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Integrating National Research Agendas on Solar Heat for Industrial Processes

Project Deliverable 8.4: Report on guidelines of relationship between Industry and European SHIP research cluster

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1 Content of deliverable

This report is the main deliverable of INSHIP's Task 8.4 '***Joint framework for active collaboration with Industry'***, allocated within ***WP8: Advanced Networking Activities***, which seeks an outreach of INSHIP activities to an enlarged core of partners creating transnational critical mass and promoting stronger foundations for long-lasting future cooperation on SHIP by involving the large majority of existing research capabilities in Europe.

One of the main goals of INSHIP Project is to strengthen ties with SHIP Industry through an exchange of ideas leading to identification of optimal ways of cooperation in order to give SHIP technologies the right place in the European energy mix.

In particular, the goal of Task 8.4 is the definition of a long-term framework to active collaboration between research actors and the industry.

In this report, a list of guidelines for the enhancement of the relationship of the R&D community with Industry is proposed and explained.

2 Introduction

2.1 Main activities within Task 8.4

This Task has been executed in parallel with Tasks 8.1, 8.2 and 8.3 addressing a number of activities to foster the collaboration between research and industrial organizations, such as:

a) Identification of mid-term and long term industrial needs on SHIP components and systems, with organization of round tables at national level on that purpose. For the sake of efficiency, such round tables have been arranged together with Work Package 7's National Workshops.

At the time of writing this report, Greece, Cyprus, France and Spain have already held their *National Workshops* and a report has been delivered for each one.

In addition, a European Workshop was organized in Brussels on 17 February 2019 in a coordination exercise between Work Packages 7 & 8 to present and discuss project results and targets with all key defined stakeholders (relevant EU industries, national and regional research financing organizations plus other relevant innovation bodies).

The outcome of those workshops have been a very valuable input for this report and the minutes' sections summarizing the '*open discussion'* sessions have been added as Annex I of this document.

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b) To establish information and collaboration channel with national professional organizations though the direct involvement of all partners, exploring possible public-private initiatives and partnership in the context of the SET-Plan.

c) In parallel, participation and delivery of presentations in national workshops/conferences in individual EU countries in relation with the national professional related organisation.

For INSHIP, the following conferences were singled out as high-priority forums for dissemination:

- Austria: Gleisdorf Solar Conference
- Cyprus: International Conference on Renewable Energy Sources and Energy Efficiency; EWACC Conference, Conference "Power Options for the Eastern Mediterranean Region"
- France: Conference DERBI, Solar Meetings, SER
- Germany: Sonnenkolloquium Cologne, Symposium Thermische Solarenergie OTTI e.V.
- Italy: Anest Annual Conference
- Portugal: APISOLAR, EnergyIN
- Spain: PROTERMOSOLAR; SOLARCONCENTRA
- Switzerland: Industrial High-Temperature Solar Energy Symposium
- International: International Conference on Solar Heating and Cooling SHC, ISES World Congress, Eurosun (organized by ISES), SolarPaces Conference

Since the topic of solar heat for industrial processes touches upon a range of disciplines and topics, the consortium partners have been free to choose additional conferences and workshops as they appear suitable for the particular content and geographic location of the consortium partners.

A further branch of dissemination is the active involvement in International Committees and Associations (e.g. IEA SHC Tasks, SolarPaces, EERA, Solar Heat Europe-ESTIF, ESTELA) and the spreading of publishable results in associated scientific circles.

In order to reach parts of INSHIP's major target group beyond the scientific sphere (associated industry, end-users, political decision makers), dedicated industry workshops and stakeholder forums are organized as supplements to all previously described dissemination activities

d) Establishment of a R&D Association on Solar Heat for Industrial Processes after INSHIP project

At the time of writing this report, the EERA JP on CSP has generated a sub-program on Concentrated Solar Heat (SP6: Solar Heat for Industrial Processes). Most European institutes making R&D on CSH (also involved in INSHIP) are already members of this JP.

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It is recommended to promote this new subprogram and keep it as the reference R&D association for a while. Later on, in case the activity expands the creation of a separate JP could be considered within the consortium.

Also, the idea of seeking a closer contact with the industrial associations has come out as a result of the surveys, workshops and studies carried out previously within this ECRIA.

It is clear that technology suppliers and EPC companies have a close contact with the end user and so they have a deep, valuable knowledge of the problems and needs related to real-life installations.

2.2 The need of a strong collaboration R&D-Industry for the deployment of SHIP in Europe

The EU member states are bound by several targets for their energy future mostly related to restricting their Greenhouse Gas Emissions (GHG). Their immediate, 2020 goals had been set a number of years ago, and now member states are settling on their 2030 goals[1], which pose a much more ambitious reduction in such emissions (a 40% cut compared to 1990 levels). Energy is central to those plans, and planned changes cut through the entirety of the economic activity, including energy use in the industry.

The 2050 vision however is more ambitious still. The EC calls for a climate neutral Europe by 2050, and the changes will have to be deep and profound. Solar is poised to have a central role, not just in electricity generation, but also towards supplying energy to heat- based applications in the domestic and industrial spheres.

While this vision is still in early stages to offer specific targets, it is assumed that the overhaul of all the energy systems across Europe that supply heat and are now based on fossil fuels or electricity conversion, will have to be converted to some kind of renewable source.

In fact, IRENA in its 2050 roadmap[2] predicts a massive 49% increase in the final share of renewables in industry, up from 14% in 2015 to 63% in 2050. For SHIP, predicted figures are even more impressive: A rough solar thermal collector area of 1 million m^2 currently is projected to jump to 3,450 million, an almost three and a half thousand times increase in the space of 35 years, most of the growth projected will be in the low-temperature domain.

On the industrial side, both, end-users and technology providers will need a two-folded support in order to make it happen:

[1] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy
[2] https://www.irena.org//media/Files/IRENA/Agency/Publication/2018/Apr/IRENA_Report_GET_2018.pdf

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- Support from policy-making institutions and funding entities in the way of a SHIP-supportive legislation and sufficient subsidy programs in order to make the solar technology competitive with the still-dominant fossil-based ones. (see Annex I)
- Support from the R&D community in the way of the transfer of new technologies and know-how, developing devices and systems more efficient and easier to integrate into industrial processes, as well.
  This exchange of knowledge must go in both directions, as it is very important for R&D-performers to receive first-hand information from Industry about their actual needs and also feedback information about the performance of existing solar systems in operation.

2.3 Objectives of coordination activities with Industry

According to INSHIP proposal, contributing to the technological development capacity and to the scientific performance and attractiveness of the European Research, while supporting the implementation of the SET-Plan in close collaboration with the industrial sector goals, is the integrated approach pursued in INSHIP. This is pursued through the successful achievement of the following **coordination objectives**:

Table 1 Objectives of INSHIP's coordination activities with Industry

Objective	Measures @ INSHIP
#1. The acceleration of knowledge transfer to the European industry, at both end-user sector and technology supplier levels, in order to ensure the industrial European leadership on SHIP, in the context of the SET-Plan and other relevant initiatives such as SEII, EMIRI, KIC-InnoEnergy, etc.	Through the promotion of specific research activities aligned with the scientific topics of the ECRIA and setting the base for the preparation of project proposals aligned with national and EC funding objectives and engaging the participation of industrial partners
#2. The reinforcement and expansion of the joint activities amongst research centers also offering researchers and industry a comprehensive and complete portfolio of research capabilities, bringing added value to innovation and Industry-driven technology	Through the implementation of Researcher's mobility and Shared Infrastructure Schemes

Considering the interrelated technological aspects of both SHIP and CSP, the European Energy Research Alliance (EERA) is the basic starting point of INSHIP project, namely through its Joint Programme on Concentrated Solar Power (EERA JP-CSP), launched in 2008 and a formally approved in April 2011. The research institutions participating in INSHIP are either partners of EERA or, alternatively, have expressed their commitment to formally joint EERA in the near future. Also, all partners of EERA JP-CSP are participating

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in INSHIP project.

The recently established joint "IEA Solar Heating and Cooling Programme-SHC Task 64 and SolarPACES Task IV - Solar Process Heat" (https://task64.iea-shc.org/) is also expected to play a key role in the enhancement of coordination activities with Industry. This new Task was launched on January 2020, it has a duration of 4 years and it is significantly supported by INSHIP partners.

The goal of the "SHC/SolarPACES Task 64/IV Solar Process Heat" is to help solar technologies be (and also be recognized as) a reliable part of process heat supply systems. These systems are hybrid supply systems and will have to be integrated in the upcoming developments of the digitalization of industrial production systems and their energy demand. A key objective of this new Task is to identify, verify, and promote the role of solar heating plants in combination with other heat supply technologies for process heat supply, such as fossil and non-fossil (biomass and biogas) fuel boilers, combined heat and power, heat pumps, or power-to-heat. The Task is organized in the following five main activities:

- Subtask A: Integrated energy systems
- Subtask B: Modularization
- Subtask C: Simulation and design tools
- Subtask D: Standardization and Certification
- Subtask E: Guideline to market

2.4 Expected impact of coordination activities with Industry

Considering the European Commission objectives on the establishment of European Common Research and Innovation Agendas (ECRIAs) in support of the implementation of the SET Action Plan, **the arguments justifying the relevance of INSHIP project include** explicitly the support the European industrial leadership on SHIP technologies.

Thanks to the support of the European Commission and some EU countries, during the last 15-20 years, EU industry has become the clear global leader in solar concentrating technologies with the potential to address SHIP applications in the untapped market of medium and high temperature industrial processes. Nevertheless, in spite of this valuable support adequate coordination is lacking due to, among others:

- i) different national policies and objectives;
- ii) intermittent support of some national programs;

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- iii) very diverse intensity and budget support of different national programs;

By providing a strong and powerful research sector in Europe, INSHIP should have significant socio-economic impacts. Indeed, it will help the SHIP European industry to develop and export new technologies, thereby improving its competitiveness worldwide.

This will be reinforced with a high level of cooperation and coordination of existing Research Infrastructures (RI), increasing interaction possibilities with industry and stakeholders and strengthening the SHIP sector as a strategic and highly innovative sector in Europe.

As consequence, a better alignment between industry needs and research centres capabilities is expected. By offering a better collaboration and cooperation amongst the associated research centres, SHIP will play a significant role giving a more effective response to European industry research needs.

The following table summarizes the expected impact of this coordination activities.

Table 2. Expected impacts of coordination activities with Industry at INSHIP

Project objective	Expected impact	Beneficiaries
#1. Adapt the European research infrastructures to the needs of the industrial sector	Provide the industrial sector with the R+D infrastructure required to accomplish the expected "learning curve" and achieve a significant cost reduction	- **Industrial sector** - R+D community - Project developers - The public at large
#2. Exchange of researchers and definition of common practices for the access and use of the R+D facilities	Standardized procedures and rules for access to R+D infrastructures. Definition and implementation of standard testing procedures	- **Industrial sector** - R+D community - Project developers
#3. Plan for the use and dissemination of the Foreground and Exploitation of research results	More efficient commercial exploitation of IPR via a better relationship with the industry	- **Industrial sector** - R+D community - Project developers

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3 Guidelines of relationship with Industry

3.1 Methodology

Two main sources of information have been used to build this list of guidelines.

First, the records of the INSHIP National Workshops already held at the time of writing this report. These events have been focused as discussion fora where each party (industry associations, policy makers and R&D players) could exchange points of view with each other and to learn about their needs and concerns.

Of particular interest has been the European Workshop, where the largest industrial associations were represented. It has been quite revealing, for instance, the need of research on business models or advanced tools for technical and financial due diligence.

On the other hand, we have explored the experience and knowledge gathered by (almost) the same partners in former projects related to the networking of large-scale research infrastructures, like SFERA I, II & III and, mostly, the EU-SOLARIS Preparatory Phase (2012-2016).

Some of these projects included specific tasks dealing with the exploration of the difficulties posed by the current R&D – Industry interaction ways and propose innovative ways to deal with them.

Suggestions gathered from the Industry side have been extracted from the mentioned existing sources of information, then analyzed and summarized as a simple list of guidelines as actions to be taken by the European CST R&D community as soon as possible in order to ease the way and boost the commercial deployment of SHIP technologies by the European industry, while keeping its global leadership in front of other players like China or the US.

Every guideline listed below is briefly explained.

3.2 Industry recommendations as an outcome of National and European INSHIP workshops

These are additional research topics suggested by industrial representatives to the CST R&D community. These topics are part of the outcomes of the National Workshops and the European workshop held in Brussels in February 2019.

a) Seek for solar technology cost reduction

Further research is required to achieve cost reductions in the fields of materials,

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assembly procedures, installation, and site works. In addition, several O&M procedures need to be revamped and reduced in overall cost.

b) Carry out research on business models

A topic often overlooked, research is needed to identify suitable business models, and develop due-diligence, risk analysis and risk sharing tools, guarantees & insurance. At a later stage, research and standardization is needed for contracting, as well as exploring the possibility of engaging venture capital, equity or commercial banking.

c) Deliver standardized information on technology cost range and validity conditions

There are strong signals from researchers and industry alike that there is a need for standardization of the technology cost range and validity conditions for easier communication of SHIP advantages.

These have to extend to O&M costs, system size scalability, benchmarking with competing technologies and/or energy sources, and technology learning curves. This will have to be followed by standardization of equipment and procedures, a task that has to be led mostly by the industry.

Moreover, it has been identified that there is a lack of project developers fostering the use of solar thermal in industrial applications. This could be remedied by information dissemination, demo projects, or faster technological adoption.

d) Carry out impact studies on socio-economic impact

An emphasis should be given to the value creation potential of SHIP, away from purely cost-based analyses. This should involve an analysis of job creation and maintenance potential, possible additional tax revenues, energy cost reduction, emissions reduction, and energy security considerations.

e) Study of behavioral aspects

Further research is merited for models of consumer-driven and sectoral-driven motivation, which can have an effect on the choices for electing SHIP technologies.

f) Develop a mixture of technical and financial due diligence tools

The goal would be to enable the reduction of transaction costs and easier access to financing (through venture capital, equity or commercial banking etc.) as required, rendering SHIP projects more attractive (and simple) to potential EPCs and/or ESCOs.

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3.3 Industry recommendations as an outcome of Research Infrastructure-related projects

Most partners of the INSHIP consortium have come a long way together in EU-funded projects around Research Infrastructures (RI). This path starts with the project SFERA (Solar Facilities for the European Research Area) in year 2009 to continue with SFERA-II and the current SFERA-III (2019-2022).

All these projects put the emphasis in the establishment of a strong network of European large-scale research infrastructures related to concentrating solar technologies and to open their doors to the European R&D and also industrial communities.

Also, these series of projects use to have three main activities:

- Open-access campaigns (merit-based selection rounds open to any EU group)
- Networking (joint conferences, summer schools, etc…)
- Joint research activities, oriented to improve the service provided by the test facilities; i.e. through development of new sensors, measuring protocols, new common test procedures….

Another important initiative is EU-SOLARIS (The European SOLAR Research Infrastructure for Concentrated Solar Power). The main goal of this initiative is to establish **the European research facility for concentrating solar technologies** as a legal, autonomous entity under the European legislation, see Annex II for further details. (ERIC entity: European Research Infrastructure Consortium).

The EU-SOLARIS Preparatory Phase Project (FP7-INFRA-312833) lasted from November 2012 to October 2016 and, among their objectives, the future interaction of the entity with Industry was explored through a number of studies and surveys (see Annex II).

Some general conclusions that can be extracted from the above mentioned exercises follow:

i) The Industry firmly believes that a strong organization of R&D centres is essential not only to increase the contribution of Research Centres to the innovations that will be finally implemented in commercial plants but also for the budgetary support both from the European and the National programs.

ii) Regarding new infrastructures, the industry recommends to empower the new EU-SOLARIS organization (whenever it is up and running) to progressively contribute to reduce overlapping tasks among the research centres in Europe, to enhance the excellence of the centres in their respective specialization areas and to increase the collaboration between the Industry and the Research Centres.

iii) Although the industry is – in most of the cases – satisfied with the delivery of the centres when establishing specific collaboration projects, there is a general opinion that a large part of the activities of the centres are not coordinated with the industry.

iv) Indeed, their research activities are far from being transferred to the market and – in many cases – there is a clear overlapping of activities.

g) Improve the dissemination of information within the industrial community

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This could be done through 'technodays', seminars or other events, publications, demonstrative actions on research centres' competences in the field, highlighting the progress in the research activity and on main targets.

h) Support SMEs participation in 'business-as-usual' R&D projects

The CST sector combines large investments for demonstration projects (tens of millions euros) and commercial projects (hundreds of millions euros) with the difficulty of sourcing the necessary funding for new technologies.

At the same time, small companies are willing to take risks but do not have the financial strength, while larger and stronger companies tend to wait until a market opportunity arises.

An increase of the support for SMEs participation in collaborative, externally-funded projects would be welcome.

i) Seek better confidentiality agreements and Intellectual Property Rights (IPR) protection

This is a prerequisite in the involvement of industry. Being aware of this essential aspect, a task of EU-SOLARIS was dedicated to this problematic. New models and formulas taking into account the issues of IPR and technology transfer were proposed (EU-SOLARIS Deliverable 2.1. See Annex II).

j) Provide guidelines for industrial companies to set up relations with R&D sector

Some companies do not have any contact with research centres so far and need a starting point. Some guidelines should be drafted in order to help SMEs or interested companies in setting up relations with the research sector.

k) Develop tools for alignment between CST R&D and industry needs

As already mentioned, a significant alignment between the R&D strategies adopted by the CST RIs and industry needs is achieved naturally to the extent that, on the one hand the R&D Infrastructures are being partially funded by the private sector (e.g., by rendering services or participating in joint R&D projects) and, on the other hand, the industrial sector does not always have enough R&D staff and/or experimental loops to develop the knowledge and innovation needed to accelerate progress towards reducing costs and, then, they use the RI capacities and capabilities for affording their own R&D and/or characterization challenges.

Therefore, this natural alignment or collaboration between RIs and CST industrial sector will continue happening by:

- Provision of services by the RIs to the CST industrial sector (e.g. for shared development and/or characterization of prototypes, etc.);
- Transfer of knowledge and technology (via training courses and / or technical advice);
- Shared technological developments (e.g. via collaboration in R&D projects whose challenges are defined jointly between industry and RI centers and use to be partly financed with own funds and partly funded by the European Commission or National Authorities);

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- Initial collaborations in the development of standards for diagnostic of plant performances;
- Collaboration in the analysis and writing of technological roadmaps.

Additional alignment is actually achieved since the Industry Associations are actively participating in the EU R&D programs definitions (both directly by their participation on expert boards or project partners and indirectly since the Strategic Research Agendas from Industry are taken in consideration for the definition of those R&D Programs).

The need to coordinate and align the activities of the R&D sector and therefore the RIs, is part of the motivations of a series of ongoing programs and projects partly funded by the EU.

l) Enhance the exchange of information

This should happen not only on ongoing activities but on lessons learned and / or improved technology solutions.

If companies do not break the current secrecy and report what things are working well and which are wrong, it will be difficult for the R&D centers to identify what are the priorities and needs in R & D.

Therefore, a key element to align the needs of the industry with the activities of the R&D would be to share more clearly what are the lessons learned and propose the technological issues to solve the current problems. Therefore, the boost of collaboration (perhaps with the participation of RIs as intermediaries) among EPC providers of CST plants may be key tool to accelerate the necessary cost reduction.

m) Strengthen the alignment of potential new Research Infrastructures development with CST industry needs

EU-SOLARIS puts the focus on the future development of the RIs and optimize their impulse by aligning it with the development needs of the CST technology and the European CST industrial sector. Thus, the challenge of identifying ways and/or tools to maintain and/or could be afforded in a double way:

i) Identifying "specific" challenges of the CST in the way to quickly grow in competitiveness (with respect to other renewable and/or other conventional solutions). To identify these challenges, the Strategic Research Agendas and other technology "position papers" become a first reference.

   Nevertheless, the risk associated to this approach (if suggested as the only way for alignment) is that these documents are based in the actual thought and in the view of a limited panel of experts. The evolution of the market and of the technologies could be different (e.g. by unexpected appearance of innovations or/and cost reduction strategies in markets with different rules -e.g. China? -). This approach would need funds and the agreement of the RIs to address the required upgrade of development for facilitating the identified challenges.

ii) By implementing strategies to maintain convergence and / or alignment in the necessary developments in both parties: RIs and industrial sector of STE. These strategies are visualized as monitoring and coordination tools with mutual benefit for both parties: industry and RIs. Among these tools we may suggest:

- The implementation of a specific strategy and work plan to achieve a greater

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transparency of the lessons learned in the implementation, operation and maintenance of the CST plants (e.g. in the election and installation of any specific equipment of these technologies, lessons learned in solar prediction strategies and plant operation optimization, etc.). Implementation of working groups with plant operators and owners is showing to be a very efficient tool for this purpose. However, it needs some formal framework and logistic support to keep activities running with continuity.

- The creation of a committee of experts to follow-up the alignment (e.g. with the commitment to create an annual report identifying: a) achievements and main challenges in the sector, b) the challenges of technology to grow in competitiveness, c) an update of the capabilities and potential services RI, d) a projection of the needs to improve the EU-Solaris Research infrastructures, ...). This committee should be composed of representatives from both the RIs and the Industry. EU-SOLARIS could be a perfect framework for such a committee.
- The collaboration in implementing useful empirical diagnostic or testing procedures (that could become proposals for international standards) to characterize the performances of CST plant's energy generators.

Conclusions of this section

As a result, it is possible to assess that confidentiality issues are one of the core issues in the private sector with a high impact on how research centres test infrastructures are used.

The industry and research centres tend to have long lasting collaboration agreements footing on the perceived successful collaboration model. In this sense the personal contacts established over many years are crucial for maintaining those business relationships. In parallel, good contacts have been also established between both sectors thanks to the share of joint projects.

Recommendations tackled by the industry are related to the gap in the way of functioning between research and industry, due to the lack of communication, the project sizes, the confidentiality and time-budget approach in particular. Nevertheless, some of the companies seem to be satisfied with the relationships already in place, since they mentioned that public funding (EU or national) was the best option to exchange knowledge.

The main outcome of this study is that a broader use of the research infrastructures by the industry could be implemented, provided that all conditions of confidentiality as well as a common understanding on the terms of reference of the R&D tests are given.

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4 Summary of Guidelines

a) Seek for solar technology cost reduction

b) Carry out research on business models

c) Deliver standardized information on technology cost range and validity conditions

d) Carry out impact studies on socio-economic impact

e) Study of behavioral aspects

f) Develop a mixture of technical and financial due diligence tools

g) Improve the dissemination of information within the industrial community

h) Support SMEs participation in 'business-as-usual' R&D projects

i) Seek better confidentiality agreements and Intellectual Property Rights (IPR) protection

j) Provide guidelines for industrial companies to set up relations with R&D sector

k) Develop tools for alignment between CST R&D and industry needs

l) Enhance the exchange of information

m) Strengthen the alignment of potential new Research Infrastructures development with CST industry needs

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ANNEX I

INSHIP National and European Workshops with Industry:

Summaries of '*Open Discussion*' Sessions

In this annex, the relevant sections of the minutes recording the outcomes of the different National Workshops held so far, and the European Workshop as well, are gathered. This annex is not meant to be exhaustive, so only those portions of the documents with a relevance to the interaction R&D community – Industry have been included.

Summary of 'Open Discussion' session at the European Workshop

Additional R&D topics (after the EU workshop):

• Technology cost reduction: On materials, assembly procedures, installation, site works, economies of scale, but also O&M procedures

• Financing: Suitable business models, due-diligence tools, guarantees & insurance, contracting, venture capital, equity or commercial banking

• Standardized information: technology cost range and validity conditions, O&M costs, dependence on system size, benchmarking with competing technologies and/or energy sources, technology learning curves. Also: Standardization of equipment and procedures

• Impact: Job creation/maintenance, additional tax revenues, energy cost reduction, emissions reduction, energy security

• Behavioral aspects: consumer driven motivation, sectoral driven motivation

Research at various TRL levels

•Low TRL (0-5): likely by R&D institutions, generating a continuous flow of innovation able to be introduced to end-users at a later (higher TRL) stage

•Higher TRL (6-7): likely to be driven jointly by R&D and end-user industries

•Market ready (8-9): end-user driven and covering "real scale" questions

•Possibility of "open TRL" calls could be foreseen by assessing potential impacts (e.g. on competitiveness, costs, efficiency…) through the use of a well-established (and suitable) learning curve, thus levelling the ground for the competition of low and high TRL solutions addressing one specific necessity

Demonstration projects:

•FLAGSHIP Demos necessary: Need for "real scale" systems, generating track record on: MW scale heat supply, high solar fraction systems; funding necessary

•Project developers: there is a lack of project developers fostering the use of solar thermal in industrial applications. A mixture technical and financial due diligence tools

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enabling the reduction of transaction costs and easier access to financing (through venture capital, equity or commercial banking), rendering SHIP projects more attractive (and simple) to potential EPCs and/or ESCOs

Summary of 'Open Discussion' session at the Spanish National Workshop

Triggering question

The discussion was triggered with the question: Which technical improvement or political support scheme (apart from subsidies) do you consider absolutely necessary to achieve a relevant penetration of SHIP technology in the Spanish industrial sector?

Inputs from participants

Before the open discussion, a number of technical questions arose during the block of technical presentations. Most of the questions were concerned with both, mid temperature and hybridization applications, while the topic on high temperature applications received less attention as it is far from the market yet.

On the other hand, we used the opportunity to disseminate the possibility currently available to industrial partners of using the *IAScheme*. A couple of questions arose from interested companies and so they were informed about the contact details of WP6 manager at PSA.

When at the open discussion session, it was first commented that end users don't even know the technology, may be they barely know PV or low temperature thermal (flat plates) but not the medium-high temperature applications based on CSP.

As an example, it was commented that the last call from AGENEX (Energy Agency of Extremadura) to subsidize up to 40% of any investments on high temperature solar installations for industries didn't receive any application last year.

CSP technology providers exposed the difficulties they are meeting when offering SHIP technology to industrial customers where it would be applicable, namely:

- They don't want to experience any difficulty beyond the usual ones related with their day-to-day businesses
- They always want to 'see and touch' before any similar facility already installed in a factory of the same sector and in the same region
- They know there are subsidies which will absorb the extra costs with respect to conventional solutions (i.e. electricity from the grid or gas burners)

Apart from these, it was already mentioned that modularity is of utmost importance for technology providers. This is because there are usually huge additional engineering efforts to adapt the solar system to the industrial process when installing new systems to customers. This integration effort uses to become a significant share of the costs and work to be done by the technology provider.

Conclusions/next actions

It is agreed that the case of the 50 MW-parabolic trough plants in Spain shows very clearly the way to follow, in the sense that only having and showing one clear case of success will allow a penetration of the technology by the way of replication.

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According to that, it is agreed that a possible way of focusing the national innovation funding for this technology should adapt to the following premises:

- Lighthouse (or demonstrator) projects in a maximum of three industrial fields where SHIP technologies based on CSP may fit optimally
- For the selected applications, build (subsidize) projects in several locations to spread the experience all over the country.
- Fund a part of the investment (BAU) but also, and maybe of higher importance, fund a technical support service to keep the SHIP plant up and running for (say) 5 years, so the end users don't have any additional problems.
- Promote free visits of other potential end users of the same field in order to disseminate the experience and create awareness
- There is a final agreement to keep in touch with Solar Concentra and to participate in future events to further elaborate on these concepts.

Summary of 'Open Discussion' session at the French National Workshop

Questions on grants for large-scale solar thermal plants (« Appel à projets national : AAP Grandes Installations Solaires Thermiques »)

Questions of heat providers :

- There is a lack of readability on future support, so it is difficult to guarantee to customers a fixed price of the heat (with reduction): lack of credibility regarding customers.
- It is asked to the ADEME to communicate the dates of futures project submission.
- What is the maximum aid rate per MWh ?
- There is a need to set a common business plan: carbon tax scenario, energy price scenario. This should be done by ADEME.
- It is asked to the ADEME to clarify the aid calculation.

ADEME answers:

PPE objective for SHIP: 300 000 m² till 2028. For heat providers, this is clearly not enough, it would represent one installation of 30 000 m² per year.

The number of project submissions is variable, so it is difficult to foresee aid amount.

Specifications of this call are under clarifications and the requested details will be provided.

Summary of 'Open Discussion' session at the Greek National Workshop

The main topics discussed during the "Open Discussion" of the Greek National Workshop were the current status, the perspectives, barriers and potential of SHIP systems in Greece. Also there was a discussion on the solar energy targets set at national level for solar thermal technology, the current policy strategies and instruments applicable for SHIP systems in Greece as well as the research and technology framework in Greece

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and the opportunities of applying SHIP systems in the current framework.

The main outcome of the discussion from the panelists from the industry sector was that there is high potential for the implementation of SHIP technology in Greece, especially in low temperatures (below 150° C). However, the current status shows that the existing SHIP systems are few and most of them were installed in the decade 1990-2000, when appropriate financing initiatives were given to the industry' end-users.

Some of the identified barriers during the discussion were the competition of solar thermal energy with conventional fuels, the existing subsidies to other RES technology, such as PV, the lack of standardization and certification of complex SHIP systems and the lack of knowledge from the designers and installers of solar thermal systems.

The panelists from the policy sectors presented two important current policy strategies in Greece, which are the National Energy and Climate Plan (NECP) of Greece and the Implementation Plan of the Strategic Energy Technologies Plan (SET Plan) for Solar Thermal Electricity / Concentrated Solar Power for Greece.

There was a discussion on how these strategies could contribute in the promotion of SHIP technology and it was concluded that specific actions and meters in line with these strategies should be established to achieve this goal. The active participation in Greek workshop of members from the Energy Policy Division of the Greek Ministry was regarded as positive to this aspect.

Another important outcome of the workshop was that research and innovation are important factors to enhance the SHIP installations. The statistics presented during the workshop shown that the share of solar thermal funded research projects in energy sector is low. There a discussion on how this barrier could be overcome. An important conclusion of the workshop was that - in order to exploit the high potential of SHIP technology is Greece - there should be a holistic approach and all relevant parties should cooperate. This could be achieved by the creation of a cluster, including members from industry, research centers, policy and funding sectors.

The Greek workshop accomplished to reach the industrial sector and to bring together significant attendance of important representatives from the whole spectrum of the energy and policy sector: executives of the Greek Environment and Energy Ministry, representatives of major research and academic institutions, important key actors in the industry field and members of professional associations. There was a fruitful and effective discussion session, where information and ideas were exchanged between participants from the different sectors.

The results of the workshop are expected to be promoted and disseminated by the attendees stakeholders to their sector and also by the attendees members of the press - who covered the workshop realization – to the general public.

Summary of 'Open Discussion' session at the Cypriot National Workshop

- **Structure of the discussion**

The discussion took place around the status of the SHIP and CSP at a national, European and global level, specifically, the challenges and the future of solar energy considering the direction for the development of offshore renewables.

Solar energy, and particularly CST and CSP might face several difficulties as the market

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seems limited, especially for a small country like Cyprus. However, if the market gets bigger it will offer opportunities, particularly for countries with high solar irradiance.

- **Inputs from participants**

The local industry was represented by Fanos Karantonis of Karantonis Group, a local company actively involved in the energy sphere of Cyprus, and in all relevant professional associations. He mentioned that the local industry is indeed placed very well to taking advantage of any SHIP development given its vast experience with solar water systems, but if the costs do not come down, these systems cannot be considered seriously. He called the local government to intervene and support SHIP systems as a way forward.

- **Conclusions/next actions**

The workshop gave an overview of the SHIP regulatory and market situation in Cyprus to a selected online audience that represented industry, policy makers and academia. The INSHIP project was used to showcase the progress taking place in aligning European research agendas and activities in the field, and Cyprus' position in it.

Summary of the Turkish National Workshop

Overview: Turkey's National Workshop was part of the larger 1-day national workshop on Concentrating Solar Technologies "ODAK$_{2023}$ Kick-Off". *ODAK$_{2023}$* is a 3-year initiative to catalyze growth in Turkey's CST 1) R&I and industrial capacities and activities, and 2) markets, with a specific focus on SHIP. The workshop attracted 95 total participants and featured 25 presentations. Eighteen of the participants and 4 of the presentations were from industry. Additionally, seven of the participants were from non-Turkish INSHIP partners (4 from CIEMAT and 3 from DLR) and one participant represented European CST Industry (ESTELA), and all 8 of these international participants gave presentations that included at least some content on European experiences with and vision for SHIP technologies and industry. A Key Note speech was also given by the Head of the Energy Efficiency and Environment Department of the Turkish Ministry of Energy and Natural Resources that emphasized Turkey's desire to focus on developing Turkey's SHIP capacities and markets rather than Solar Thermal Electricity (STE) in the near term. The final session of the event was a Round Table and Open Discussion.

Main outcomes:

- The event demonstrated large interest across a diverse range of stakeholders for SHIP in Turkey, including from industry as a technology provider and as an end-user.
- While Turkish SHIP industrial capacities and markets are presently almost non-existent, they are estimated to potentially be among the largest in ERA.
- The Turkish SHIP activities are fragmented and the community lacks a common voice and vision.
- There is a lack of a well-developed national plan to grow and exploit Turkey's SHIP industrial capacities and market opportunities.
- Turkey can study how Spain grew its CST R&I and industrial capacities and markets to become a global CST leader, and identify best-practices that can be

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adapted to the unique conditions of Turkey.

Main Conclusion: Turkey has large SHIP industrial capacities and market potentials, and large R&I capacities potentials to support these industrial capacities and markets. While there are barriers to realizing these potentials, there is a strong national desire to overcome or find ways to work around these barriers. To further strengthen outreach to and engagement with industry, a booth and a 3.5 hour special session on CST co-organized with ESTELA was scheduled for the main Turkish solar energy industrial fair *SolarEx* in April 2020 with a continued focus on SHIP. However, due to COVID-19 restrictions SolarEx 2020 was postponed to 2021 and therefore this follow-up even has not been realized.

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ANNEX II
REFERRED REPORTS FROM *EU-SOLARIS* PREPARATORY PHASE PROJECT (Grant Agreement # 312833)

What EU-SOLARIS is:

EU-SOLARIS initiative aims to create a new legal entity (ERIC: European Research Infrastructure Consortium) to explore and implement new and improved rules and procedures for research infrastructures (RI) for concentrating solar technologies, in order to optimize Research Infrastructures development and RTD coordination.

Once the Preparatory Phase Project is finalized, EU-SOLARIS will provide research infrastructures (RI) for the scientific communities devoted to the use of solar energy through concentrating systems; for both electricity and industrial heat generation. The new distributed research infrastructure of EU-SOLARIS will have the following characteristics:

- Provide the most complete, high quality scientific infrastructure portfolio at international level
- Facilitate researchers' access to highly specialized research infrastructure through a single access point
- Link the scientific communities, Industry and universities involved in the CST sector
- Speed up the development of research and innovation due to a closer collaboration model, knowledge exchange management and a wider dissemination of results
- Increase the efficiency of the economic and human resources required throughout the European research context
- Provide efficient resource management to complement research and to avoid unnecessary technological duplication and repetition.

A special attention has been given to the interaction between R&D and industrial communities at EU-SOLARIS Preparatory Phase Project (focusing particularly on the Research Infrastructures aspect), so a number of related deliverables about this topic were issued.
The list below contains the documents referred to in this report and the corresponding sections, as well. The documents are included in the EU-SOLARIS website: www.eusolaris.eu.

EU-SOLARIS INTERNAL DELIVERABLE 4.4: Report on Recommendations of Industry Regarding New Infrastructures and Research Lines (May 2016)

3. Recommendations of the Industry Regarding New Infrastructures

EU-SOLARIS DELIVERABLE 4.1: Report of Evaluation on the Collaborative Activities of the Research Centres and Industry (December 2015)

2.2.2 Industry Recommendations

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Conclusion

EU-SOLARIS INTERNAL DELIVERABLE 4.2.4: Recommended Ways to Align EU-SOLARIS new Research Infrastructures and Strategy with Industrial Needs (September 2016)

5. Tools for Alignment between RI and Industry Needs

EU-SOLARIS MILESTONE 23: Report on Case Studies and Breakdown of Typologies on Confidentiality Issues (March 2016)

4. Recommendations of confidentiality procedures for EU-SOLARIS facilities

EU-SOLARIS DELIVERABLE 2.1: Report on the intellectual and industrial property system applicable to the activity of the organism (July 2016)

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