelt countries and will extend its benefits to many other regions.

The European industry has led the renaissance of the solar thermal electricity technology - after the break between the last commercial power plant built in California in 1991 and new ones in Spain in 2007. Nowadays, a significant number of new solar thermal electricity plants are being constructed, contracts have been awarded and support programs have already been launched in many regions of the world, like USA, MENA, India, South Africa, Australia, etc. And Spain is continuously adding power to the grid.

STE technologies are also demonstrating a quick evolution in the cost learning curve and presenting an impressive long track record. Despite the fact that the amount of installed power is still much lower than the corresponding to other technologies which starting earlier many years ago, but have been more widely deployed up to now.

We have, in front of us, an enormous emerging market and a full range of innovation opportunities: new plant concepts, conversion cycles, working fluids, component materials, storage, hybridization, by-products, etc.

Altogether industry, research centres and public administrations, will make our technology become more and more performable and competitive in order to play this major role that we deserve in the near future.

Valeriano Ruiz, Vice-president and President of Protermosolar (2007-2011) 1

Truth be told I feel proud to write these lines to mark the 5th anniversary of ESTELA, as I was one of the three people who signed its constituency in Brussels, July 2007.

In those days it became evident to us that Europe, as a geographic and political space, could not be absent from the movement - especially focused in Spain - toward the construction of solar thermoelectric plants and its commercial integration into the electricity system in general. We knew how in the past various countries from the South of Europe (France, Italy, Portugal, and Greece) who had good levels of direct solar radiation had made efforts in investigating these technologies. And others, with lower levels of radiation (Belgium, Switzerland, and Germany) had participated in the first pilot projects in the Almeria Solar Platform during the first part of the eighties.

This made us realise that companies in all European countries could contribute to this renaissance, and in stepping toward the commercialisation of concentrated solar technologies. Without any doubt, this is what is happening now and it is the ESTELA association that is bringing them together and acts as the sector's catalyst throughout the continent from a central position close to Europe's political powers.

Challenges in the technology, commercialisation, financing and even those of image need to be overcome in a joint effort, and with determination, because overcoming them would open the way to a sustainable energy future in the European Union.

We can feel satisfied with ESTELA's trajectory lead by José Alfonso Nebrera, as its first President, and Mariàngels Pérez Latorre as Secretary General. I am convinced that its new President, Luis Crespo, will add a new impulse to the future in which many forecasted projects will be concretised.

Nikolaus Benz, Vice-president (2007-2011) 2

When we founded ESTELA 5 years ago, we not even thought about forming an industry association which rapidly grows to more than 60 members.

This impressive membership is the evidence of the huge interest in CSP in Europe and the progress it made. Mainly due to the project pipe line in Spain, CSP developed to a remarkable industry.

Today ESTELA members are the leading companies in the world's CSP business, manufacturing components and building power plants in all the emerging CSP markets.

CSP is not only an important contribution to our future energy supply; it is as well an industry success story in Europe.

Michael Geyer, Vice-president (2007-2011)

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I have participated in ESTELA since its creation and I am really proud of the role that ESTELA played in helping the growing of our solar thermal electricity sector and becoming the voice of the industry particularly in front of the European Union's Institutions.

The "Directive on Electricity Production from Renewable Energy Sources 2001/77/EC", set the European renewable electricity production targets until 2010 as a reference for the renewable electricity regulatory frameworks for European Member States. For ESTELA members, this framework and its subsequent member state regulation in Spain set the regulatory security to invest in the development of large scale concentrating solar power technologies. This European transnational private-public technological effort, where ESTELA is always active, lead to the successful commercial market launch of commercial concentrated solar power plants worldwide from 2007 until now and further into the future.

Henner Gladen, Treasurer (2007-2011)

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The sun is providing ten thousand times the energy human mankind is using. While solar energy is abundant, today we are only making use of a tiny fraction of it. But this is changing rapidly and is being driven by global understanding that every country has to mitigate climate change and to improve energy access and supply security, especially by dispatchable solar thermal electricity.

Starting in the US and Spain, countries and companies are now investing in solar power generation in the entire Sunbelt of the world on an unprecedented scale. As a consequence, costs continue to fall and technologies thus will be developed and improved. This 5 years report gives a review of solar thermal power technologies and markets, emphasising especially on the activities in creating favourable framework conditions under European legislation. Several support schemes were achieved and introduced, which can work as guidelines for policy makers, industry representatives and concerned stakeholders on how best to use and successfully promote solar thermal electricity production in their countries.

José Manuel Nieto Jiménez, Member of the Executive Committee

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Concentrated Solar Power thermal generation is a frequently misunderstood technology; most people still refer to the collectors as 'panels'. However beneath this lake of disregard a remarkable reality is rising. Solar Thermal Electricity has become utility quality dispatch generation and is posed to have a significant role in developing alternatives to fossil and nuclear fuel plants. Thanks to the quiet effort of a group of industry leaders, a number of viable fully proven solutions is increasingly available and this, coupled with the cost reductions, we are witnessing indicate that STE will be part of the generation mix in any country with solar resource. ESTELA's effort in bringing this technology forward is important for the current and future generations of European citizens who will benefit from clean generation and diminished reliance on foreign fuel imports.

Leonardo Merlo, Member of the Executive Committee

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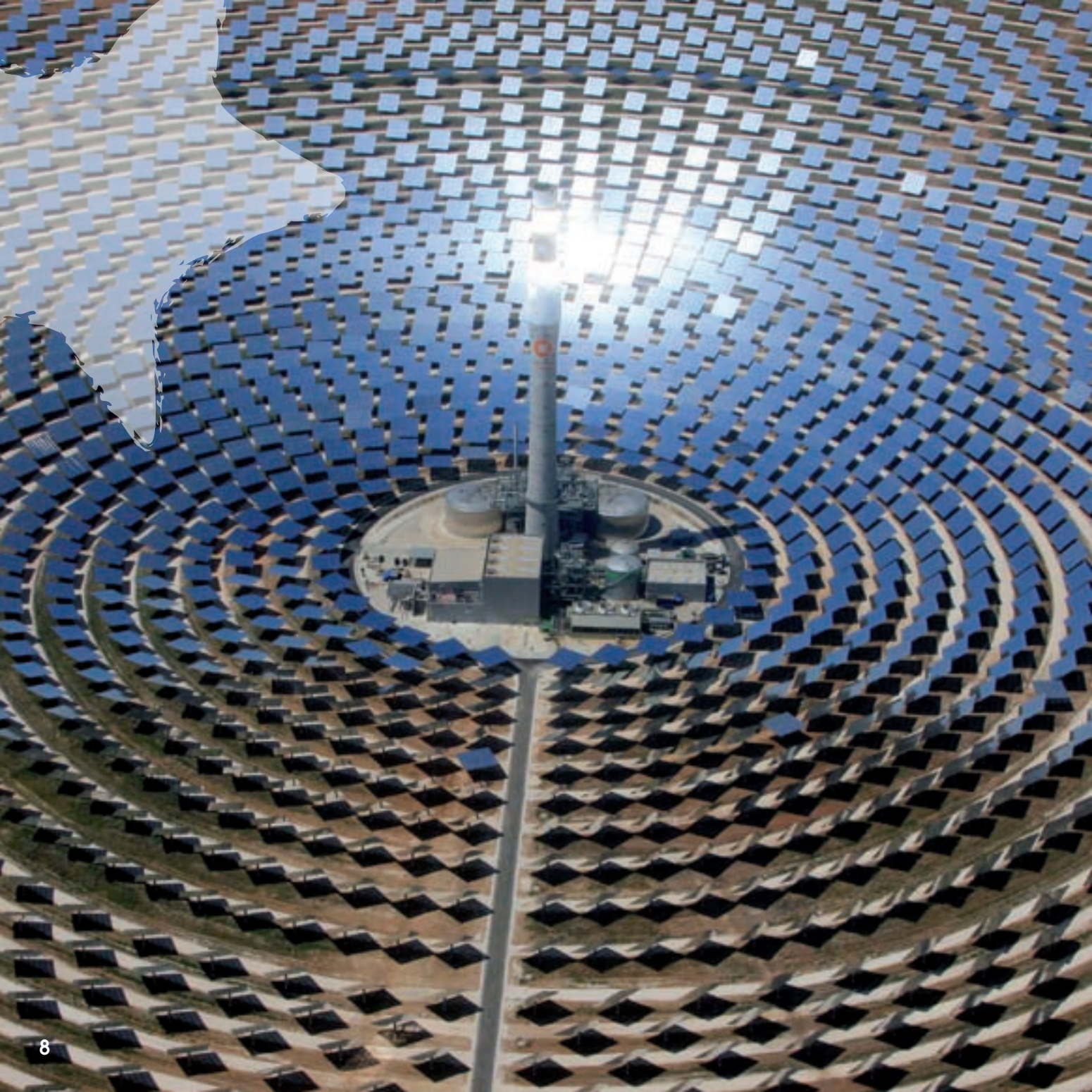
Since the year 2007, the year that can be considered as the renaissance of the Solar Thermal Electricity technologies, the installed capacity has been continuously increasing. Also considerable improvements of the technologies are currently being developed and new challenges must be faced. In this evolving scenario, ESTELA plays a key role.



ESTELA'S OBJECTIVES AND PRIORITIES

The Association

ESTELA is a non-profit association which main objectives are: promoting, supporting and representing the solar thermal electricity sector and its Members. ESTELA is a service oriented association assisting public bodies and institutions, elaborating studies, disseminating best practices in solar thermal electricity generation and creating opinion. Today ESTELA represents more than 200 companies and institutions, including the national associations Protermosolar (Spain), ANEST (Italy) and SER (France). ESTELA has consolidated its position and has been taken as a reference for other industry associations such as SASTELA (South Africa) and AUSTELA (Australia) created in 2011.

The Priorities

ESTELA builds its activity on three pillars: policy, research and innovation and dissemination.

Policy - An industry sector can only develop in a supportive and stable legal framework. Activity on policy has been during the period 2007-2011 at the core business of ESTELA. Since its creation ESTELA has become a reference stakeholder for the European Union's institutions and national authorities. ESTELA has conveyed the voice of the European solar thermal electricity industry, based on Members' experience and companies know-how, to decision makers.

Research and Innovation - ESTELA has devoted its energy to research and innovation in order to build a reference framework at medium and long-term: firstly by preparing and adopting the Solar Thermal Electricity Industry Initiative for 2020; secondly by elaborating a Strategic Technology Agenda for 2020-2025 (currently undergoing). To succeed on these tasks, ESTELA has created the Scientific and Technical Committee composed by professors and researchers at the front of the excellence in solar thermal electricity technologies.

Dissemination - ESTELA, in these 5 years, has consolidated the Industry Forum (the third Forum in February 2012), the Summer Workshops (the fourth workshop in July 2011) and the specific, technical workshops to analyse problems, seek solutions and make progress. ESTELA regularly provides with dedicated information to Members and participates in European and worldwide events of the STE Sector.

Statutory Objectives

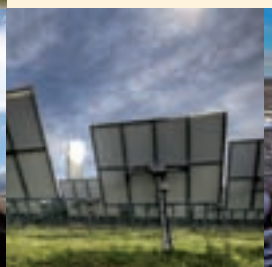
- To promote high and mid temperature solar technologies for the production of thermal electricity to move towards sustainable energy systems
- To promote thermal electricity in Europe at policy and administrative levels (local, regional, national and European)
- To support Union's action in favour of European industry development and to contribute to reach the Union's energy objectives and its main renewable energy targets
- To support research and innovation, including vocational training, and favouring equal opportunities
- To promote excellence in the planning, design, construction and operating of thermal electricity plants
- To promote thermal electricity at international level, mainly in the Mediterranean area and developing countries
- To co-operate at international level to contribute to combat climate change
- To represent the solar thermal electricity sector at European and world level

ACTING ON POLICY

EUROPEAN UNION

Since 2007 the EU legal framework concerning directly or indirectly the solar thermal electricity sector has been improved and extended mainly, thanks to two new Directives that are the most solid pillars to support renewable development ever at EU level: the RES Directive and the ETS Directive. The third pillar is the measures taken to complement the Third Energy Package.

ESTELA has had a proactive participation during the legislative process which mainly involves the European Commission, the Parliament and the Council. However, the activity of ESTELA covers the preparatory and consultation tasks developed mainly by the European Commission. Public consultations, communications, assessment measures, etc. are analysed and feedback conveyed to the authorities in order to adapt the foreseen measures to the particularities of the solar thermal electricity sector and the European industry.



The first pillar of the regulatory framework that supports the deployments of the solar thermal electricity sector is the Directive on the promotion of renewable energy sources.

RES Directive

The RES Directive 2009/29/EC establishes the legislative framework to achieve the Union's binding target of 20% final energy consumption from renewable energy by 2020. Member States implement the Directive through their National Action Plans (NREAP) submitted to the Commission by 30 June 2010. Today all countries have established precise targets, the share of generation technologies expected to deploy and the regulatory and administrative measures they will adopt to develop RES use.

Seven countries have reflected Solar Thermal Electricity in their National Renewable Energy Action Plans: Cyprus, France, Greece, Italy, Portugal and Spain, adding to a total of 7GW by 2020, setting as well financial supporting mechanisms in the form of feed-in tariffs/premiums to ensure its deployment stability.

Taking into account the difference in the geographical distribution of renewable energy sources potential, as for instance, the most abundant solar radiation is found in the Mediterranean Basin, the RES Directive introduces "flexibility mechanisms" which allow different ways of collaboration among Member States and with Third Countries such as in transferring amounts of energy from renewable sources, setting up new RES generation projects and coordinating national support schemes. They are identified as Statistical transfers, Joint projects between Member States and between Member States and Third Countries and Joint support schemes.

Almost all Member States are open to use these mechanisms in their NREAPs, including those who will not need them to meet their targets.

ESTELA will ensure a follow-up for its Members concerning the implementation of the RES Directive by national authorities, the monitoring by the Commission on the achievement of the goals by Members States and will propose measures if the progress is not in accordance with the compulsory targets, rules and expectations announced by the Directive.

The second pillar of the EU legislation relevant to solar thermal electricity sector is the Directive on the Emission Trading System. ESTELA's main contribution has been in assisting in elaborating the priorities to be supported by the revenues generated by the ETS in Members States.

ETS Directive

The European Emission Trading System was established by Directive 2003/87/EC entering into force in 2005. It is a "cap and trade" system, meaning that it imposes a limit on the total amount of CO_2 emissions that the power and heat generation sector can produce. This amount is translated into allowances, which constitute the right to emit one tone of CO_2 equivalent. The number of allocations is reduced over time, in order to reach in 2020 a 21% reduction of emissions compared to 2005 levels.

The third trading period will start in 2013 and last until 2020, bringing an important change in methodology: the major auctioning of allowances by each Member State. Under the first phase from 2005 to 2007, and the second trading period from 2008 to 2012, Member States were required to establish a National Allocation Plan which determined how these allowances were to be distributed among the installations covered by the scheme. Now, around half of the allowances will be auctioned and at least 50% of the revenues shall be used for the purpose of financing projects which shall contribute to the reduction of greenhouse gas emissions.

New Entrant Reserve 300

The denominated NER300 mechanism derives from the revised Emission Trading Directive 2009/29/EC, which contains the provision to auction 300 million allowances of CO_2 emissions to finance demonstration projects for innovative renewable energy technologies and carbon capture storage. These allowances which come out from the 10% cap assigned to the reserve for new entering countries to the Union, and they shall be managed by the European Investment Bank.

One Solar Thermal Electricity Power Project will be financed in the first of the two calls for proposals, which will be known in the second half of 2012 when the European Investment Bank will publish its list of recommended projects. The second call will be set up in 2013-2014.

In May 2011, the European Commission provided details on how many renewable energy proposals were submitted per NER300 category and per Member State. Cyprus, Greece, Italy and Spain have submitted eligible projects for STE.

The role of ESTELA in the future still remains the STE sector's priorities to be funded under the NER300 mechanism, in order to maintain all STE technologies eligible for the NER300 calls: Parabolic troughs, Central receiver, Fresnel and Dish Stirling.

The third pillar essential for the future deployment refers to the completion of the internal market of electricity: its rules, and its bodies.

Internal Market of Electricity

On 25 June 2009, the Council of the European Union adopted The Third Energy Package, the new liberalisation rules for the European gas and electricity markets, to be transposed in Member States by March 2011. Europe's Energy Internal Market should be operational by 2014, as requested by Council Conclusions of the 4th of February of 2011. A rapidly implementation is therefore necessary.

Action falls under The European Network of Transmission System Operators (ENTSO) and Agency for the Cooperation of Energy Regulators (ACER) work programme, which were created under the new legislation to assure better coordination at Europe-level on market, technical and legislative issues. ENTSO and ACER will collaborate on the development of technical standards on operation, development and marketability of the network system, otherwise known as the network codes.

The role of renewable energy in the future Internal Market is implicit. Only through endorsing RES deployment will the targets of competitive, secure and environmentally sustainable market be achieved.

ESTELA action focus on the updating of the 10 years action plan to be developed by ENTSO as by today the plan has avoided the specific needs for transmission renewable electricity. Solar thermal electricity is dispatchable and able to generate firm electricity. This is a factor that contributes to the stability of the grid and should be taken into consideration by grid operators and regulators.

Infrastructures

Europe's Energy Infrastructure needs are in the spotlight of the Internal Market, as only an updated energy transmission system will enable the free circulation of electricity. The Supergrid will be the most economic and efficient way to connect Europe and neighbouring countries.

Recent infrastructure regulation proposal from Commission and the Connecting Europe Facility (CEF) under the next Multiannual Financial Framework 2014-2020, identify key energy transmission corridors, otherwise referred to Projects of Common Interest and sets out provisions on new ways for financing of the projects. One of these is the North-South Corridor in Western Europe, which will help in the elimination of internal energy bottlenecks between the Iberian Peninsula and the rest of Europe, while enabling imports of renewable energy from North Africa.

To profit from solar renewable power generation projects in the South, a new trans-Mediterranean power grid to interconnect Europe with the regions of the South will contribute to the integration of electricity markets, to the improvement of energy security and enable to respond to the increasing energy demand.

MENA COUNTRIES

ESTELA shares the vision of the European Union looking at the future electricity supply from a pan-European perspective. The next logical step forward would be to reinforce the trans-Mediterranean trade in renewable energy with a focus in solar power. This could only be done going one step ahead of the needs of the Market, and developing already a close integration with the Middle East-North Africa (MENA) neighbouring countries. ESTELA has invest efforts on that direction since the very beginning convinced that the solar thermal technologies have the prime role to play in the massive deployment of solar power in the world to satisfy energy needs on a sustainable basis.

Union for the Mediterranean

The Union for the Mediterranean (UfM) was launched in the Paris Summit of 2008 in the path of the Euro-Mediterranean Partnership (Euro-Med) established at the Barcelona Conference in 1995. The UfM is a multilateral partnership that encompasses 43 countries from Europe and the Mediterranean Basin, which The UfM permanent Secretariat in Barcelona is responsible for carrying out the feasibility studies and elaborating 6 regional projects, among which the Mediterranean Solar Plan (MSP).

As a regional initiative, the Mediterranean Solar Plan shall contribute to the improvement of the security of the energy supply in the EU countries, as well as to meet the increasing domestic demand from RES, while boosting economic development in the UfM and non-EU countries.

The European Investment Bank, through its FEMIP program, has recently signed a Memorandum of Understanding with UfM Secretary General, proving their clear commitment to finance energy initiatives.

ESTELA provided a first proposal on a MSP, the Solar Thermal Electricity Industry's Proposal for the Mediterranean Solar Plan entitled "Solar Power from the Sun Belt," to the French Presidency of the European Union in July 2008. Since then ESTELA has analysed and improved its proposal together with the main industry actors in order to assist decision makers to progress and help the MSP to become a reality by suggested new organisational instruments.

The proposal of the solar thermal electricity industry is backed-up by European leading companies and promotes the deployment of solar thermal electricity plants in countries with high solar direct radiation, an area known as the World's Sun Belt. The proposal calls for the creation of a full-trade market through a complete Mediterranean transmission infrastructure and integrated market which will ensure the compliance of EU market rules and related Directives and laws. It includes an implementation plan for the roll-out of the technology, together with a possible Roadmap for STE deployment in the South Mediterranean.

> *"As part of the MSP, building 20 GW of Solar Thermal Electricity Plants by 2020 could generate a win-win process for all UfM partners. If successfully implemented, the conditions for an accelerated, purely market driven, development of STE plants will be created. These plants will feed the long term electricity needs of the UfM countries by using the virtually endless potential of the North African deserts."* - As stated in ESTELA's first proposal on a MSP, entitled "Solar Power from the Sun Belt."

ESTELA participated in May 2010 on the MSP Conference organised in Valencia under the Spanish EU Presidency, where Ministers of both sides of the Mediterranean shores, authorities of the EU institutions, relevant members of the energy industry as well as of the financial sector were gathered to push forward and advance on the Mediterranean Solar Plan's keys to success. ESTELA is also participating in the Working Groups created by the UfM Secretariat related to the MSP's deployment, infrastructures, financing and training.

Paving the way for the Mediterranean Solar Plan

"Paving the Way for the Mediterranean Solar Plan" is an EU funded regional project assisting the development of renewable energy sources in the Mediterranean Partner Countries. The three-year project, which started on 1 September 2010, aims at providing advisement on the regulatory framework to support the effectively implementation of sustainable energy policies as well as improvements on transfer of knowledge and capacity building. A consortium of important European companies will be in charge of identifying financing mechanisms and cooperation initiatives for the development of Mediterranean Solar Plan.

European Neighbourhood Policy

The European Neighbourhood Policy regulation was developed in 2004, with the objective of tying political, economic and social relations with EU's neighbouring countries. It is mainly a bilateral policy between the EU and each partner country in the form of Partnership and Cooperation Agreements or Association Agreements. It is further developed with regional and multilateral co-operation initiatives such as the Union for the Mediterranean.

FOSTERING RESEARCH AND INNOVATION

ESTELA's activity in the field of Research and Innovation focused in three stream lines: by elaborating a proposal for the European Solar Industry Initiatives, by establishing the priorities for annual working programmes in FP7 2007-2013 and by introducing solar thermal electricity technologies in the different initiatives, programmes and entities created at EU level as the European Research Infrastructures, the European Research Area or the Energy Research Networks where solar thermal electricity was absent.

ESTELA made all efforts in filling the gap between its position and the position of other renewable technologies participating in EU initiatives, for instance, the Technology Platforms that supported by the EU have been the framework to elaborate the Research Agendas for other renewable technologies. As the EU framework support for Technology Platform was discontinued, ESTELA has built on this own resources to fill the gap. To be assisted in this task ESTELA has created the Scientific and technical Committee composed by 10 members of the Academia and from institutions that are at the forefront of the excellence in the field of solar thermal electricity technologies research and innovation.

Technological innovation and development of demonstrative concepts in renewable energy technologies are one of the cornerstones of Europe's 2020 Strategy. The Framework Programme is the main financial instrument to support EU research and development activities in all scientific sectors. So far, the STE sector has received about 75 million € on research grants under the Framework Programmes between 1998-2012.

FP	TOPIC DESCRIPTION	PROJECTS	ESTIMATED EC CONTRIBUTION (€)
Demonstration Plants			
FP 5	PS10 First solar thermal tower plant	PS10	5,000,000
FP 5	Main CSP components for high-temperature operation	AndaSol	5,000,000
FP 5	Solar Tres solar thermal power plant with storage	SOLARTRES	5,000,000
FP 7	Demonstration of innovative multi-purpose solar power plant	MATS	11,760,000
Systems, Components and Storage			
FP 5	Direct Solar Steam generation	DISS	2,000,000
FP 5	Solar volumetric air receiver for commercial solar plants	SOLAIR	1,497,092
FP 6	Cost reduction for Dish Stirling systems	EURODISH	750,000
FP 6	Energy storage for Direct Steam Solar power plants	DISTOR	2,228,917
FP 6	European CSP road-mapping	ECOSTAR	223,129
FP 7	Using CSP for water desalination	MED-CSD	999,960
FP 7	Improve the environmental profile of the CSP installations	SOLUGAS	5,997,752

Research - EU Framework Programme

Support from the FP started in the 90's and the results of projects financed by the 5th or 6th Framework Programme have arisen when the solar thermal electricity plants went into operation in 2007. Research by well-established institutions, such as the PSA, DLR, CENER, ENEA, all of them are members of ESTELA, has never been discontinued. Those efforts coupled by the huge effort accomplished by the industry allowed for a steady improvement progress on innovation and demonstration.

Common Strategic Framework for Research and Innovation - Horizon 2020

Horizon 2020 is the new name given to the Framework Programme, now under a bigger umbrella which is the Framework Programme Research and Innovation (CSF). Horizon 2020 comprises a complete and structured programme with a strong emphasis on procedures simplification, new countries participation, to enhance closer to market projects, creation of business opportunities and promotion of young scientists.

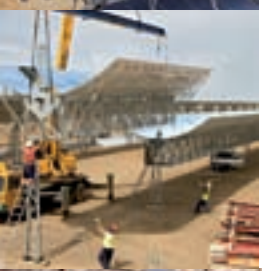
FP 7	Using CSP for water desalination	DIGESPO	3,280,000
FP 7	Energy production by a combined solar thermionic-thermoelectric system	E2PHEST2US	1,980,000
FP 7	Dry-cooling methods for multi-MW sized concentrated solar power plants	MACCSOL	4,088,546
FP 7	Main CSP components for high-temperature operation	HITECO	3,440,194
FP 7	Thermochemical Energy Storage for Concentrated Solar Power Plants	TCSPOWER	2,850,000
FP 7	Advanced heat transfer fluids for CSP technology	CSP2	2,260,000
Solar Hybrid Plants			
FP 5	Solar hybrid gas turbine electric power system	SOLGATE	1,498,772
FP 5	Dish Stirling hybrid system	HYPHIRE	971,894
FP 5	Desalination and process heat collector	EUROTHROUGH	1,199,899
FP 6	Solar-Hybrid Power and Cogeneration plants	SOLHYCO	1,599,988
FP 7	Novel solar-assisted fuel-driven power system	SOLASYS	1,568,320
Solar Chemistry			
FP 5	Solar carbothermic production of zinc	SOLZINC	1,284,282
FP 5 / FP 6	Solar hydrogen via water splitting	HYDROSOL I and II	3,499,849
FP 6	Solar steam re-forming of methane-rich gas	SOLREF	2,100,000
FP 6	Hydrogen from solar thermal energy	SOLHYCARB	1,997,300
Research Infrastructure			
FP 6	High flux solar facilities for Europe	SOLFACE	345,000
TOTAL			**74,420,894**

The European Strategic Energy Technology Plan (SET-Plan) and The Solar Industrial Initiatives

The SET-Plan was launched by the European Commission in February 2008 to support innovation in new low carbon technologies. Its implementation began with the establishment of the European Solar Industrial Initiatives for both STE and PV.

The SET-Plan offers an enormous opportunity to develop STE. For the solar thermal industry, the EU SET-Plan could be contributed to fill in the traditional enormous gap between lab and field, which has been delaying the industry actual development for decades.

In order to help and contribute to the implementation of the SET-Plan, ESTELA released in June 2009 "Solar Power from Europe's Sun Belt" (The European Solar Thermo-Electric Industry Initiative Contributing to the European Commission Strategic Energy Technology Plan) a projection of the research needs for the effective deployment of STE technology as well as a description of its enormous potential.



Implementing the SET-Plan

In April 2010, the EC created the Solar Team to manage and ensure an effective implementation of the STE-EII (STE and PV). This team is a flexible platform for the planning and programming of actions to implement the Initiative. The team is composed by the EC, Member States and ESTELA.

ESTELA has been the voice for the industry, providing the Commission and Member States with industry's key proposals in STE Research and Innovation in the regular meetings that take place. Discussions aim at establishing priorities, determining timelines and financing possibilities, but overall, in defining an efficient road to full solar deployment.

Fostering Research and Innovation: A step forward

Scientific Research Agenda (SRA) for solar thermal electricity technologies

The main goals of the STE industry are to contribute to the EU 2020 targets and to enhance market penetration and consolidate European industry global leadership.

To achieve these goals a planned strategy for research and innovation for 2020-2025 is of paramount importance. For this reason, ESTELA, assisted by its Scientific and Technical Committee, is elaborating a Strategic Research Agenda which will reflect the main priorities in research and innovation for the solar thermal electricity sector at mid and long-term.

This Strategic Research Agenda for STE technologies intends to face the main industry challenges: increase efficiency, reduce costs, improve dispatchability and improve environmental profile.

Facilities of PSA and CTAER at Almeria. Core installation of EU-SOLARIS

European Strategy Forum on Research Infrastructures (ESFRI)

The ESFRI was launched in April 2002 to coordinate research infrastructures' new needs together with a better exploitation of existing facilities. It brings together representatives of EU Member and Associated States to work on regulatory issues of research infrastructures led by a common advancing strategy.

A pan-European Solar Thermal Electricity research infrastructure "EU-SOLARIS", promoted and coordinated by CTAER (Centro Tecnológico Andaluz de Energías Renovables) and supported by ESTELA, has been included in the ESFRI Roadmap by the EC. EU-SOLARIS will be built in Almería, Spain. This STE research infrastructure will also play an important role in reaching the goals of the European Strategic Energy Technology Plan (SET-Plan).

European Energy Research Alliance (EERA)

EERA, launched in November 2008, is an alliance of leading European Research Institutes. The idea is to move forward into a new methodology of integration of resources and funding at national and EU level of Joint Research Programmes in line with the Strategic Energy Technology SET-Plan. The EERA Joint Programme on Concentrated Solar Power was officially launched in the SET-Plan Conference held in Warsaw in November 2011. ESTELA contributes to follow this strategic approach through her active participation in the meetings held by the European Commission.

Solar Facilities for the European Research Area (SFERA)

The EU-funded SFERA project was founded in July 2009 gathering 12 partners among the leading research institutions in the field of solar concentrated energy. The main objective of SFERA is to initialise a much stronger long-term integration

effect than it can be achieved by co-operation on a project by project basis through networking, transnational access to information and joint research activities. ESTELA will be a full partner of the SFERA third campaign, taking place from November 2011 to February 2012. The projects selected will be run from May to October 2012.

Solar ERA-Net

The Solar ERA-Net Call is the FP7 instrument for the implementation of the European Industrial Initiatives through joint actions in the form of public-private partnerships. The main objective is to mitigate costs and efforts through network research programmes carried out at national or regional level and financed by three or more Member States.

The 2012 FP7 ERA-Net call provides 2 million Euros for Horizontal Programme Actions is the field of solar energy. ESTELA participates in the sessions providing up to date information on the latest STE technologies, maintaining active collaboration with the stakeholders to help promote and push forward this financing opportunity for less exploited break-through STE technologies.

The Solar Power and Chemical Energy Systems (SolarPACES)

This collaborative programme has been held annually since 1980 under the umbrella of the International Energy Agency (IEA), with the aim of bringing the world actors to focus on a stronger market implementation of concentrated solar power systems.

This periodic event presents the state-of-the-art on all aspects of the technology i.e research, industry, politic and financing and provides the opportunity to stakeholders and leading world experts to exchange their views and strengthen or create partnerships through forums, workshops and scientific conferences. During the stay, a visit of the CSP plants situated nearby is generally organised.

SolarPACES comprises nowadays 19 members from all continents. The increasing number of participants to this international cooperative network, reaching the thousand in Granada last year, translates the growing concern for a better coordination for developing the next generation of technologies.

ESTELA has actively been supporting the SolarPACES conferences since 2009, through its contribution to the event organisation, and through the constructive participation of its members.

The 18th SolarPACES Conference will be held in Marrakech (Morocco) on the 10 - 14 September 2012.

Past Conferences with ESTELA participation for the last 5 years:

- 17th SolarPACES Conference, 20 - 23 September 2011, Granada, Spain
- 16th SolarPACES Conference, 21 - 24 September 2010, Perpignan, France
- 15th SolarPACES Conference, 15 - 18 September 2009, Berlin, Germany
- 14th SolarPACES Conference, 4 - 7 March 2008, Las Vegas, USA

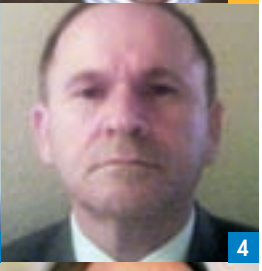
ESTELA'S SCIENTIFIC AND TECHNICAL COMMITTEE

Since its creation in 2007, ESTELA has developed its scientific and technical activities supporting research and innovation and establishing priorities at short and long-term in order to foster the market penetration of solar thermal power plants and to consolidate the leadership of European industry at world level.

Up to now ESTELA has taken advantage of having among its Members, the main Research Institutions active in this field in Europe, to build an innovation strategy. Today ESTELA steps further by creating the Scientific and Technical Committee that will help the Association to build a Strategic Research Agenda for 2020. It is the right moment for mainly two reasons: first of all, the economic and financial crisis calls for more innovative efforts and a mid- and long-term vision; and secondly, ESTELA should contribute to the Union's debate on the programmes to support research, demonstration and innovation in the framework of the financial perspectives for the period 2014-2020. The Scientific and Technical Committee currently has 10 Members, 8 of them from Institutions Members of ESTELA and 2 from the University that complete what can be considered as a team of excellence as far as all together constitute the "crème" of the scientific knowledge in this sector in Europe and beyond.

Objectives

The objective of the STC is to provide with scientific and technical advice to ESTELA upon request and under the supervision of its Executive Committee. As a preliminary programme the main task is to define a Strategic Technology Agenda, on the basis of the existing documents produced by ESTELA and approved by ESTELA Members, – STE-European Solar Industrial Initiative, Costs Roadmap, etc.



Coordinator

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Master degree in Industrial Engineering and Ph.D. in Industrial Engineering at University of Seville. Head of the R&D Unit on Solar Concentrating Systems at the Plataforma Solar de Almería (PSA).

PROMOTING-SHARING-SUPPORTING-DISSEMINATING

Disseminating work progress, updated information concerning solar thermal electricity and ESTELA activities is one of the top priorities of ESTELA. General Assembly and Members' Meetings are held every year, not only to inform members about updates of policy issues, but also to provide an opportunity for networking and sharing among members. Moreover, promotion solar thermal electricity activities, as one of the main objectives of ESTELA, since 2007 until now have evolved dramatically. As in addition to the annual Members' gatherings, ESTELA has been organising STE Industry Forums and Summer Workshops for both members and public in order to strengthen its position and unite the STE industry through discussions and sharing expertise experience.

From **technical workshops** organised to debate and find solutions to concrete challenges or problems in order to be in a good position giving advices to policy leaders, to regular **Brussels Summer Workshops** for Members in order to build sectors' position on crucial strategies and to consolidated **STE Industry Forum**, covering topics from policy to financing, organised in different countries with the support of national associations and authorities, there is a substantial progress in the last 5 years.

Main speakers, whom have been invited to share their viewpoints, were representatives of the European Commission, the European Parliament, the National authorities, international and national agencies, national energy bodies, grid operators associations, etc. ESTELA continues strive to ensure STE voice to be heard in the EU.

STE Industry Forums: In order to unite the STE industry, the 1st STE Industry Forum was held in 2010 in Seville under the patronage of the Spanish Presidency of the European Union. The outcome of this brought another success to the 2nd STE Industry Forum, which was successfully held in Syracuse, Italy in 2011. In 2012 we will be organising the 3rd STE Industry Forum and expecting the same success in Cologne.

Summer Workshops: On occasion of annual informal Members' Meeting, Summer Workshops, addressing both Members and general public, are organised as an open space for discussions about new development in legislation, market measures and other outcome of interest for the STE industry since the first Summer Workshop in 2008.

Promotion and dissemination activity is complemented with ESTELA participation as a partner in the main conferences of the sector, mainly Solar Paces and CSP Today Summits. The President, Vice-presidents and members of the Executive Committee have participated in hundreds of conferences in 5 years. Companies Members of ESTELA are often requested to participate in workshops around the world.

STE INDUSTRY FORUMS

1ST SOLAR THERMAL ELECTRICITY INDUSTRY FORUM

"Facing the 2020 Challenge"

The First STE Industry Forum organised by ESTELA and PROTERMOSOLAR under the patronage of the Spanish Presidency of the European Union, was held successfully in Seville on the 16th and 17th February 2010 and gathered around 200 experts from the industry and relevant institutions. A visit to Solucar solar power plant was organised by Abengoa on the 15th February for members of ESTELA and Members of the ITRE Committee of the European Parliament. Representatives of EU, national and regional Andalucian administrations expressed their fully commitment in the development of STE plants to meet 2020 targets.

2ND SOLAR THERMAL ELECTRICITY INDUSTRY FORUM

"Solar Thermal Power: From Legend to Reality"

After the successful first edition of the STE Industry Forum in Seville in 2010, the industry met for two days debate, technical visits and networking in Syracuse, Sicily from 10-12 March 2011. The Second STE Industry Forum, organised in collaboration with ANEST, the Italian Association, focused on three key issues for the further deployment of STE sector: the development and implementation of EU Directives; the development of STE plans and projects in the Union for the Mediterranean countries; and the present situation and future of STE around the world.

Amongst near 150 participants from Europe, 50 Italian companies where present announcing a take-off of the sector in Italy. Relevant speakers from other Mediterranean countries shown that in spite of the particular conditions in the region there is an enormous interest in developing STE plants in the area. From the USA, China, India, Australia and South Africa messages from governments, associations and companies highlighted that we should take advantage of the momentum and join efforts at world-wide.

WORKSHOPS AND MEMBERS' MEETINGS

2008

- **17 July, 2008 - 1st Summer Workshop in Brussels, Belgium:** the first ESTELA Summer Workshop was organised in the Renewable Energy House in Brussels. The EU SET-Plan was presented by representative of the Directorate General for Research of the European Commission. The debate focussed on the implementation of the "Solar Industry Initiative". "Solar Programme for the Mediterranean" was also in the agenda on the basis of the information sent to the French Ministry for EU-MED summit. Members' General Meeting was held on the same day in order to share updates of new developments of STE in Spain, Italy and Portugal.

- **21 October, 2008 - Workshop in Seville, Spain:** the workshop was held in Seville in Spain focusing on the deployment of STE in the Mediterranean region, such as technical aspects, grid connection, transmission etc. The main purpose of the workshop was to identify the main challenges and explore possible solutions for the achievement of the Mediterranean Solar Plan, as part of the on-going process to define a roadmap for the development of bankable solar power projects in the entire Mediterranean region.

PARTICIPATION IN CONFERENCES

2008

- Roundtable on grid infrastructure and the Mediterranean Solar Plan, Paris, France, November 2008
- EU Presidency Renewable Energy Policy Forum, Paris, France, November 2008
- REMAP Conference, Paris, France, December 2008

2009

- MEP Visit to Solar Plants in Southern Spain, Seville, Spain, January 2009
- CIS-IT 2009, Conferenza dell Industria Solare, Hilton Rome Airport, February 2009
- "Mediterranean Solar Plan" Conference, Brussels, Belgium, February 2009
- Lunch-conference: "Europe and its regions: challenges and opportunities of Solar Thermal electricity. The case of Castilla-La Mancha", February 2009
- CEPS 5th Annual Energy Conference, Brussels, Belgium, March 2009
- 4th Euro-Mediterranean Energy Forum, Barcelona, Spain, March 2009
- Workshop on Energy Research by DG RTD and MHESR, Cairo, Egypt, March 2009
- SolarPACES 2009, Berlin, Germany, September 2009
- WWF NOAH 2009 Workshop on Climate Change and Renewable Energies in the Mediterranean, Palamos, Spain, October 2009

2009

- **12 February, 2009 - Workshop in Brussels, Belgium:** The purpose of the workshop was to discuss the main issues related with the activities of ESTELA for 2009 in order to build a strong position based on deep analysis and discussion among ESTELA members. The workshop focused on Mediterranean Solar Plan and Solar European Industrial Initiative (SET-Plan).
- **25 June, 2009 - 2nd Summer Workshop in Brussels, Belgium:** Overview of ESTELA Activities was presented at the beginning of the meeting. ESTELA members were encouraged to highlight the advantages and potential of STE technologies to Member States representatives. Implementations of the EU RES Directive and ETS Directive were discussed. Issues of SET-Plan were also discussed.
- **16 September, 2009 - Members' Meeting in Berlin, Germany:** This informal meeting took place during the SolarPACES 2009 in Berlin in order to exchange views and present ESTELA's up-to-date activities and dossiers, New brochure of ESTELA was released as well as a new banner advertising ESTELA was displayed at the SolarPACES 2009.

- ENERTECH 2009, Athens, Greece, October 2009
- Barcelona EuroMed Forum, Barcelona, Spain, November 2009
- EREC 3rd European Renewable Energy Policy Conference, Brussels, Beligum, November 2009
- COP15, Copenhagen, Denmark, December 2009

2010

- EUSEW, Brussels, Belgium, February 2010
- IEA Renewable Energy Working Party Workshop, Paris, France, March 2010
- Fund. Campanals, Barcelona, Spain, March 2010
- Solar XXL, Hannover, Germany, April 2010
- EU High Level Seminar on Renewables, Pamplona, Spain, April 2010
- MENASOL, Cairo, Egypt, May 2010
- 8th FEMIP Conference, Valencia, May 2010

2010

- **15 July, 2010 - 3rd Summer Workshop in Brussels, Belgium:** "Enhancing Solar Thermal Electricity Supply and Exchanges to Meet EU Renewable Energy Targets for 2020 and Beyond" was the main theme of this workshop. The implementation and cooperation mechanisms of RES Directive were presented and discussed. The Solar Thermal Electricity Industrial Initiative and Emission Trading Scheme were discussed during the workshop. Members' General Meeting was held to present ESTELA's latest activities and news.
- **23 September, 2010 - Members' Meeting in Perpignan, France:** On occasion of the SolarPACES 2010, General Meeting took place in order to inform Members about the progress of implementation of RES Directives. Representative from the European Commission responsible for the STE sector introduced new EC developments and the short version of A.T. Kearney Cost Roadmap study was demonstrated in the meeting.

PARTICIPATION IN CONFERENCES

- CEC Conference, Adelaide, Australia, May 2010
- PV Technology Platform, Toledo, June 2010
- 4th Concentrated Solar Power Summit USA 2010, San Francisco, U.S.A., June 2010
- ASEF - ASIA SOLAR ENERGY FORUM, Manila, the Philippines, July 2010
- EASAC CSP Workshop, Casacia, Italy, August 2010
- ZeroEmission Fair, Rome, Italy August 2010
- XI World Renewable Energy Congress (WREC), Abu Dhabi, September 2010
- SolarPACES 2010, Perpignan, France, September 2010
- SolarMed 2010, Paris, France, September 2010
- CSP Summit, New Delhi, India, September 2010
- Tunisia Solar International Conference, Gammarth, Tunisia, October 2010
- Mediterranean Green Development Investors Forum, Athens, Greece, October 2010
- 2nd Energy Storage Forum Europe 2010, Barcelona, Spain, October 2010
- Dii Annual Conference, Barcelona, Spain, October 2010
- DIREC 2010, New Delhi, India, November 2010
- GCC Solar Power meeting 2010, Doha, Qatar, November 2010
- ASEF - ASIA SOLAR ENERGY FORUM, Tokyo, Japan, December 2010
- CSPToday Summit, Seville, Spain, December 2010
- ENERMENA Course, Almeria, Spain, December 2010

2011

- ITRE R.E. Workshop, European Parliament, Brussels, March 2011
- EREC 2011 - Europe's Renewable Energy Policy Conference, Brussels, Belgium, May 2011

2011

- **5 July, 2011 - 4th Summer Workshop in Brussels, Belgium:** This summer workshop began with the discussion on the overview of EU RES Directive. Deputy Director for International Energy Affairs from the Ministry of Industry, Tourism and Trade of Spain, and representative from Regulatory policy & Promotion of renewable energy, DG Energy were invited to share their views. CEO from Friends of the Supergrid presented the main points concerning the need of a pan-European Grid Interconnection. Head of Unit of New and Renewable Energy Sources, DG Research, also discussed the financing of the SET-Plan and the Solar European Industrial Initiatives; as well as the Associate Director for Energy Efficiency and Renewables of the European Investment Bank presented the FEMIP Study on the Financing of Renewable Energy Investment in the Southern and Eastern Mediterranean Region. Last but not least, Board Member of Masen gave a presentation on legal and institutional framework for RES development in Morocco.
- **22 September, 2011 - Members' Meeting in Granada, Spain:** Taking advantage of the SolarPACES event in Granada, ESTELA held its Members' Meeting. This meeting was an occasion to announce the creation of STELA Wold, and ESTELA's Scientific Technical Committee.

- Solar Energy for Science DESY, Hamburg, Germany, May 2011
- Wind to Wheel / Leonardo Program, Barcelona, Spain, May 2011
- CSPToday Yield Optimization, Seville, Spain, May 2011
- MENASOL, Casablanca, Morocco, May 2011
- EU-GCC Clean Energy Network, Brussels, Belgium, May 2011
- INTERSOLAR, Munich, June 2011
- World Bank - Job Creation, Casablanca, Morocco, June 2011
- INTERSOLAR Europe Conference, Munich, Germany, June 2011
- CSPToday webinar PV-CSP, July 2011
- SER First Solar Thermodynamics Meeting, Paris, France, July 2011
- SolarPACES 2011, Granada, Spain, September 2011
- ABB Solar Days, Barcelona, Spain, September 2011
- Workshop ERNC-W.G.Senate, Valparaiso, Chile, September 2011
- Res4Less-CIEMAT, Madrid, Spain, September 2011
- SolarPaces Conference, Granada, Spain, September 2011
- EnerExpo, Casablanca, Morocco, October 2011
- CIEMAT STE Course, Madrid, Spain, October 2011
- Asian D.B. CSP Course, Madrid, Spain, October 2011
- CSPToday Webinar on South Africa, November 2011
- Workshop CLUSTER Extremadura, Badajoz, Spain, November 2011
- CSPToday Summit, Seville, Spain November 2011
- COP 17 / Event IEA, Durban, South Africa, December 2011
- EASAC CSP Report, Madrid, Spain, December 2011

1 2
3 4

SOLAR THERMAL ELECTRICITY SECTOR

STATE-OF-ART BY TECHNOLOGY SECTOR

1 Parabolic Trough Plants

- **Size:** unlimited, related to the turbine power (typically < 250 MW)
- Proven utility scale technology and in operation since 1984
- Heat transfer fluid temperature up to 400 ° C.
- R&D activity with molten salts or with direct steam generation as HTF that will increase the working temperature.
- Storage capacity commercially available
- Integration in Conventional Power Plants to increase efficiency and reduce fossil fuel consumption proven in several power plants
- Total world installed capacity 1630 MW
- Total world capacity under construction 2130 MW

2 Central Receiver Plants

- **Size:** up to 150 MW
- First commercial plants in operation since 2007
- Heat Transfer Fluid temperature up to 560 ° C
- Different HTF commercially available (molten salts and steam)
- Storage capacity commercially available
- Total world installed capacity 55 MW
- Total world capacity under construction 502 MW

3 Dish Stirling Systems

- **Size:** 3 to 25 KW(per unit)
- Several demonstration plants of around 1MW installations in operation
- Applications appropriate for both utility-scale projects and stand-alone distributed energy projects due to its modularity

4 Linear Fresnel Systems

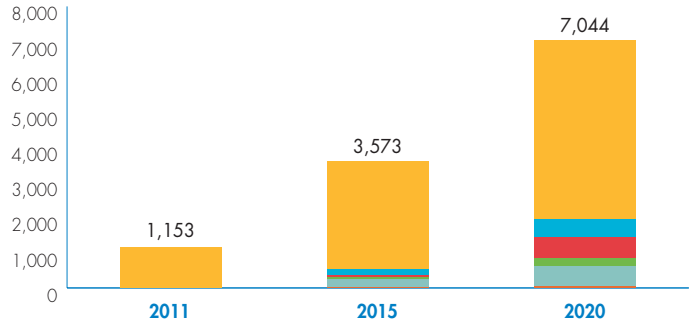
- **Size:** unlimited, related to the turbine power
- First commercial plant in operation since 2009
- Heat Transfer typically saturated steam up to 300 ° C. New plants designs expect to reach 500 ° C with superheated steam
- New generation plants already under construction and in advance stage of development
- Total world installed capacity 10 MW
- Total world capacity under construction 30 MW
- Large projects - integrated with conventional power plants - announced

WORLD MAP OF THE STE POWER PLANTS

ESTELA has created a Solar Thermal Electricity Power Plants Map which is generated by Google map on ESTELA official website. This map displays Solar Thermal Electricity power plants which are in operation and under construction worldwide in their locations. Research facilities are also displayed in the map. ESTELA will keep this service updating regularly.

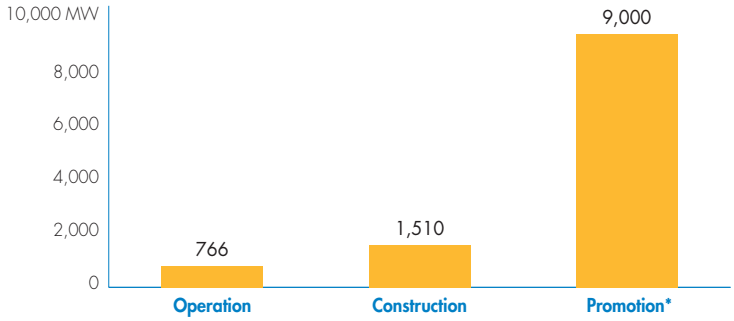
INSTALLED CAPACITY IN EUROPE AND THE WORLD

In 2011 the STE installed capacity in Europe was 1,158 MW. Six countries have established own objectives for STE in their "National Renewable Action Plan" for 2020, in total more than 7 GW.



Installed Capacity	2011	2015	2020
Cyprus	0	50	75
France	0	203	540
Greece	0	30	250
Italy	5	62	600
Portugal	0	180	500
Spain	1,153	3,048	5,079

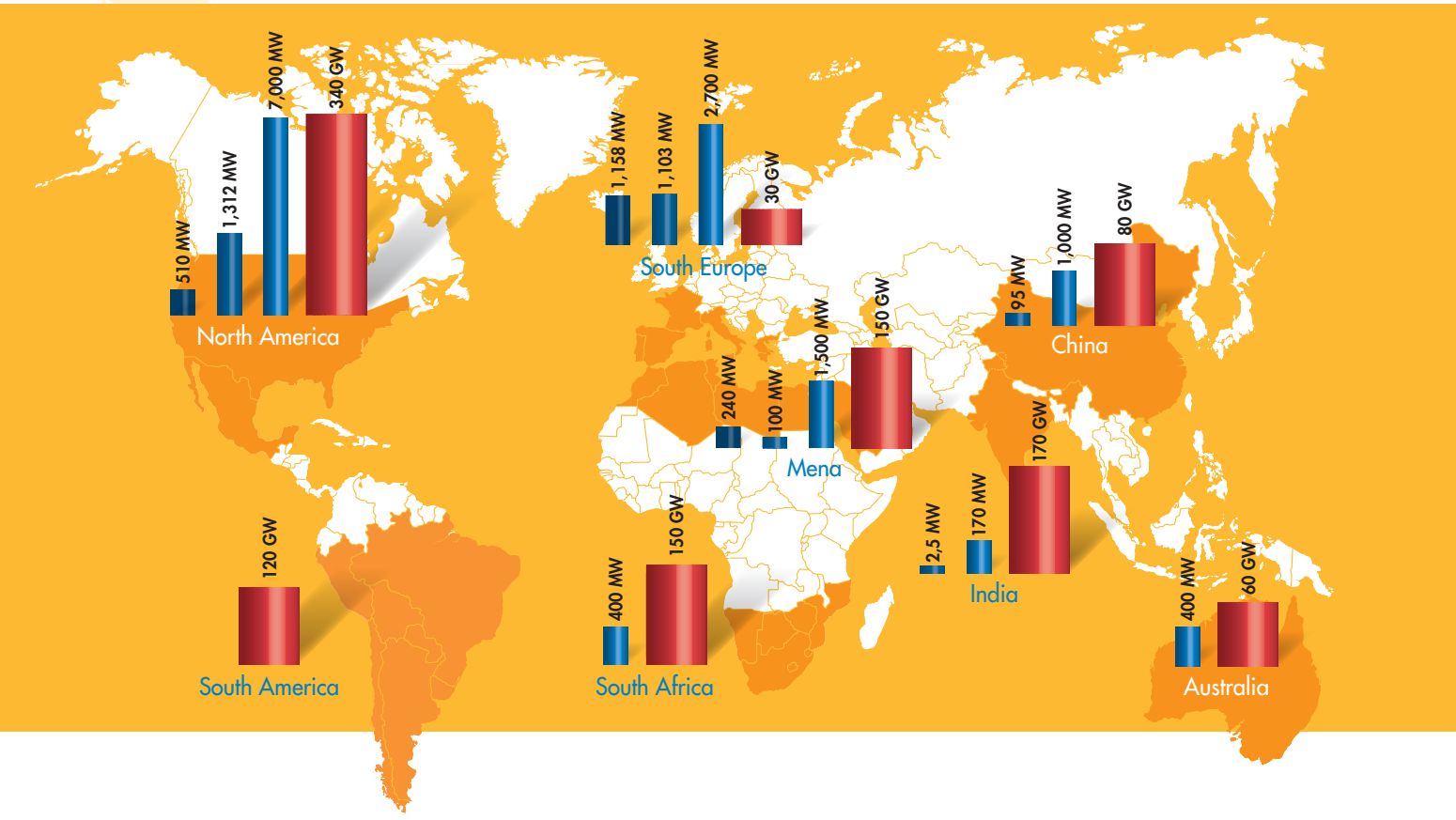
In the rest of the world the situation of STE is as shown in the diagram:



*Promotion means projects either with signed PPAs or corresponding to short term national programmes.

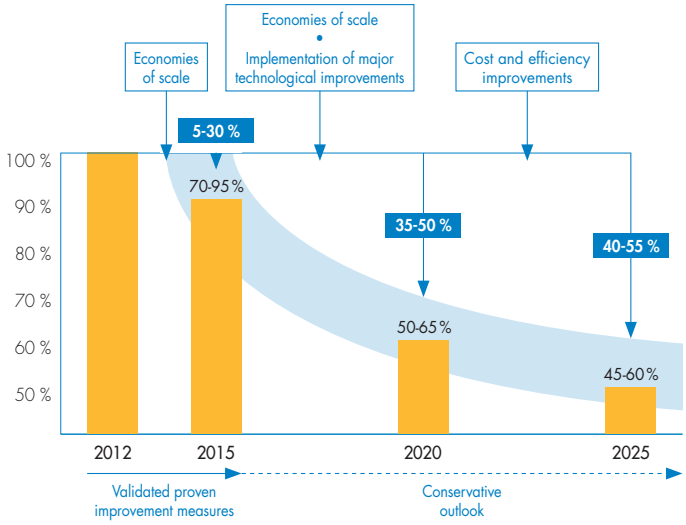
STE ESTIMATE MAP OF THE WORLD

- MW Operation
- MW Construction
- MW Promotion
- MW Estimation by 2050



COST ROADMAP

It is important to have in mind that STE takeoff is occurring now. There are only 2,103 MW in operation around the world plus 2,662 MW under construction, in total 4,765 GW. Therefore, STE is at very early stage of its learning curve, compared with PV (70 GW) and WIND (250 GW). That means that there is a wide range of opportunities for quick cost reduction. Big cost reduction is expected for the future:



Estimated tariff reductions

Main drivers for tariff reduction

Source: A.T. Kearney Solar Thermal Electricity 2025 Study 1

There are several factors that will contribute to the future cost reduction of STE. Some facts will take place on the short term:

- STE plants with 1 GW of installed capacity in Spain will have the cost reduced by around 10-20 % even now with the **first steps on the learning curve** of STE.
- With the **new plants designs** 15-25 % cost reduction is estimated.
- The same plants currently being built in Spain will have a cost reduction of 30% if they are built in **locations with better DNI.**
- In Spain there is a limit for the **size of the plants** of 50 MW. With unrestricted plant size due to **scalability** there can be a 20% cost reduction.

And some others in the mid-long term:

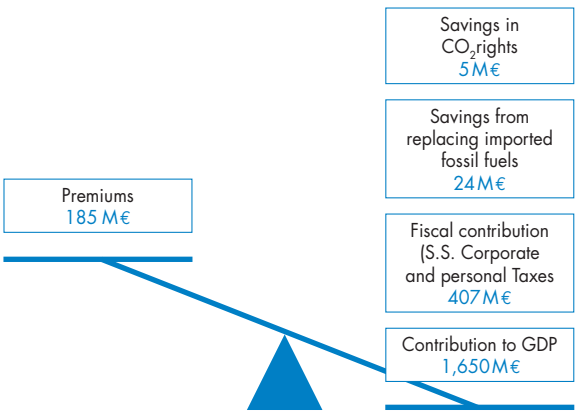
- With the future System & Component **innovations** up to 20% cost reduction
- With **large deployment of technology** which means further advance on the learning curve cost reduction will be of even more than 30%.

MACROECONOMIC IMPACT & JOB CREATION

Protermosolar, the Spanish Solar Thermal Electricity Association, has published a study elaborated by Deloitte on the macroeconomic impact of CSP in Spain.

The study has been elaborated for the year 2010 with the participation of a wide spectrum of companies covering all the value chain of the CSP sector in Spain.

The main results of the study reveal a much greater economic contribution compared to the received premiums for the production, thus incentive policy for this technology was an efficient economic and technological decision for Spain:



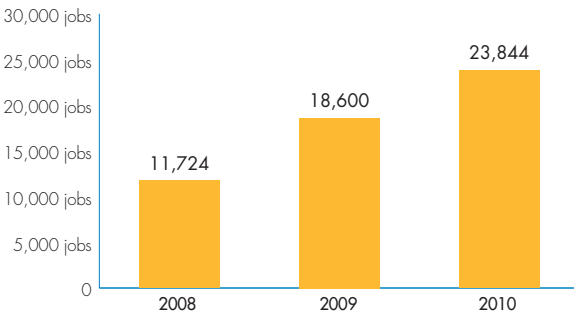
The impacts in the coming years regarding savings in imported fuels and in CO_2 emmissions will be much higher as more plants will be fully operational.

There are other very important factors that cannot be quantified in economic balance but have the same importance:

- Jobs creation: Only in year 2010, almost 24,000 jobs were created in STE sector. In other words, subsides for those 24,000 people were avoided in case of unemployment in an economic crisis scenario.
- Leadership of the Spanish industry: Spanish companies are very good positioned in emerging STE international markets.
- Industrial development: The local content in the Spanish STE plants grew from 50% in 2008 to 80% in 2011.
- Reducing hourly pool price of electricity.
- Contribution to regional economic convergence between Spanish regions.
- Local taxes paid by the porters of the plants.

Breakdown of GDP contribution by industry sector of STE reveals that the biggest contribution is in the sectors affected by economic crisis: construction and assembly, manufacturing of metal products, professional services (engineering, consulting, legal, etc.), metallurgy, manufacture of mirrors, chemicals, transport, land, machinery and mechanical equipment, etc.

The jobs creation during this firs faze of STE implementation in Spain has grown strongly and continuously:

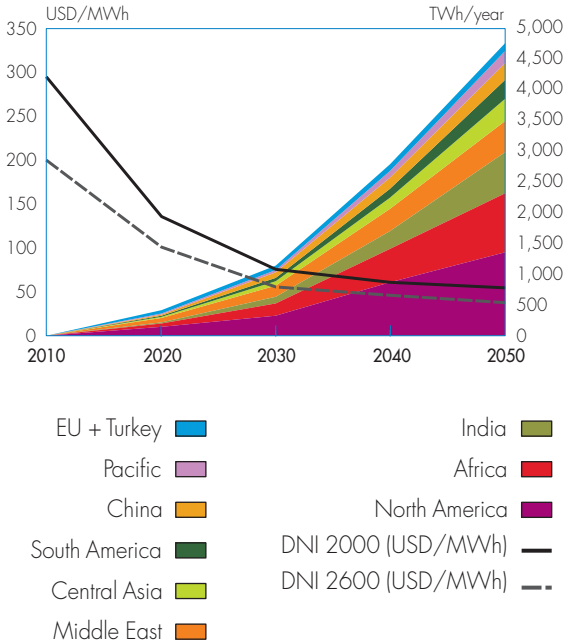


THE FUTURE

The future energy generation mix will be largely based in renewable technologies with the ultimate goal of zero emissions.

STE profits from the greatest and inexhaustible renewable source on the Earth: the Sun. Thanks to its distinct characteristics with respect to other intermittent renewable technologies as dispachability, storage and hybridization potential which result in large capacity factors and firmness of the electricity supply, STE will have an important share in the mix by 2030 and beyond.

Decreasing costs and increasing CSP production



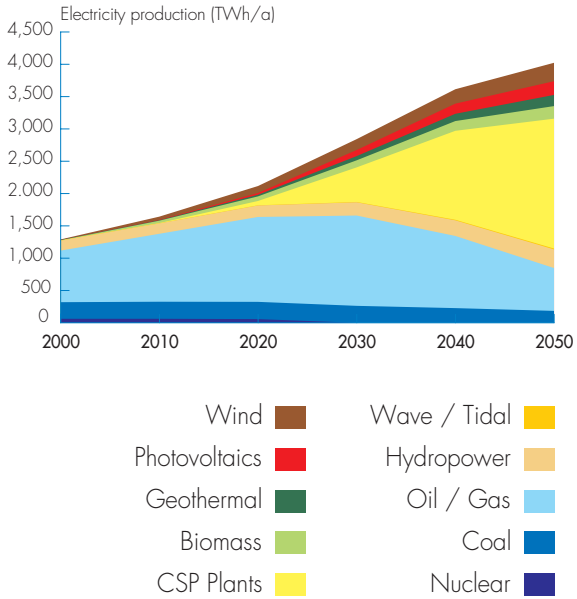
Source: *Solar Energy Perspectives* © OECD/International Energy Agency 2011, figure 8.9, page 160

The prospects included in the IEA publication "Solar Energy Perspectives" are shown below:

As it can be seen the expected production in 2030 will be around 1,200 TWh/year.

Regarding southern Europe and our neighbours in the MENA region, Solar Thermal Electricity is expected to take the major share in the long future as shown in the figure where a contribution over 2,000 TWh/year by 2050 in expected.

Electricity generation from 2000 to 2050 and mix in 2050 in all MENA and South-European countries



Source: *Solar Energy Perspectives* © OECD/International Energy Agency 2011, figure 3.11, page 59; DLR, 2005

The main challenges that STE must face in the short and medium term are:

- **Reduction of investment costs**

  This will partly come from scale factor both in terms of larger unit sizes and power installed at world level for each STE technology. Incremental improvements at component level, use of alternative materials will also play an important role.

- **Increase of efficiency**

  Higher working fluid temperatures will result in higher efficiencies. New conversion cycles and plant preferred concept will also contribute.

Operational strategies and optimized storage and hybridization design to better match the demand curve or dispatchability profile along with the above mentioned concepts will position STE in a competitive position with respect to fossil fuel conventional generation plants.

Depending on the country specific electricity supply issues, power increase requirements, grid current features and direct normal irradiation, the competitiveness with conventional sources might be reached sooner or later. For many regions grid parity will be achieved before 2020.

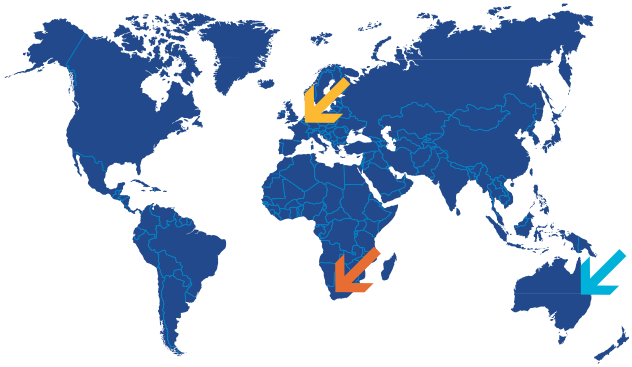
STELA WORLD

On the 18th October 2011, **ESTELA** (The European Solar Thermal Electricity Association), **AUSTELA** (The Australian Solar Thermal Energy Association) and **SASTELA** (The Southern Africa Solar Thermal and Electricity Association), the industry associations representing the solar thermal electricity industry in Europe, Australia and South Africa, announced the formation of the World Solar Thermal Electricity Association - STELA World.

STELA World has been formed to work with international agencies such as the IEA, IRENA, the UNFCCC, UN Development Program, the World Bank, the International Monetary Fund, and the European, American, African and Asian Development Banks to assist policy-makers and energy investors to access information on solar thermal electricity development, and the value and rapidly reducing cost of solar thermal electricity production.

Through its member bodies, STELA World aims to promote data and information exchange from industry, research agencies, academic institutions and government bodies around the world relating to solar thermal power generation.

STELA World seeks to help the world to see the unique value and benefits of solar thermal electricity generation, and to promote policy settings that will accelerate investment in the development of large-scale solar thermal power around the world. Other national STE associations around the world are expected to join STELA World in the near future.



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2007

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Elena Dufour

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ESTELA INDUSTRY MEMBERS

National Associations

PROTERMO SOLAR

Spain: Protermosolar

Asociación Española de la Industria Solar Termoeléctrica Protermosolar, the Spanish Solar Thermal Power Industry, was founded in 2004 with the aim of promoting the development of the Spanish solar industry, currently has 100 members covering the entire industry value chain: Promoters, Builders, Manufacturers Components, Engineering, Consulting, Research Centres, etc. The main objective is to promote the expansion of Protermosolar and development of solar thermal technology in Spain and the rest of the world.
Website: www.protermosolar.com

ANEST

Italy: ANEST

Associazone Nazionale Energia Solare Termodinamica ANEST, Associazone Nazionale Energia Solare Termodinamica, the Italian STE association was created in 2009. It currently has around 25 Members and co-organised with ESTELA the 2nd STE Industry Forum in March 2011 in Sicily where the Archimede parabolic trough plant has begun operating in the summer 2010 (5MW + 7 h storage, the first plant with molten salt heat transfer). Within the framework of its National Renewable Energy Action Plan, Italy is planning to have an installed capacity of STE reaching 600 MW by 2020 although its potential is higher.
Website: www.anest-italia.it

ESTELA ASSOCIATED MEMBERS

France: SER

Syndicat des Energies Renouvelables - Commisssion Solaire Thermodynamique SER, Syndicat des Energies Renouvelables, the French Renewable Energy Agency has recently created a new Commission dedicated to Solar Thermal Electricity. This Commission currently has around 30 Members. France was home to the first demonstration solar power plant, Themis in the Pyrenees, and has integrated STE in its National Renewable Energy Action Plan. By 2020 it is estimated that the installed capacity will reach 540 MW and represent 10% of the renewable energy sources capacity. The first plants should begin operating in 2012.
Website: www.enr.fr

THE HIGHLIGHTS: 2007-2011

2007

ESTELA is founded

- **MARCH** - The PS10 Solar Power Plant, Europe's first commercial 10 MW concentrating solar power plant operating near Seville was inaugurated.
- **MARCH** - The European Council set a binding target of a 20% share of EU final energy consumption from renewable energy by 2020.
- **SEPTEMBER** - The Third Energy Package was proposed by the Commission.
- **SEPTEMBER** - ESTELA positively saw the appointment of four European coordinators to monitor and facilitate the implementation of the most critical identified priority projects, among which the Spain-France interconnection.

- **SEPTEMBER** - ESTELA held the first General Assembly at the Renewable Energy House in Brussels.
- **NOVEMBER** - Publication by Commission of the SET-Plan technologies recognized STE.
- **DECEMBER** - The 2nd General Assembly was held at the Renewable Energy House in Brussels.

2008

- **JANUARY** - The first draft of the RES Directive for the promotion of the use of energy from renewable sources was presented by the Commission.
- **JANUARY** - The second EU ETS period, to run until ends of 2012 began, as the First Commitment Period under the Kyoto Protocol.
- **FEBRUARY** - ESTELA welcomes SET-Plan adoption and endorsement of Member States.
- **JULY** - ESTELA's first Workshop took place in the Renewable Energy House of Brussels.
- **JULY** - The Union for the Mediterranean (UfM) was launched at the Paris Summit as a continuation of the Euro-Mediterranean Partnership (Euro-Med).

- **OCTOBER** - 2nd workshop of ESTELA was held in Seville, Spain
- **DECEMBER** - The RES Directive was adopted by the Parliament.

2009

- **FEBRUARY** - 3rd workshop of ESTELA was held in Brussels, Belgium
- **APRIL** - Adoption of the RES Directive by the European Council.
- **APRIL** - Adoption of the revised ETS Directive by the European Council and Parliament.
- **JUNE** - Entry into force of the RES Directive.
- **JUNE** - 2nd Summer Workshop in Brussels, Belgium
- **JUNE** - ESTELA released The European Solar Thermo-Electric Industry Initiative Contributing to the European Commission Strategic Energy Technology Plan "Solar Power from Europe's Sun Belt" (2010-2020)
- **JUNE** - Adoption by the Commission of the template for the National Renewable Energy Action Plans (NREAPs)
- **JUNE** - Commission workshop on collaboration between SET Plan EII and grid integration.

- **JUNE** - ESTELA released The European Solar Thermo-Electric Industry's Proposal for the Mediterranean Solar Plan "Solar Power from the Sun's Belt" (2010-2020)
- **JULY** - Adoption of the Third Energy Package by the European Council and the Parliament.
- **SEPTEMBER** - Entry into force of the Third Energy Package.
- **SEPTEMBER** - On occasion of SolarPACES 2009, Members' Meeting was held in Berlin, Germany

- **FEBRUARY** - ESTELA's First STE Industry Forum, together with the 4th General Assembly, took place in Seville, Spain.
- **MARCH** - The Secretariat of the Union for the Mediterranean (UfMS) was inaugurated in Barcelona.
- **MAY** - Publication of the 3rd joint report by Greenpeace International, ESTELA and IEA SolarPACES, "Concentrating Solar Power Global Outlook".
- **MAY** - ESTELA released The Solar Thermal Electricity European Industrial Initiative (STE-EII) Implementing Plan 2010-2012.
- **JUNE** - Publication of a joint study by A.T. Kearney and ESTELA. Solar Thermal Electricity 2025. Clean electricity on demand: attractive STE cost stabilize energy production.
- **JUNE** - Deadline for submission of NREAPs. Cyprus, France, Greece, Italy, Portugal and Spain reflect STE in their NREAPs adding up to 7 GW in 2020.

2010

- **JUNE** - Publication by ENTSOe of the first pilot Ten Year Network Development Plan.
- **JULY** - 3rd Summer Workshop in Brussels, Belgium
- **SEPTEMBER** - Work began on the Paving the way for the Mediterranean Solar Plant project.
- **SEPTEMBER** - Members' Meeting, on occasion of SolarPACES 2010 in Perpignan, France
- **NOVEMBER** - ESTELA welcomed the NER300 financing instrument for the financing of innovative renewable energy technologies.

- **FEBRUARY** - European Council Conclusions called for the establishment of the Internal Market of electricity and gas by 2014.
- **FEBRUARY** - European Commission provided details on how many renewable energy proposals were submitted per NER300 category and per Member State. Cyprus, Greece, Italy and Spain submitted eligible projects for CSP financing under NER300.
- **MARCH** - Agency for the Coordination of Energy Regulators (ACER) was opened in Ljubljana, Slovenia.
- **MARCH** - ESTELA's Second STE Industry Forum took place Syracusa, Italy.
- **JULY** - ESTELA's 4th Summer Workshop took place in Brussels, gathering important members of the STE Industry in a very fruitful venue.
- **JULY** - ESTELA welcomed ENTSOe publication of the Study Roadmap towards the Modular Development Plan on pan-European Electricity Highways System 2050.
- **OCTOBER** - SEII Working Group on the ERA Net setting out provisions for next year.

2011

- **SEPTEMBER** - Members' Meeting during SolarPACES 2011 in Granada, Spain
- **NOVEMBER** - The EXTRESOL-2 concentrated solar power plants reached world record in operating hours
- **NOVEMBER** - Regulatory Proposal for Horizon 2020

Publications

- Concentrating Solar Power - Global Outlook 2009
  (Greenpeace International, SolarPACES and ESTELA)

- Solar Thermal Electricity 2025
  (A.T. Kearney and ESTELA)

- Macroeconomic Impact of the Solar Thermal Electricity Industry in Spain
  (Protermosolar and Deloitte)

ACKNOWLEDGMENT

ESTELA's board and staff would like to thank all ESTELA Members and international institutions, agencies and particular individuals that have collaborated with us during these first 5 years. By sharing their valuable experience, they have contributed to achieve the Association's goals.

ABOUT ESTELA

ESTELA is a non-profit association which main objectives are: promoting, supporting and representing the solar thermal electricity sector and its Members. ESTELA is a service oriented association assisting public bodies and institutions, elaborating studies, disseminating best practices in solar thermal electricity generation and creating opinion.
estela@estelasolar.eu

JOINT ESTELA

Download the Membership Application Form at:

www.estelasolar.eu

European Solar Thermal
Electricity Association

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Printed on Satimat green, silk coated paper, FSC® certified, produced from 60% FSC® certified recycled fibre and 40% FSC® certified virgin fibre, ensuring a reduced impact on the environment.

FSC www.fsc.org MIX Paper from responsible sources FSC® C008551

Design: www.acg-bxl.be