



# HYCOOL-IT

HYBRID COOLING & MANAGEMENT  
FOR IT INFRASTRUCTURES

## WP6 – Exploitation and Standardisation 1

Task 6.2 Product/Services definition, Exploitable  
Results identification & management and IPR  
treatment

### **D6.2 Exploitable Results table V1**



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## Executive Summary

The goal of HYCOOL-IT project is to propose a standardised comprehensive set of processes, digital tools and advanced adsorption equipment to achieve a replicable cost-effective thermal management and energy optimisation of tertiary buildings with high energy demand IT Rooms.

This report presents an overview of the exploitable results of the Hycool-IT project identified during the first 18 months of the 3-year project. The report provides an overview of the strategies and actions needed for adoption and exploitation of results generated by the Hycool-T project. As such, it provides a framework for identifying, developing, and optimising the exploitation of the project results during the project and after its completion.

Eleven exploitable results have been identified which are summarised under three categories: 6 Products & Applications, 3 Knowledge, and 2 Other (standards, methodology). It is envisioned that 1 of the results will be exploited on a commercial basis and the remaining 10 results will be made available for free for public or scientific exploitation.

An assessment of expected project foreground conducted within the project revealed two key exploitable results:

1. **Hycool-IT Solution:** A combination of building digital twin technology and software-in-the-loop simulation software accompanied by engineering guidelines and supported by recommendations for new standards and policies. The Hycool-IT solution combines the individual results of the project into a solution that enables the IT server room construction and operation industry to maximise energy efficiency.
2. **Rack-integrated adsorption chiller:** An advanced version of the rack-integrated adsorption chiller as developed by SORGE. The innovations make the chiller more efficient, adaptable, and reliable, particularly in environments with fluctuating demands, such as data centres, thereby offering substantial operational and environmental benefits.

The methods and products developed in Hycool-IT will contribute to the energy efficiency of IT server rooms and the further digitalisation of the construction industry and can be of great benefit for all stakeholders involved. This report forms the basis for the exploitation plan that will be delivered in Month 36.

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# 1 Introduction

## 1.1 Scope

The present public deliverable is an initial version of the project's exploitation plan, the final version being due at the end of the project (M36 – November 2026). The main aim of the work presented is to maximise the economic, scientific, and environmental impact of the project and initiate timely action for the preparation of post-project exploitation and replication activities. The presented information will help the project partners with the preparation and focussing of exploitation activities and the management of the accompanying IP.

## 1.2 Audience

The target group of this deliverable includes:

- Hycool-IT partners, especially those partners who are owners or developers of one or more exploitable results. Specific interest is given to those partners developing a service which can be interconnected with others to increase its efficiency.
- Market players in the construction and renovation industry, especially those players targeting the tertiary sector, manufacturers of IT server room equipment, and developers of simulation and digital twin software.
- The European Commission to provide a clear understanding on which organisations, which results and how the expected results and potential economic, social and environmental impact of the project will be managed.

## 1.3 Contributions of partners

The main author of this deliverable is R2M Solution (WP6 leader).

R2M Solution contacted all project partners in order to collect their Exploitable Results. This has resulted in an updated list of Exploitable Results which can be found in Chapter 3. The owner(s) of each Exploitable Result have also been contacted one by one and interviewed in order to assess the expected impact and innovation risk of their result.

## 1.4 Relation to other activities

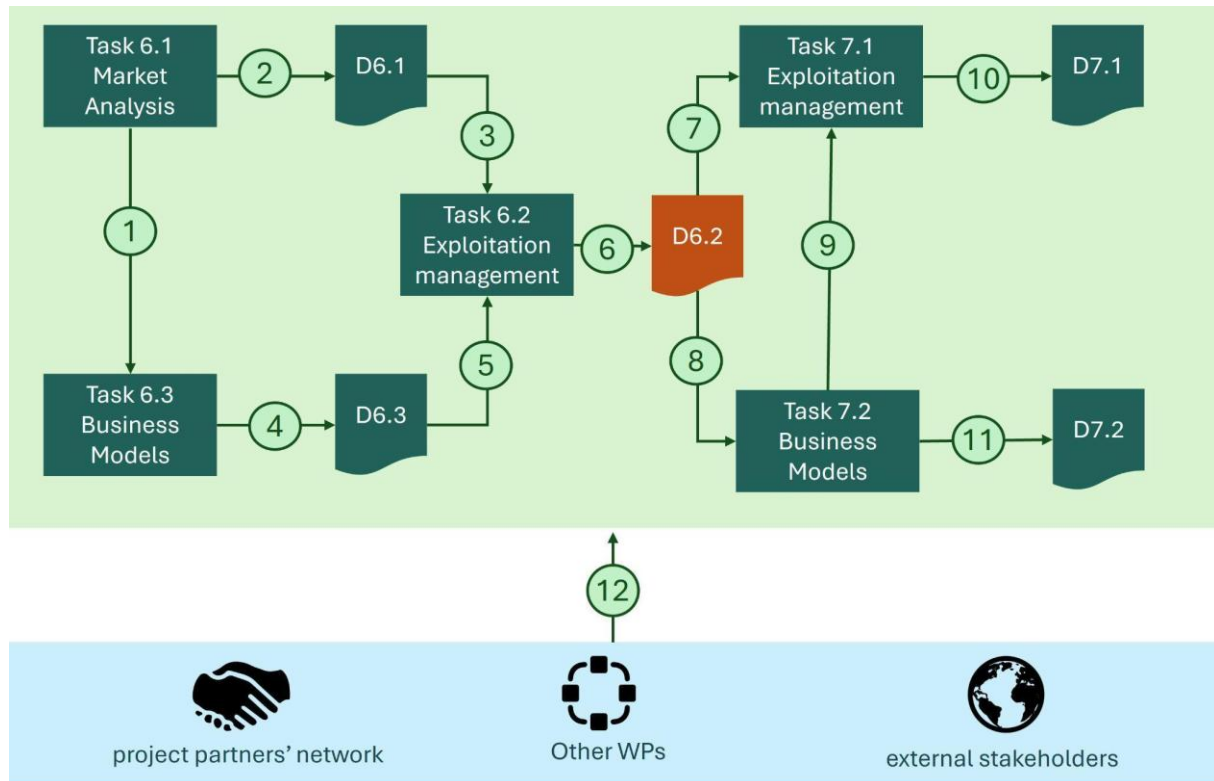


Figure 1 - Relationship of D6.2 with other activities and deliverables

Figure 1 illustrates the relationship of this deliverable to other activities and deliverables in the HYCOOL-IT project. These relationships are represented as links numbered from 1 to 12 and are described as follows:

**Link 1:** Task 6.1 conducts a market analysis, focussing on the relevant market segments for HYCOOL-IT covering building digital twin, cooling solutions for IT server rooms, and energy efficiency. The selected target markets set the scope for the analysis of relevant business models.

**Link 2:** The results of the market analysis, including an overview of the key actors in the HYCOOL-IT business ecosystem, drivers and barriers, and a PESTEL analysis, are presented D6.1.

**Link 3:** The results of the market analysis sets the business context for the project results for which the draft exploitation plans will be developed in Task 6.2.

**Link 4:** Based on the selected target markets, Task 6.3 conducts an analysis of the dominant business models in the HYCOOL-IT business ecosystem and drafts an initial business model for the HYCOOL-IT solution.

**Link 5:** The overview of the business models of key actors in the HYCOOL-IT ecosystem and the initial business model for the HYCOOL-IT solution, as presented in D6.3, will be input for the preparation of the exploitation plans for the project results as developed in the other WPs.

**Link 6:** Based on the market research performed in Task 6.1 and the business model analysis from Task 6.3, the initial exploitation plans and IPR strategies for the project results are described in this report, D6.2.

**Link 7:** The draft exploitation plans as described in D6.2 are a starting point for Task 7.1 which will finalise the exploitation plans for the project results.

**Link 8:** The draft exploitation plans as described in D6.2 are a starting point Task 7.2 which will validate and finalise the business model for the HYCOOL-IT solution.

**Link 9:** The results of the business model validation activities as conducted in Task 7.2 are input for the TA 7.1 which will develop the final exploitation plans for the project's results.

**Link 10:** The final exploitation plans for the project's results, including IPR measures, will be presented in D7.1.

**Link 11:** The final business model for the HYCOOL-IT solution, including an overview of the validation results will be presented in D7.2.

**Link 12:** The input from the project partners and external stakeholders, together with the solutions developed in the other work packages, are used as input for the market analysis and definition of the HYCOOL-IT business model and exploitation plans.

## 1.5 Document structure

The report is structured in five chapters. This introductory chapter describes the goals and outline of the document as well as the position of the document related to the project context. The remainder of this document is organised as follows:

- **Chapter 2** describes the methodology used for the management of exploitable results.
- **Chapter 3** provides a summary overview of the exploitable results of the project.
- **Chapter 4** presents the draft exploitation plan for the smart building digital twin, using the strengths of the combined project results.
- **Chapter 5** provides the expanded view of the individual exploitable results, presenting more detailed information for each of the results. A short description, ownership, maturity level, exploitation vision, IPR, related Work Package, and deliverables are described for each of the ERs.
- **Chapter 6** presents the conclusions of the report outlining the implications for the wider activities in the Hycool-IT project.

## 2 Methodology

This chapter describes the methodology used for the identification and management of the exploitable results of the project. It clarifies the different steps that led to the definition of the exploitable results, exploitation strategies and exploitation plans presented in this report. In doing so it explains how the outcomes of this work will drive future activities and contribute to the impact of the project.

This section has been conceived using R2M's exploitation methodology, which has been developed across time as R2M has fulfilled this role in several EU projects (e.g. PARMENIDES GA: 101096453; ENERGY MATCHING GA: 768766). Although continuous improvements happen, the core of the methodology is common to other deliverables and, for this reason, the table of contents, some pictures and some text modules are similar or very similar to other ERs tables developed in the framework of previous projects.

### 2.1 Exploitable results

As a base definition, Exploitable Results (ER) are the achieved and/or expected results coming from the project that will have an impact on the economy, environment and/or society as a whole. These results have commercial or social significance and can be exploited as stand-alone products, processes, services, etc. In principle, these exploitable results might need further R&D, prototyping, engineering, validation after the project ends and before they become commercially exploitable.

Exploitable results can be categorized into several areas. They are not rigid but, for here, the following areas are considered:

- **Products & applications** – items for sale (e.g., hardware or software)
- **Processes** – ways to make or do something
- **Knowledge** – valuation of “how to”
- **Services** – by offering the above products, processes, equipment, or knowledge
- **Other** – Platform, publications, patent....

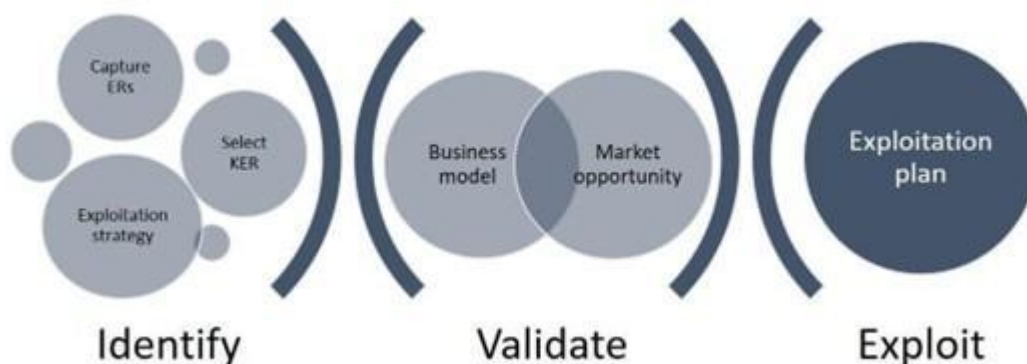
A Key Exploitable Result (KER) is an identified main interesting result (as defined above) which has been selected and prioritised due to its high potential to be “exploited” – meaning to make use and derive benefits- downstream the value chain of a product, process or solution, or act as an important input to policy, further research, or education. For Hycool-IT, two KERs have been identified based on innovativeness and impact:

1. **Hycool-IT Solution**, which combines the individual exploitable results of the project resulting in a solution that helps further digitalisation of IT server room design and management.
2. **Rack-integrated adsorption chiller**, a next generation cooling solution that comes with a smart digital twin.

## 2.2 Overall strategy for the management of exploitable results

The exploitation of the project's results means to make use of the results produced in further activities (other than those covered by the project, e.g. in other research activities; in developing, creating and marketing a product, process or service; in standardisation activities).

The overall strategy for the management of exploitable results can be broadly divided in the three phases as shown in Figure 2-1.



*Figure 2 - Overall strategy for exploitation management*

The phases consist of a range of activities and are supported by a set of tools. Each phase is explained briefly below.

**Identify:** In this phase, exploitable results are being identified, collected, and analysed. The starting point is the list of project results as defined in the Grant Agreement. For each identified result key information is being collected like the manager of the ER, type of ER, the used background, the co-developers, the current and expected TRL, development status and initial exploitation vision. For the collection of this information, an ER-questionnaire has been distributed to the ER managers (Appendix 1).

**Validate:** In the Validation phase, it is being explored what kind of value propositions are being enabled by the ER. The focus shifts from the technical capabilities of the ER to the customer value and accompanying business model. A quick market analysis is being conducted and by engaging with target customers, end-users and other stakeholders, a check is done if the ER addresses a real need or problem. The goal is to come to a validated viable, feasible and desirable business model supported by the ER owner(s). Tools typically used in this phase are the business model canvas, value network model or value proposition canvas.

**Exploit:** In the Exploit-phase the exploitation plan is being detailed out. After having developed the business model in the previous phase, arrangements need to be made to secure post-project

exploitation of the ER. This involves setting up partner agreements, IPR agreements and secure funding for further commercialisation or development of the ER. This phase ends with the kick-off of the exploitation plan.

This three-phase strategy is a continuous process where during any time in the project, new project results can be identified as an exploitable result. To ensure timely identification of exploitable results, meetings with all project partners have been organised on a regular basis to discuss and review the list of (key) exploitable results.

### 3 Exploitable results - consolidated view

The following ER's are an expansion of the preliminary list of technologies and results proposed in the Grant Agreement and include results identified by the partners during the first 18 months of the project. Each ER is assigned to an ER manager who is responsible for providing information and updates on the result, defining the steps needed to reach full exploitation and launching it eventually into the market or in follow-up research activities.

Compared to the list of Results as presented in the Grant Agreement two new Results have been identified, being the Hycool-IT Solution (ER1) and the tool for waste heat reuse for IT-server rooms (ER11), and one Result, Design the waste heat integration with new gen thermal grids, has been merged with the Innovative engineering guidelines for ICT Server's Room design (ER9).

*Table 1 - Overview of HYCOOL-IT exploitable results*

#	Name & description	Type of ER	ER manager	Exploitation vision
1	Hycool-IT Solution	Other (Method)	IDP/BDTA	Public
2	Methodology for SIMBot creation	Knowledge	BDTA	Public
3	Methodology for predicting and optimizing building performance using SiL	Knowledge	BDTA	Public
4	SiL Predictive Control Module	Product / application	IMP	Public
5	Simulation Model Tracking System (SMTS) Module	Product / application	IDP	Public
6	Generic SIMBot libraries for IT rooms	Product / application	IDP	Public
7	Specific SIMBot of Rack-integrated adsorption chiller system libraries	Product / application	BDTA	Public
8	CEN TC442/WG9 new working item or CWA aggregating HYCOOL-It's ICT tools and methods	Other (standards)	BDTA	Public
9	Innovative engineering guidelines for ICT Server's Room design	Knowledge	R2M	Public
10	Rack-integrated adsorption chiller	Product	SORGE	Commercial
11	Tool for waste heat reuse for IT server rooms	Product / application	POLIMI	Public

## 4 Exploitation plan for the Hycool-IT Solution

This chapter presents the draft exploitation plan for the Hycool-IT solution.

### 4.1 The Hycool-IT solution

The Hycool-IT solution is a combination of building digital twin technology and software-in-the-loop simulation software accompanied by engineering guidelines and supported by recommendations for new standards and policies. A new innovative rack-integrated adsorption chiller is a first example where a physical component of an IT server room gets a digital equivalent which can be used for simulation and optimising energy performance purposes. The Hycool-IT solution combines the individual results of the project into a solution that enables the IT server room construction and operation industry to maximise energy efficiency. Figure 3 shows how the combination of exploitable results of the project as presented in Chapter 3, result in the Hycool-IT solution.

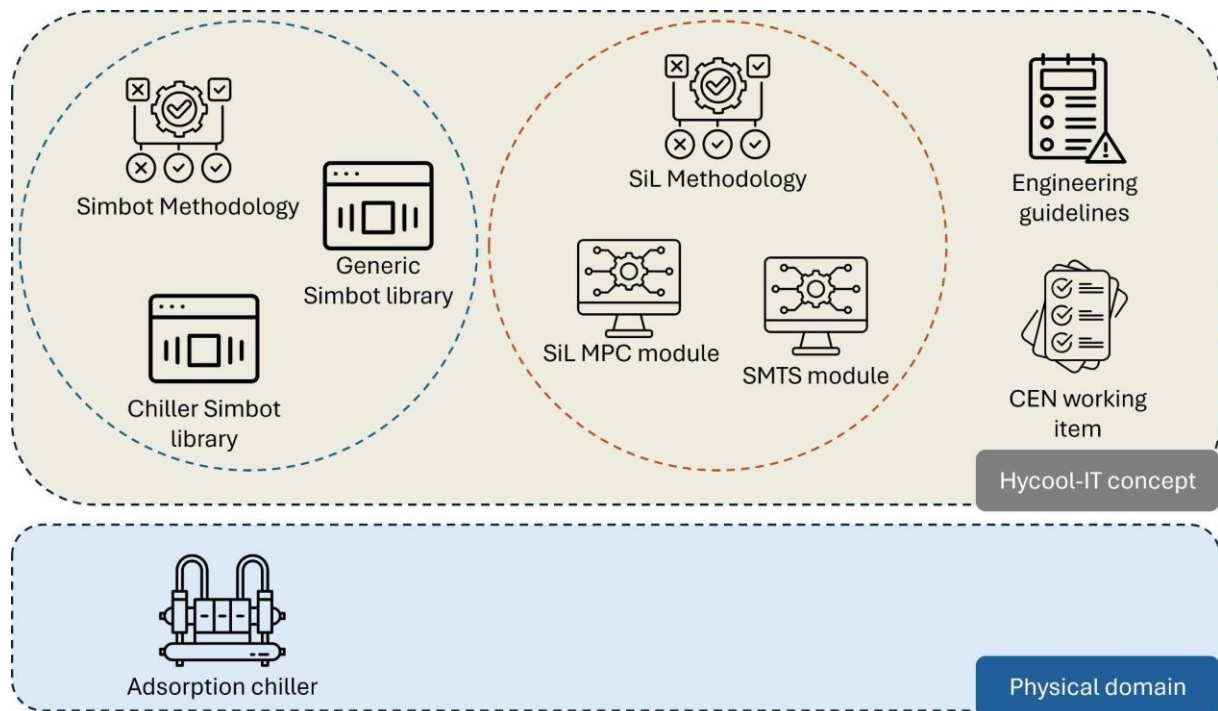


Figure 3 - Clustering of Hycool-IT Results

### 4.2 Hycool-IT value proposition and innovation

The innovative element of the Hycool-IT solution is the real-time coupling of the digital model with the physical IT server room and its components and equipment, allowing for optimisation of the energy performance of the IT server room during all phases of its lifecycle.

The Hycool-IT value proposition is its promise to the customer. Together the project partners developed the following value proposition statement: *“HYCOOL-IT solution enables IT server room operators in tertiary buildings to monitor, optimize, and improve the performance of existing or newly built IT server rooms from design to operation. Using real-time data and simulations, it provides insights into planned vs. actual performance and suggests efficiency improvements.”*

The Hycool-IT value proposition is worked out in more detail in Deliverable 6.3.

### 4.3 Target market

Hycool-IT targets IT server rooms in tertiary buildings. Tertiary buildings encompass a wide range of structures primarily used for service-based activities. The table below shows the different categories of service industry and buildings.

*Table 2 - Overview of tertiary buildings*

Service sector	Tertiary buildings
Hospitality and leisure	<ul style="list-style-type: none"> <li>• Hotels</li> <li>• Restaurants</li> <li>• Swimming pools</li> <li>• Gyms</li> <li>• Theme parks</li> </ul>
Commercial	<ul style="list-style-type: none"> <li>• Shopping centres</li> <li>• Office buildings</li> </ul>
Healthcare	<ul style="list-style-type: none"> <li>• Hospitals</li> <li>• Clinics</li> </ul>
Education	<ul style="list-style-type: none"> <li>• Schools</li> <li>• Universities</li> </ul>
Transport	<ul style="list-style-type: none"> <li>• Airports</li> <li>• Train stations</li> <li>• Bus terminals</li> <li>• Port</li> </ul>
Cultural	<ul style="list-style-type: none"> <li>• Theatres</li> <li>• Concert halls</li> <li>• Museums</li> </ul>

For the rack-integrated adsorption chiller to work efficiently, a minimum level of waste heat needs to be available. Service providers that require computing intensive tasks and applications for delivering their services are therefore the key target customers. Examples of such organisations are universities and hospitals which operate 24/7.

Typically, businesses have the following options for managing the storage and accessibility of their data and applications:

- **On-premise data centre:** A company houses its servers, networking hardware, or other necessary IT equipment in a facility that is owned and run by the company itself, often within their corporate office.
- **Colocation:** Housing hardware and IT equipment (while still owned by the enterprise) in a secure third-party facility.
- **Cloud data centre:** A cloud data centre is a facility owned by a cloud service provider who offer virtualised environments that enable organisations to store, process and analyse data and run applications over the Internet.
- **Hybrid data centre:** A mix of on-premises data centre components and virtual data centres components.

Hycool-IT focusses on the first type of users and customers, more specifically owners of tertiary buildings who are equipped with an in-house server room.

#### 4.4 Stakeholders and value web

The design, construction, operation and renovation of IT server rooms is linked to the lifecycle of the building of which the IT server room is part of. Figure 4 shows the key business actors and the value streams connecting these actors.

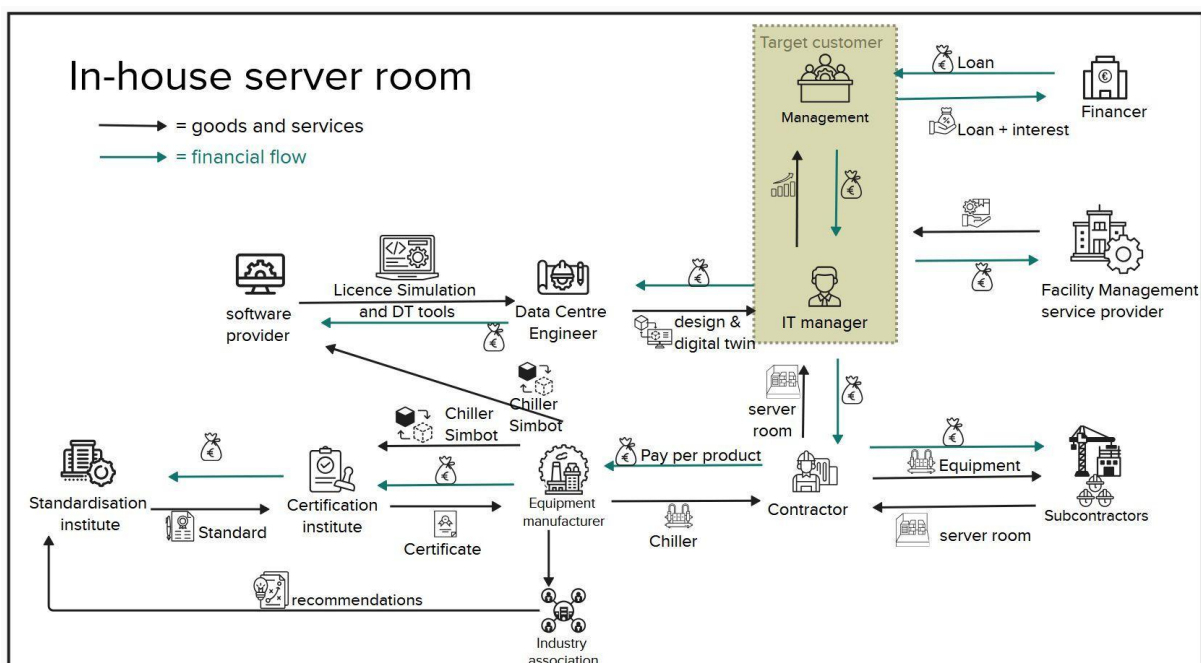


Figure 4 - Hycool-IT value web

Not all actors are active at the same time, depending on the phase in the lifecycle, actors are involved or not. For the Hycool-IT solution to work fully, multiple business actors need to adapt their way of

working and business model. The stakeholders in the Hycool-IT ecosystem are impacted directly or indirectly by the Hycool-IT solution. The impact of the Hycool-IT solution on key stakeholder's business models is further detailed in Deliverable 6.3. The table below presents an overview of the archetype and experience of the different stakeholders.

*Table 3 - Stakeholders Hycool-IT experience*

Stakeholder	Archetype	Experience
IT Manager	Governing user	Receives real-time performance data of the IT server room and recommendations for performance improvement
IT Staff	Direct user	Simulate scenarios and implement efficiency measures in the IT server room
Customer's Management	Governing user	Reduced down-time and increased energy efficiency of IT infrastructure
Facility Management service provider	Ambient user or direct user	Receives data centre performance information from digital twin. Could potentially manage the digital twin and optimise performance
Data Centre Engineer	Direct user	Designs IT server room and digital twin using SIMBOT components
Software provider	Intermediary user	Bundles SIMBOT libraries with its software
Equipment Manufacturer (racks, servers, cooling)	Direct user	Provider of SIMBOT component together with their physical products
Industry Association	Indirect user	Promotion of standard and SIMBOT method across the industry
Contractor	Ambient user	Engages with the digital twin and simulation results during the construction and commissioning of the data centre
Subcontractor	Ambient user	Engages with the digital twin and simulation results during the construction of the data centre
Certification Institute	Direct user	Need to train their staff and organise certification of new SIMBOT components
Standardisation Institute	Intermediary user	Adoption and publication of new digital twin standard

Exploitation activities are organised in such a way that the project engages with all stakeholders in order to gain their support for the adoption of the Hycool-IT solution. To ensure commitment and support from the key actors in the business ecosystem, the following organisations are involved in the development of the Hycool-IT solution.

*Table 4 - Stakeholders and their role in the Hycool-IT ecosystem*

Stakeholder	Involved party/parties	Role
IT Manager	POLIMI	The IT manager of the pilot lab will provide feedback about the perceived value of the solution.
IT Staff	POLIMI	The IT staff working at the pilot lab are end-users of the solution and will provide feedback about the user experience.
Customer's Management	POLIMI	Department management of POLIMI will provide feedback about the business case of the solution.
Data Centre Engineer	IDP	Developer of the digital twin and SiL solution.
Software provider	EcoSim Pro, Dymola	Providers of simulation software, exploring if SIMBOT libraries can be included in their software.
Equipment Manufacturer (racks, servers, cooling)	SORGE, Scheider Electric	SORGE is the manufacturer of advanced rack-integrated adsorption chiller. Provides information for developing a SIMBOT of their product. SE is the provider of the climate control system in the pilot and provides feedback.
Industry Association	REHVA	Promoting the Hycool-IT solution amongst its members and providing feedback from the HVAC industry.
Certification Institute	BDTA	Preparation of a CEN TC442/WG9 new working item.
Standardisation Institute	CEN	Preparation of a CEN TC442/WG9 new working item as a first step towards an enhanced building digital standard.

Since the Hycool-IT solution will change the way IT server rooms are designed, built, and managed, it has been identified that a new business role emerges which is responsible for the use of the digital

twin during the building's lifecycle. Traditionally, facility service companies offer building maintenance and support services. Their role could be extended with providing advice on efficiency measures and preventive maintenance using the Hycool-IT solution.

## 5 Exploitation plans for individual Results

This chapter presents a more detailed view of the individual exploitable results of the Hycool-IT project as listed in Chapter 3. The results are presented in no particular order. For each result, the type of result, owner, exploitation vision, IP ownership and protection measures, and their relation to project deliverables, is presented.

### 5.1 Methodology for SIMBots creation

<b>ER Type</b>	Knowledge	<b>ER Manager</b>	BDTA
<b>TRL before Hycool-IT</b>	3	<b>TRL after Hycool-IT</b>	6
<b>Related WP</b>	WP1	<b>Related deliverable(s)</b>	D1.3

#### Short description:

Development guidelines for SIMBots. Based on the pilot in the data centre of POLIMI, a set of libraries for real time mathematical simulation will be developed. The guidelines will be extended to underpin the creation of a specific SIMBot targeting KET1.4 new component potential equipment's certification tests, as future key service to manufacturers of appliances and equipment for construction. The guidelines will be assessed as a potential standardization framework and its potential presentation in CEN442 WG9.

#### Innovation:

SIMBOT standardization can enable quick conceptual development of data centres in the design phase. Can be used to assist in operation (like a virtual AI operator) and will be improving the efficiency of the installation. It can make profitable mathematical simulation, improving control strategies.

#### IPR protection plan:

The methodology will be protected by copyright. Contents will be public and included in a standard, but protection of copyright makes BDTA the manager for future implementations. The methodology as presented in Deliverable 1.3 should be copyrighted and final libraries with the ontology will be registered as well.

#### Exploitation vision:

Public use. Standard development. Coordination with software developers (Dymola, SimulationX, Ecosimpro). Once these developers are implementing market libraries, a deployment in the market with big manufacturers will be possible.

Target users are software developers and mid-size engineering firms. The methodology will help them reduce the time for defining the concept of data centre installations (from 3-4 weeks to 3-4 hours). Dynamics and simulation as contractual definition and scope of investment.

Pitch: “Model based AI helps the operator to improve the Data Centre exploitation”.

## 5.2 Methodology for predicting and optimizing building performance using SiL

ER Type	Process	ER Manager	BDTA
TRL before Hycool-IT	3	TRL after Hycool-IT	6
Related WP	WP1	Related deliverable(s)	D1.3

### Short description:

Integrated simulation in real time, considering weather and server load, building performance and occupancy. SMTS (Simulation Model Tracking System) methodology for predicting malfunction or operation problems, connected to the DCIM system. What-if scenarios and prediction based on expected loads and weather. Optimization strategy assisting the operator in real time.

### Innovation:

This methodology uses model-based AI in real time, assisting the operator to take decisions concerning operation modes, maintenance and supervision in general.

### IPR protection plan:

To check who the owners of the IP are. BDTA, POLIMI, IDP, and IMP will, most likely all contribute to this result. To be checked if an IP agreement is needed. The methodology will be protected by copyright. Contents will be public and included in a standard, but protection of copyright makes BDTA the manager for future implementations.

### Exploitation vision:

Public. The methodology will be used to define common uses in real time of SIMBOTs and mathematical simulation. Some KPIs would be accepted as they are coming from standardized simulations. Target customers are software developers and mid-size engineering firms. Usually, the “operator” in a Data Centre usually is not specialized personnel on HVAC or process. This methodology will be assisting that operator to supervise and optimize the installation in a better way.

### 5.3 SiL Predictive Control Module

ER Type	Product/application	ER Manager	IMP
TRL before Hycool-IT	2	TRL after Hycool-IT	7
Related WP	WP2	Related deliverable(s)	D2.3

#### Short description:

SIL (Software-In-the-Loop) based MPC (Model Predictive Control) algorithms are a type of control algorithm that use a software simulation of a physical system to optimize the control actions. The algorithm predicts the future behaviour of the system using a mathematical or data-driven model and optimizes the control actions over a finite time horizon, taking into account constraints on the system inputs and outputs. The algorithm will be used to control equipment by following the input coming from measurements in the data centre and BDT as well as simulation. The SIL-based MPC algorithm can be divided into two main components: the model and the optimizer. The model is a mathematical representation of the system that predicts the future behaviour of the system based on the current state and the control inputs. The optimizer takes the predicted behaviour of the system and determines the optimal control actions over a finite time horizon.

#### Innovation:

- **Simulation-based testing:** The algorithm uses software simulations to predict and test control strategies before they are used in real systems. This reduces risk and allows for safer and more efficient development.
- **Real-time adjustments:** The algorithm continuously adapts based on real-time data from the data centre, optimizing system performance and responding quickly to changes in conditions.
- **Optimized control within limits:** It takes into account system limits, ensuring the best possible control actions without exceeding equipment capabilities, which is important for safe and energy-efficient operation.
- **Predictive control:** By predicting future behaviour, the algorithm can act in advance, improving stability and avoiding potential problems before they happen.

#### IPR protection plan:

The result could be exploited as a module within the BDTA platform or as a standalone module. IMP will be the sole owner of the result. The result will be given in a form of software module which will be protected by copyright. An IP agreement needs to be put in place before the end of the project.

#### Exploitation vision:

The SIL Predictive Control Module is a software solution designed to be easily integrated into Building Management Systems (BMS), helping optimize energy use and control equipment in real time. By

connecting with the DTwin Platform, it can use both real-time and simulated data to predict and improve system performance. The goal is to first showcase its ability to enhance efficiency in data centres, with the potential to later be deployed in real-world systems like BMS for broader use.

The SIL Predictive Control Module allows customers to simulate and predict how the system will perform in real-world conditions before actual deployment. This predictive capability helps identify potential issues early on, enabling more efficient planning and system adjustments. Once integrated into a BMS, the module offers real-time control and optimization, leading to benefits such as reduced energy consumption, improved operational stability, and lower overall costs, all while ensuring that systems run efficiently and within their operational limits.

*Pitch: “Our SIL Predictive Control Module helps data centres and building automation companies who aim to optimize energy efficiency and enhance system performance by enabling them to test and refine control strategies on the DTwin Platform using both real-time and simulated data before deployment. This unique capability ensures confident implementation of solutions that lower costs, improve operational efficiency, and minimize risks.”*

#### 5.4 Simulation Model Tracking System (SMTS) Module

ER Type	Product/application	ER Manager	IDP
TRL before Hycool-IT	3	TRL after Hycool-IT	5
Related WP	WP2	Related deliverable(s)	D2.3

##### Short description:

This tool integrated into the DTwin environment will capture the dynamic characteristics and off-design performance of the HYCOOL-IT system under different working conditions. In this way, this tool will unify and display in the same interface/dashboard both Real (Monitoring) and Synthetic (Simulation) Dynamic Data Sets coming from the same Digital Twin Prototype and/or Instance. The effect of heating/cooling load on the dynamic behaviour of the HYCOOL-IT systems in the IT-Server rooms of tertiary buildings can be displayed after running the dynamic simulations, showing the heat performance that has been estimated. The SMTS will display the main parameters values simulated and will make a comparative representation against the real time measurements coming from the installed sensors. The geometrical disposition of the sensors (simulated and real) will be located in the same place, so the digital twin can establish precise correlations among the sensors, their location and the parameters estimated and measured.

##### Innovation:

The simulation will analyse the dynamic behaviour and performance of the Hybrid Cooling system under various operating conditions, including off-design scenarios. A control strategy will be

implemented to optimize system performance. Additionally, the simulation will evaluate the system's ability to meet hourly heating and cooling demands of the server room building.

**IPR protection plan:**

The Result will be jointly developed by IDP, IMP, and BDTA. The Result will be patented. An IP agreement needs to be put in place.

**Exploitation vision:**

Commercial. Toolkit to improve geometrical HVAC simulations supported by real-time measurements. A new dynamic simulation software can be developed and exploited. Target customers are HVAC designers, refrigeration systems designers, architects, HVAC engineering companies, Universities and Research centres. USP is improvements in the design according to the working conditions of the HVAC systems and in the efficiency of the cooling/heating machines.

Exploitation actions to be taken in the coming period are to define IP ownership and licensing, access control and security, and prepare post-development IP transfer.

## 5.5 Generic SIMBot libraries for IT rooms

<b>ER Type</b>	Product/application	<b>ER Manager</b>	BDTA
<b>TRL before Hycool-IT</b>	3	<b>TRL after Hycool-IT</b>	6
<b>Related WP</b>	WP3	<b>Related deliverable(s)</b>	D3.4

**Short description:**

Generic SIMBOT libraries are good for the design process, before selecting a specific equipment model. Assumptions taken to generate a truly replicable basis will be done following recommendations of BDTA Simulation Working group for future standardization of such VIRTUAL, GENERIC components.

**Innovation:**

It tries to standardize the same libraries (for data centres) between all software vendors. This can make results comparable and vendor-independent

**IPR protection plan:**

BDTA is the single owner of the IP. Contents will be public and included in a standard, but protection of copyright makes BDTA the manager for future implementations. The methodology as presented in D1.3 should be copyrighted and final libraries with the ontology will be registered as well.

#### Exploitation vision:

Public. Development of a standard draft. Target customers are software developers and mid-size engineering firms. It supports them with the conceptual definition of a data centre with dynamic response, and integration with other installations.

## 5.6 Specific SIMBot of Rack-integrated adsorption chiller system libraries

<b>ER Type</b>	Product/Application	<b>ER Manager</b>	BDTA
<b>TRL before Hycool-IT</b>	3	<b>TRL after Hycool-IT</b>	6
<b>Related WP</b>	WP4	<b>Related deliverable(s)</b>	D4.3

#### Short description:

This result contains the definition and implementation of a specific SIMBot of the rack-integrated adsorption chiller (model based, with very easy use, with only few parameters). The implementation will be based on the recommendations of BDТА Simulation Working group for standardization of such models. The model for the rack integrated adsorption chiller will be adapted and implemented to create the corresponding SIMBOT.

#### Innovation:

There is no standard methodology for creating real time components for simulation, other than downstream connecting via input/outputs or co-simulation. This tries to go upstream in the simulation process, defining the basic mathematical components of the models (ports, fluids and basic components).

#### IPR protection plan:

BDТА is the single owner of the Result. IP will be protected by copyright, knowledge base.

#### Exploitation vision:

An ontology will be developed to represent all specific components and will be made publicly available. And commercial libraries could be developed based on that ontology.

## 5.7 CEN TC442/WG9 working item or CWA aggregating HYCOOL-IT's ICT tools and methods

<b>ER Type</b>	Other (standards)	<b>ER Manager</b>	BDTA
<b>TRL before Hycool-IT</b>	NA	<b>TRL after Hycool-IT</b>	NA
<b>Related WP</b>	WP7	<b>Related deliverable(s)</b>	D7.3

### Short description:

The HYCOOL-IT Consortium envisages the CEN Workshop Agreement (CWA) process as the most suitable given the project duration and relatively low TRL of the Rack-integrated adsorption chiller. The NWI (New Work Item) would directly focus on standards for mathematical simulation of data centres.

### Innovation:

There are no standards for the mathematical representation of simulation components

### IPR protection plan:

Project partners POLIMI and IDP will contribute to the development of the NWI. Once adopted, the new norm will be protected by copyright via CEN. The IP will be part of CEN's IP.

### Exploitation vision:

BDTA will advocate for the creation of a new Working Group in the EU-level Technical Committee. The HYCOOL-IT Consortium envisages the CEN Workshop Agreement (CWA) process as the most suitable given the project duration and relatively low TRL of the Rack-integrated adsorption chiller. The NWI is in preparation for a workshop in BDTIC5 in Kaunas 14th May 2025.

## 5.8 Innovative engineering guidelines for ICT Server's Room design

<b>ER Type</b>	Knowledge	<b>ER Manager</b>	R2M
<b>TRL before Hycool-IT</b>	NA	<b>TRL after Hycool-IT</b>	NA
<b>Related WP</b>	WP7	<b>Related deliverable(s)</b>	D7.4

### Short description:

This result is a set of standard guidelines to be used when designing ICT server rooms in tertiary buildings, either newly built or retrofitted. Such guidelines will align with existing standards to enable full replication. Guidelines will be provided by type of server room (small, medium, large) and by

climate zones. Guidelines will include design of waste heat integration with next generation thermal grids.

The know-how available from [www.dceureca.eu](http://www.dceureca.eu) will be used as a basis and further developed. A chapter of the publication will be devoted to the contribution of HYCOOL-IT 's technologies to the SET Plan and shared with IWG5 Energy Efficiency in Buildings.

**Innovation:**

The guidelines include state-of-the-art solutions for minimising the carbon footprint of IT server rooms like waste heat reuse, digital twin and software in the loop solutions.

**IPR protection plan:**

The guidelines will be jointly owned by the Hycool-IT consortium. The engineering guidelines will be made available as download (pdf) and in a limited number of printed versions for distribution at relevant events, and include a copyright statement.

**Exploitation vision:**

The guidelines will be made available to designers and architects on a free to use basis.

## 5.9 Rack-integrated adsorption chiller

<b>ER Type</b>	Product/application	<b>ER Manager</b>	SORGE
<b>TRL before Hycool-IT</b>	3	<b>TRL after Hycool-IT</b>	5
<b>Related WP</b>	WP5	<b>Related deliverable(s)</b>	D5.3

**Short description:**

This result is an advanced version of the rack-integrated adsorption chiller as developed by SORGE. Advancements are in the redesign of certain parts (e.g., gear pumps, heat exchangers, valves) and fine-tuning of the control system. The new version of the rack-mounted adsorption chiller will be subjected to extensive energy performance testing in a calibrated calorimeter at the POLIMI facilities. Test conditions are set according to cooling water temperatures and flow rates, room air temperatures and relative humidities, and heating resistor capacities (to simulate variable IT loads).

**Innovation:**

This result represents a significant leap forward in adsorption chiller technology due to its comprehensive redesign, enhanced control system, space-efficient rack integration, and rigorous performance testing. The innovations make the chiller more efficient, adaptable, and reliable,

particularly in environments with fluctuating demands, such as data centres, thereby offering substantial operational and environmental benefits.

#### **IPR protection plan:**

SORGE is the single owner of the IP. The IP will be protected by a Patent & Utility model. First application is foreseen in Germany, PCT application within 18 months, Nationalization for European Patent, US, China, Japan.

#### **Exploitation vision:**

- Commercial Exploitation
- Technology Demonstration and Validation
- Collaborative and Industry Partnerships
- Knowledge Sharing and Patents

The key aspects of the exploitation vision are:

- Commercialization of advanced Cooling Technology
- Market Positioning
- Leveraging Testing and Validation Results
- Sustainability and Energy Efficiency
- Strategic Partnerships and Industry Adoption

Target customer segments are: IT industry, Data centres, Server providers, Cooling industry.  
 Customer benefits are:

- Energy efficiency and cost reduction
- Reliability and Performance under Variable Conditions
- Scalability and Adaptability
- Sustainability and Environmental Impact
- Operational Flexibility

The USP is:

- Low electrical need;
- Higher PUE compared with State of Art;
- Rack-integrated solution.

*Pitch: "Our machine helps data centre owners to reduce energy consumption in servers by using innovative rack-integrated adsorption chillers."*

The rack-integrated adsorption chiller is expected to be market ready by 2028-2030.

## 5.10 Tool for waste heat reuse for IT server rooms

ER Type	Product/application	ER Manager	POLIMI
TRL before Hycool-IT	1	TRL after Hycool-IT	4
Related WP	WP3	Related deliverable(s)	D3.2

### Short description:

First version of a data-driven tool designed to optimize small server rooms by processing data from their status to produce KPIs for decision support for owners and managers. Waste-heat recovery is a particular focus of the tool in this first version as it can also evaluate the possibility of using the server room's waste-heat for space heating within the building.

### Innovation:

This tool can be considered innovative because it acts as a data-driven decision support system that assists managers of small server rooms in improving the energy efficiency of their IT infrastructure, placing an emphasis on the benefits of waste-heat recovery. The tool requires as main inputs the IT consumption of the room, geographical location (local climate conditions are considered), and building information related to space heating. This way, by evaluating changes to the server room cooling system and the introduction of waste-heat recovery for space heating, it produces KPIs that highlight possible energy, financial, and CO2 emission savings. These outputs can provide managers with the required information to evaluate the economic feasibility related to the investment behind those changes, and the possible valorisation of the recovered thermal energy. Building/server room owners could also use these outputs in making decisions for specific building-related targets, such as reducing the cooling system/space heating energy consumption for a decrease of bills related to the cost of energy.

### IPR protection plan:

POLIMI is the single owner of the IP. The IP will be protected by copyright.

### Exploitation vision:

Public. Target users/customers are managers of small server rooms located in public buildings from the tertiary sector. Considering the current topic of energy transition, and new policies/regulations regarding the energy consumption of small server rooms and public buildings, this tool could assist small server room owners in making decisions about possible investments to meet specific targets related to energy consumption. Considering waste-heat recovery specifically, the tool can also assist owners in deciding the impact of using the server room's waste heat within the building for space heating. The USP is that it is a "simple" data-driven tool that provides significant KPIs for optimizing small server rooms from public buildings by means of predictive-scenario modelling.

## 6 Conclusion

This report presents an overview of the exploitable results of the Hycool-IT project identified during the first 18 months of the 3-year project. The report provides an overview of the strategies and actions needed for adoption and exploitation of results generated by the Hycool-T project. As such, it provides a framework for identifying, developing, and optimising the exploitation of the project results during the project and after its completion.

Eleven exploitable results have been identified which are summarised under three categories: 6 Products & Applications, 3 Knowledge, and 2 Other (standards, methodology). It is envisioned that 1 of the results will be exploited on a commercial basis and the remaining 10 results will be made available for free for public or scientific exploitation.

An assessment of expected project foreground conducted within the project revealed two key exploitable results:

- 1. The Hycool-IT solution:** A combination of building digital twin technology and software-in-the-loop simulation software accompanied by engineering guidelines and supported by recommendations for new standards and policies. The Hycool-IT solution combines the individual results of the project into a solution that enables the IT server room construction and operation industry to maximise energy efficiency.
- 2. Rack-integrated adsorption chiller:** An advanced version of the rack-integrated adsorption chiller as developed by SORGE. The innovations make the chiller more efficient, adaptable, and reliable, particularly in environments with fluctuating demands, such as data centres, thereby offering substantial operational and environmental benefits

The methods and products developed in Hycool-IT will contribute to the energy efficiency of IT server rooms and the further digitalisation of the construction industry and can be of great benefit for all stakeholders involved. This report forms the basis for the exploitation plan that will be delivered in Month 36.

## Appendix 1 - ER Questionnaire



### EXPLOITABLE RESULTS QUESTIONNAIRE

#### ERXX - Title

##### DEFINITION AND PURPOSE

**“Results” are outputs generated during the project**, which can create impact during and/c after the funding period. Results are owned by the beneficiary that generates them; they can be used either by the project partners or by other stakeholders. **Typically, results are elements (knowledge, technology, processes, networks) that have potential to contribute to further work, research or innovations.** Administrative deliverables, reports or dissemination materials (e.g. publications) are often not results in themselves.

According to our Grant Agreement, each beneficiary must take measures aiming to ensure exploitation of its results by: using them in further research activities (outside the action); developing, creating or marketing a product or process; creating and providing a service; or using them in standardisation activities.

A first step in the exploitation management process is the analysis and monitoring of the Exploitable Results. This is the aim of this questionnaire.

General information			
<b>RESULT NUMBER</b>	<b>NN</b>	Title:	<b>Date</b>
<b>ER Manager / Owner</b>			
<b>Contributor(s) / Co-owner(s)</b>		-	
<b>Used Background</b>			
<b>Type of result</b>		<input type="checkbox"/> Product/Application <input type="checkbox"/> Service <input type="checkbox"/> Process <input type="checkbox"/> Knowledge <input type="checkbox"/> Other (specify)	
<b>Short description of the result</b>			
<b>Why is the result innovative?</b>			
<b>Current state of development</b>			

Current level of development for the result (TRL1-9)	
Expected level of development for the result (TRL1-9)	
Where will the result be demonstrated?	
Related deliverables	
<b>Exploitation Vision</b>	
Type of exploitation	
Exploitation vision	
Target customer(s)	
What customer problem does the result solve?	
Unique selling point	
Pitch	<i>Our RESULT helps CUSTOMER SEGMENT who want to JOB TO BE DONE by VERB 1 and VERB 2.</i>
Expected time for marketability	
<b>Intellectual Property Rights</b>	
Who is/are the owners of the IP?	
How do you plan to protect the IP?	(Patent, Industrial Design Rights, Copyright, Trademark, Trade Secret, No protection, Other -> Please specify)
IP protection strategy details	
IP Partner	
Agreement needed?	
IP Licence Agreement needed?	
Technology Transfer Agreement needed?	