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Towards an Alignment of National Research Programmes and Funding for CST Technologies in Europe

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Abstract. One of the STAGE-STE project work packages aims to develop relations with public bodies relevant to Concentrating Solar Thermal (CST) research, such as national research funding agencies, ministries and other leading decision making bodies, in order to foster coordination and alignment of research programmes and funding at European level. Working groups have been created in eight European countries and concept notes were prepared regarding each group's position on national CST research and funding programmes and its possible alignment at European scale. General trends and main conclusions drawn from the concept notes are presented, aiming to provide clues and common themes to the development of aligned CST research and funding programmes. Although the National Working Groups present different approaches there are coincident points, thus a common Research and Technological Development agenda for CST can be achieved at European scale. The alignment of CST research funding represents an harder task and will demand the improvement of available funding schemes or the development of a new one. However, there is some convergence regarding the general characteristics of the scheme and the kind of projects to be funded.

INTRODUCTION

The security and environmental sustainability of the energy system are two of the most pressing issues of the start of the twenty first century. To develop and deploy secure, reliable and non-pollutant energy sources is a global challenge that is currently being addressed throughout the world. The European Union (EU), acknowledging those challenges, advocates for an increase of the use of endogenous energy sources for energy production with a special focus on renewable energy sources, claiming the existence of a significant cost-effective potential for renewable electricity and heating able to displace a significant amount of fossil fuel consumption. However, both the transition to a low carbon economy and the reduction of EU external energy dependence requires a change of paradigm of the energy system in the medium to long term. To bring this change in the energy system significant Research and Technological Development (RTD) efforts are needed in order to reduce costs and increase efficiency [1, 2].

Concentrating Solar Thermal (CST) systems such as solar thermal electricity (STE) plants present unique characteristics (as the cost-effective use of thermal energy storage) which increase their interest in a world with very high renewable energy share, due to STE capacity of providing high levels of stable and dispatchable power generation. Such characteristics and capacities are the reason behind the relevance given to STE within European and international documents [1, 3, 4]. Despite this interest and the fact that European industry is successfully competing worldwide, CST is still a marginal field in Europe, at country level, in terms of funding, amount of institutions involved and

number of ongoing projects. In order to sustain and improve the European leadership in renewable energy technologies, and in this case in CST technologies, it is necessary to improve the current *status quo* regarding research and demonstration activities and funding programmes.

Public interest and resource scarcity require judicious choices regarding the allocation and management of RTD activities funding. Considering the fragmented landscape of the European Union, where public RTD funding is provided at European, national and regional level, each level with its different programmes (when existent) and goals, it is hard not to disperse resources and efforts. Additionally, CST development at medium to high Technical Readiness Level (TRL) requires significant resources. Thus, the alignment of national efforts (including regional levels) among the EU countries is very important in order to achieve a cost-effective development of the CST technology in Europe, avoiding overlaps and duplication of efforts, while pooling together enough resources to significantly advance the technology and drive cost reductions.

The European Union Seventh Framework Programme project STAGE-STE promoted a specific activity focused on developing relations with public bodies relevant to CST research, namely national research funding agencies, ministries and other leading decision making bodies, the purpose being to foster coordination and alignment of research programmes at European level, highlighting the added value of pooling resources for enhanced impact.

This paper presents some conclusions drawn from these activities. It focuses on the general trends and main common themes identified after a comparative analysis of national concept notes dealing with the position of each country on CST research and funding programmes and its possible alignment at European scale.

NATIONAL WORKING GROUPS AND CONCEPT NOTES

Building upon the STAGE-STE partners' existing contacts with their countries' public bodies, exploratory meetings with relevant national authorities were carried out in Cyprus, France, Germany, Italy, Portugal, Spain, Switzerland and the United Kingdom. Besides sharing information regarding CST technologies, these exploratory meetings aimed at establishing a communication link between the partners and relevant stakeholders in order to set up in each country a National Working Group (NWG), operating within the scope of the STAGE-STE project.

The NWGs are a contact point between CST stakeholders, ensuring an adequate exchange of information regarding the developments on CST technology, relevant policies and funding. Additionally, the NWGs are being used as a vehicle to advocate to the authorities the value of CST in the overall energy mix and, therefore, the need for further basic and applied CST research, and system deployment, in order to achieve economic viability and to ensure the development in Europe of the next generation technologies. Finally, the NWGs also advocate and foster the development of coordinated actions and funding programmes for CST research. Although each country presents its own specificities, a typical NWG gathers representatives from industry, research institutions, national research funding agencies, ministries (mostly the ones related with energy, industry, research or international cooperation) and other leading decision making bodies (such as regional agencies), promoting at least one meeting every year.

In order to address and discuss possible ways of aligning national research programmes and funding for CST technologies, it was proposed to each NWG to elaborate a concept note regarding the group position on CST research and funding programmes and its possible alignment at European scale. In order to simplify and harmonize the different concept notes, its template suggested 8 distinct subjects to be addressed:

- "Background and context" - presenting the current RTD research programmes and funding for CST at national/regional level;
- "Future orientations" - identifying ideas for future national research goals for the next five years in the field of CST;
- "Resources" - presenting current research infrastructure and existing resources;
- "Needs assessment" - identifying the additional resources needed to fulfil the goals identified in the future orientation section;
- "International cooperation" - stating current international cooperation efforts;
- "Stakeholders" - quantifying and listing the types of entities involved in supporting the CST research and innovation sector;
- "Possible funding alignment models" - listing possible approaches for funding alignment;
- "Proposed funding model to be developed" - identifying the preferred funding model for implementation;
- "Tentative conditions required for suitable projects" - short listing the conditions that potential projects should fulfil to be eligible within the aligned funding model.

The national concept notes delivered by each group were presented and discussed among representatives of each NWG at the *Alignment of National CSP RTD Funding and Policies International Workshop*, held in April 2016 at Madrid within the scope of the STAGE-STE project and under the auspices of the Spanish Ministry of Economy and Competitiveness. An analysis of the different concept notes has been achieved and its main conclusions are presented in the next sections.

Although there are evident differences on the organization and development of the CST RTD sector of the different European countries, also reflected in the concept notes elaborated by the 8 countries previously mentioned, it is possible to draw some general trends, noting similarities and differences, and to identify sets of countries with similar characteristics.

TOWARDS ALIGNED RESEARCH PROGRAMMES

Background and Context

Despite being under development since the late 1970s, research on CST technologies in Europe has been, and still is, a minor area within the renewable energy sector. With the exception of Spain and Germany (and France to a lesser extent) there is a lack of awareness from policy makers, funding agencies, energy agencies and companies, industry and the general public in relation to these technologies, being overlooked in benefit of more established renewable technologies such as wind power and PV. This situation is slowly changing, and during the last years, with the development of the Research and Innovation Strategies for Smart Specialisation (RIS3), CST has been explicitly mentioned and/or integrated in the regional strategies of some European regions such as Languedoc-Roussillon (France), Cyprus and Alentejo (Portugal).

However, there is a lack of specific research programmes devoted to the development of CST technologies. A noticeable exception is Switzerland, where a High-Temperature Solar Energy research programme was defined by the Swiss Federal Office of Energy, within the Swiss Energy Research Master Plan [5]. It should be stated that the non existence of CST research programmes is not necessarily an indication of a strategy void. For example, France does not have a specific CST RTD programme but has a national roadmap for CST whose latest version was developed in 2011 by the French Environment and Energy Management Agency [6].

The lack of specific CST research programmes leads to a lack of specific national funding mechanisms for CST. In fact, for most countries, the majority of the available funding specific for CST RTD activities originates from European funding schemes such as the structural funds and specific CST calls under the Framework Programmes (the latest being Horizon 2020) or ERA-NET initiatives (which includes a large share of national resources) such as the Solar ERA-NET. National CST RTD activities are mostly funded under general (non-thematic) calls open by national or regional research/industrial development agencies (e.g. general calls for scientific research and technological development or related to energy, renewable sources, environment, or similar topics).

Future Orientations

Each NWG approached differently the identification of ideas for future national research goals for the next five years. However, some common points can be identified and derived as a result of the concept notes analysis. This strongly hints at the possibility of achieving a common RTD agenda. Such agenda should focus on the reduction of costs (both capital and operation and maintenance), increase of the system performance and improvement of the plants' environmental footprint, which were the main common themes proposed in the concept notes.

In order to accomplish these objectives it is necessary to: develop new components and systems, including new concepts aiming to improve feasibility and dispatchability; improve the plants' durability and long-term performance; develop solar resource assessment and prediction methods and tools; and promote standardization activities. Although such actions encompass a wide range of specific technical areas, some were specifically and consistently mentioned as relevant by the NWGs, namely: thermal energy storage; solar fuels production and system hybridization.

Resources

Although of different dimension and relevance, all NWGs identified RTD centres (including universities) with relevant activity in the CST field as well as related experimental facilities and/or laboratories.

Research infrastructures devoted to CST RTD activities are spread over a small number of institutions across Europe. Experimental facilities for thermal energy storage research have been identified in Cyprus, Germany, Italy and Spain. Infrastructures devoted to testing and demonstration of point focusing technologies are present in Cyprus, France, Germany and Spain, while relevant facilities for linear focusing technologies are located in France, Italy, Portugal and Spain. Due to their flexibility and relative simplicity, solar furnace installations (ranging from small to high power) are widespread across Europe, being present in France, Germany, Portugal, Spain and Switzerland. Three countries operate high-flux solar simulator facilities: Germany, Spain and Switzerland. Lastly it should be mentioned that all these infrastructures are supported by a network of dedicated laboratories for material development, component testing, thermal analysis, etc., being mentioned as relevant by the German, Portuguese and Spanish NWG.

Needs Assessment

Considering not only the different resources available in each country but also the background and development stage of the research activity and industrial implementation there will be different needs in each country. However, it is possible to draw common themes in the necessities identified by the different NWGs. Most agree there is a need for suitable and stable funding of CST RTD activities and for a specific RTD strategy for CST, considering not only short-term but also long-term goals. It is worthwhile mentioning this is not simply a request for more funds but for a stable stream of funding, coupled with a long term RTD strategy able to promote a stable research environment, fostering innovation and technology transfer to the industry.

Another relevant aspect impacting the research environment is the relation with industry. The lack of national industry committed to CST can be a hindrance to the development of RTD activities. This was also present in the minds of the NWG's members, with some raising the case for the necessity of support also to the demonstration and industrial scale-up stages, while others mention the need of support to CSP stakeholders, including industrial stakeholders (e.g. stable regulatory framework and long-term deployment programme).

Additionally, the Cypriot and Spanish NWGs also identified the need for enhanced coordination between regional, national and European programmes and financing instruments. Such coordination could be used to enhance and leverage existing funds whose dispersion currently hamper the implementation of large projects typical of the demonstration stages of these technologies.

International Cooperation

Currently, institutions from the eight countries routinely develop close collaboration activities within the scope of EU-funded actions. Significant international cooperation with international RTD institutions, industry and regional stakeholders is ongoing, with several NWGs claiming cooperation activities between entities from their countries and counterparts from North Africa (4 NWGs), Southern Africa (4 NWGs) and Middle East (3 NWGs). Specific countries have also been mentioned such as Chile (3 NWGs), China (2 NWGs), Brazil (2 NWGs), Australia (2 NWGs) and Mexico (2 NWGs).

Stakeholders

From the analysis and subsequent discussion of every concept note, it is possible to conclude that the main stakeholder groups are similar, being the most significant difference the size of some of these groups. All countries identified as CST stakeholders elements from their national scientific community, as well as industry and enterprises. However, in terms of industry/enterprises a clear division occurs in terms of dimension and quantity. Thus, the countries can be roughly divided in two groups, the ones with a relevant amount of industry/enterprises working within the CST field (the cases of France, Germany, Italy, Spain and Switzerland) and countries with lower representation (such as Cyprus, Portugal and the United Kingdom). Other CST stakeholders present in some of the countries are, for example, industrial associations, chambers of commerce and governmental bodies and institutions.

CHARACTERISTICS OF AN ALIGNED RESEARCH FUNDING PROGRAMME

The existence of common characteristics among the different concept notes in issues related with research programmes, such as future orientations and necessities, unveils a possible path towards achieving an alignment of the research programmes. The same is not so clear when devising an alignment of the funding programmes. In fact, the funding programme landscape is more diverse, with different possible paths for their alignment.

Several possible instruments were mentioned in the concept notes, such as the ERA-NET, EUREKA, Joint Technological Initiatives, Public-Private Partnerships, the Berlin model, Integrated Research Programmes or European Joint Programme Co-fund actions.

Despite the different funding instruments identified by the NWGs several of them agree that the first priority lies on aligning regional and national funding with European funds, including both structural and Horizon 2020 funds. It is also suggested that such alignment should be performed under the scope of CST priorities defined under the EU Strategic Energy Technology Plan, with the goal of achieving a single common policy driving funding and its distribution.

A new funding mechanism will have to be created, either by adapting existing ones or by developing a new one. The desirable properties of such scheme should be: to have a common programme; to join national and European funds; to have a reasonable pool of resources (both in quantity and quality), enabling demonstration projects; to present a single access point and simplified evaluation and approval procedure, reducing the overall time to grant; to have flexible funding allocation.

When asked about the tentative conditions for project approval under a new funding scheme aligning national and European funds, most of the NWGs stated that the tentative projects should be aligned with the priorities identified in the concept notes, funding both applied research and demonstration activities. However, there was a split among the NWGs in regard to the funding of basic research activities, with three countries defending and other three opposing the funding of such activities. A minimum number of RTD partners from different countries should also be a required condition. The inclusion of industrial partners in the projects should be fostered, with some NWGs requesting a minimum number of industrial partners as a condition for a project to be deemed suitable.

CONCLUSIONS

STAGE-STE project fostered the development of relations with public bodies relevant to CST research in order to promote coordination and alignment of national and European research programmes. National Working Groups have been created and concept notes were prepared regarding each group position on CST research and funding programmes and its possible alignment at European scale. In several countries the NWG proved to be an effective forum, promoting information exchange and debate among the CST stakeholders, and connecting entities from CST RTD sector with national and regional agencies (both funding agencies and policy makers).

From the concept note analysis it is possible to conclude that all 8 countries (Cyprus, France, Germany, Italy, Portugal, Spain, Switzerland and the United Kingdom) have RTD centres with relevant activity in CST as well as capable experimental facilities and laboratories devoted to CST development. It is also shown that most of those countries do not have a specific CST RTD programme, neither dedicated funding for CST, being CST RTD activities funded under general calls at national and regional level. Despite this, all agree on the need for suitable and stable funding of CST RTD activities and for a specific RTD strategy for CST at both national and European level. It is concluded that although the NWGs present different approaches to their future orientations, there are some coincident points, thus a common RTD European agenda can be achieved. Such agenda should foster the development of RTD activities focused on lowering the technology and energy costs (i.e reducing capital and operation and maintenance costs, and increasing the produced energy) and improving its value (i.e. improving CST technologies' flexibility and ancillary services capability).

An alignment of CST research funding may be harder to achieve, demanding the adaptation of existing mechanisms or the development of a new funding scheme. However, the NWGs converge in regard to the general characteristics of the projects to be submitted, regardless of the exact funding scheme, and the need to bring together regional, national and European funds into such scheme.

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