Sesión informativa nacional: Convocatoria Redes Doctorales - MSCA DN 2022

Redes Doctorales MSCA DN 2022: aspectos prácticos de la convocatoria

TOPCSP (HORIZON-MSCA-2021-DN-01)

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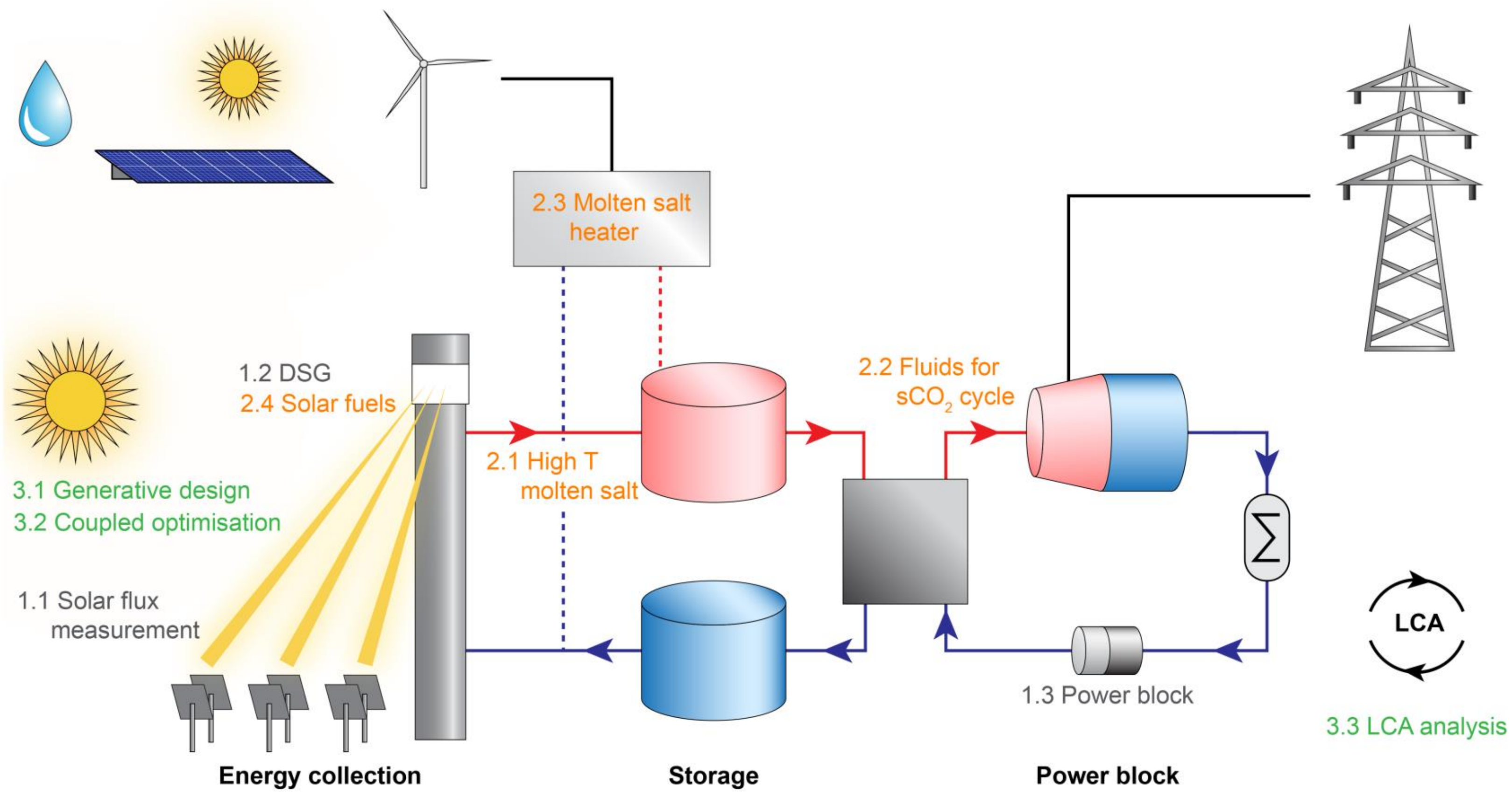
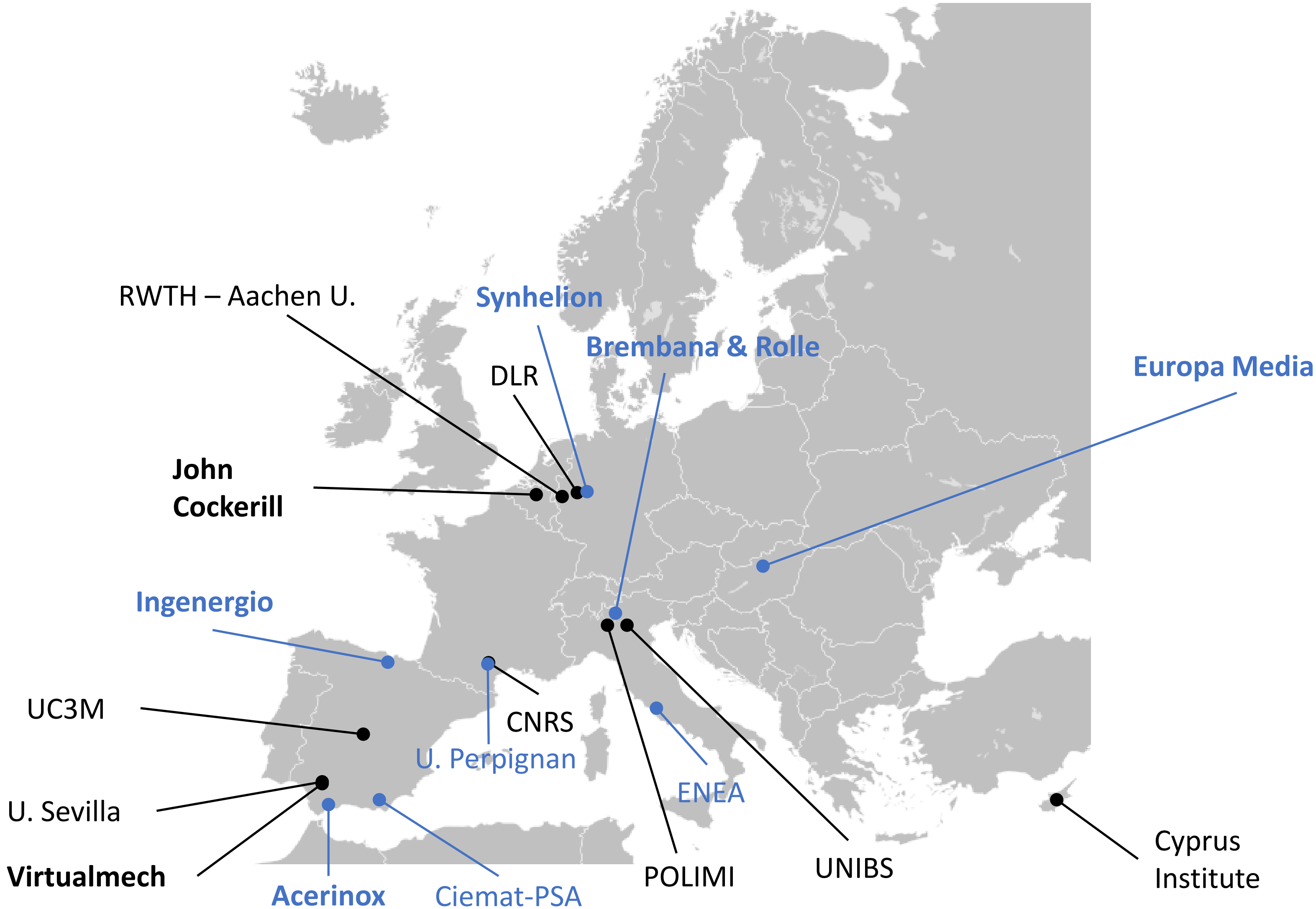
TOPCSP doctoral network



Improving the design of the different systems of a CSP plant to increase its cost-competitiveness, reliability, environmental profile, and operational safety.

TOPCSP doctoral network



Where to begin?

- Contact the research service of your institution.
- Attend an info day of FECYT.
- Funding to support coordinated proposals "Acciones de dinamización Europa Investigación"
- Main documents:
  - Work Programme MSCA
  - Guide for applicants MSCA DN
  - Proposal template
- Look for help:
  - Companies that develop the whole project/ Reviewer
  - English edition service
  - Revision service of NCP MSCA

Excellence

- Work package list

WP No.	WP Title	Lead Beneficiary No.	Start Month	End Month	Activity Type	Lead Beneficiary Short Name	Researcher Involvement
1	Cost reduction of commercial CSP plants	B8	7	42	Research	DLR	DCs 1, 2, 3
2	Next generation of CSP plants	B2	7	42	Research	UNIBS	DCs 4, 5, 6, 7
3	New scientific approaches and computational tools to generate disruptive innovation in CSP technologies.	B7	7	42	Research	CyI	DCs 8, 9, 10
4	Training	B9	7	42	Training	POLIMI	All
5	Project management	B1	1	48	Management	UC3M	2 DCs in SB
6	Communication, dissemination, and exploitation of results	B3	3	48	Dissemination	USE	All

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1.1.2 Pertinence and innovative aspects of the research programme

WP	State of the art	Advances foreseen in TOPCSP
1	Flux density measurement systems for large receivers in prototype stage, different suitability for external and cavity receivers, moderate performance of image processing.	Universal flux density measurement system for large-scale external and cavity receivers with high-performance image processing.
	DSG plants exist at both the research and commercial levels, and 1D and CFD codes have been developed to model the thermo hydraulic behaviour of DSG receivers. Thermal energy storage solutions for DSG plants are still being researched.	Numerical simulations will be conducted, providing a reliable prediction of the steam produced using commercial software already used by industrial stakeholders and calculations of the thermomechanical stress experienced by the receiver. Experimental data will be obtained to reproduce the physics of boiling flows in a DSG receiver
	Improvements to conventional Rankine cycles to increase plant flexibility (start up, load change) and efficiency/costs have been made.	Improved cycle designs and operation strategies for CSP Rankine systems will be developed (e.g., turbine preheating and warm keeping, feed water preheater optimization, intermediate storage of water).

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1.2.1 Overall methodology

WP2: Next generation of CSP plants working with alternative fluids

Lead beneficiary: UNIBS (P. Iora). Contributors: UC3M, USE, POLIMI, CNRS, ACX, RWTH, B&R, Ingenergio, CyI, Synhelion.

In this WP, hight-temperature liquid receivers (Task 2.1), the power cycle to be integrated with this receiver (Task 2.2), and novel systems to enhance CSP system dispatchability such as an electrically heated molten salt reservoir and a reactor to produce solar fuels (Tasks 2.3 & 2.4) will be proposed and studied using simulations and experiments.

Task 2.1 (DC4): New liquid HTFs for the next generation of CSP plants

Host: UC3M Contributors: CNRS, ACX

Background: Thermal energy conversion into electricity in current CSP plants is based on conventional steam cycle technology because the maximum temperature of the HTF is 565 °C. As a result, the power section has limited efficiency (approximately 40%) and suffers from high condensing temperatures and high capital costs.[1] Innovative HTFs (advanced molten salts and liquid metals) that have been proposed as heat transfer and/or storage media must withstand temperatures up to 750 °C, have limited corrosion and be safe and environmentally friendly.[2] In this way, the Rankine cycle could be substituted by a sCO_2 cycle, which has a higher efficiency at moderate maximum temperatures and high compactness, simplicity, and flexibility. The feasibility of carbonate molten salt has been proven at the demonstration scale[3] and liquid sodium is being used in the receivers of a 1.1 MWe Vast Solar Pilot Plant.[4] However, many aspects need further research before higher temperature fluid technology can be industrially implemented, such as the high corrosion rates of chloride salts, the high melting temperature of carbonate molten salt, the determination of heat transfer coefficients, the start-up process when the fluid circulates in the receiver and the design of a heat exchanger to transfer the heat to the fluid circulating in the power block.

Objective and research plan: DC4, hosted at UC3M, will compare different HTFs in terms of thermodynamic properties, heat transfer and heat storage characteristics and material compatibility with respect to state-of-the-art solar salts. The DC will perform experiments at the molten salt loop facility[5] circulating high temperature HTFs (carbonate and chloride salts) and exposing the receiver pipe at different heat fluxes using an induction heater. The results on tube and fluid temperatures, tube deformation and corrosion will be obtained to determine the operational limits of the receiver. In parallel the DC will numerically simulate the receiver based on previous thermo-mechanical models developed by UC3M[6] that will be validated using the experimental results. During a secondment at CNRS the researcher will work on the CFD simulation of the tube to develop heat transfer correlations for the high temperature molten salt flow in the receiver tube. In the second secondment the corrosion of innovative alloys exposed to molten salt will be studied at the ACX's Corrosion Laboratory and the DC will be trained in the mechanical testing of steel tubes that can provide data on the mechanical properties needed in the simulation of the mechanical behaviour of the receiver at the Metallurgical Laboratory of ACX.

1. Binotti M., Astolfi M., Campanari S, Manzolini P., Silva P. (2017) Appl. Energy. 204, 1007-1017, https://doi.org/10.1016/j.apenergy.2017.05.121

2. Polimeni S., Binotti M., Moretti L., Manzolini G. (2018) Sol. Energy 162, 510-524, https://doi.org/10.1016/j.solener.2018.01.046

3. Prieto C., Fereres S., Ruiz-Cabañas F.J, Rodríguez-Sánchez A., Montero C., (2020) Renew. Energ. 151, 528-541, https://doi.org/10.1016/j.renene.2019.11.045

4. Wood C., Drewes K. (2019) Vast Solar: improving performance and reducing cost and risk using high temperature modular arrays and sodium heat transfer fluid, SolarPaces Conference 2019.

5. Fernández-Torrijos M., Sobrino C., Almendros-Ibáñez J.A., Marugán-Cruz C., Santana D. (2019), Int. J. Heat Mass Transf. 139, 503-516, j.ijheatmasstransfer.2019.05.002.

6. Pérez-Álvarez R., Acosta-Iborra A., Santana D. (2020) Results Eng. 5, 2020, 100073, https://doi.org/10.1016/j.rineng.2019.100073

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1.2.2 Integration of methods and disciplines to pursue the objectives

WP	Expertise	Interdisciplinary integration
1	DLR and CIEMAT-PSA: long track record of cooperatively operating CSP experimental facilities with new working fluids. CNRS: numerical simulation of multi-phase flow. RWTH: turbomachinery research. JC: Development of molten salt receivers and steam generators for commercial CSP plants. Synhelion: Industrial perspective on CSP plants in general and on flux density measurement. Operation of demonstration plant for solar fuel production (starting 2023).	- Experience in demonstration experimental facilities and interaction with industrial partners will lead to robust measurement systems fulfilling industry requirements. - Interaction between solar field and receiver experts with power block experts will result in an increase in the overall efficiency and reliability of CSP plants. - Fluid simulations knowledge together with the expertise in the optimisation CSP plants will focus the fundamental research on resolving relevant issues in the industry.

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1.2.3 Gender dimensions and other diversity aspects

Women will be leaders and participants in developing access to clean energy economies. Society should be an aspect to be accounted for life cycle analysis (Task 3.3) and in the development of innovative solar plant concepts, including forced labour, indigenous rights, poverty wages and gender equity, since they have been identified as potential risks associated with CSP plants. CSP plants are often placed far from population centres due to reasons such as solar radiation, or the scale of the plant, which leads to demanding mobility requirements for the field workers of CSP plants. Although this can be challenging for men and women alike, this should be considered when introducing the location in the analysis of the WP3 tasks, so that it does not become a barrier to workers with care-giving responsibilities. The development of CSP projects of lower size, but still comprising a storage system, such as those investigated in Task 1.2, which can be organised at the village scale and managed, operated and even owned cooperatively by women (and men) will have more chances to reduce gender inequality.

1.2.4 Open science practices

The results of TOPCSP research will be published in open access journals or hybrid journals under the open access option. In addition, the papers will be available through the repositories of TOPCSP institutions. Computer codes that were developed in the past by TOPCSP researchers and that will be used in the different tasks will be subjected to early sharing through data repositories (see Section 1.2.5). An exception to this will be certain technical and economic data of the power plants provided by the companies of the consortium, such as those needed in Task 3.3 (LCA), which are confidential. Workshops and round tables will be organised to engage civil society in the design of technology roadmaps (e.g a presentation by the NGO Greenpeace on their vision for CSP planned in one of the network wide meetings) since the social acceptance of solar energy as a sustainable option is crucial for its success. For example, the failure of Hualapai CSP project in Arizona (US) showed the ways in which public opinion and concerns over water use can impact a project's design and ultimate approval. This will allow the DCs to consider all the implications of CSP technology, including the role of civil organisations that are helping to promote the social acceptance of solar energy as a sustainable option.

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Table 1.3c Main Network-Wide Training Events and Conferences and Contribution of Beneficiaries.

	Activity Code	Main Training Events & Conferences	ECTS	Lead Institution	Location	Action Month
1	NWM-1	Network-wide meeting-1: Challenges in concentrating solar power plants. (CR, TS concerning face to face interactions)	NO	CNRS	France	7
	TC-1	Training course-1: Responsible research and innovation, including research communication and public engagement. (RR)	1			
2	WS-1	Workshop-1: Advanced materials and working fluids applied to CSP plants. (CR, RR concerning diffusion, TS)	NO	DLR	Online	12
	TC-2	Training course-2: Career development for young researchers (TS)	1	DLR and RWTH		
3	WS-2	Workshop-2: High temperature & pressure systems in CSP plants. (CR, RR, TS in the talk 'Technology based entrepreneurship')	NO	POLIMI	Italy	18
	TC-3	Training course-3: Solar power generation and the techno-economic assessment of CSP plants. (CR)	2			
4	CF-1	Conference-1: International conference on the role of CSP Technologies in the Energy Transition (CSP4Climate). (CR, RR concerning diffusion)	NO	CyI	Cyprus	24
	NWM-2	Network-wide meeting-2: New solutions and improved understanding of next generation CSP. (CR, TS)	NO			
5	WS-3	Workshop-3: Innovation in CSP plants: From new concepts to commercial systems (CIEMAT-PSA). (CR, RR, TS)	NO	CIEMAT-PSA	Spain	33
	TC-4	Training course-4: Horizon Europe proposal writing course. (TS)	1	EM	Online	
6	CF-2	Conference-2: International Solar Power & Chemical Energy Systems Conference (SolarPACES). (CR, RR)	NO	USE, JC and VM	Not yet known	34
7	NWM-3	Network-wide meeting-3: Final network meeting. (CR, TS)	NO	UC3M	Spain	42

Events: NWM = network-wide meeting, TC = training course, WS = workshop, CF = conference,
Acquired skills: CR = core research skills, RR=research-related skills, TS = transferable skills

Excellence

Table 1.4a Supervisors of the DCs at the recruiting institution and during secondments

DC No.	Main supervisors and research indicators (see nomenclature below the table)	Supervisor 1st secondment	Supervisor 2nd secondment
4	A. Acosta-Iborra (UC3M) – PhD=3, P=48, Pt=5, Y=21 C. Sobrino (UC3M) – PhD=2, P=32, EU=1, Y=13	A. Toutant (CNRS)	A. Nuñez (ACX)
	= academic		= non academic
PhD: No. PhDs supervised, P: No. papers (journal+conference), Pt = No. patents, EU = participation in EU projects, Y= years of experience			

Impact

Table 2.2 Impact of the research and training on the DCs' careers

Elements of the programme	Academic career impact	Non-academic career impact
Local core-research (Sec. 1.2.1.a.1)	Advanced theoretical and applied skills, the PhD degree, and the excellence of the hosting institution facilitate access to top academic positions in science and engineering	Advanced applied skills and the use of cutting-edge facilities, which are inaccessible to common doctoral students, and the prestige of the hosting institution facilitate access to highly qualified non-academic jobs
Research-related and transferable skills local courses (Sec. 1.2.1.a.2)	Interdisciplinary courses promote the research career by providing the DCs with applied scientific tools (e.g., data processing), communications skills (e.g., scientific writing, papers, open science), better handling of research (e.g., integrity and ethics, gender dimension)	Interdisciplinary courses empowering the DCs' research increase their career prospects in the R&D department of companies as a researcher (applied scientific tools) or as a manager (communication and handling of research skills)
	Entrepreneurship, leadership, management, and conflict resolution are cross-disciplinary skills that will promote the DCs' success in research groups, companies and employment positions. Learning the language of the hosting institution increases career opportunities in that country.	
Research skills network training courses (Sec. 1.2.1.b.3)	Technological and applied skills on diverse engineering systems are needed in CSP teaching or research careers due to the rapid evolution of solar technologies, avoiding standard PhD specialisation.	Technological and applied skills in diverse engineering systems are highly demanded in CSP companies and other industry sectors because of the diversity of solar energy systems, avoiding standard PhD specialisation
Transferable skills network training courses (Sec. 1.2.1.b.3)	Communication of research and RRI are crucial skills in any academic career to differentiate the DCs from other standard doctoral students. A course on Horizon Europe proposal development will contribute to the future funding of the DCs' research	Communication of research and RRI will positively differentiate the DCs from other candidates in job positions for R&D companies. Skills in Horizon Europe project development are demanded by companies with strong R&D
Workshops and conferences (Sec. 1.2.1.b.2,4)	Publications in high-level peer reviewed journals increase impact of the DCs' research. A worldwide network of scientific contacts is created.	Discussions on technology trends. Talks about entrepreneurship encourage self-employment. A worldwide network of employers' contacts is created.
Network wide meetings (Sec. 1.2.1.b.1)	Face-to-face interaction with potential employers and direct knowledge of the industry's needs in the field of CSP as well as in other related sectors (energy systems, advanced materials, etc.).	
Secondment's research (Sec. 1.2.1.c)	Exposure to academic and non-academic views on research and experience in dealing with different CSP technologies increases employment opportunities in both sectors. The secondments allow the DCs to make informed decisions about their career. The prestige of the secondment institutions makes the DCs' CVs more attractive to employers	
International mobility and networking (Sec. 1.2.1)	Intercultural communication skills, needed for any position after the PhD period, are acquired. Transnational learning simplifies the transition from learning to work in academic/research institutions and companies because CSP is becoming an international field of collaboration. A network of international contacts for collaboration and potential future employment is created.	

Impact

Table 2.3b Summary of the communication (CO) and public engagement (PE) actions of TOPCSP

Action (target)	Timing (per year)	Metrics
Submission of press notes as well as advertisements of the communication actions and public engagement actions: CO1: Institutional web pages of the participants: techno-economical view of achievements (C) CO2: Institutional web pages of the participants: schematised and illustrated content (M) CO3: Media directory: Soft-level scientific/technical content adapted to (SS) and (GP)	1 each per WPL (DCs contribute to the contents)	Number of accesses to the web
Participation and uploads in science channels on the net (e.g., Youtube EDU, corporative video channels) Note: All the videos will have an associated RSS linking them with the organisations Facebook and Twitter pages. CO4: Interviews about the general results and benefits of CSP: CO5: Short videos, 5 minutes, and medium-size videos, 20 minutes (GP, P and DM). CO6: Specialised technical (C) and scientific videos CO7: Scientific content videos (R and US)	1 each per WPL (DCs contribute to the contents with the assistance of communication office beneficiaries)	Number of started visualisations, and number of completed visualisations
Elaboration of information, videos and images, including the DC experiences, on the social networks of the institutions: PE1: Facebook and Twitter pages: Explanations of the research achievements of (SS and US) PE2: Personalised Facebook/twitter accounts of each DC: Live in the training programme and recommendations for future PhD candidates (YR)	4 each per WPL 4 per DC	No. of visits/plays, items of feedback (likes and comments on the chat)
Participation in Science-Week and European Researchers' Night PE3: Simple explanations with models and group activities: Promotion of science for children 'CSP camps' (SS), levelling girls' enrolment in STEM studies 'TOPCSP Girls' PE4: Discussion about the role of CSP in Europe and future perspectives (adult GP)	1 per DC (with supervisor assistance)	No. of attendees
Open days with a visit to the beneficiary and partners installations PE5: Initial talk and visit to laboratories and offices (GP)	1 per supervisor (assisted by WPLs)	No. of attendees
PE6: Meeting with Greenpeace at NWM-3 (GP, P and DM)	1 per PC (assisted by WPLs)	No. of attendees and questions
Experts' round tables in workshops: PE7: Presentation of potential applications to interested companies (C)	1 per WPL	No. of attending companies
PE8: Participation in scientific cafes: 'Sunny breaks' in which each DC will explain first-hand their research to the rest of the university community (US).	3	No. of Attendees
C = CSP sector companies, DM = R+D decision makers, GP = general public, M = media, P = politicians, R = researchers in general, SS = school students; US = university students; YR = young researchers		

Impact

Table 2.3c KER (Key exploitation results)

Key Exploitation Results (Task, DC)	Key Exploitation Results (Task, DC)
Flux density automated measurement software (1.1, DC1)	Electric heater shell and tube heat exchanger design (2.3, DC6)
System level simulation software of a DSG plant (1.2, DC2)	Novel designs of (photo-) thermochemical cycles (2.4, DC7)
New CSP plant turbine technologies & cycle layout (1.3, DC3)	Computational framework for receiver generative deigns (3.1, DC8)
Receiver layouts & start-up strategies for new HTFs (2.1, DC4)	Solar field-receiver optimisation software (3.2, DC9)
Modified working fluid for sCO_2 cycles (2.2, DC5)	Real plant database & novel tools for CSP plant LCA (3.3, DC10)

Implementation

Table 3.1d Individual Research Projects

Fellow	Host institution	PhD enrolment	Start date	Duration	Deliverables
DC4	UC3M	Y (UC3M)	7	36	2.1, 2.2, 4.3, 6.4, 6,5
Project Title and Work Package to which it is related: New liquid HTFs for the next generation of CSP plants -WP2					
Objectives: To study the thermomechanical and corrosion behaviour of solar receivers working with high temperature HTFs (chloride and carbonate molten) using numerical models and experiments.					
Expected Results: An experimentally validated numerical model of the thermo-mechanical behaviour of solar receivers working with high temperature HTFs.					
Planned secondment(s): **1)** At **CNRS,** supervised by Dr. S. Mer (M16-18). CFD simulation of the receiver tube circulating high temperature molten salt and development of heat transfer correlations. **2)** At **ACX** supervised by Dr. A. Nuñez (M28-30). Corrosion study and mechanical testing of tube a material that has been exposed to high temperature molten salt.					

Implementation

3.1.5 Network organisation

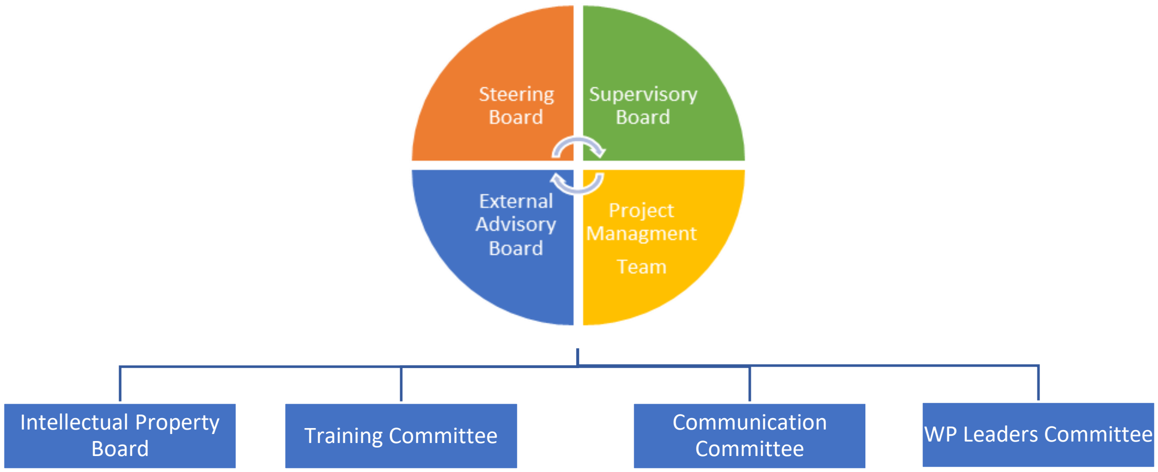

Figure 3.1 Management Structure

Writing tips

- Design the overall objectives and schematic of the project in an initial meeting with beneficiaries.
- Avoid writing sentences that could fit in any other project.
- Detailed description of scientific hypotheses and plan.
- Cite relevant papers from partners of the consortium.
- Apart from papers cite technical documents, technological pathways, communication documents from the industry…
- Set several internal deadlines during the writing process.
- Collect specific inputs from the beneficiaries: description of the individual research project, key exploitation results, communication/dissemination strategies…

Evaluation summary report

Strengths:

- *An overview of the action with European policy context for CSP predicted global demand and targets for the development of technology is compelling.*
- *The proposal clearly identifies the researchers' individual projects which well-focused on the specific research aspects and appropriately.*
- *The role of the non-academic sector in the training program is very well explained, extensive and convincing.*
- *The employability of the involved researches is properly described. There is evidence of how the competences acquired by ESRs in the program could be integrated with the current employability needs requested by the public and private sector. - The co-supervision at the consortium level comprises, for all the ESRs, 3 or 4 elements, with at least one from a non-academic partner.*
- *The ESRs will be exposed to different research environments. The training programme contains interdisciplinary research training.*

Weaknesses:

- *The ability to develop sustainable elements of the doctoral program and, therefore, to have a structuring effect on the doctoral training at the European level is not fully demonstrated.*
- *The research-related risks and contingency plans at the individual projects level are not well elaborated.*
- *Information provided on supervisors and mentors for some of the non-academic partners is not provided with sufficient detail or is missing.*
- *The unbalanced allocation of resources.*
- *There are very few scientific milestones planned.*