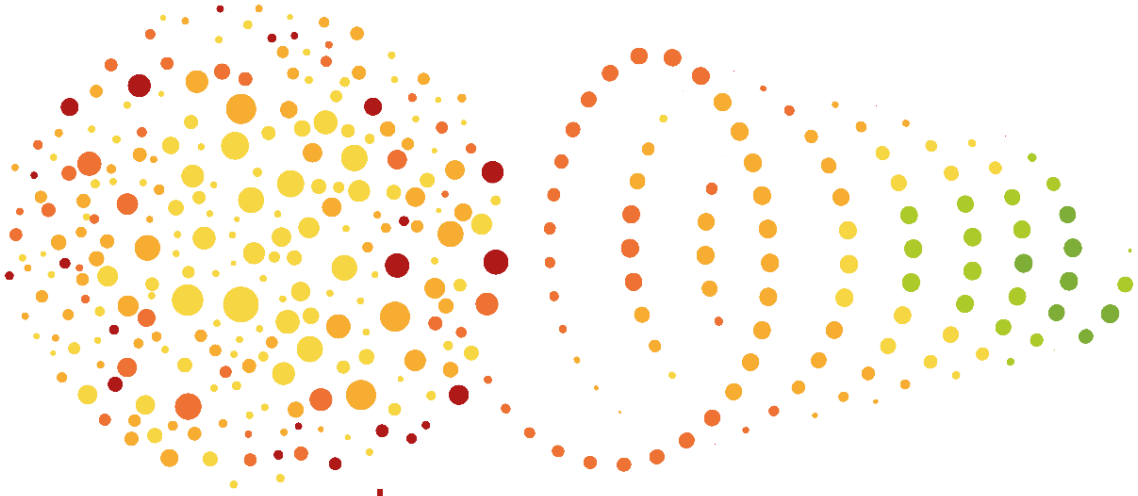

powder2power

MW-scale fluidized particle-driven CSP prototype demonstration

Grant Agreement n° 101122347

Project Management Plan

Deliverable 1.4

WP1 – Project Management

Due date of delivery:	30/11/2023	**Leading institution:**	PROMES-CNRS
Actual delivery date:	31/01/2024	**Contributor(s):**	CSP-Boost

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Deliverable Information

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Deliverable title	Project Management Plan	
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Author(s)	CSPB	Anastasiya BADZIAKA
	CNRS	Sergio MARIN ZAPATA
	CNRS	Emmanuel GUILLOT
Reviewer(s)	CNRS	Gilles FLAMANT
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Actual delivery date	31/01/2024	
Version - Date	V1.1 – 31/01/2024	
Summary	The Project Management Plan is the deliverable D1.4 of the POWDER2POWER project elaborated in the framework of the Work Package "Project Management". The deliverable outlines the planning and execution strategy of the project, including a detailed Gantt Chart, Work Breakdown Structure, task and subtask organization, overview of the deliverables and milestones as well as assignment of partners' roles. The content of this deliverable is compliant with the project charter documents: Grant Agreement number 101122347 signed between the beneficiaries and the European Commission as well as the Consortium Agreement signed among the beneficiaries. This deliverable mandates two strategic revisions before the conclusion of the 1st and 2nd reporting periods, ensuring an efficient and project progress-aligned coordination.	
Deliverable type	R – Report	
Dissemination level	PU – Public	
Repository	*Intranet, Online repository*	

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0.3	17/01/2024	Review	Gilles Flamant (CNRS)
1.0	30/01/2024	Review, edition	Emmanuel Guillot (CNRS)
1.1	31/01/2024	Final version	Sergio Marin Zapata (CNRS)

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POWDER2POWER Project Factsheet

Grant Agreement n°	101122347	**Project Acronym**	POWDER2POWER		
Project Full Title	MW-scale fluidized particle-driven CSP prototype demonstration				
Call identifier	HORIZON-CL5-2022-D3-03 “Innovative components and/or sub-systems for CSP plants and/or concentrating solar thermal installations”				
Funding instrument	Innovation Action				
Project start date	01/09/2023	**Duration**	48 months		
Website	www.powder2power-project.eu				
Partners Short Name	• PROMES-CNRS • EDF	• EPPT • JCR	• B2Z • POLIMI	• KTH • CSPB	• SEI • KUL

WP	Task
WP1 - Project Management (CNRS)	Task 1.1 – Administrative, legal, and financial management
	Task 1.2 – Quality Management
	Task 1.3 – Coordination of the activities
	Task 1.4 – Data Management Plan
WP2 - Particle Behavior, Transport and Handling (EPPT)	Task 2.1 – Particle flow properties as a function of temperature
	Task 2.2 – Erosion, attrition and dust emission
	Task 2.3 – Assessment of particle transport issues at pilot & commercial scale
	Task 2.4 – Design & construction of the particle conveyance system for the P2P pilot plant
	Task 2.5 – Design & construction of the particle electrical heater
WP3 - Solar Pilot Modification, Component testing and complete Pilot Demonstration (CNRS)	Task 3.1 – Pilot loop modification and implementation
	Task 3.2 – Commissioning of the particle loop
	Task 3.3 – Complete solar pilot testing
	Task 3.4 – Guideline for operation and maintenance
WP4 - P2P Technology Up-scale Towards Commercialization (B2Z)	Task 4.1 – Definition of up-scaled integrated P2P power plant layouts, including PV + heaters hybridization
	Task 4.2 – Design of a utility-scale heliostat field and solar receiver
	Task 4.3 – Design of a utility-scale particle-to-sCO_2 heat exchanger
	Task 4.4 – Design of utility-scale electrical heating system
	Task 4.5 – Design of utility-scale sCO_2 cycle
WP5 - Environmental, Social, Economic and Technical Performance Assessment (EDF)	Task 5.1 – Definition of optimal operational strategies and flexibility assessment of the utility scale P2P plant
	Task 5.2 – Techno-economic assessment of a utility-scale hybrid CSP-PV P2P power plant
	Task 5.3 – Techno-economic model development & verification
	Task 5.4 – Environmental and social impact assessment via LCA and sLCA modelling
	Task 5.5 – Social impact assessment of the best identified cases
WP6 - Communication, Exploitation, Dissemination (CSPB)	Task 6.1 – Identification and protection of exploitable results
	Task 6.2 – Exploitation and dissemination of the project results
	Task 6.3 – Communication activities results

Executive summary

This document is the deliverable D1.4 “Project Management Plan” of the EU-funded POWDER2POWER project, Grant Agreement number 101122347 (full title: “MW-scale fluidized particle-driven CSP prototype demonstration”), hereinafter referred to as “POWDER2POWER”.

The POWDER2POWER Project Management Plan (PMP) represents a strategic framework for the systematic and efficient project execution within Work Package 1 throughout the project duration of 4 years. This deliverable meticulously delineates the project implementation schedule and execution strategy, featuring a detailed Gantt Chart, Work Breakdown Structure, and specify the roles allocated among partners. Task and subtask organization is elucidated, articulating interdependencies with associated deliverables and milestones.

The deliverable establishes a proactive approach to the project management with two (2) mandated strategic revisions, strategically positioned before the 1st and 2nd reporting periods with subsequently issued versions. These revisions are integral to fostering an efficient and progress-aligned coordination strategy, allowing for dynamic adjustments as needed. By integrating these periodic reviews, the Project Management Plan serves as a living document, adapting to the evolving needs of the project and maintaining synchronization with its progress, thereby enhancing overall project success.

The content of this deliverable aligns with the terms and conditions established in the project foundational charter documents, specifically the Grant Agreement and its Annexes, as well as in the Consortium Agreement requirements and specifications. This alignment ensures legal and procedural adherence throughout project execution.

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List of Acronyms and Abbreviations

Acronym / Abbreviation	Meaning / Full text
°C	Celsius
B2Z	Build To Zero Energy Sociedad Limitada
CA	Consortium Agreement
CINEA	European Climate, Infrastrcture and Environment Executive Agency
COOR	Project Coordinator
Cordis	Community Research and Information Development Service
CNRS	Centre National de la Recherche Scientifique
CSP	Concentrated Solar Power
CSP2 project	Concentrated Solar Power in Particles
CSPB	CSP-Boost
D	Deliverable
DEC	websites, patents filings, videos, etc.
DEM	Demonstrator, pilot, prototype
EB	Executive Board
EC	European Commission
EDF	Electricité de France
EEAB	External Expert Advisorty Board
EPM	European Project Manager
EPPT	European Powder and Process Technology BVBA
EU	European Union
FOK	First-of-its Kind
GA	Grant Agreement
HTF	Heat transfer fluid
IPR	Intellectual Property Rights
JCR	John Cockerill Renewables
KPI	Key Performance Indicator
KTH	Kungliga Tekniska Hoegskola
KUL	Katholieke Universiteit Leuven
kW	Kilowatt
m	meter
M	Month
M	Milestone
MW	Megawatt
MW_e	Megawatt electrical
MW_{th}	Megawatt thermal
Next-CSP project	High Temparature concentrated solar thermal power plant with particle receiver and direct thermal storage
P2P	POWDER2POWER
PMP	Project Management Plan
PMT	Project Management Team

PO	Project Officer
POLIMI	Politecnico di Milano
POWDER2POWER	MW-scale fluidized particle-driven CSP prototype demonstration
PROMES-CNRS	PROcédés, Matériaux et Energie Solaire – Centre National de la Recherche Scientifique
PU	Public
PV	Photovoltaics
R	Report
sCO_2	Supercritical carbon dioxide
SEI	SEICO Heizungen GMBH
SEN	Sensitive
SET Plan	Strategic Energy Technology Plan
StC	Steering Committee
TRL	Technology Readiness Level
WBS	Work Breakdown Structure
WP	Work Package
WPL	WP Leader

Introduction

1.1 Scope and Objectives of the deliverable

The Deliverable D1.4 “Project Management Plan” (PMP) is elaborated in the framework of the Work Package 1 – Project Management and serves as a strategic framework for the systematic and efficient project execution over the four-year duration. It outlines the project's implementation schedule and execution strategy, incorporating a Gantt Chart and Work Breakdown Structure (WBS). Additionally, it specifies the project governance structure and roles assigned to each partner in the project. The document provides the organizational structure for tasks and subtasks, elucidating the interdependencies between them, as well as their connections to associated deliverables and milestones.

The deliverable is complementary to the deliverable D1.1 “Project Handbook”, which provides guidelines on the project standards, internal agreed rules and procedures relating to or complementing the Grant Agreement (GA) and the Consortium Agreement (CA) for ensuring the quality of project communication and documentation, reporting and payments, project meetings and activities, evaluation of results and deliverables, change management and other day-to-day activities. Together with the D1.1, the PMP covers the overall strategy for organization and execution of core tasks to achieve the objectives of the WP1 – Project Management in terms of administrative, legal, financial and technical coordination.

1.2 Targeted Audience

The prior target audience of the PMP are the governance bodies of the POWDER2POWER project, specifically the Steering Committee (StC), the Executive Board (EB), the Project Management Team (PMT) and External Expert Advisory Board (EEAB), as this deliverable is elaborated as an internal project management, planning and execution reference and guidelines. As the dissemination level of the PMP is “Public” (PU), the document is also available to all the members of the consortium, the European Climate, Infrastructure and Environment Executive Agency (CINEA) Project Officer (PO), all the Services of the European Commission (EC) as well as the general public.

1.3 Deliverable Structure

Deliverable D1.1 includes the following 7 sections:

- Section 1 “Introduction” outlines the scope, purpose, targeted audience and document structure of this deliverable as a detailed framework for coordinating the project execution, intended for Consortium members and the European Commission.
- Section 2 “Project Management Structure” describes the project governance, including the roles and responsibilities of the Consortium bodies involved in the management of the project.
- Section 3 “Project Work plan Structure” presents the project Work structure covering the overview and breakdown of the project activities, timetable, description of the Work Packages, tasks and subtasks and role of the project partners.
- Finally, sections 4 and 5 list the project deliverables and milestones.
- The last section includes the Conclusion.

2. Project Management Structure

This section provides a general presentation of the POWDER2POWER project governance structure. The detailed roles and responsibilities of the bodies involved in the project management of the project are covered by the deliverable D1.1 "Project Handbook" and the Part B of the GA.

Figure 1 depicts the organizational framework for POWDER2POWER includes four essential governance bodies coordinating the project management at four different levels:

- **Strategic management level:** the Steering Committee (StC), featuring a representative from each partner organization, represents the ultimate decision-making body of the consortium.
- **Tactical management level:** the Executive Board (EB) is responsible for executing the project and is accountable to the StC.
- **Operational management level:** the Project Management Team (PMT) coordinates and implements the day-to-day operational aspects of the project, supporting the Executive Board and Project Coordinator (COOR) in implementing StC decisions and managing project activities.
- **Advisory management level:** the External Expert Advisory Board (EEAB) operates as a consultative body, engaging with StC and EB members to discuss scientific strategies and issues related to the exploitation of the project results.

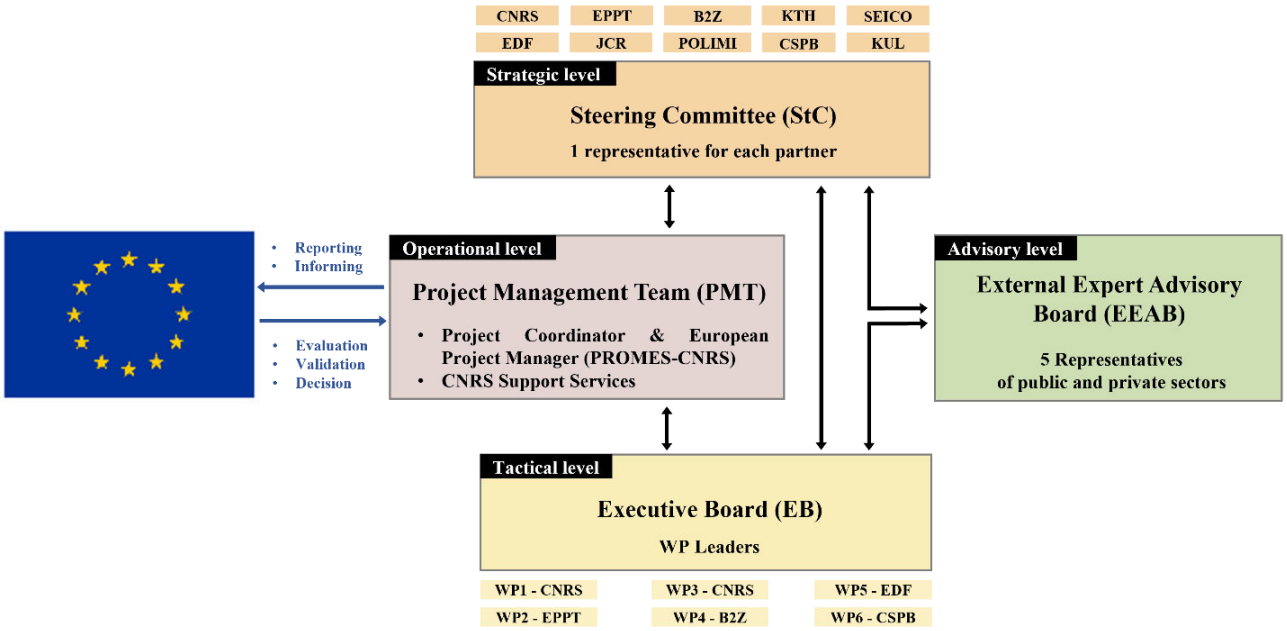

Figure 1. POWDER2POWER Governance structure.

2.1 Steering Committee (StC)

The preeminent decision-making body within the POWDER2POWER project is the Steering Committee (StC), which includes a representative from all 10 project partner organizations, each vested with voting rights. StC members are duly authorized to deliberate, negotiate, and decide on behalf of their respective organizations. Additionally, each representative appoints a deputy possessing the requisite knowledge and authorization to act on behalf of the organization within the POWDER2POWER project, serving as a replacement when the primary representative is unable to attend StC meetings.

The Project Coordinator chairs all StC meetings, which convene on a regular 6-month basis, e.g. M6, M12, M18, M24, M30, M36 and M42, as well as on an ad-hoc basis as required.

The StC has right to act on its own initiative to formulate proposals and take decisions in accordance with the procedures set out in the CA. In addition, all proposals made by the EB shall also be considered and decided upon by the StC. The StC holds authority to deliberate on various matters, including:

- **Content, finances and intellectual property rights (IPR):** informing the EC on any substantial project-related topics through the PMT; modifying the overall project plan, the tasks implementation and financial resources allocation; organizing project events; making strategic decisions at specific milestones; evaluating consortium activities in terms of technical and overall quality alignment with the project expected objectives, gender issues and stakeholders' needs; resolving conflict persisting post-WP meetings;
- **Evolution of the consortium:** entry of a new partner and/or the withdrawal of a project partner; declaration of a beneficiary to be a defaulting partner as well as all the actions pertaining to the latter.

2.2 Executive Board

The POWDER2POWER Executive Board (EB) is composed of the project Coordinator (COOR) and WP leaders (WPL). Under the provisions of the CA, the tasks of the EB include:

- Being responsible for the proper execution and implementation of the decisions of the StC;
- Monitoring the effective and efficient implementation of the project activities;
- Gathering the information related to every 6-month project progress, assessing that information in terms of compliance with the project plan and, if necessary, suggesting modifications of the project plan to the StC;
- Supporting the Coordinator in preparing the review meetings with the EC, preparing related data, presentations and deliverables;
- Recommending any significant developments for dissemination and exploitation of the results, including the preparation of the content and timing of the press releases and joint publications by the consortium or European Commission.

Moreover, each WP Leader (WPL) oversees the planning, advancement, and achievement of the results within the respective WP, including:

- Formulating the work plan for the assigned WP in alignment with the overall project plan;
- Supervising the effective, coordinated and efficient execution of the tasks, deliverables' submission and milestones' achievement.
- Reporting achieved work, deviations and mitigation plan updates.

2.3 Project Management Team (PMT)

The Project Management Team (PMT) holds responsibility for the effective administrative, legal and financial aspects of the project and quality of the management operational management of the project. The PMT includes the Project Coordinator and European Project Manager (EPM) at PROMES-CNRS laboratory, assisted by the corresponding administrative, legal and financial CNRS support offices. Within the PMT, the Coordinator acts as the intermediary between the EC and consortium members.

The Project Coordinator assumes the role of supervising the overall coordination of the project as described in the GA and CA. The coordinator is assisted by the European Project Manager, who is in charge of the operational daily management of the project.

Whenever necessary, the PMT is assisted by the relevant financial, administrative, legal and IPR specialized departments of the CNRS Occitanie Est Regional Delegation located in Montpellier, France.

The Coordinator and Project Management Team are tasked with:

- Ensuring vigilant monitoring of the partners adherence to their respective GA and CA obligations;
- Keeping the contact list of the Consortium members and other contact persons updated and available;
- Collecting, reviewing and verifying the consistency of the submitted reports, deliverables and other documentation (including financial statements and related certifications) as well as any specific requested documents to the EC;
- Providing all necessary project-related documentation and information to the relevant partners;
- Facilitating the transfer of the EC payment to partners, aligning with the stipulations of the GA and CA procedures;
- Providing, upon request, the partners with official copies of documents being in sole possession of the Coordinator;
- Ensuring the adequate communication between the consortium and the EC as well as any necessary amendments, decided upon by the StC, to the GA with the EC on behalf of the consortium;
- Monitoring the project activities and promptly reporting any actual and / or potential changes impacting the project work plan, scope and / or schedule;
- Taking in charge the organization, facilitation, and documentation of StC meetings, while actively overseeing the implementation of decisions;
- Addressing any IPR related issues.

2.4 External Expert Advisory Board (EEAB)

The External Expert Advisory Board (EEAB) is appointed and steered by the StC. It is composed of 6 external experts coming from both public and private sectors, presented in Table 1.

Table 1. POWDER2POWER External Expert Advisory Board

Sector	Organization
Academia	University of Duisburg-Essen, Germany
	Ruhr Universität Bochum, Germany
	National Renewable Energy Laboratory (NREL), Colden-Co, USA
Industry	Lloyad and Flemish Government, Belgium
	MTJA, Belgium
	Eiffage-Smulders, Belgium

The EEAB bears no operational responsibility and functions as an external reviewer offering non-binding advice. The EEAB supports the project by providing valuable recommendations to the consortium and facilitating connections with relevant stakeholders. The involvement of the EEAB ensures:

- a more specific identification of realistic opportunities for the proper and appropriate exploitation of the project results,
- a finer alignment of the project outcomes with the needs of stakeholders and the market, and
- a more in-depth analysis of various market deployment scenarios, benefitting from insights provided by representatives from private and private sectors.

Each member of the EEAB is required to sign a non-disclosure agreement (NDA) with the Coordinator mandated to execute this procedure on behalf of the consortium.

3. Project Work plan Structure

3.1 Work plan Overview

The POWDER2POWER project aims to demonstrate the viability of an innovative, cost-effective, and highly reliable Concentrated Solar Technology for MW-scale power and industrial heat production (TRL7). The prototype, a modified and improved version of the previous experimental loop built within the framework of the EU-funded H2020 project Next-CSP (grant no. 727762), includes essential components of a commercial plant. These include a multi-tube fluidized bed solar receiver (2 MW_{th}), an electricity-driven particle superheater (300 kW), a hot store, a particle-to-working fluid cross-flow fluidized bed heat exchanger (2 MW_{th}), a turbine (hybrid Brayton cycle gas turbine, 1.2 MW_e), a cold store, and a vertical particle transport system (~100 m). An exhaustive experimental campaign is scheduled for a one-year duration at the Themis tower in France.

The integrated electricity-driven superheater aims to validate a CSP-PV concept at 750°C, expecting reduced electricity costs. This temperature enables high-efficiency conversion cycles, such as 750°C for supercritical CO2 (sCO_2) cycles, projecting a 5-9% increase in conversion efficiency and a 5,4% cost reduction compared to molten salt technology. The hybrid CSP-PV concept aims for a 9% efficiency boost, while CSP-only targets 5%. The project includes a technical, environmental, economic and social sustainability assessment, emphasizing transparent documentation for replicability and future planning support.

The overall work plan consists in 6 Work Packages, 4 technical Work Packages addressing the different issues of the POWDER2POWER concept from the particle level to the system level and 2 Work Packages dedicated to the cross-cutting activities of Project management as well as Dissemination, Communication, and Exploitation. WP2 deals with particle properties, conveying and handling in different components (electric heater and heat exchanger). The MW-scale pilot facility is modified, upgraded and demonstrated at Themis solar tower in WP3. The new implemented layout is representative of a commercial CSP plant. WP4 uses the experimental data obtained in WP3 and additional model concerning advanced sCO_2 heat exchanger and cycles to upscale the POWDER2POWER concept at the utility-scale with a 50 MW_e plant as a reference but considering other options including hybrid CSP-PV layout enabling high-capacity factors. Finally, economic, sustainability and social aspects of the solar power plants designed in WP4 are addressed in WP5.

3.2 Work plan Breakdown Structure

The WP2 “Particle Behavior, Transport and Handling” deals with the measurement of the particle properties under operating conditions in terms of temperature and velocity. After the modifications of the solar pilot loop layout, the WP3 “Solar Pilot Modification, Component testing and complete Pilot Demonstration” consist in developing engineering models of the main components to compare

the model predictions with the experimental results collected during the test campaign. This comparison is used to validate the models. The upscaling step within the WP4 “P2P Technology Up-scale Towards Commercialization” integrates both previous models and feedback from CSP industry participating in the project. Feedback from industry is of key importance concerning the type of component integration and related plant operation issues. The last step of the upscaling work is the design of utility-scale solar thermal plants based on the POWDER2POWER technology. Various power levels are envisioned to cover the only power production, both heat and power cogeneration and energy delivery to the electricity grid or to an industrial plant (1 - 10 MW_e). Eventually, the techno-economic and sustainability assessment performed under the WP5 “Environmental, Social, Economic and Technical Performance Assessment” offer a range of options that enables to decrease the costs and impacts of CSP plants. At each stage of their implementation, every Work Package engages with WP6 "Communication, Dissemination, Exploitation" for the purpose of publishing results or exploiting them, as well as with WP1 "Project Management” for the purpose of proper project implementation, monitoring and reporting.

The Figure 2 illustrates the overview of the POWDER2POWER Work Breakdown Structure (WBS) and interdependence between the Work Packages.

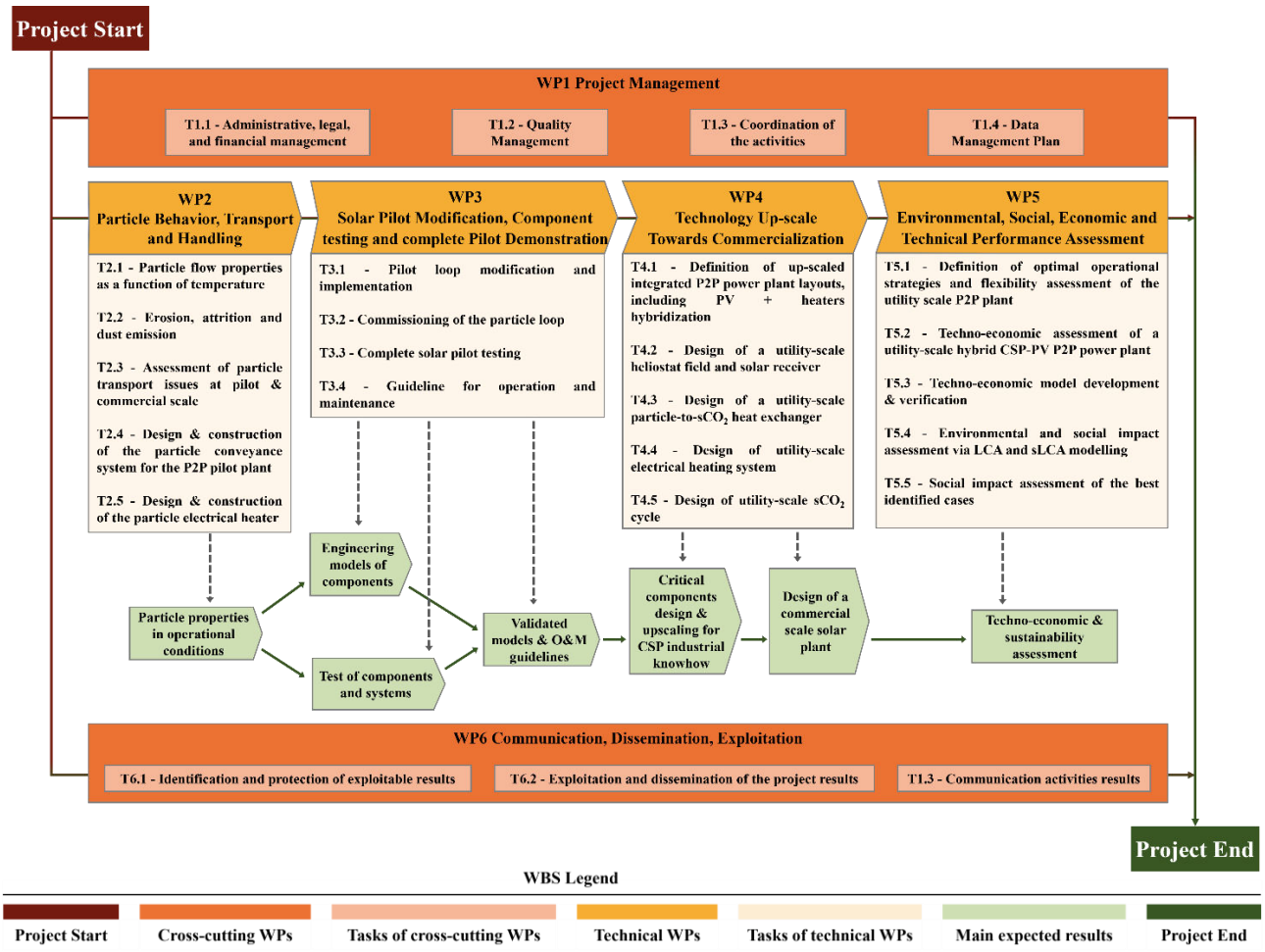

Figure 2. POWDER2POWER Work Breakdown Structure overview.

3.3 Timetable

The Gantt chart presented in Figure 3 provides a visual representation of the POWDER2POWER project timeline and task allocation for each WP as well as indicates the Work Package Leaders.

- WP1 – Project Management (WP Leader: CNRS):

Tasks under WP1 encompass administrative, legal, financial, and quality management, as well as coordination of project activities. The duration spans the entire project timeline (Month 1 – Month 48), emphasizing the ongoing nature of project management responsibilities.

- WP2 – Particle Behavior, Transport, and Handling (WP Leader: EPPT):

This Work Package focuses on understanding particle behavior, including flow properties and issues related to erosion, attrition, and dust emission. Tasks extend over the first 24 months (M), with specific emphasis on designing and constructing the particle conveyance system and electrical heater.

- WP3 – Solar Pilot Modification, Component Testing, and Complete Pilot Demonstration (WP Leader: CNRS):

WP3 involves modifying the solar pilot loop, commissioning the particle loop, and conducting complete solar pilot testing. The tasks span the entire project duration (M1 - M48), with emphasis on operational guidelines and maintenance planning.

- WP4 – P2P Technology Up-scale Towards Commercialization (WP Leader: B2Z):

This Work Package aims to upscale POWDER2POWER technology toward commercialization. Tasks include defining integrated power plant layouts, designing utility-scale components, and developing electrical heating systems and sCO_2 cycles. The duration extends from M6 to M48.

- WP5 – Environmental, Social, Economic, and Technical Performance Assessment (WP Leader: EDF):

Focused on assessing performance from multiple perspectives, WP5 tasks include defining operational strategies, conducting techno-economic assessments, and evaluating environmental and social impacts. Tasks span from M12 to M47, with an emphasis on modeling, assessment, and impact analysis.

- WP6 – Communication, Exploitation, Dissemination (WP Leader: CSPB):

WP6 involves identifying and protecting exploitable results, as well as disseminating project outcomes. The tasks cover the entire project duration (M1 – M48), highlighting the ongoing status of communication, exploitation, and dissemination efforts.

The associated deliverables and milestones are presented in the next sections.

POWDER2POWER Gantt chart			1st Reporting Period												2nd Reporting Period												3rd Reportig Period											
			YEAR 1												YEAR 2												YEAR 3											
			Oct	Nov	Dec	Jan	Fev	Mar	Avp	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Fev	Mar	Avp	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Fev	Mar	Avp	May	Jun	Jul	Aug	Sep
WP & Task	**Leader**	**Duration**	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
WP1	**CNRS**	**M1 - M48**																																				
Task 1.1	CNRS	M1 - M48																																				
Task 1.2	CNRS	M1 - M48																																				
Task 1.3	CNRS	M1 - M48																																				
Task 1.4	CNRS	M1 - M48																																				
WP2	**EPPT**	**M1 - M24**																																				
Task 2.1	EPPT	M1 - M12																																				
Task 2.2	EPPT	M1 - M12																																				
Task 2.3	EPPT	M9-M14																																				
Task 2.4	EPPT	M12 - M24																																				
Task 2.5	SEI	M1 - M24																																				
WP3	**CNRS**	**M1 - M48**																																				
Task 3.1	CNRS	M1 - M30																																				
Task 3.2	CNRS	M30 - M36																																				
Task 3.3	CNRS	M36 - M48																																				
Task 3.4	CNRS	M42 - M48																																				
WP4	**B2Z**	**M6 - M48**																																				
Task 4.1	B2Z	M12 - M48																																				
Task 4.2	CSPB	M6 - M46																																				
Task 4.3	JCR	M18 - M42																																				
Task 4.4	SEI	M12 - M27																																				
Task 4.5	POLIMI	M6 - M26																																				
WP5	**EDF**	**M12 - M48**																																				
Task 5.1	POLIMI	M15 - M32																																				
Task 5.2	EDF	M12 - M48																																				
Task 5.3	KTH	M12 - M42																																				
Task 5.4	KUL	M12 - M42																																				
Task 5.5	KUL	M12 - M42																																				
WP6	**CSPB**	**M1 - M48**																																				
Task 6.1	CSPB	M1 - M48																																				
Task 6.2	CSPB	M1 - M48																																				
Task 6.3	CSPB	M1 - M48																																				

			3rd Reportig Period											
			YEAR 4											
			Oct	Nov	Dec	Jan	Fev	Mar	Avp	May	Jun	Jul	Aug	Sep
WP & Task	**Leader**	**Duration**	M37	M38	M39	M40	M41	M42	M43	M44	M45	M46	M47	M48
WP1	**CNRS**	**M1 - M48**												
Task 1.1	CNRS	M1 - M48												
Task 1.2	CNRS	M1 - M48												
Task 1.3	CNRS	M1 - M48												
Task 1.4	CNRS	M1 - M48												
WP2	**EPPT**	**M1 - M24**												
Task 2.1	EPPT	M1 - M12												
Task 2.2	EPPT	M1 - M12												
Task 2.3	EPPT	M9-M14												
Task 2.4	EPPT	M12 - M24												
Task 2.5	SEI	M1 - M24												
WP3	**CNRS**	**M1 - M48**												
Task 3.1	CNRS	M1 - M30												
Task 3.2	CNRS	M30 - M36												
Task 3.3	CNRS	M36 - M48												
Task 3.4	CNRS	M42 - M48												
WP4	**B2Z**	**M6 - M48**												
Task 4.1	B2Z	M12 - M48												
Task 4.2	CSPB	M6 - M46												
Task 4.3	JCR	M18 - M42												
Task 4.4	SEI	M12 - M27												
Task 4.5	POLIMI	M6 - M26												
WP5	**EDF**	**M12 - M48**												
Task 5.1	POLIMI	M15 - M32												
Task 5.2	EDF	M12 - M48												
Task 5.3	KTH	M12 - M42												
Task 5.4	KUL	M12 - M42												
Task 5.5	KUL	M12 - M42												
WP6	**CSPB**	**M1 - M48**												
Task 6.1	CSPB	M1 - M48												
Task 6.2	CSPB	M1 - M48												
Task 6.3	CSPB	M1 - M48												

Figure 3. POWDER2POWER Gantt chart.

3.4 Work Packages Description

WP1. Project Management (M1-M48), led by CNRS

This WP aims at supervising and managing the implementation of the scientific project and to ensure that all the participants comply with the objectives, the tasks, the deadlines, and the allotted budget. WP leader CNRS will also guarantee a smooth communication among project participants, ensure an effective management and the adequate coordination of all activities throughout the project's duration. This WP's tasks are:

- Task 1.1: Administrative, legal, and financial management (M1-M48), led by CNRS
- Task 1.2: Quality Management (M1-M48), led by CNRS
- Task 1.3: Coordination of the activities (M1-M48), led by CNRS
- Task 1.4: Data Management Plan (M1-M48), led by CNRS

WP2. Particle Behavior, Transport and Handling, led by EPPT

This WP addresses fundamental and technological issues related to the use of particle suspensions as heat transfer medium and storage material in the CSP plant, namely the particle conveying loops and the particle super-heating. The WP's tasks are:

- Task 2.1: Particle flow properties as a function of temperature (M1-M12), led by EPPT
- Task 2.2: Erosion, attrition and dust emission (M1-M12), led by EPPT
    - Task 2.2.1: Particle attrition and dust emission
    - Task 2.2.2: Erosion
- Task 2.3: Assessment of particle transport issues at pilot & commercial scale (M9-M14), led by EPPT
- Task 2.4: Design & construction of the particle conveyance system for the P2P pilot plant (M12-M24), led by EPPT
- Task 2.5: Design & construction of the particle electrical heater (M1-24), led by SEI
    - Task 2.5.1: Design of the particle heater
    - Task 2.5.2: Testing and validation of a downsized lab prototype
    - Task 2.5.3: Construction of the particle electrical heater for CNRS lab-installation

WP3. Solar Pilot Modification, Component testing and complete Pilot Demonstration, led by CNRS

This WP gathers the experimental contributions necessary to carry on the experimental demonstration campaign and address the upscaling issues, drawing from the existing solar pilot developed during the execution of the Horizon 2020 Next-CSP project (grant no. 727762). It will modify the existing pilot facility layout in order to fit the layout of a commercial power plant, aim to demonstrate the P2P concept during one year and draft an operations and maintenance guide drawing from the experimental campaign. This WP's tasks are:

- Task 3.1: Pilot loop modification and implementation (M1-M30), led by CNRS
    - Task 3.1.1: Improvement of the solar receiver instrumentation and control system
    - Task 3.1.2: Implementation of the power block components on ground level
    - Task 3.1.3: Implementation of the particle transport system
    - Task 3.1.4: Integration of the particle electric heater
    - Task 3.1.5: Completion of the instrumentation and control system

- Task 3.2: Commissioning of the particle loop (M30-M36), led by CNRS
  - Task 3.2.1: Commissioning of the particle circulation loop
  - Task 3.2.2: Testing the solar receiver at partial and full load
  - Task 3.2.3: Testing the particle electric heater and the existing heat exchanger
- Task 3.3: Complete solar pilot testing (M36-M48), led by CNRS
  - Task 3.3.1: Solar-only tests (without electric heating of particles)
  - Task 3.3.2: Tests in hybrid mode (solar + electric heater)
- Task 3.4: Guideline for operation and maintenance (M42-M48), led by CNRS

WP4. P2P Technology Upscale Towards Commercialization

This WP aims to leverage the P2P demonstration facility to scale up the solution to commercial application for FTM in sizes between 10 MWe and up to 60 MWe and BTM in sizes below MWe. It will do so by designing major components in utility scale for application in commercial applications, designing hybrid systems to be coupled to solar facilities with P2P technology, and defining KPIs for this technology. This WP's tasks are:

- Task 4.1: Definition of upscaled integrated P2P power plant layouts, including PV + heaters hybridization (M12-M48), led by B2Z
  - Task 4.1.1: FTM above 10 MWe of up to 50-60 MWe P2P plant set up
  - Task 4.1.2: BTM of less than 10 MWe P2P plant set up
  - Task 4.1.3: Hybridization of the solar P2P technology
  - Task 4.1.4: Definition of KPIs and battery limits
- Task 4.2: Design of a utility-scale heliostat field and solar receiver (M6-M46), led by CSPB
  - Task 4.2.1: Optical performance of the solar field
  - Task 4.2.2: Thermal performance of the solar receiver
  - Task 4.2.3: Lifetime assessment of the solar receiver
  - Task 4.2.4: Solar receiver control using deep reinforcement learning
- Task 4.3: Design of a utility-scale particle-to-sCO2 heat exchanger (M18-M42), led by JCR
  - Task 4.3.1: Modelling of particle-to-sCO2 heat exchanger
  - Task 4.3.2: Basic engineering particle-to-sCO2 heat exchanger
  - Task 4.3.3: Detail engineering of particle-to-sCO2 heat exchanger
- Task 4.4: Design of utility-scale electrical heating system (M12-M27), led by SEI
- Task 4.5: Design of utility-scale sCO2 cycle (M6-M26), led by POLIMI
  - Task 4.5.1: Performance assessment of reference state-of-the-art steam power block
  - Task 4.5.2: Optimization of the sCO2 power block
  - Task 4.5.3: Preliminary sizing of plant components and cost evaluation

WP5. Environmental, Social, Economic and Technical Performance Assessment

This WP aims at assessing techno-economic performances of a utility-scale P2P plant and its environmental and social footprint. These results will be compared to those corresponding to various alternative plant architectures designed and operated with the same hypotheses, including a molten salt tower that is the current benchmark. The knowledge of the operational constraints will be integrated into a system-level modelling tool (to be used by R&D and/or industrial actors) that allows optimizing the dispatch profile of the power generated by the plant. This WP's tasks are:

- Task 5.1: Definition of optimal operational strategies and flexibility assessment of the utility scale P2P plant (M15-M32), led by POLIMI
  - Task 5.1.1: Definition of operational maps for the solar field and solar receiver
  - Task 5.1.2: Definition of operational maps for power block optimal management
- Task 5.2: Techno-economic assessment of a utility-scale hybrid CSP-PV P2P power plant (M12-M48), led by EDF
  - Task 5.2.1: LCOE of a utility-scale P2P power plant
  - Task 5.2.2: Comparison of a utility-scale P2P power plant with other plant configurations
- Task 5.3: Techno-economic model development & verification (M12-M42), led by KTH
  - Task 5.3.1: Development of bottom-up cost functions and definition of KPI for hybrid layouts
  - Task 5.3.2: Development of embedded optimization models for layouts defined in T4.1
  - Task 5.3.3: Model GUI development, documentation and industrial trials
- Task 5.4: Environmental and social impact assessment via LCA and sLCA modelling (M12-M42), led by KUL
- Task 5.5: Social impact assessment of the best identified cases (M24-M42), led by KUL

WP6. Communication, Exploitation, Dissemination

This WP aims to determine the different pathways towards the exploitation of the project results as well as the innovation while protecting the intellectual property rights of consortium members, the industrial sector and the public at large. It will also implement dissemination measures about the information of the project to a broad spectrum of stakeholders in the field, and it will guarantee the project's visibility through fitted communication activities. This WP's tasks are:

- Task 6.1: Identification and protection of exploitable results (M1-M48), led by CSPB
- Task 6.2: Exploitation and dissemination of the project results (M1-M48), led by CSPB
- Task 6.3: Communication activities results (M1-M48), led by CSPB

3.5 Role of the Partners

This section provides a brief overview of the primary technical responsibilities allocated to each partner within the POWDER2POWER project. The role of Project Coordinator is undertaken by CNRS in WP1 and all partners actively contribute to coordination (WP1) and dissemination (WP6) tasks.

3.5.1 CNRS and PROMES-CNRS

CNRS is represented for scientific, technical and management activities by the PROMES-CNRS laboratory. Administrative support is given by CNRS regional headquarters in Montpellier.

In WP3, PROMES-CNRS supervises the pilot loop modification and performs the demonstration test campaign of the POWDER2POWER pilot plant developed within the project at the solar research infrastructure of Themis.

As a provider of the experimental results and operator at the used facility, CNRS is involved in the design and construction of the particle electrical heater (WP2), contributes to the thermal and artificial intelligence (AI) modelling of the solar receiver (WP3) and design of a utility-scale particle-to-sCO_2 heat exchanger (WP4).

3.5.2 EDF

In WP5, EDF leads the cost assessment of a utility-scale solar power plant based on the project concept.

In WP4, EDF contributes to the Key Performance Indicators (KPIs) definition with market considerations and provides data for utility-scale sCO_2 cycle design.

3.5.3 EPPT

EPPT is the WP2 Leader in charge of the evaluation of the particle flow properties and behavior, transport and handling and is involved in the design and construction of the particle conveyance system for the POWDER2POWER pilot.

In WP3, EPPT contributes to the implementation of the particle conveyance system.

3.5.4 John Cockerill Renewables

In WP4, JCR defines the KPIs and battery limits, and designs industrial-scale fluidized particles-sCO_2 heat exchanger.

3.5.5 Build To Zero

In WP3, B2Z participates in the development of the guidelines for operation and maintenance by evaluating the pilot operation, enhancing from manual to automatic mode and developing control narratives for future commercial-scale plants.

In WP4, B2Z leads the technology upscaling towards commercialization by designing the utility-scale particle driven solar power plants based on the POWDER2POWER technology. B2Z participates in techno-economic assessment and provides relevant data for social and environmental assessment.

3.5.6 Politecnico di Milano

In WP4, POLIMI leads the design of a utility-scale sCO_2 Brayton cycles, assesses solar receiver thermal performance, and provides a lifetime assessment of the solar receiver.

In WP5, POLIMI is in charge of the tasks related to operational strategies, flexibility assessment, techno-economic assessment and model development.

3.5.7 KTH

In WP2, KTH contributes to the particle heater's design.

In WP4, KTH contributes to utility-scale electrical heating system and sCO_2 cycles' design.

In WP5, KTH leads the techno-economic assessment of the POWDER2POWER technology for different scenarios including CSP-PV hybrid systems.

3.5.8 CSP-Boost

In WP4, CSPB leads the tasks related to the solar field and solar receiver optical and thermal modeling, contributes to the engineering model of the heat exchanger.

In W6, CSPB takes the lead of the Dissemination, Exploitation and Communication activities. CSPB is in charge of the development and execution of the dissemination and exploitation plan, including the mapping of the project exploitable results and opportunities for its exploitation. CSPB is responsible for the elaboration and implementation of the communication and dissemination plan and actions.

3.5.9 SEICO

In WP2, SEI leads the task related to the design and construction of the particle heater at pilot and utility scales.

In WP4, SEI participates in utility-scale electrical heating system's design.

3.5.10 KU Leuven

In WP2, KUL provides technical assistance to EPPT for particle flow properties and conveying technologies.

In WP5, KUL leads the tasks dedicated to the environmental and social impact assessment of the POWDER2POWER technology.

4. Deliverables

The Deliverables section of this document provides an overview of the project's main results, which are documented in 25 written reports (R), embodied in 1 web-based product (DEC - websites, patents filings, videos, etc.) and 1 fabricated component (DEM – demonstrator, pilot, prototype). These results ensure the demonstration of the project partners contributions and allow to track the project progress and achievements.

There are 14 deliverables with “Sensitive” (SEN) dissemination level that will be accessible on the Participant Portal only for the project members and European Commission Services, while 13 deliverables with “Public” (PU) dissemination level will be made available to the wider community through the EU Community Research and Information Development Service (Cordis) at https://cordis.europa.eu/ as well as POWDER2POWER project website at www.powder2power-project.eu.

The 27 deliverables are detailed in Table 2:

Table 2. List of POWDER2POWER deliverables

Deliv. n°	Deliverable name	WP n°	Lead part.	Type	Diss. level	Due Date
D1.1	Handbook	WP1	CNRS	R	SEN	3
D1.2	Intranet	WP1	CNRS	DEC	SEN	3
D1.3	Data Management Plan	WP1	CNRS	R	PU	6
D1.4	Project Management Plan	WP1	CNRS	R	PU	2
D2.1	Report on particle	WP2	EPPT	R	SEN	12
D2.2	Erosion Assessment	WP2	EPPT	R	SEN	12
D2.3	Assessment of particle transport	WP2	EPPT	R	SEN	15
D2.4	Design and construction of the conveyance system	WP2	EPPT	R	SEN	24
D2.5	Design & construction of the heater	WP2	SEI	R	SEN	30
D3.1	New layout of the complete P2P pilot loop	WP3	CNRS	DEM	PU	30
D3.2	Test results of the commissioning phase	WP3	CNRS	R	PU	36
D3.3	Demonstration of the P2P solar pilot	WP3	CNRS	R	SEN	48
D3.4	Operation & maintenance issues of the P2P solar power plant concept	WP3	CNRS	R	SEN	48
D4.1	Preliminary Process Flow Diagrams (PFDs)	WP4	B2Z	R	PU	20
D4.2	Design of the heliostat field and solar receiver	WP4	CSPB	R	SEN	46
D4.3	Utility scale particle-to-sCO_2 heat exchanger	WP4	JCR	R	SEN	42
D4.4	Utility scale electric particle heater	WP4	SEI	R	SEN	28
D4.5	Utility scale sCO_2 cycles	WP4	POLIMI	R	SEN	26
D4.6	Utility scale power plant design & performance	WP4	B2Z	R	SEN	48
D5.1	Operational maps of P2P utility scale system	WP5	POLIMI	R	PU	32

D5.2	Techno-economic comparison of a utility-scale P2P power plant with other plant configurations	WP5	EDF	R	PU	48
D5.3	Definition of KPIs and methodology for techno-economic assessment	WP5	KTH	R	PU	18
D5.4	Final LCA report	WP5	KUL	R	PU	40
D5.5	Final social impacts (results, conclusions & recommendations from the S- LCA)	WP5	KUL	R	PU	42
D6.1	Exploitation/ Dissemination plan	WP6	CSPB	R	PU	6
D6.2	Mid-term report on dissemination / communication	WP6	CSPB	R	PU	24
D6.3	Final report on exploitation / communication / dissemination & impacts on innovation	WP6	CSPB	R	PU	48

5. Milestones

This section presents the overview of the 17 project Milestones (MS), including their associated WP, due date of achievement and means of verification.

The monitoring and accomplishment of the milestones lays on the Executive Board. If any deviation or setback in their achievement requiring the corresponding modifications and adjustments of the Work plan, the StC is in charge of deciding on the modification and / or readjustment of the project objectives and / or project allocated resources.

Table 3. List of POWDER2POWER milestones

MS n°	Milestone name	WP n°	Lead part.	Due Date	Means of verification
1	Kick off meeting	WP1	CNRS	1	Meeting minutes
2	Final meeting	WP1	CNRS	48	Meeting minutes
3	1st physical StC meeting	WP1	CNRS	12	Meeting minutes
4	2nd physical StC meeting	WP1	CNRS	24	Meeting minutes
5	3rd physical StC meeting	WP1	CNRS	36	Meeting minutes
6	All experimental setups ready for starting test campaign	WP2	EPPT	6	List of setups for particle testing with operation parameters ranges
7	P2P pilot plant new layout ready for operation	WP3	CNRS	30	Components installed and connected
8	Starting of the P2P demonstration campaign	WP3	CNRS	36	First test of the complete solar loop
9	Design of an optimized utility-scale heliostat field coupled with solar receiver	WP4	B2Z	18	Data sheet and drawings
10	sCO_2 power block numerical model validated and running	WP4	B2Z	18	Technical note
11	P2P power plant simulation model for <10 MW – >10 MW	WP4	B2Z	24	Technical note
12	Techno-economic assessment of a utility-scale P2P power plant	WP5	EDF	36	Presentation of results during project meeting
13	Full package of techno-economic models (including GUI)	WP5	EDF	42	Delivery of models for industrial trials
14	Website	WP6	CSPB	3	Connection to the Website
15	Training on the IPR and Exploitation	WP6	CSPB	12	Training course
16	Activities of communication assessment & actualization of the plan for dissemination & exploitation of the results	WP6	CSPB	24	Report of the KPI

17	Success evaluation through key exploitable results	WP6	CSPB	48	Portfolio elaborated by the internal supervisory board

Conclusion

The Deliverable D1.4 “Project Management Plan” establishes a clear and strategic framework for the efficient execution of WP1 over the project's four-year duration and represents an important milestone for the execution of the Task 1.1 “Coordination of the activities”. The detailed schedule, execution strategy, and governance structure outlined in the PMP significantly contribute to the well-coordinated and efficient project execution.

The organizational structure for tasks and subtasks, along with the delineation of interdependencies and connections to associated deliverables and milestones, provides a clear roadmap for project coordination. This approach is fundamental in achieving the objectives of the Project Management work package, encompassing administrative, legal, financial, and technical coordination.

The PMP completes the deliverables D1.1 “Project Handbook” and D1.3 “Data Management Plan” in order to form an exhaustive Project Management reference documentation aligned with the standards, rules, and procedures outlined in the Grant and Consortium Agreements. The PMP will be revised twice throughout the project duration – before the end of the 1st and 2nd reporting periods – to ensure the quality of the project effort organization, activities implementation and high quality of the project results.