RE-WITCH

The coolest cold from the cleanest heat

D1.2 – Risk and contingency management plan – first version

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About

The overarching aim of RE-WITCH, a project funded by the European Horizon programme, is to deliver cost-competitive, game-changing solutions in the field of sustainable industrial cooling and heating. To do so, RE-WITCH will demonstrate advanced thermally driven industrial cooling technologies based on ADsorption and ABsorption processes driven by an optimized mix of low-grade waste and renewable sources (innovative high vacuum flat plate solar collectors).

Such solutions will be demonstrated in 4 demo sites (3 confirmed as of January 2024, in Greece, Spain and Poland) encompassing food and beverage sectors as well as industrial sectors where heat-to-cold solutions are not yet widely explored (bio-refinery). The activity will be completed by studying the replicability of proposed technologies in replication sites even integrated with District Heating Networks (DHN).

The project will be delivered by an industrial-driven consortium of 26 partners from 10 countries and it is composed by some of the most innovative SMEs, LEs and R&D centres in the field of industrial renewable H&C leveraging experience from industrial and EU-funded projects (HYCOOL, SO-WHAT, Indus3Es).

The multi-disciplinary composition of the consortium ensures that all the challenges (technical and non-) will be addressed to ultimately bring RE-WITCH solutions to the market by 2029. Innovative open access modelling platforms and engineering solutions will also be developed to facilitate the design, upscale, replication and integration in industrial processes of the proposed technologies. Thanks to a stakeholders' driven dissemination and communication campaign, RE-WITCH will ultimately demonstrate transformative technological solutions that unlock the combined potential of low-grade waste and renewable heat use in industries, hence also targeting integration of heat-to-cold technologies into relevant EU policies.

Project partners

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Abbreviations

GA	Grant Agreement
GAs	General Assembly
PC	Project Coordinator
PMT	Project Management Team
RMP	Risk Management Plan
WP	Work Package

1. EXECUTIVE SUMMARY

This deliverable focuses on the presentation of the Risk Management Plan approach that will be implemented during the RE-WITCH project. At first, the relevance of the proper risk management implementation is discussed, followed by the proposed methodology which will be applied in tracking and addressing the risks during the project activities. Finally, the current risk table defined internally to the project is presented. This table will be regularly updated by the WP leaders, with the support of the Risk Manager and the Coordination Team. It will be maintained as a living document on the project' repository accessible by the whole consortium.

2. RISK MANAGEMENT PLAN

The risk management plan (RMP) of RE-WITCH project is one of the core activities of WP1, 2 and 3, led by the coordination team at CNR, with the support of the entire consortium at each WP level. Setting up a RMP is of primary importance to guarantee the proper implementation of the foreseen activities. Indeed, as for any research and development project, both technical and administrative issues can arise during the implementation phase, which need to be carefully checked, identified, and solved to avoid major impacts on the whole project.

At this purpose, already at proposal stage, a preliminary list of possible risks associated with the project' implementation was defined and reported in Grant Agreement. Nevertheless, the risk management is a process that needs a continuous monitoring to guarantee that all the issues arising could be properly identified and addressed to minimize their impact. For this reason, the RMP is organized as an iterative process following the steps reported below:

- Risk identification.
- Risk analysis and evaluation.
- Risk treatment.
- Risk monitoring and review.

In the following section, first, the roles and responsibilities at consortium level will be introduced. Afterwards, each of the above reported steps will be described in detail.

2.1. ROLES AND RESPONSIBILITIES

Given the complexity of the project, with many partners and activities, it was decided to create a proper structure dedicated to the risk management. As reported in D1.1, dr. Valeria Palomba (CNR) was nominated as project Risk Manager. She will have the duty of setting up the risk table and to guarantee the proper implementation of the RMP. Her role will be supported by the project coordinator and by all the WP leaders, that will be in charge for the periodic check and update of the risk table, considering the possible risk materialization and mitigation measures to put in place as well as possible new risks arising.

A dedicated session for the project risks will be included in the PMT meetings whenever relevant updates need to be presented. Moreover, in each GAs a slot will be allocated to provide an overview to the entire consortium regarding the risk monitoring.

2.2. RISK IDENTIFICATION

Risk identification represents the phase during which the possible source of risks is identified and classified. A first classification is made between technical and administrative risks. Moreover, the identified risks are further differentiated between internal and external ones.

Technical risks are related to the implementation of the research and innovation activities described in the GA. Accordingly, their careful check is of primary importance for the success of the project itself. On this aspect, the role of WP leader is crucial, since they are the partners directly managing and implementing the technical activities of each WP.

Administrative risks are mainly linked with the overall management of the project, thus considering, for instance, the proper participation to the project' activities of all the partners, the information flow across the consortium, any budget and contractual-related issue etc.

For what it concerns internal risks, these arise from activities carried out in the framework of the GA by the project' partners. Differently, external risks are related to issues that cannot be managed by the project partners but are caused by uncontrollable sources, e.g. political issues, pandemic outbreak, legal factors affecting the project.

Depending on the nature of the risk and its source, different approaches can be proposed to manage it. Usually, technical and internal risks can be mostly manged directly by the consortium, while external and administrative risks often require different approaches that can involve agreements with actors not directly involved in the project.

2.3. RISK ANALYSIS AND EVALUATION

To analyse and evaluate the risk, two main factors need to be considered:

- The probability that a certain risk materializes during the project activities.
- The impact that the risk itself can have on the whole project implementation.

This classification can be applied to any risk, regardless its nature (i.e. internal vs. external, technical vs. administrative). Based on it, a table for the risk assessment can be prepared as represented in Table 1.

Table 1: Risk assessment table.

Risk Assessment	**Impact**			
Probability		High	Medium	Low
	High	High risk	High risk	Medium risk
	Medium	High risk	Medium risk	Low risk
	Low	Medium risk	Low risk	Low risk

According to the risk assessment table, the most urgent and critical risks can be immediately identified, and the proper contingency plan can be proposed and implemented. This will help in minimizing the issues for the whole project.

2.4. RISK TREATMENT

Once the risks materialize, a possible contingency plan must be implemented. The main aim of the plan is to either eliminate or reduce the impact of the risk.

In case of limited impact, it can be also decided to accept the minor deviation from the plan, without implementing any specific action. On the other hand, any risk that can cause a main impact on the project needs to be carefully addressed by the consortium partners.

The identification of mitigation measures and the partners in charge for their implementation are part of the roles of the PMT, where all the WP leaders, the RM and the PC are participating.

2.5. RISK MONITORING AND REVIEW

Once a risk is materialized and a contingency plan is implemented, every concerned WP leader will be responsible for the monitoring of the evolution of the contingency plan implementation. The outcome of the performed activity needs to be reported to the RM and the whole PMT. Specific

sessions of the monthly PMT meetings and GAs will be dedicated to the review of the risk table and the monitoring of the already materialized risks, to guarantee prompt reactions and possible corrective actions to propose even to the agreed contingency plan.

3. CURRENT RISK MANAGEMENT TABLE

The risk management table started from what was identified during the proposal preparation. At the beginning of the project, most of the identified risks are still represented by the original ones, nevertheless, the possibility of occurrence of new risks needs to be considered. Accordingly, to guarantee a continuous check and update of the risk table, a living document was prepared and shared on the project' repository under the 'WP1-3 Project Management' folder.

Each WP leader is in charge for the periodic update of the table and the communication to the PMT and the entire consortium when needed.

The table is reported in a spreadsheet organized with the following sub-spreadsheets:

- 'Risk DoA': spreadsheet where all the risks identified during the proposal preparation and listed in the GA are reported.
- 'WP1-3': spreadsheet reporting the administrative risks of the project. As for any of the other sub-spreadsheets, here the risks are differentiated between the ones already reported in the GA and the ones occurring during the project implementation.
- 'WP6-8': spreadsheet reporting the technical risks connected to the new technologies' development activities.
- 'WP4, 9-13': spreadsheet reporting the risks associated with the demo planning and implementation.
- 'WP5, 17': spreadsheet reporting the risks associated with the modelling and the replication activities.
- 'W14-16': spreadsheet reporting the risks associated with the exploitation, standardization, and business modelling activities.
- 'WP18-20': spreadsheet reporting the risks associated with the communication and dissemination activities.

Clearly, in case of update of the risks reported in the GA, this shall be reported in both the 'Risk DoA' sub-spreadsheet as well as in the concerned sub-spreadsheet related to the specific project' activities.

Following the risk management table organization, the partners in charge for the management of each sub-spreadsheet are the following:

- 'WP1-3': CNR (and STAM in case of specific contractual issues given the role of administration manager).
- 'WP6-8': SOR, HM, CNR.
- 'WP4, 9-13': UoB, IDP, SIGLA, TECNALIA.
- 'WP5, 17': UNIGE, STAM.
- 'WP14-16': IVL (and PNO for the topics related to exploitation activities, given the role of exploitation manager).
- 'WP18-20': IEECP.

In the following sections, the current structure of the risk table is reported. This represents the situation at the time of the deliverable submission. Being a living document, the table will be continuously updated and a second version of the risk management table will be presented at M24 of the project.

3.1. TECHNICAL RISKS AT EACH WP LEVEL

'WP6-8' spreadsheet:

Risks according to the DoA							
Description of Risk	**WP**	**Probability**	**Impact**	**Mitigation**	**Mitigated risk**	**Risk Materialized**	**Measures applied**
New adsorbent materials identified show high cost or reduced long-term stability	WP6	M	M	Employment of silica gel as adsorbent to optimize its operation under the RE-WITCH conditions, for instance improving heat and mass transfer thanks to better integration (e.g. by binder-based coating)			
Adsorption chiller design doesn't meet the capacity target.	WP6	M	H	In case of capacity lower than expected, a re-design phase will be carried out according to WP8 outcomes.			
Optimized adsorption components (pump, valves) too expensive and not mechanically stable	WP6. WP8	M	M	To reduce the cost of the pump, the 3D printed pump parts can be investigated at lab-scale using standard components in the demos; in case of low stability of the valves, standard ones will be implemented (higher maintenance frequency).			
Control strategy of the absorption chillers too complicated	WP7	M	L	The control strategy will be defined based on numerical evaluation to guarantee effectiveness. In case of issues in operation, it will be simplified losing a bit of flexibility			
Optimal absorption chillers design not realistic for large scale application	WP7	L	L	In case of issues with scale-up, HEXs and pumps will have to be put in parallel etc.			
Hybrid chiller having high pressure losses in the compressor section or overflow bypass circuit	WP7, WP8	M	M	Careful design supported by experiments. Redesign of flow duct or self-actuated overflow bypass in case of issues identified in			

				the lab-testing (WP7)			
Hybrid Chiller: insufficient tightness of flanged integration of compressor flow duct	WP7, WP8	L	H	Tightness test performed before any testing or commissioning activities and required tightness level restored. Sensor automatically checking the current pressure inside the machine installed to have continuous monitoring			
Solution circulation and condensation flow fail in the dual evaporator absorption chiller	WP7, WP8	L	H	The hydraulic connection will be adapted, by modifying the pumps and the control devices or installing backflow pumps.			
Delay in RE-WITCH technologies manufacturing and procurement	WP8, WP12, WP13	M	H	Conservative time estimation has been considered in the task definition (delivery delays due to the novelty of some of the equipment).			

Risks identified during the project implementation

Description of Risk	WP	Probability	Impact	Mitigation	Mitigated risk	Risk Materialized	Measures applied
Prototype parts delayed due to prevailing supply chain disruptions	WP6,WP 7	M	H	Start early with conceptual design and early ordering of critical components.			

Turbo Compressor for refrigerant water not available from external supplier	WP7	L	H	Identification of alternative supplier		Supplier Efficient Energy has been taken over by company Vertiv. Manufacturing of the eChiller, including the Turbo Compressor, has been stopped. Continuation by company Vertiv is under preparation.	Communication with company Vertiv (Italy) for supply of turbo compressor. Different sizes of compressor in discussion: 30 kW (evaporation) for lab-scale test. Higher capacity for Demo (COVAP) Communication with company Leviathan (France): Development of turbo compressor (higher capacity, about 100 kW) ongoing. Further information available in summer 2024.
Energy demand at demo site lower than expected	WP7	M	L	Modification of nominal design capacity, Modification of solar thermal system (size)		First analysis shows low on-site energy demand. To be confirmed.	Additional measurement of demand data in COVAP system
Refrigerant pumps does not work properly	WP6	M	H	Start early with conceptual design and preliminary test of the pump in vacuum pipes		First analysis show a potential cavitation issue	Test the chosen pump into similar operating condition and modify the speed of the rotor to a lower velocity
Air compressor provide water not warm enough from the waste heat circuit	WP6	L	H	Re-design the HT circuit and plan a different flow and dT. Work with the local Kaeser compressor representative to find a suitable solution to work with the compressor		The hot water recovered from the air compressor does not reach the optimal temperature to turn on the adsorption prototype	

				with higher recovery heat temperature			

'WP4, 9-13' spreadsheet:

Risks according to the DoA							
Description of Risk	**WP**	**Probability**	**Impact**	**Mitigation**	**Mitigated risk**	**Risk Materialized**	**Measures applied**
Inadequate physical details of the demo sites for implementing DTwin counterpart	WP9,WP12 , WP10	M	M	Setting up a demo management structure, planning monthly meeting from the beginning, gathering all the info needed and make a clear planning for each phase of the demo design.			
Difficulties to gather legal and technical requisites in the different demo-site countries. Differences in rules, regulations, and policies.	WP9,WP12 , WP10	M	H	Detailed analysis of the regulatory framework for each demo site performed right at the beginning of the project. Continuous update through the established working group and support provided by each demo also relying on local engineers who will finalize all the processes for the demo engineering.			
Proper integration between the DTwin model of the demos and the control/monitoring platform	WP11, WP9, WP10	M	M	In the preliminary phases: 1) choose a platform generally used for industrial/research simulation; 2) choose a common approach to the simulation, to make all changes or additions to the plant simulation scalable and flexible.			
RE-WITCH technologies have issues of integration in the demo sites	WP4, WP12	L	H	Integration of RE-WITCH technologies will be analyzed at first in WP4 and then in WP12 to minimize the issues and the interference with the industrial processes. All time aspects will be tracked carefully to avoid delays.			

Delay in RE-WITCH technologies manufacturing and procurement	WP8, WP12, WP13	M	H	Conservative time estimation has been considered in the task definition (delivery delays due to the novelty of some of the equipment).			
Lower performance of the proposed technologic concepts	WP13	M	M	Measures will be taken to trade performance against cost or vice versa.			
Demo site 4 is not still confirmed	WP4, WP6, WP7, WP9, WP13	M	H	Ask the Project leader to progress on the engagement of the final industry to be involved.	No	Yes	Demosite identified and under negotiations
Lack of reliable data for characterization of industrial cooling demand and waste heat availability	WP4, WP9	M	H	If needed, the project will also leverage on prior energy audits know-how collected and curated from past industrial and EU-funded projects.			

Risks identified during the project implementation

Description of Risk	WP	Probability	Impact	Mitigation	Mitigated risk	Risk Materialized	Measures applied

'WP5, 17' spreadsheet:

Risks according to the DoA

Description of Risk	WP	Probability	Impact	Mitigation	Mitigated risk	Risk Materialized	Measures applied
Replication sites data are few and not easy to allow integrated use of WP5 modelling tools	WP5, WP17	L	M	Integration of data from historical projects performed by the consortium and other industrial sectors processes compatible. Soft integration of modelling tools by stand-alone replication studies and results cross-comparison			

Risks identified during the project implementation

Description of Risk	WP	Probability	Impact	Mitigation	Mitigated risk	Risk Materialized	Measures applied

'WP14, 16' spreadsheet:

Risks identified during the project implementation

Description of Risk	WP	Probability	Impact	Mitigation	Mitigated risk	Risk Materialized	Measures applied
Difficulties in selecting KERs	WP14-WP16	L	L	All the results that can potentially be exploited (Exploitable Results) will be analysed, in case of doubts the selection of Key Exploitable Results (KERs) will be expanded so as not to exclude any relevant result			
Difficulties in collecting the information necessary for the characterization of KERs	WP14-WP16	L	L	Meetings have been planned with the project partners, if necessary additional meetings will be organised both online and in person			
Uncertainty of the possibility to identify contractual factors and business model concept for the new demonstrator to be included in the project, later than initially expected.	WP14-WP16	L	M	Status of new demonstrator is followed closely and plans to collect information is adjusted accordingly.			

'WP18, 20' spreadsheet:

Risks according to the DoA							
Description of Risk	**WP**	**Probability**	**Impact**	**Mitigation**	**Mitigated risk**	**Risk Materialized**	**Measures applied**
Lack of participation by external stakeholders	WP18-WP20	M	M	Performing of additional workshops, leveraging the connection of many partners with industrial and research communities.			

Risks identified during the project implementation							
Description of Risk	**WP**	**Probability**	**Impact**	**Mitigation**	**Mitigated risk**	**Risk Materialized**	**Measures applied**

3.2. ADMINISTRATIVE AND MANAGEMENT RISKS

'WP1-3' spreadsheet:

Risks according to the DoA							
Description of Risk	**WP**	**Probability**	**Impact**	**Mitigation**	**Mitigated risk**	**Risk Materialized**	**Measures applied**
Cost of raw materials and components on the market increased	All	M	M	In case of extra costs, and internal re-assessment in the consortium will be carried out to support the demo phase.			
WP's resources not well balanced	All	M	L	Constant monitoring by PC. If needed, resources will be reallocated by the PC with approval of WP leaders.			
Project delays due to external major forces (e.g. pandemic crisis)	All	L	H	Even without physical meetings project activities would progress smoothly, thanks to a sharing/working environment setup at the start of the project for the consortium.			
Slow or ineffective communication inside a large consortium	All	M	H	A high focus on internal communication will be raised at the kick-off meeting and maintained thereafter. Each WP leader will organize monthly meetings to increase the info exchange among the consortium			

Risks identified during the project implementation							
Description of Risk	**WP**	**Probability**	**Impact**	**Mitigation**	**Mitigated risk**	**Risk Materialized**	**Measures applied**
Financial issues and/or bankruptcy of a partner	All	L	H	All partners are financially sound to the knowledge of the coordinator. In the even of withdrawal of one of the partners, the ones with similar profile will be involved to apply the provisions of the Grant Agreement (GA). Consortium has sufficient			

				strength and diversity so that other partners can assume more tasks besides their own ones.			
Some partners may not agree with the IPR rules, with negative impact on the exploitation and dissemination of the results.	All	L	M	A dedicate task on IPR is foreseen. The Project Management Team will take appropriate action for protecting, sharing, and developing the intellectual property rights of the project, according to the rules from Horizon Europe programme.			

4. CONCLUSIONS

Within D1.2, the risk management plan of RE-WITCH is presented. Specifically, the expected approach to monitor, identify and address potential risks for the project' implementation is discussed. The risk table already prepared during the GA phase is integrated with risks identified during the project and each WP leader, under the guidance of the RM and the whole PMT, is in charge for its periodic update. A living document is uploaded in the form of spreadsheet on the project' repository, to properly monitor the risks materializing and the contingency plans implemented. Dedicated sessions during the monthly PMT meetings and the GAs will be organized to the risk management activities.

On M24 a second version of this deliverable will be prepared and submitted to provide an update regarding the risk management implementation.

5. REFERENCES

- RE-WITCH project. D1.1 Project Management Plan - first version. March 2024.