Scientific and Technological Alliance for Guaranteeing the European Excellence in Concentrating Solar Thermal Energy

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Project Deliverable 4.5:

Report on the assessment of the reference course implemented

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1. Executive summary

The 1-week Introductory Course on the Concentrated Solar Thermal (CST) technologies comprised of 5 days with 5:00-6:00 hours of lectures which were attended by around 40-46 listeners with more than 55 prior demands of attendance. The objectives and the aims set for the CST course have been successfully achieved. A number of constructive comments and suggestions improvements have been received from the attendees of the course after its accomplishment for the next events of this kind, if such will be organized in the future.

2. Introduction

The 1-week Introductory course on CST technologies has been designed for the scientific communities and especially towards the industry, in order to foster their awareness and deep understanding of the latest innovative research and technologies in STE, to bridge the gap between industry and STE research centers, to enhance the deployment of innovations driven by industries. This report details the assessment of the implemented course based on the feedback provided by the event attendees.

The CST training course was designed for covering all the fields of research of the STAGE-STE project http://stage-ste.eu/. It has been presented mainly as an "introductory course" on CST to get the basic knowledge and key concepts in these technologies: specifically, it included a general introduction to CST energy, a brief overview of each CST technology with its basic concepts, description of components, state-of-the-art and other. Such horizontal topics as current trends for the future, O&M and other have been also addressed in a succinct way. This training course aimed to encourage the course's attendees – mainly the graduate students (Masters and PhDs), but also the professionals from CSP companies and other interested stakeholders, without excluding any sector – to acquire strategic knowledge in the CSP field. It was also an opportunity for the public to further explore the STAGE-STE project, meet researchers and industrial partners involved therein and create and enhance the possible future collaborations.

The 5-days CST training course has been prepared by CNRS and the University of Seville with the Higher Technical Engineering School in Seville as co-organisators and the STAGE-STE partners ABENGOA (Spain), the French Alternative Energies and Atomic Energy Commision (France), the Fundación CENER-CIEMAT (Spain), the Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (Spain), the National Scientific Research Center (France), Cranfield University (United Kingdom), Cyprus Institute (Cyprus), the German Aerospace Center (Germany), European Solar Thermal Electricity Association (Belgium), EURONOVIA (France), Fraunhofer Institute for Solar Energy (Germany), the IMDEA Energy Institute (Spain), the Instituto de Engenharia de Sistemas e Coputadores – Investigação e Desenvolvimento (Portugal), the Training Center RENOVETEC (Spain), the Università degli Studiu di Palermo (Italy), the University of Evora (Portugal).

This training course has been held within the STAGE-STE project, an Integrated Research Programme (IPR) that engages all major European and International research institutes, with

relevant and recognized activities on STE and related technologies. The aim of the project is to make STE a major technological global player in the medium to long term. This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 609837.

An assessment has been carried out after the end of the course through the on-line questionnaire distributed to the participants. The feedback received as well as the conclusions will be outlined in this report that also may serves as organization guidelines for any future events potentially organized.

3. Aims and objectives

The course has been delivered with the aim of facilitate the achievement of the following objectives:

- To strengthen the rapprochement between research centers and the industry and to foster their awareness and deep understanding of the latest innovation research and technologies in STE;
- To facilitate the access to the course by the private industrial sectors as well as student public thanks to the short duration of the training course;
- To bridge the gap between the training offer currently available and what is required by both scientific community and industry.

4. Overview of the one-week Introductory course on the CST technologies

The reference course has been implemented during 5 days from October 16 to 20, 2017 at the Higher Technical Engineering School in Seville with approximately 5:30-6:00 hours of lectures, two 30-minutes coffee breaks and 1-hour lunch per day. Lectures have been delivered by 26 highly-qualified professionals from the CST fields, both researchers and industrials, and often followed by the thought-provoking exchanges between the attendees and the lectures. The lectures have been recording the audio-visual service of the University of Seville, SEFILMA company, in order to further provide the course's content to the interested public having not being able to attend the course.

The topics presented in the table 1 have been covered during the 5 days. Two topics have not been presented at the course because of the availability reasons of the lecturers: "Striling dishes" within the Day 1 "General Introduction" and "Hydridization" within the Day 5. This lack has been partly offset with the CST course workbook and presentations distributed to the attendees.

Table 1. Programme of the CST training course

Day 1 – General introduction:

- Context – Energy and Future; - Concentrating Solar Thermal Energy (encompassing Solar Thermal Electricity (STE), Solar Fuels, Solar Process, Heat and Solar Desalination);	- Introduction to the different concentrating solar technologies (CST). State of the art and overview of the components and plant configurations
Day 2 – Solar Thermal Power Plants pre-design and site selection:	
- Plant pre-design;	- Site Selection
Day 3 – Alternative applications for high and medium temperature:	
- Desalination; - Medium temperature for industrial processes;	- Solar fuels: Hydrogen, Syngas, Liquid Fuels; - Solar chemistry
Day 4 – Storage and Hybridization:	
- Current storage technologies; - Hybridization; - Upcoming ideas and concepts (prototype stadium);	- Other concepts; - Case study
Day 5 – Trends in STE R&D to reduce the cost of solar thermal electricity :	
- Current R&D activities in European funded projects; - Cost and value of solar thermal electricity; - Advanced Plan designs;	- Current market and trends; - Value chain and related costs; - O&M issues

Further information on the delivered lectures is available in the CST Course workbook. Intended to be distributed before the course and used as its promotion, the workbook has been finally sent to the attendees after the course accomplishment as a final complete summary of the covered topics of the course. For more details on the practical organization of the course, please see the Annex 1 “Leaflet of the implemented course”.

In order to make the course more interactive and provide a greater opportunity to the attendees to get involved in this 1-week training course, an optional social dinner has been suggested to the attendees and some lecturers on Thursday October 19 in order to contribute to the exchange of ideas, addresses, brochures and enhance the further communication between them.

5. Evaluation method

The feedback from the officially registered course’s attendees has been collected using an on-line electronic form. The link to the survey has been sent to the participants. To view the developed evaluation questionnaire, please see Annex 2.

Using the electronic questionnaire as the assessment method allowed to receive a number of responses sufficient to get quantitative and qualitative elements for the evaluation of the implemented course as well as of the achievement of the objectives set. However, there was an unavoidable problem of feedback gathering: only 9 out of 35 attendees that confirmed their presence and out of 40-46 attendees registered during the course have evaluated the course and

the programme offered. A greater number of feedbacks would certainly help to assess the impact of the course and, thus, to identify the ways for improvement in a more specific and efficient way.

5.1 Context

In order to provide the idea of the audience required to evaluate the course, it is important to summarize the characteristics of the targeted public.

The total initial number of demands for the course's attendance was 60. In order to guarantee the heterogeneity of the participants (countries, maximum number of participants per organization, gender, type of organization and other), the number of places was limited to 40 with a restricted number of participants coming from the same work or study institution has been allowed. Therefore, a prior evaluation procedure of the applicants' profiles based on the review of their application forms and CVs has been established. Please see the application form distributed in the Annex 3.

The total number of the selected candidates was 40. A waiting list of the not selected participants has been created for a possible replacement in case of withdrawal. The final number of expected attendees was 32 participants: 2 of selected participants have not been able to attend the course for availability reasons; 1 of selected participants has not confirmed the attendance after the official invitation email; 5 participants out of the 40 selected have not been able to attend the course for visa issues. The real number of attendees registered during the course was 40-46 depending of the days and attendees' unforeseen availability constraints. The discrepancy between the foreseen number of the attendees and the real one was due to the growing interest of the students of the Higher Technical Engineering School in Seville and the University of Seville to the distributed course and the number of available places.

The characteristics of the attendees are presented in the following sections.

5.1.1 Geographic statistics

The course's attendees were coming from the countries such as Canada, Germany, India, Israel, Italy, Morocco, South Africa, Spain, Peru, and Portugal.

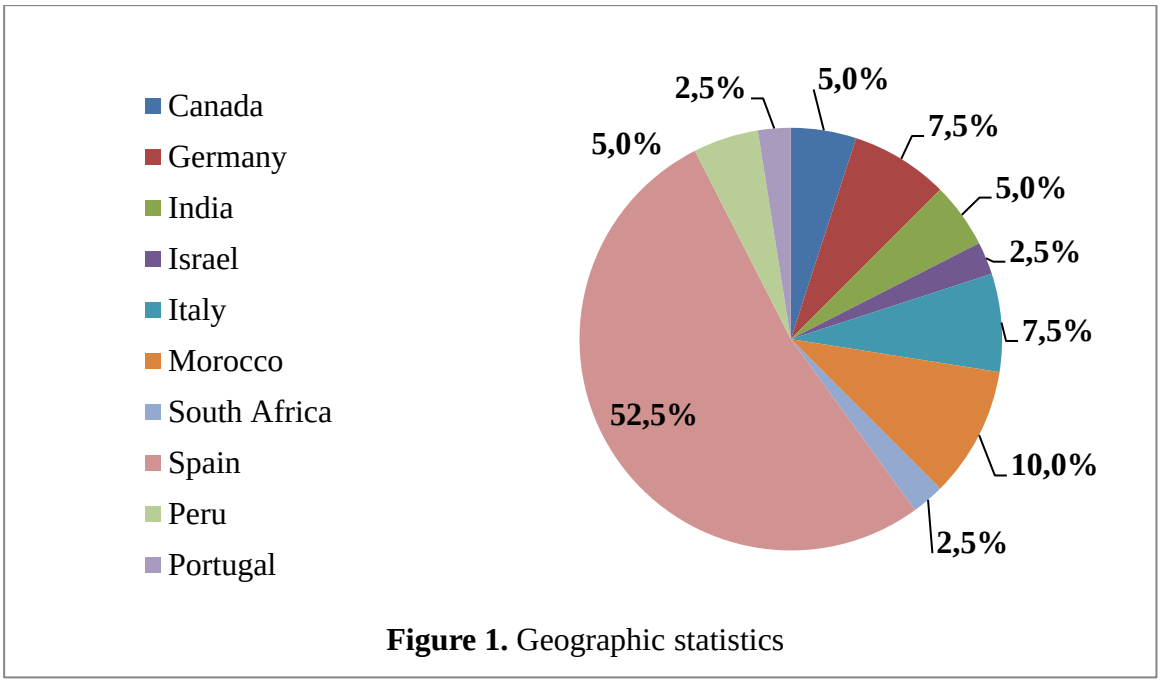


Figure 1. Geographic statistics

5.1.2 Statistics of the type of the organization of the attendees

The different sectors activity of the attendees is presented in the Figure X proving the achievement of the course's objective of reaching the most heterogeneous audience.

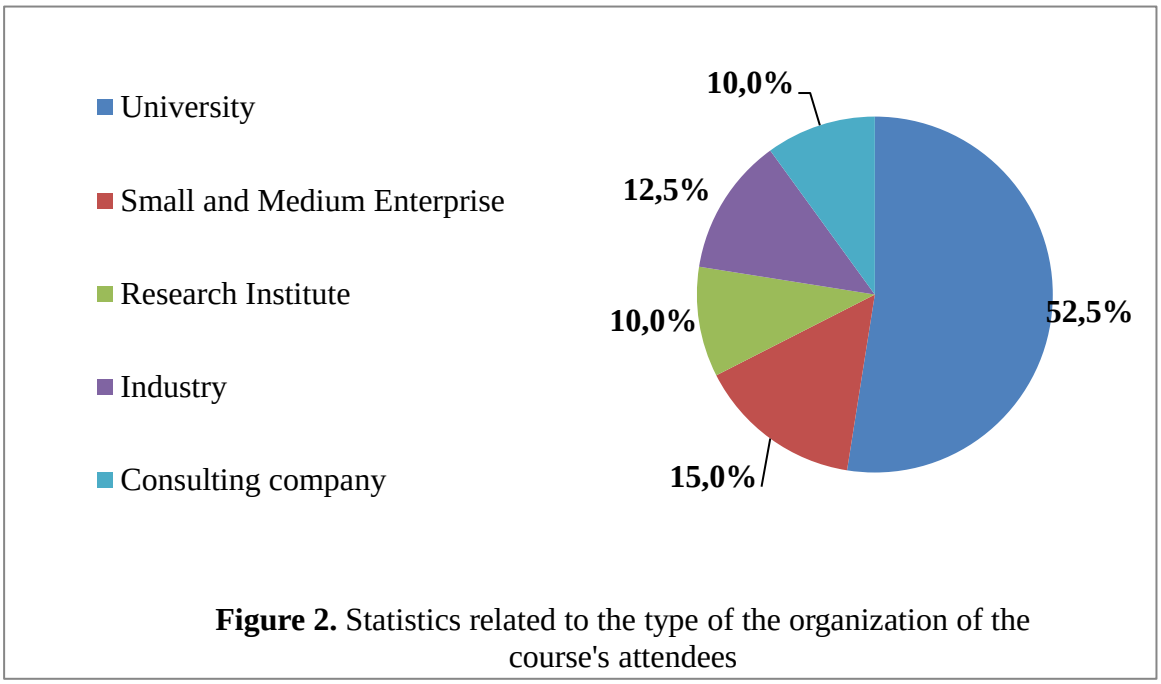


Figure 2. Statistics related to the type of the organization of the course's attendees

5.1.3 Gender statistics

The gender dimension has not been a direct focus of the CST course, but it is important to note that the further specific steps and measures have to be undertaken to improve the gender balance at such events as CST Course.

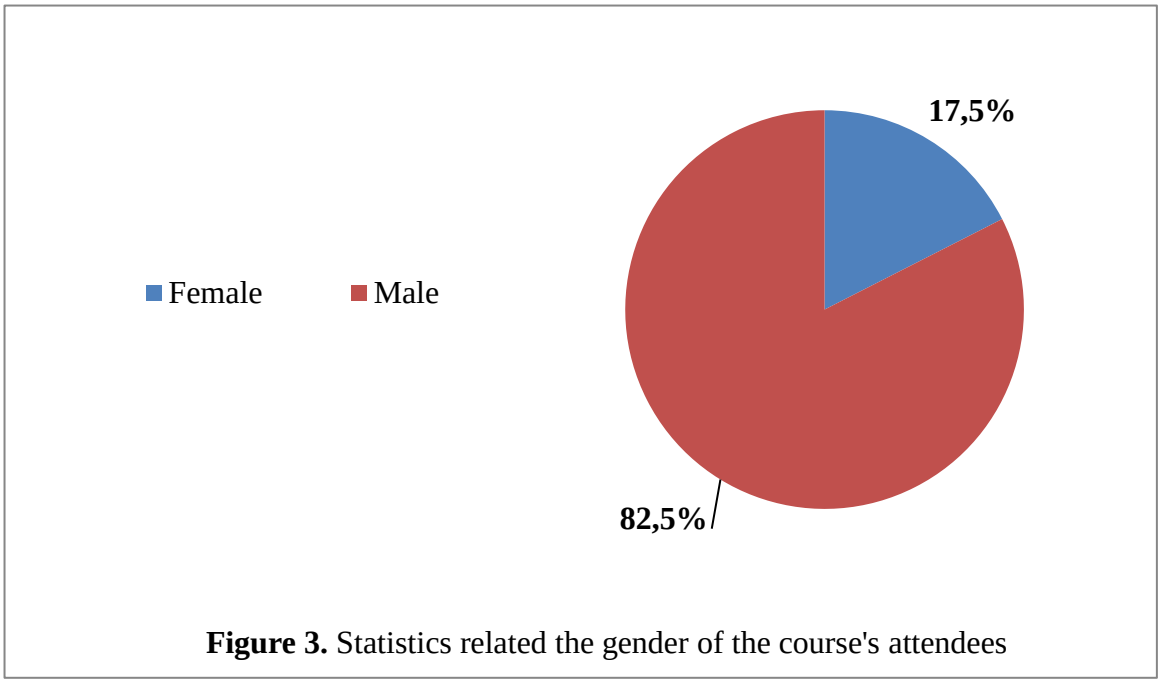


Figure 3. Statistics related the gender of the course's attendees

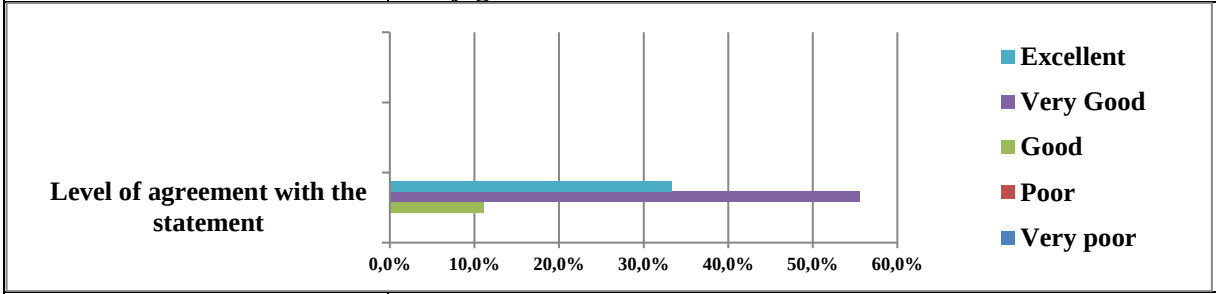
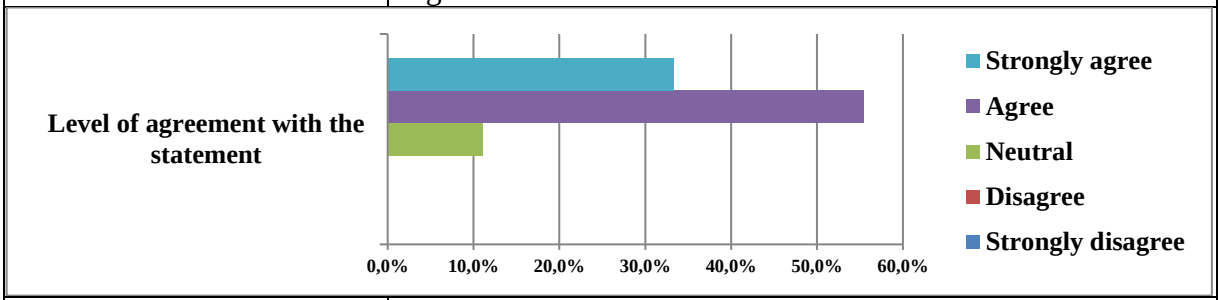
5.2 Qualitative and quantitative feedback

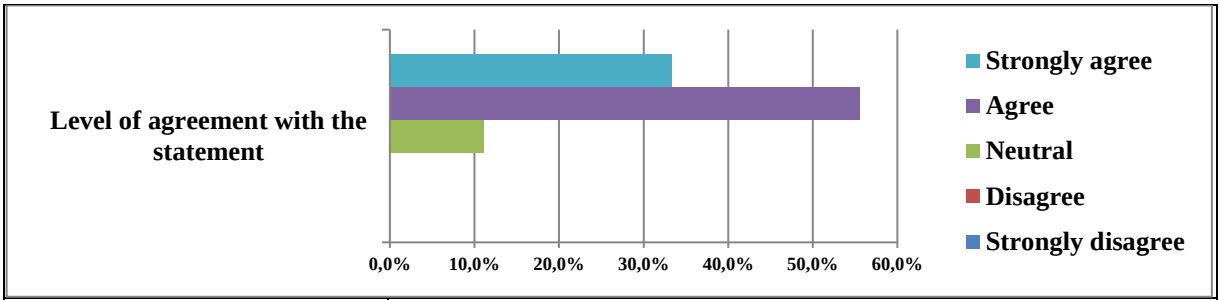
This section presents the feedback of the attendees regarding different aspects of the implemented course in a qualitative way (comments and improvement suggestions) and in a quantitative way (the overview of the general impressions related to the various aspects of the course in percentage).

5.2.1 Attendees' feedback regarding the general impressions from the course and its implementation

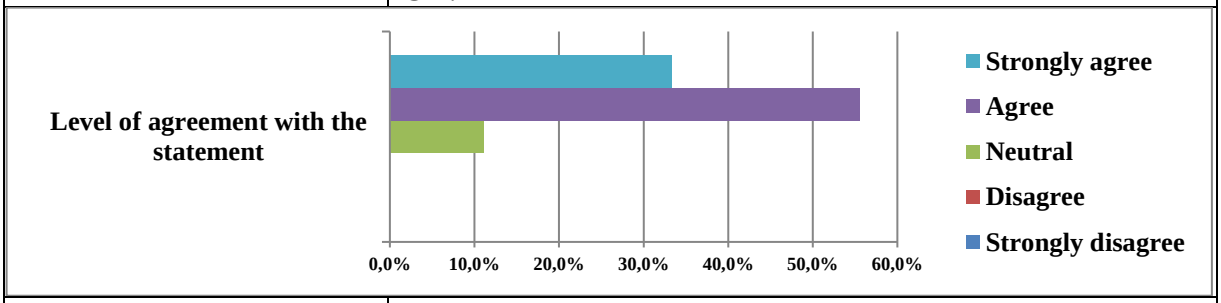
The following questions have been asked to the attendees in order to evaluate the general level of satisfaction of the course offered and identify the specific needs of the covered public for its better understanding and further adjustment of the offer within the potentially organized training course in the future. The percentage evaluation of the satisfaction level is presented below with the specific comments of the attendees.

Asked questions or statements suggested	Answers and additional suggestions for future improvements
What overall rating would you give to the course?	Very good course as starting point in CSP.
	Very good. I learned a lot and met a lot of experts.
	A very complete course.
	Now I can be more autonomous in this domain, search better and learn better.
	CSP technology is a very powerful tool to avoid or reduce global fuel consumptions and CO2 emission in high temperature activities. This course has been very useful in providing the principles and experiences of CSP technology and also excellent contacts with experts.

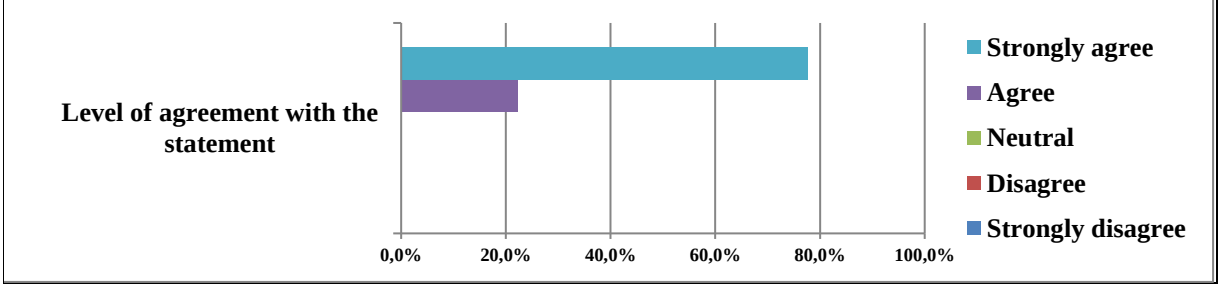
	CSP technology is an excellent alternative to reduce global fuel consumptions and related CO2 emission in high temperature activities. This course has been very useful in providing the tools to apply CSP technology and excellent contacts with experts.
	Very good; 7/10.
	
The objectives of the training course were clearly defined.	Clear objectives.
	Well defined.
	It was fine.
	The expectations before the course were in the line of a more technical approach (plant design) but during the course it was clear that the objective was a technology presentation (state of the art and beyond).
	I don't recall getting the course objectives in advance
	Yes, as it was an introductory course in Concentrating Solar Thermal.
	Strongly agree. The course covered all application of CSP at High, medium and low temperatures. Theoretical and practical aspects and real and useful data regarding Capex and Opex.
	Agree. It was defined in the leaflet
	
The course's objectives were met.	Yes. I would have preferred to go in depth to some aspects.
	My professional objectives were met.
	In the sense of an overview, the course's objectives were met.
	I wasn't aware of the objectives.
	Yes, in my opinion I believe so.
	Yes, they were fully met.
	OK.



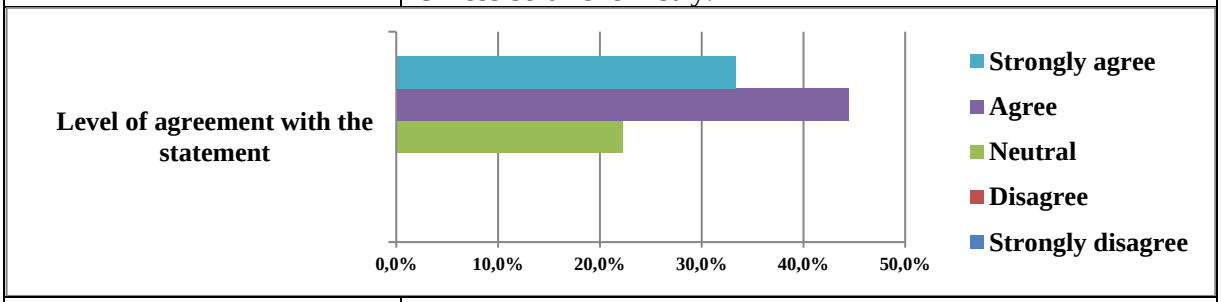
The course corresponded to my expectations.	Yes.
	Professional objectives met. A lot of good contacts.
	A more technical approach in some parts regarding the basic design was expected.
	I would have liked to get more engineering and design insights related to commercial facilities.
	Yes because I had an idea of most of the topics while developing my thesis, but nevertheless I was excited to feel other attendees and speakers even more excited than me about this theme and its synergic capabilities. I learned very much from this 5-days course and know better how to search and be up to date in this field.
	Yes it fully did. I was great for our goals.
	OK.



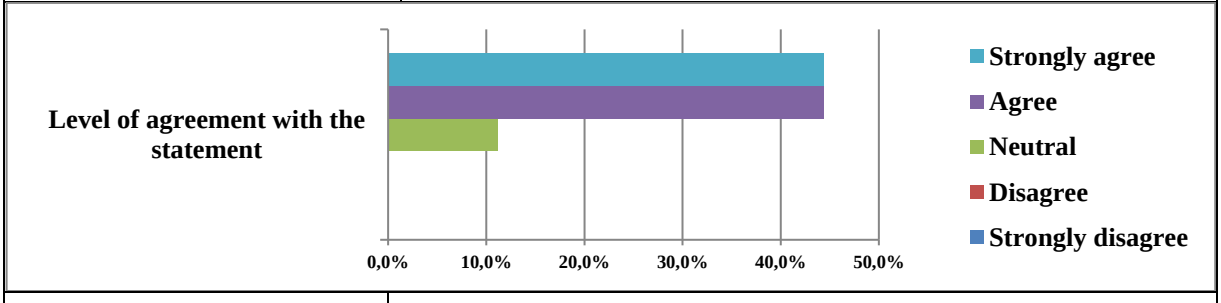
The lecturers were well prepared and knowledgeable about the covered topics.	The lecturers were a top of their field. All very knowledgeable.
	Their experience was clear and very appreciated.
	They were indeed. This complex theme with much related topics has to be delivered with inherent experience and discourse skills.
	Yes they mostly were. Two lecturers were not the case, look that the chief lecturer could not assist and who replaced was unable to answer all questions.
	Yes they mostly were. In just very few cases the lecturers were not principal.
	Too many researches and little presence of engineers talking about O&M issues



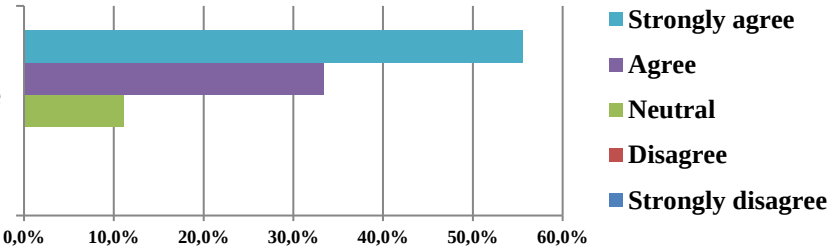
The topics covered were relevant for you.	Very interesting for workday.
	A lot of information where for utility scale CSP. It would have been nice to have more information on SHIP.
	Relevant topics, but maybe too many of them.
	Many of the presentations were very R&D-focused, which wasn't so interesting for me
	Indeed, while doing my Master Thesis I have been in contact with these fields, but which I have not had the depth in these matters while studying in the Energy and Environment Engineering Master course. We studied photovoltaic systems and solar thermal systems but not the concentrating type.
	Yes, even though 80% of course were devoted to electrical energy generation through CSP, these topics were relevant to us since the collecting, storing and transporting thermal energy are common to other applications. The course also covered CSP applications in Chemical and metallurgical processes.
	Yes, all CSP topics were relevant to us since the collecting, storing and transporting thermal energy are common to other applications. The course also covered CSP applications in Chemical and metallurgical processes which is the area where we work.
	Unless solar chemistry.



The content was organized and easy to follow.	All the content were clearly organized.
	Most of the presentations were easy to follow and understand.
	Some parts had too much content in short time.
	It was organized and easy to follow even if we don't have some basic knowledge on some of the fields.
	Yes, even it was the first time we got deep into the CSP technology the course was easy to follow.
	Yes, was easy to follow even for a beginner like me.
	OK.



	Very helpful workbook.

The course workbook was clear and helpful.	The workbook wasn't available but the presentations were helpful. It would be nice to have the workbook before so we can follow and take notes.
	Must still be checked.
	This was unexpected to me, and clearly helpful. Most of the information was on the presentations, but some details were not. I wrote lots of notes during the course, but some of them remained incomplete, and now I had the opportunity revise my course notes. Thank you.
	Yes, the course workbook was clear and has been very helpful for developing the application of CSP in our projects.
	Perfect.
Level of agreement with the statement 	
Which was the most interesting part of the course?	CSP power plant design concepts
	Ballparks for costs for infrastructure, operation and maintenance / confirmation that parabolic troughs are the solution for process heat / knowing about the study in Spain for ship.
	General catalogue of technologies and experience based view from the experts.
	The market insights, e.g.: presentations by Luis Crespo, and the generic presentations --not so much based on a particular project-- such as the parabolic through pre-design presentation by Eduardo Zarza or the O&M presentation.
	O&M in CSP plants.
	Personally it was all topics, but specially: Manuel Silva Presentations; Plant pre-Design; Central Receiver; Plants with central receivers; Medium temperature for industrial processes; Hybridization; Luis Crespo presentations; O&M issues. It was also very important to have coffee breaks / lunch so we could interact with course attendees and speakers.
	Everything was quite interesting, perhaps collecting sun radiation and thermal energy storing was the most interesting since many applications, like in our case, can be envisaged from it. Aluminum melting in a CSP furnace was a specific application that we found very useful too.
	Everything was quite interesting, but collecting sun radiation and thermal energy storing was the most interesting; many applications, like in our case, can arise from it. Dual application, engaged to biomass production was very interesting.
	O&M issues like the Solar Tower from Abengoa and the Value Chain and cost estimation from Luis Crespo. The real cases of

	desalination from Greece were very interesting. First hand info of the project manager and people really involved in the project is always a good choice.
Which was the least interesting part of the course?	None
	Because most of the information was on utility scale, some presentations were less appropriate for Rackam's needs.
	Simulation part was too complex and maybe disconnected from other parts.
	The purely R&D presentations and those focusing on a literature review of current projects/ commercial plants. Also, when providing the presentations introductions, a lot of background information (CSP technologies, market indicators) was repeated throughout the course duration. If there is more alignment between the presenters, this could be avoided.
	Personally all topics were interesting, but perhaps it was not so easy to keep up in the desalination, and solar chemistry domains (nevertheless they were very interesting).
	Hard to say, every part was interesting to me.
	Every part was interesting.
	Solar Chemistry, too much research and poor pilot plant data.
What topics would you like to hear, but were not included?	Same topics but more detailed explanations.
	CSP for SHIP and its perspectives in the future.
	Automation and communication technologies to support solar plant infrastructure.
	More commercial power plant design aspects. For example, in line with Eduardo Zarza's through pre-design presentation. Also, more focus on processes, I&C and O&M.
	More information about pressurized air receivers.
	1. Deeper description of experiences on CSP application to lime, cement manufacturing, sludge dehydration and metallurgical processes; 2. Description of procedures and experiences to generate local radiation data; 3. Description of dependence of radiation intensity and altitude; 4. Manufacturing procedure and operating data sheets of parabolic troughs, linear Fresnel, Central receivers and so on; 5. CSP applications to small power plants.
	More about economics of a ST Plant, how to finance, technologies comparison, main challenges of the overall solar thermal technologies. Perhaps a broader view of the future of the STE.

The feedback on the course's content is of a great interest for the future training events on CST topics, if such will be held in the future. A closer analysis of the targeted audience expectations as well as a very precise description of the lectures to be delivered and careful estimation of the course's schedule will be needed in order to meet as far as possible the academic and professional objectives of the selected candidates. The interactive panel discussions after the lectures should be taken into account and included in the initial course's timing because of their

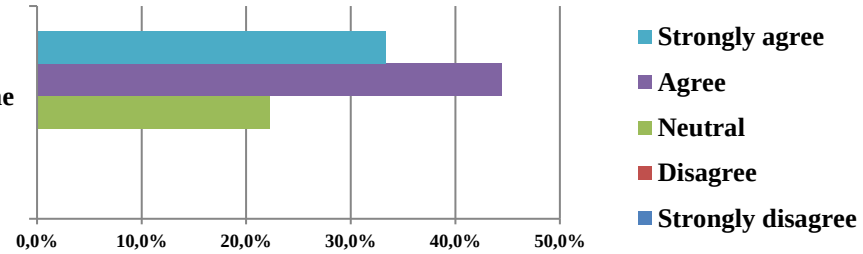
highest utility as efficient tools for a deeper understanding of the presented material and development of the further collaboration activities between the lecturers and the listeners.

Further improvements could be made on the level of the management of timing of the course organization: e.g., clear and notification of the course's organization progress (timely prior public announcement and distribution of the programme and course's materials delivering, logistic information…) in order to facilitate the preparation of the attendees to the course as well as to contribute to a more efficient exchange during the course. In particular, the course's workbook planned as a promotion support of the upcoming course has been distributed after the course for the contributions' availability reasons.

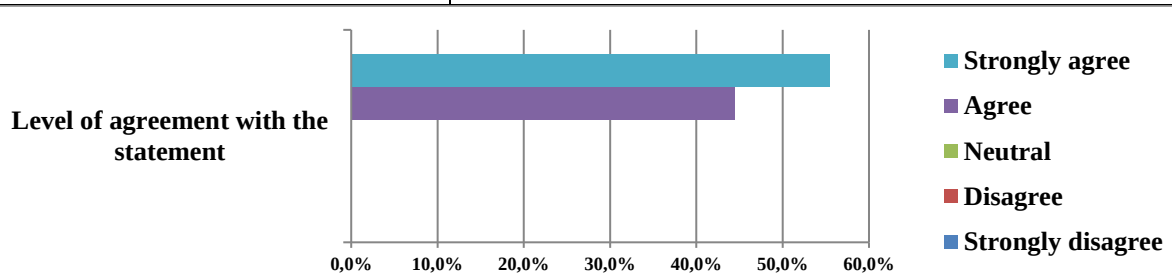
5.2.2 Attendees' feedback regarding the practical considerations of the course implemented

The next questions present an important interest for the evaluation of the host institution of the course and a better organization of the course form the practical point of view.

The course has been held in the Higher Technical Engineering School in Seville with approximately 5:30-6:00 hours of lectures, two 30-minutes coffee breaks and 1-hour lunch per day. The host institution has been chosen in accordance with a number of criteria as a guarantee of quality and feasibility, such as easily reached location of the host institution for the majority of the participants, both lecturers and attendees; a facilitated access to the necessary accommodations (hotels, transport, alimentary shops and other); availability of the host locations at the fixed dates; interest from the professional and academic point of view (facilities related to the topic of the course), even if the visits have not been foreseen by the course programme because of the short duration of the course and other.

Asked questions or statements suggested	Answers and additional suggestions for future improvements
The time allotted for the course was sufficient.	Enough to give a general view of CSP.
	I think the time was enough.
	The time allotted was appropriate in general. Maybe should focus more on real cases.
	I noticed that some of the presentations had to be fast-paced at some point in order to have time so others speakers could present their topics. Some topics may have deserved more time.
	Yes it was enough but a field visit would have been desirable for CSP beginners like me.
	Yes it was sufficient.
	OK.
Level of agreement with the statement 	

The meeting room and facilities were adequate and comfortable.	Good and confortable installations.
	It was good. Only the access to restaurants other than the cafeteria would have been nice.
	Microphone or sound system could be probably better.
	As the number of attendees were restricted (perhaps by the meeting room available seats itself) the meeting room and facilities were adequate and comfortable.
	Yes they were. The place was also easy to reach from Hotel.
	Yes they were. It was also easy to reach there every day.
	OK.

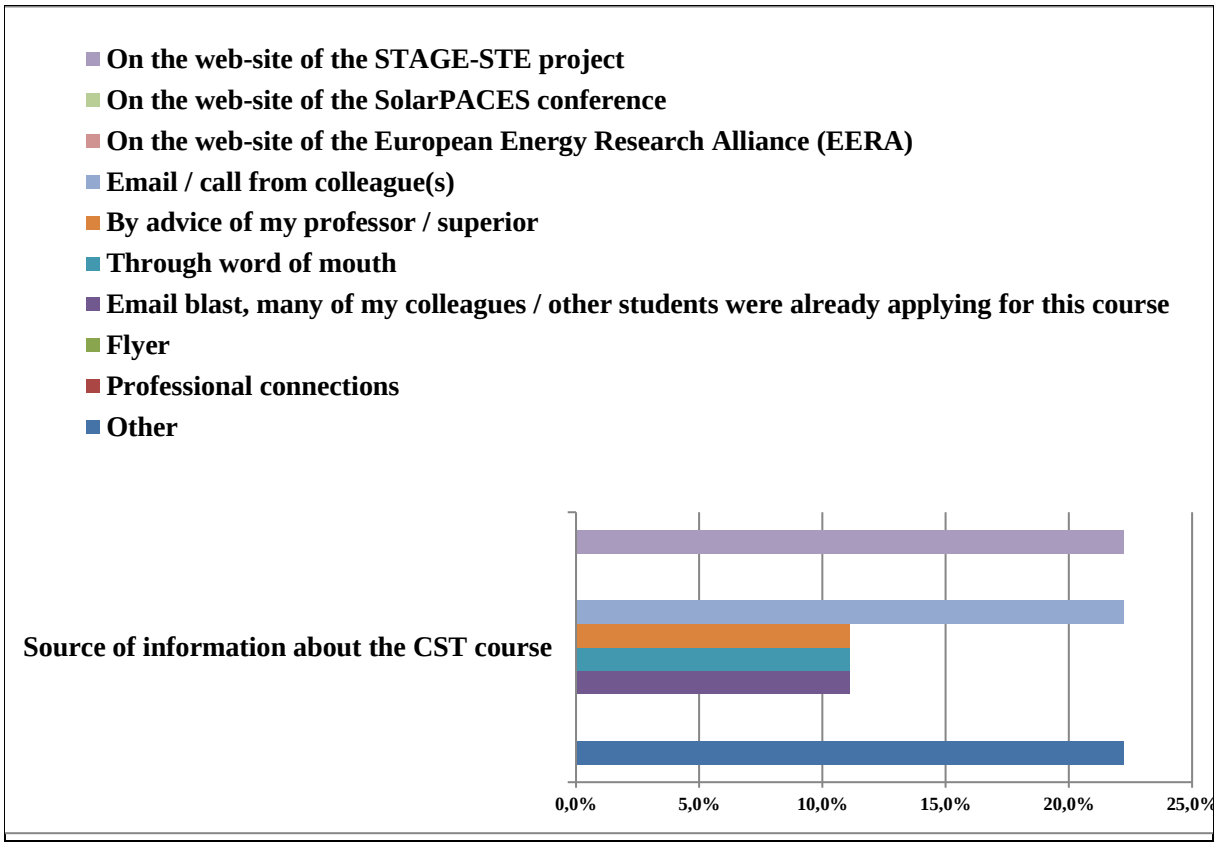


Further improvements could be made by implementing the suggestions of the course's attendees, specifically on the more careful development of the course's schedule, better assessment of the time distribution to the different topics and greater diversification of the course programme aiming to respect the balance of the theoretical and practical approaches of the material delivered (including on-site visits and demonstrations).

5.2.3 Attendees' feedback regarding the communication activities related to the course

This part is extremely helpful for the identification of the communication and publicity goals reached.

Asked questions or statements suggested	Answers and additional suggestions for future improvements
How did you hear about the course?	STAGE-STE previous course participant
	Email / call from colleague(s)
	Through word of mouth
	On the web-site of the Engineering school of Seville
	By advice of my professor / superior
	On the web-site of the European STAGE-STE project
	Email blast, many of my colleagues / other students were already applying for this course



The analysis of the assessment shows that the implemented communication and dissemination strategy was efficient, since the demand of the course's attendance was noted as very high (more than 55 demands of attendance). However, further effort on the dissemination activities on such events as the CST course is wished for covering a larger audience with an appropriate communication channel relevant for each particular type of targeted public: e.g., publication in the LinkedIn professional electronic network, better targeted individual notifications for further spreading of the message, specific professional and/or academic web-sites and other.

The evaluation of the number of the views of the web-pages where the information on the course has been published would be useful to identify the best communication way on such type of events as this training course.

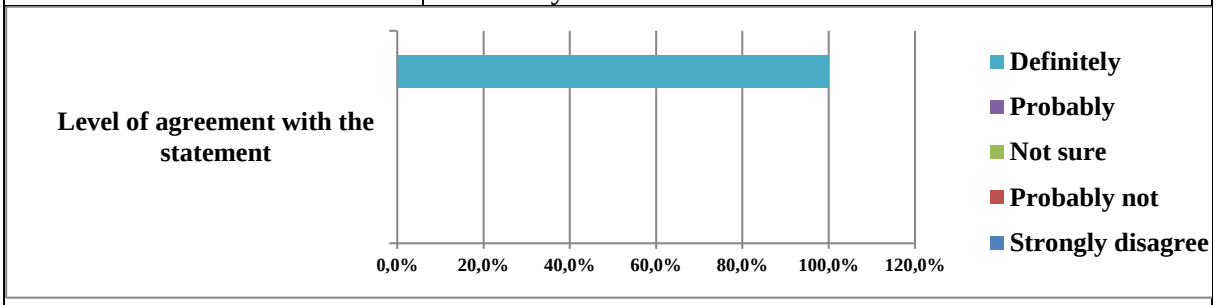
5.2.4 Attendees' feedback regarding the impact of the implemented course and its further impact

The analysis of the next range of questions presents a great importance for the evaluation of the efficiency of the implemented course and achievement of its objectives, in particular, the interest of the further use of the offered materials by the public.

Asked questions or statements suggested	Answers and additional suggestions for future improvements
What motivated you to apply to this course?	Best knowledge of CSP.
	Networking and to know the latest achievements in the field.
	I was looking for an introduction/overview of the state of the art in this sector that I was joining.

	Get more insights about the current status of the CSP market.
	I am currently working as researcher on energy storage applied to CSP.
	The idea that this course would be most interesting and an important complement to what I already know about this exciting theme (Concentrating Solar Thermal), right after concluding my Master Thesis and before initiate the early stages of my professional career in this field (Solar).
	We are currently doing I+D+i work in mining and environmental field where we deal with technologies to capture and use CO2 from conventional, acid mine effluent treatment and sludge residues management and several hydro-pyro metallurgical process to extract copper, lead, zinc, silver, gold and so on, where we have to use high amounts of thermal energy. On the other side, Peru has a large area where solar radiation is quite high all year long and is also a global leader of common and precious metals production; even though a successful application of solar concentration energy looks very feasible no project has been carried out so far in Peru. This course was expected to give us the proper tools to set up CSP projects in our country and it did so.
	I've been working in the thermal solar industry many years and I wanted to know the state of the art technologies about it.
Will this experience be useful in your work?	Yes.
	A lot of important contacts were made there.
	I'm now using this knowledge in my work.
	This will be very helpful because I'm currently working in the field of Solar Heating for Industrial Projects (SHIP) in Portugal.
	Very useful. We are already doing preliminary test work for applications of CSI in lime production, water treatment and metallurgical processes.
	Very useful. We are already doing preliminary test work for applications of CSI in lime production, CO2 capture-microalgae generation, and acid and industrial.
Would you recommend or share information about this course to your colleagues / other students / other contacts?	Definitely. Very interesting course for people interested in CSP.
	Definitely. I think it was a good training.
	Definitely. My colleagues have already shown interest in information about the course.
	Definitely. Personally the experience is most valuable and on top of that, it is really up to date topics that are shared with great wisdom, which is amazing to absorb from motivated people in the field.
	Definitely. Yes, we recommend to share this information with Institutions related to the CSP so that they can spread

	up the technology and increase the applications of CSP to decrease CO2 emissions.
	Definitely. Yes, I recommend to share this information.
	Definitely. No doubt



What could be done to improve this training course?	More detailed explanations (but limiting the topics).
	Maybe to have laboratory sessions with new software or exercises/examples to have make it more concrete.
	On-site demonstration could be included.
	Due to the knowledge gap between the audience members (some of them having very limited CSP knowledge), I would suggest to have some of the initial sessions focused in covering a basic level of understanding --and this to be clearly indicated before the actual course-- so repetition of concepts is minimized throughout the course and there is more interest for those with more CSP related experience. In addition, I would invite more presenters from industry.
	To have a few hours to go to installed CSP plants nearby. The location for this course was perfect, as Seville as the PS10, PS20 and Gemasolar in less than 75 km radius.
	I suggest: - Field trip to one CSP Plant nearby or on the other hand the course could be done in a place like Almeria at PSA-CIEMAT. - To have a free afternoon at the 3rd day in order to have a meeting where most of lecturers and pupils can exchange ideas, addresses, brochures, and so on. If this left for the end no much people will assist to the meeting.
	I recognise is really hard to find some lecturers from companies related to the topic who would like to attend such courses, but those persons give a realistic point of view about how is the technology evolving and if it is economically viable. Some visit to plant would be nice to have in the next one, especially in cities where solar industry is well established like in Sevilla.

This is important to notify that the most important impact is the obvious strong interest in attending such events as the CST course which 100% of respondents strongly agreed with. Among the various arguments of this statement is the extension of the professional network, deeper understanding of the CST field and high utility of the shared knowledge in the future work. Further conclusions will be given in the next section “Conclusions and improvements to make based on feedback”.

7. Conclusions and improvements to make based on feedback

Attendance at this training course could be assessed as adequate regarding the objective set (46 participants regarding 40 fixed as a total number with more than 55 demands of attendance) with the overall great impression on the delivered course (evaluation going from "good" to "excellent"). The CSP training course succeeded in meeting all the goals set and gathered research and industrial participants, both among attendees and lecturers. In this way, the following aims are to be considered as fulfilled:

- The sharing of the knowledge, main achievements and the latest innovation research and technologies in STE between research centers and the industry has been successfully done. Further dissemination and use of the training course has been offered to the persons involved in the course implementation, both to attendees and lecturers. The majority of the presentations distributed during the course have been allowed for the public use with the restriction on the compulsory authorship recognized in all copies distributed; the video recording of the delivered lectures will be publicly available on the relevant web-site. To bridge the gap between the training offer currently available and what is required by both scientific community and industry.
- The heterogeneous audience from the private and research sectors with various level of knowledge in the CSP domain (e.g., PhDs and Master degree students, Postgraduate students, researchers, engineers) and professional and/or academic activity fields (e.g., water desalination and electricity production, environmental consulting, renewable energies, solar collectors systems, thermal energy storage and other) has been reached that encouraged the productive ideas and competencies exchange and contribute to the further collaborations and long-term progress of the CSP fields;
- The offered course includes both research and industrial approaches to address the topics filling the gap between the training offer currently available and needs of both scientific community and industry.

Improvements on the design, content and implementation of the course:

- The course has been delivered by professional both form research and industrial sectors. However, a greater effort in establishing a balance of the theoretical and practical aspects of the topics addressed would be appreciated. A greater participation of the professionals from the industrial sector, especially on the O&M issues. At least one facilities visit or on-site demonstration or laboratory session could be introduced in the programme and schedule of the course;
- The content of the course was well organized and easy to follow. The attendees have been aware of the "introductory" character of the course from the beginning. However, since the audience also includes the attendees with a higher CSR related experience, a better alignment between the lectures would be appreciated in order to minimize the repetition of the introductory information and basic concepts during the course. Also a more precise identification of the needs of the targeted audience could be made in order to identify the topics of greater interest for a better considered timing of the lectures. For more specific suggestions on the content of the course, please see the section 5.2.1.

- Greater effort should be made on the management and organization of the course, in particular, the support documents to the course to provide before the event in order to help the attendees to deeper understand the presented material and have much more productive post-lecture exchanges (e.g., thanks to the priorly prepared questions and other).

Considered as a great possibility to acquire a deeper understanding of the CSP field and an excellent opportunity for networking for further development of projects and collaborative actions in CSP field for both beginners and professionals experiences in this field, this training course has been highly evaluated by the attendees willing to recommend it to their networks. Therefore, it is appropriate to conclude that this training course constitute an experience strongly required to be implemented in the future.

8. Annexes

This training Course is held within the framework of the European STAGE-STE project and presents an overview of the latest developments and knowledge in the following fields related to Concentrating Solar Thermal Technologies:

- Energy System;
- Solar Resource;
- The physical phenomena underlying technologies;
- The technologies as systems and of various components;
- Uses of solar energy in medium and high temperature;
- Techniques and facilities design tools;
- New concepts of design of plants with different components;
- Reduction of costs of operation and maintenance of power plants.

- Registration and receipt of the electronic Course workbook and name badge: October 16, 2017 from 08:30 to 09:00

- Common evening meal (optional and to be paid by the participant): October 19, 2017 from 8.00 pm; Location to be precised during the course

- End of the 5-day Course: questionnaire to be filled onsite and departure

There are no registration fees.

All the travel, accommodation and food expenses must be covered by the participants themselves.

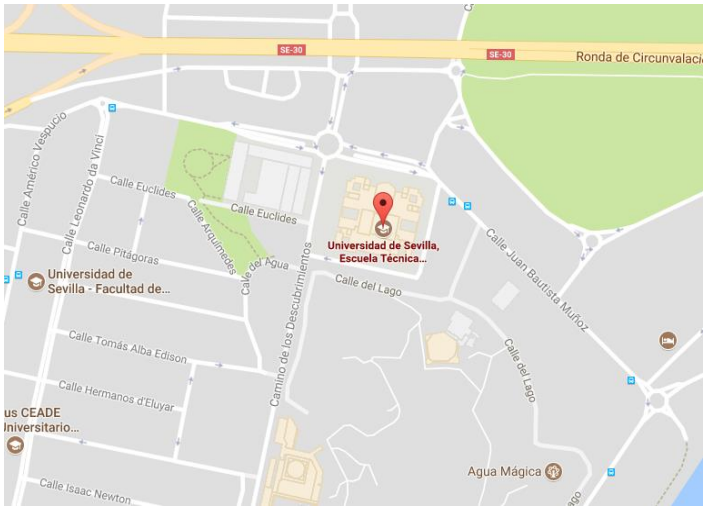
Lunches must be paid the first day of the course by the participant for a value of 50 euros.

The coffee breaks are offered.

ACCESS MAP:

Higher Technical School of Engineering (Escuela Técnica Superior de Ingeniería), Isla de la Cartuja, Camino de los Descubrimientos s/n 41092 Seville, Spain

Room: Juan Larrañeta (sala de reunions)



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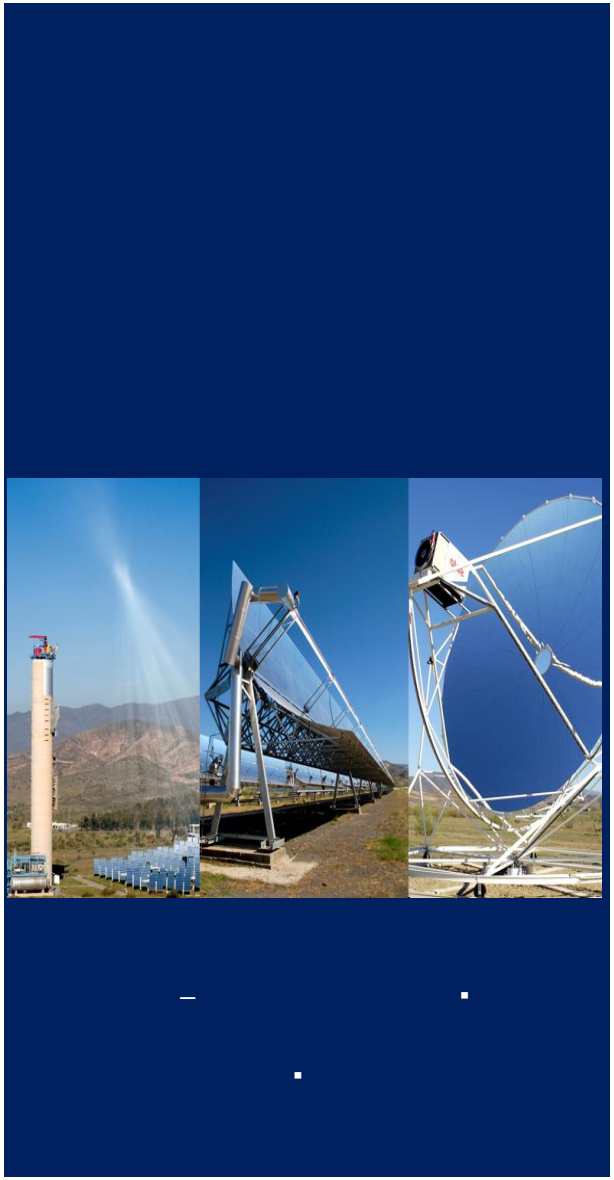
Institution: Euronovia
Telephone number: +33 (0)6 48 86 70 85
Email: m.prouteau@euronovia-conseil.eu



16 October Day 1	GENERAL INTRODUCTION
09:00	**Welcoming speech** *Jaime Domínguez Abascal, director of the Higher Technical School of Engineering*
09:10-09:40	**Context: energy and future** *Manuel Silva, University of Seville, Spain*
09:40	**Concentrating Solar Thermal Energy (encompassing Solar Thermal Electricity (STE), Solar Fuels, Solar Process, Heat and Solar Desalination)**
09:40-10:30	Optical, technological and thermodynamics concepts *Manuel Silva, University of Seville, Spain*
10:30-11:00	**Coffee break**
11:00-11:30	Solar resource *Manuel Silva, University of Seville, Spain*
11:30-12:00	STE & Desalination (general concepts) *Marios Georgiou, Cyprus Institute, Cyprus*
12:00-12:30	Temperature control of STE plant *Joao Miranda Lemos, INESC-ID, Portugal*
12:30-13:30	**Lunch**
13:30	**Introduction to the different concentrating solar technologies (CST). State of the art and overview of the components and plant configurations**
13:30-14:45	Parabolic troughs *Cyril Caliot, CNRS PROMES, France*
14:45-16:00	Central receiver *Alain Ferriere, CNRS PROMES, France*
16:00-16:30	**Coffee break**
16:30-17:00	Linear Fresnel *Alaric Montenon, Cyprus Institute, Cyprus*
17:00-17:30	Stirling dishes *Emmanuel Guillot, CNRS PROMES, France*
17:30	**End of Day 1**
17 October Day 2	SOLAR THERMAL POWER PLANTS PRE-DESIGN AND SITE SELECTION
09:00	**Plant pre-design**
09:00-10:30	Plants with Parabolic trough collectors *Eduardo Zarza, CIEMAT-PSA, Spain*
10:30-11:00	**Coffee break**
11:00-12:30	Plants with Central receivers *Cristina Prieto, ABENGOA, Spain*
12:30-13:30	**Lunch**
13:30-15:00	**Desalination** *Diego Alarcòn Padilla, CIEMAT-PSA, Spain*
15:00	**Site Selection**
15:00-16:00	Site selection according with solar radiation available *Carlos Fernandez, CENER, Spain*
16:00-16h30	**Coffee break**
16:30-17:30	Other aspects to be evaluated *Christopher Sansom, Cranfield University, United Kingdom*
17:30	**End of Day 2**
18 October Day 3	ALTERNATIVE APPLICATIONS FOR HIGH AND MEDIUM TEMPERATURE
09:00-10:30	Plants with Linear Fresnel concentrators *Diogo Canavarro, Manuel Collares, University of Evora, Portugal*
10:30-11:00	**Coffee break**
11:00-12:30	**Medium temperature for industrial processes** *Martin Karl, Fraunhofer, Germany*
12:30-13:30	**Lunch**
13:30-15:00	**Solar fuels (hydrogen, syngas…)** *Christian Sattler, DLR, Germany*
15:00	**Solar chemistry**
15:00-16:00	Solar Chemistry Thermal Processes *Christian Sattler, DLR, Germany*
16:00-16h30	**Coffee break**
16:30-17:00	Solar chemistry: coupling of CSP and indirect solar reactors to drive chemical processes *Alessandro Galia, UNIPA, Italy*
17:00	**End of Day 3**
19 October Day 4	STORAGE AND HYBRIDIZATION
09:00-10:00	**Current storage technologies** *Pierre Garcia, CEA, France*
10:00-11:00	**Coffee break**
11:00-12:30	**Upcoming ideas and concepts (prototype stadium)** *Christian Odenthal, DLR, Germany*
12:30-13:30	**Lunch**
13:30-15:00	**Hybridization** *Ralf Müller, Fraunhofer, Germany*
15:00	**Other concepts**
15:00-16:00	Integrated Storage and Receiver Concepts *Evgeny Votyakov, Cyprus Institute, Cyprus*
16:00-16:30	**Coffee break**
16:30-17:00	Cold storage *Pierre Garcia, CEA, France*
17:00-17:30	**Case study** *Martin Karl, Ralf Müller, Fraunhofer, Germany*
17:30	**End of Day 4**
20 October Day 5	TRENDS IN STE R&D TO REDUCE THE COST OF SOLAR THERMAL ELECTRICITY
09:00-09:30	**Current R&D activities in European funded projects** *Marie Prouteau, Euronovia, France*
09:30-10:15	**Current market and trends** *Luis Crespo Rodriguez, ESTELA, Belgium*
10:15-11:00	**Cost and value of solar thermal electricity** *Luis Crespo Rodriguez, ESTELA, Belgium*
11:00-11:30	**Coffee break**
11:30-12:30	**Value chain and related costs** *Luis Crespo Rodriguez, ESTELA, Belgium*
12:30-13:30	**Lunch**
13:30-14:30	**Advanced Plant designs** *José Gonzalez, IMDEA, Spain*
14:30-15:30	**Hybridization** *Daniel Pereira, ACS COBRA, Spain*
15:30-16:30	**O&M issues** *Santiago García Garrido, RENOVETEC, Spain*
16:30	**End of Day 5**

Survey questionnaire of the One Week Introductory Course on Concentrating Solar Thermal Technologies

Dear Participant,

You have completed a training course in October 16 – 20, 2017. This questionnaire allows you to express your views on the quality of the course and other aspects. Your answers to the following questions will help to evaluate the effectiveness of this course and further improve the quality of the next similar activities potentially organized in this field.

*Required

Scientific and Technological Alliance for Guaranteeing the European Excellence in Concentrating Solar Thermal Energy

1. **Name (optional)**

2. **Email (optional)**

1. General

1.1 How did you hear about the course? *

- ◯ On the web-site of the European STAGE-STE project
- ◯ On the web-site of the SolarPACES conference
- ◯ On the web-site of the European Energy Research Alliance (EERA)
- ◯ Email / call from colleague(s)
- ◯ By advice of my professor / superior
- ◯ Through word of mouth
- ◯ Email blast, many of my colleagues / other students were already applying for this course
- ◯ Flyer
- ◯ Professional connections
- ◯ Other: _____

1.2 What motivated you to apply to this course? *

_____

_____

_____

_____

_____

2. Questions about the training course

2.1 The objectives of the training course were clearly defined. *

Please rate your agreement with the statement above on a scale of "Strongly agree" to "Strongly disagree" and comment in the line "Other".

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly disagree
- ☐ Other: _____

2.2. The topics covered were relevant to me. *

Please rate your agreement with the statement above on a scale of "Strongly agree" to "Strongly disagree" and comment in the line "Other".

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly disagree
- [ ] Other: _____

2.3 The content was organized and easy to follow. *

Please rate your agreement with the statement above on a scale of "Strongly agree" to "Strongly disagree" and comment in the line "Other".

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly disagree
- [ ] Other: _____

2.4 The course workbook was clear and helpful. *

Please rate your agreement with the statement above on a scale of "Strongly agree" to "Strongly disagree" and comment in the line "Other".

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly disagree
- [ ] Other: _____

2.5 This experience will be useful in my work. *

Please rate your agreement with the statement above on a scale of "Strongly agree" to "Strongly disagree" and comment in the line "Other".

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly disagree
- [ ] Other: _____

2.6 The lecturers were well prepared and knowledgeable about the topics. *

Please rate your agreement with the statement above on a scale of "Strongly agree" to "Strongly disagree" and comment in the line "Other".

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly disagree
- [ ] Other: _____

2.7 The course's objectives were met. *

Please rate your agreement with the statement above on a scale of "Strongly agree" to "Strongly disagree" and comment in the line "Other".

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly disagree
- [ ] Other: _____

2.8 The time allotted for the course was sufficient. *

Please rate your agreement with the statement above on a scale of "Strongly agree" to "Strongly disagree" and comment in the line "Other".

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly disagree
- [ ] Other: _____

2.9 The meeting room and facilities were adequate and comfortable. *

Please rate your agreement with the statement above on a scale of "Strongly agree" to "Strongly disagree" and comment in the line "Other".

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly disagree
- [ ] Other: _____

2.10 The course corresponded to my expectations *

Please rate your agreement with the statement above on a scale of "Strongly agree" to "Strongly disagree" and comment in the line "Other".

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly disagree
- [ ] Other: _____

2.11 Which was the most interesting part of the course? *

_____

_____

_____

_____

_____

2.12 Which was the least interesting part of the course? *

_____

_____

_____

_____

_____

2.13 What topics would you have liked to hear, but were not included? *

_____

_____

_____

_____

_____

2.14 What overall rating would you give to the course? *

Please rate your appreciation on a scale of "Excellent" to "Very poor" and comment in the line "Other".

- [ ] Excellent
- [ ] Very good
- [ ] Good
- [ ] Poor
- [ ] Very poor
- [ ] Other: _____

2.15 Would you recommend or share information about this course to your colleagues / other students / other contacts? *

Please provide the answer based on a scale of "Definitely" to "Definitely not" and comment in the line "Other".
Tick all that apply.

- [ ] Definitely
- [ ] Probably
- [ ] Not sure
- [ ] Probably not
- [ ] Definitely not
- [ ] Other: _____

2.16 What could be done to improve this training course? *

_____

_____

_____

_____

_____

Thank you for your time and your valuable feedback.

One Week Introductory Course on Concentrating Solar Thermal Technologies

Location and dates:
Seville, Spain - 16 - 20 October 2017

Deadline:
To apply to the STE Course, please complete this form, submit and send your updated CV to Anastasiya Badziaka at anastasiya.badziaka@promes.cnrs.fr before 12:00pm (Seville time) by September 15, 2017. Your personal information and data will be treated as strictly confidential.

Please pay a special attention that submitting this form does not guarantee your attendance at the STE Course. Since the number of places is limited (40 places), all the forms jointly with the participants' CV will be reviewed. A selection of participants will take place afterwards to guarantee the heterogeneity of the participants (countries, maximum number of participants per organisation, gender, type of organisation and other). Further to the selection, the selected candidates will receive the confirmation email inviting them to join the Course.

*Required

Scientific and Technological Alliance for Guaranteeing the European Excellence in Concentrating Solar Thermal Energy

1. **Your first name:** *

2. **Your last name:** *

3. **Your gender:** *

- Mr
- Ms

4. **Your nationality:** *

5. **Your birth date:** *

Example: 15 December 2012

6. **Your contact phone number with your country dialing prefixes:** *

7. **Your email address:** *

8. **Name of your organisation:** *

9. **Type of your organisation:** *

Mark only one oval.

- Research Institute
- University
- Industry
- Small and Medium Enterprise
- Consulting company
- Non-governmental organisation
- Other:

10. **Organisation's activity field:** *

11. **Your position in the organisation:** *

12. **Your organisation's location (address and country):** *

Thank you for submitting your application.

Here is a kind reminder to send your CV to Anastasiya Badziaka at anastasiya.badziaka@promes.cnrs.fr to complete your application. Without your CV, your application to participate to this training course will not be taken into account. You will be informed about the results of the evaluation after September, 15, 2017, as soon as possible.