Ref. Ares(2023)7422664 - 31/10/2023

Tech UPGRADE

D8.5 Impact assessment plan

Funded by
the European Union

This project has received funding from European Union's Horizon Europe's Research and Innovation Program under grant agreement No. 101103966. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.

Deliverable 8.5

Actual Submission Date:	**31/10/2023**
Produced by:	**Institute of Entrepreneurship Development**

TechUPGRADE

techupgrade.eu

HORIZON-CL5-2022-D4-01

Thermochemical Heat Recovery and Upgrade for Industrial Processes

Grant Agreement no.: 101103966

Start date: May 1st, 2023 - Duration: 48 months

DELIVERABLE FACTSHEET

Deliverable 8.1	
Nature of the Deliverable:	R — Document, report
Due date of the Deliverable:	M6 – 31/10/2023
Actual Submission Date:	M6 – 31/10-2023
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Dissemination level	
X	PU = Public
	PP = Restricted to other programme participants (including the EC)
	RE = Restricted to a group of the consortium (including the EC)
	CO = Confidential, only members of the consortium (including the EC)

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1 Public Summary

The TechUPGRADE project has developed a forward-looking impact assessment plan. Deliverable D8.5 *Impact Assessment Plan* of the TechUPGRADE project stands as a comprehensive guide, detailing the methodologies and overarching goals of our project's impact assessments. Designed with clarity and purpose, this document caters to a broad audience, ensuring everyone, from our dedicated project team to the informed public, gains a clear understanding of our objectives.

Within the TechUPGRADE project, we've outlined Key Performance Indicators (KPIs) across three pivotal categories:

Specific Technical Objectives: Focusing on technical enhancements, this dives into improvements of reactive materials and the harnessing of low-energy heat flows.

TechUPGRADE Systems and Market Integration: Emphasizing the bridge between technological breakthroughs and their market presence, this section underscores feasibility, thorough demonstrations, and a comprehensive impact assessment.

Dissemination, Exploitation, and Communication: A testament to our unwavering commitment to open communication, this category underscores the significance of widespread outreach, stakeholder interactions, and transparent project communication.

Further, the impact assessment and monitoring segment is dedicated to the methodical evaluation of TechUPGRADE's influences throughout its duration. Using a structured methodology, we collate, scrutinize, and derive meaningful insights from project-related data, ensuring our objectives are met with precision and efficiency.

Furthermore, inherent to our approach is the rigorous risk assessment mechanism, highlighting our proactive stance towards identifying potential challenges and crafting efficient strategies to address them. This ensures that the TechUPGRADE project not only achieves its goals but also sets new benchmarks for projects of a similar nature.

2 Introduction

Deliverable 8.5 Impact Assessment Plan has been designed to serve as a blueprint for understanding and quantifying the impacts of the TechUPGRADE project. This document delves into the methodologies, purposes and impacts of the assessment, addressing a wide audience, from the core project team to the general public.

2.1 Scope

This document outlines the strategies and methodologies that will be employed to assess the impact of the TechUPGRADE project. It encompasses the technical, financial, environmental, and societal dimensions of the project's outcomes. The scope also includes the identification of key performance indicators (KPIs) that will be tracked, data sources to be used, and the stakeholders that will be involved in the assessment process.

2.2 Purpose

The primary purpose of the Impact Assessment Plan is to:

- Provide a structured approach to evaluate the outcomes of the project against its intended objectives.

- Identify areas of strength and potential improvement.

- Ensure that the project delivers value to its stakeholders and does not adversely affect the ecosystem it operates in.

- Guide decision-making processes in subsequent phases of the project.

2.3 Context

The insights derived from Deliverable 8.5 will be pivotal in steering the project toward its intended goals and ensuring it meets the expectations of all stakeholders.

2.4 Intended Audience

Deliverable 8.5 ‘Impact Assessment Plan’ is intended for:

Project Team Members: To understand the evaluation metrics and ensure alignment with the project's goals.

Stakeholders: Including investors, partners, and end-users, to gain insights into the project's potential impacts and returns.

Regulatory Bodies: To ensure the project aligns with industry standards and norms.

General Public and Media: To maintain transparency and keep the community informed about the project's intentions and outcomes.

Section 3 describes the concrete objectives of the TechUPGRADE project, complemented by the relevant Key Performance Indicators (KPIs) and associated target values. These elements collectively support the overall vision of the project. Following this foundational framework, Section 4 highlights our rigorous methodology for continuously reviewing, evaluating and improving project results, underpinned by tools and strategies used to ensure optimal performance and delivery.

3 The TechUpgrade Impact Framework

The KPIs for the TechUPGRADE project are organised into three different categories, each of which plays a critical role in supporting the overall vision of the project:

Specific objectives (SO1 to SO5): Encompassing the field of technical improvements, this category is dedicated to the fine-tuning of reactive materials, up to the exploitation of low energy heat flows.

TechUPGRADE systems and market integration (TSM1 to TSM3): This section highlights the vital transition of technological developments to the market. It highlights the importance of feasibility, robust demonstration and in-depth impact assessment.

Dissemination, Exploitation and Communication (DEC): This component illuminates our firm commitment to transparent communication. It highlights the essential nature of outreach, stakeholder engagement and the broader communication of the project.

3.1 Specific Objectives KPIs

3.1.1 SO1: Optimization of Reactive Materials for Long-Term Cyclic Operations

KPI SO1 Category 'Optimization of Reactive Materials for Long-Term Cyclic Operations' aims to ensure that the selected reactive materials (salt hydrates) are not only suitable for immediate application but also maintain their efficacy in long-term cyclic operations within a specific temperature range. The KPIs that fall into this category are summarised in Table 1.

Table 1: KPIs for the Development and Optimization of Reactive Materials in Long-Term Cyclic Operations

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 1.1	Cyclic Stability	Number of Cycles Before Stability Decline	Number of Cycles	10	March 2025
KPI 1.2	Operational Temperature Range	Material Performance within Temperature Band	°C temperature range	≤250	March 2025
KPI 1.3	Conversion Speed	Time for Full Conversion	Minutes	10	March 2025
KPI 1.4	Energy Density	Energy Storage Capacity at Material Level	kWh/m³	300	May 2025

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 1.5	Production Cost in Mass Production	Cost per Kilogram in Mass Production	€/kg	≤3	August 2026

These KPIs, rooted in both scientific criteria and operational demands, serve as benchmarks for material performance. Below are the detailed descriptions of each of these pivotal KPIs, their targets, and the underlying rationale for their inclusion.

Cyclic Stability KPI 1.1: Number of Cycles Before Stability Decline

- **Target**: The material should remain stable for more than 10 cycles. If any sign of instability is observed within the initial 10 cycles, further tests up to 100 cycles should be conducted to confirm longer-term stability.
- **Rationale**: Material longevity and consistency in performance are paramount. A material that exhibits declining trends within the first 10 cycles might not be apt for extended use. Testing up to 100 cycles will provide a clearer picture of its durability and reliability.

Operational Temperature Range KPI 1.2: Material Performance within Temperature Band

- **Target**: Achieve consistent and optimal performance within the 150-250°C temperature range on the upgraded side while lower temperatures for the charging part will be possible.
- **Rationale**: The given temperature bracket is essential for the intended applications of these materials. It's crucial to confirm that the material can operate effectively and maintain its structural and functional integrity within these thermal limits.

Conversion Speed KPI 1.3: Time for Full Conversion

- **Target**: Achieve full conversion in less than 10 minutes.
- **Rationale**: Speed is of the essence, especially in scenarios demanding rapid responses. A swift conversion ensures that the material can meet these demands efficiently, potentially leading to operational cost savings.

Energy Density KPI 1.4: Energy Storage Capacity at Material Level

- **Target**: Attain an energy density surpassing 300 kWh/m^3.
- **Rationale**: A superior energy density indicates that even a minimal volume of the material can house a considerable amount of energy. This attribute translates into a compact, space-efficient storage solution, making it ideal for settings where space is at a premium.

Production Cost in Mass Production KPI 1.5: Cost per Kilogram in Mass Production

- **Target**: Keep the production cost under 3 €/kg.
- **Rationale**: Cost-effectiveness is a cornerstone of large-scale adoption. A production cost under 3 €/kg ensures the material's economic feasibility, making it a tantalizing proposition for mass production and broad market application.

3.1.2 SO2: Heat Upgrade Reactor Design for Cyclic Dehydration/Hydration Operations

This category focuses on the design attributes of the heat upgrade reactors. The overarching objective is to establish reactors that can efficiently handle the cyclic dehydration and hydration processes of selected salt hydrates. These reactors must demonstrate resilience and durability, especially in the context of mechanical and dimensional stability. The KPIs pertaining to this category are outlined in Table 2.

Table 2: KPIs for the Heat Upgrade Reactor Design for Cyclic Dehydration/Hydration Operations

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 2.1	Reactor Geometry Design	Optimal Reactor Shape and Configuration	Achievement Status	1 (Achieved)	April 2024
KPI 2.2	Reactor Sizing	Adequate Reactor Volume and Dimensions	Achievement Status	1 (Achieved)	April 2024
KPI 2.3	Reactor Type Selection	Appropriate Reactor Type	Achievement Status	1 (Achieved)	April 2024
KPI 2.4	Cyclic Stability	Number of Cycles Before Stability Decline	Number of Cycles	200	April 2025

In the pursuit of optimal performance and longevity for the cyclic dehydration/hydration operations with selected salt hydrates, the following KPIs have been established to guide reactor design and ensure its operational integrity.

Reactor Geometry Design KPI 2.1: Optimal Reactor Shape and Configuration

- **Target**: The reactor should be designed to facilitate efficient dehydration/hydration cycles, optimizing flow patterns, and ensuring even heat distribution.
- **Rationale**: Proper geometry will ensure consistent reactions, minimize dead zones, and optimize heat and mass transfer, crucial for the process's efficiency.

Reactor Sizing KPI 2.2: Adequate Reactor Volume and Dimensions

- **Target**: The reactor size should be suitable for the intended operational scale, ensuring that there's adequate space for the salt hydrates while also allowing for expansion and contraction during the hydration/dehydration cycles.
- **Rationale**: Proper sizing is essential to prevent overflow, ensure safety, and maximize operational efficiency.

Reactor Type Selection KPI 2.3: Appropriate Reactor Type for Cyclic Operations

- **Target**: Choose a reactor type (e.g., batch, continuous, semi-batch) that best supports the dehydration/hydration cycles of the selected salt hydrates.
- **Rationale**: The type of reactor chosen can significantly influence the efficiency and safety of the process, making this a crucial decision in the design phase.

Mechanical and Dimensional Integrity KPI 2.4: Reactor Durability Across Cycles

- **Target**: The reactor should display no mechanical or dimensional degradation for at least 200 cycles.
- **Rationale**: Durability ensures that the reactor remains safe and operational over its intended lifespan, reducing maintenance and replacement costs.

3.1.3 SO3: Proof-of-Concept Development and Demonstration for Reactive Material Structures

This KPI category revolves around the development and demonstration of a proof-of-concept for reactive material structures. The key performance indicators ensure that the developed structures replicate the thermochemical and thermomechanical characteristics observed in small-scale specimens and can be incorporated into a suitable reactor unit to showcase the proposed technology at Technology Readiness Level (TRL) 5. The breakdown is presented in Table 3.

Table 3: KPIs for Proof-of-Concept Reactive Material Structures

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 3.1	Material Characteristics Reproducibility	Thermochemical and Thermomechanical Reproducibility	Achievement Status	1 (Achieved)	August 2025
KPI 3.2	Reactor Integration	Integration into Relevant Reactor Unit	Achievement Status	1 (Achieved)	August 2025
KPI 3.3	Thermal Upgrade Effect	Temperature Lift for Solar Thermal and WHR Systems	°C	>100	August 2025
KPI 3.4	Cyclic Dehydration/Hydration Process	Number of Successful Cycles within Expected Temperature	Number of Cycles	≥100	August 2025

This category of KPIs ensures the technology's readiness, effectiveness, and reliability at a proof-of-concept scale, setting the stage for potential scaling and real-world application.

Material Characteristics Reproducibility KPI 3.1: Thermochemical and Thermomechanical Reproducibility

- **Target**: The proof-of-concept-scale reactive material structures should maintain consistent thermochemical and thermomechanical properties observed in small-scale specimens.
- **Rationale**: Ensuring the scalability of the material without losing its essential properties is pivotal for the technology's eventual real-world application.

Reactor Integration KPI 3.2: Integration into Relevant Reactor Unit

- **Target**: Successful incorporation of the developed material structures into a reactor unit fit for demonstrating the proposed technology.
- **Rationale**: The reactive material's practical application relies on its seamless integration into an appropriate reactor unit, making this a critical step in the development process.

Thermal Upgrade Effect KPI 3.3: Temperature Lift for Solar Thermal and WHR Systems

- **Target**: Achieve a thermal upgrade effect with a temperature lift greater than 100°C.
- **Rationale**: The ability to uplift the temperature significantly proves the efficacy of the material in solar thermal and Waste Heat Recovery (WHR) systems.

Cyclic Dehydration/Hydration Process KPI 3.4: Number of Successful Cycles within Expected Temperature Range

- **Target**: Consistent and effective dehydration/hydration process for at least 100 cycles within the temperature range of 150-250°C.
- **Rationale**: Verifying the material's performance over multiple cycles in the given temperature range ensures its reliability and effectiveness in long-term applications.

3.1.4 SO4: Integration of Scaled-Up Heat Upgrade System

The overarching goal of this KPI category is to devise technically feasible process designs for a scalable heat upgrade system. The integration of this system with industrial processes possessing waste heat flows should lead to optimized scenarios that are cost-effective in terms of Levelized Cost of Heat (LCOH). The relevant KPIs are outlined in Table 4.

Table 4: KPIs for Assessing the Technical Feasibility, Integration, and Scale-Up Strategy of the Heat Upgrade System.

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 4.1	Feasible Process Design	Technical Feasibility of Process Designs	Achievement Status	1 (Achieved)	January 2026

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 4.2	Integration with Industrial Processes	Compatibility with Waste Heat Flows	Achievement Status	1 (Achieved)	January 2026
KPI 4.3	Optimized Scenarios	Achieving Low LCOH	c€/kWh	4-6	February 2027
KPI 4.4	Scaled-Up Demonstration Strategy	Drafting an Effective Scale-Up Strategy	Achievement Status	1 (Achieved)	October 2026

This KPI category focuses on ensuring that the heat upgrade system, once scaled up, can be efficiently integrated into industrial processes, making the entire operation more cost-effective.

Feasible Process Design KPI 4.1: Technical Feasibility of Process Designs

- **Target**: Creation and validation of technically feasible process designs for the heat upgrade system.
- **Rationale**: Establishing the practicality and operability of the proposed designs ensures that they can be integrated smoothly into the industrial processes.

Integration with Industrial Processes KPI 4.2: Compatibility with Waste Heat Flows

- **Target**: Seamless integration of the heat upgrade system with industrial processes with waste heat flows.
- **Rationale**: To fully utilize and enhance the efficiency of waste heat flows, the integration needs to be smooth and complementary to existing processes.

Optimized Scenarios KPI 4.3: Achieving Low LCOH

- **Target**: Design scenarios that can offer an LCOH between 4-6 c€/kWh, aiming to go even lower than competing solutions like natural gas heaters.
- **Rationale**: A competitive LCOH is pivotal for the commercial success of the technology, ensuring it remains a cost-effective solution for industries.

Scaled-Up Demonstration Strategy KPI 4.4: Drafting an Effective Scale-Up Strategy

- **Target**: Draft a concrete and actionable strategy for the scaled-up demonstration of the integrated technology in real industrial conditions.
- **Rationale**: Having a clear roadmap for scaling up and demonstrating the technology is essential for its adoption in actual industrial environments.

3.1.5 SO5: Valorisation of Low-Exergy Heat Flows through Heat-Upgrade Solution

The primary aim of this KPI category is to harness and enhance the value of low-exergy, low-value heat flows. This involves the utilization of waste heat from cost-free processes, large-scale low-grade solar

heat, and district heating. The developed heat-upgrade solution is expected to deliver process heat within the temperature range of 150-250°C at competitive costs, while minimizing electricity consumption and maintaining a carbon-neutral approach. The relevant KPIs for this objective are delineated in Table 5.

Table 5: KPIs for the Heat-Upgrade Solution Targeting Low-Exergy Heat Flow Valorization.

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 5.1	Utilization of Low-Value Heat Sources	Successful utilization of various low-value heat sources (waste heat, solar heat, district heat)	%	100	July 2025
KPI 5.2	Affordable Process Heat Production	Production cost of process heat	c€/kWh	3-6 c€/kWh	February 2027
KPI 5.3	Reduced Electricity Consumption	Electricity usage compared to VCHPs	%	Below VCHPs by at least 700%	February 2027
KPI 5.4	Carbon Neutrality	Carbon emissions from the operation	%	0	February 2027

This category focuses on optimizing the use of low-value heat sources through the heat-upgrade solution, ensuring cost-effective, efficient, and sustainable heat production for various industrial applications.

Low-Value Heat Source Valorization KPI 5.1: Utilization of Various Low-Value Heat Sources

- **Target**: Successfully utilize various low-exergy, low-value heat flows, such as waste heat from processes at no cost, and large-scale low-grade solar heat or district heating.
- **Rationale**: Diversifying the types of low-value heat sources that can be used ensures the versatility and broad applicability of the heat-upgrade solution.

Affordable Process Heat Production KPI 5.2: Heat Production Cost

- **Target**: Provide process heat in the temperature range of 150-250°C at a cost of 3-6 c€/kWh, varying based on the specific heat source and target temperature.
- **Rationale**: Offering competitive production costs ensures that the solution remains an attractive option for industries seeking affordable and efficient heat sources.

Reduced Electricity Consumption KPI 5.3: Minimal Electricity Usage

- **Target**: Achieve operation with minimal electricity consumption, especially in comparison to Vapor Compression Heat Pumps (VCHPs).
- **Rationale**: Low electricity consumption not only reduces operational costs but also enhances the overall efficiency of the system.

Carbon Neutrality KPI 5.4: Carbon Neutral Operation

- **Target**: Operate the heat-upgrade solution in a carbon-neutral manner.
- **Rationale**: As industries move towards more sustainable practices, offering a carbon-neutral solution ensures environmental responsibility and meets the sustainability goals of potential adopters.

3.2 TechUPGRADE Systems and Market Integration KPIs

3.2.1 TSM1: Technical Feasibility and Market Integration of Heat Upgrade Systems

This category aims to ensure the heat upgrade systems' technical reliability and its acceptance and integration into the target industries. The KPIs presented in Table 6 measure the success of the technology's demonstration, its adaptability, and the progress in achieving market recognition.

Table 6: KPIs for Evaluating the Technical Feasibility and Market Integration of TechUPGRADE's Heat Upgrade Systems

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 6.1	Technical Feasibility	Successful validation of the thermochemical heat upgrade process: Multiple validations across configurations.	Achievement status	1 (Achieved)	February 2027
KPI 6.2	Versatility	Number of configurations effectively tested (e.g., source heat types, storage options)	Count	4	February 2027

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 6.3	Industry Engagement	Identified target industries (chemical, petrochemical, etc.) showing interest and engagement	Achievement status	1 (Achieved)	April 2027
KPI 6.4	Market Awareness	Recognition in the European industry, (inquiries, partnerships, or publications)	Achievement status	1 (Achieved)	April 2027

This category zeroes in on the technical feasibility, versatility, and industry engagement of the thermochemical heat upgrade process, aiming to bolster its recognition and application in the European industry.

Technical Feasibility KPI 6.1: Validation of the Thermochemical Heat Upgrade Process

- **Target**: Achieve successful validation of the thermochemical heat upgrade process through multiple validations across various configurations.
- **Rationale**: Ensuring successful validations across different configurations guarantees the robustness and reliability of the thermochemical process, thereby promoting its feasibility for real-world applications.

Versatility KPI 6.2: Testing Multiple Configurations

- **Target**: Test and effectively validate at least four different configurations, exploring various source heat types and storage options.
- **Rationale**: By examining a variety of configurations, the project can attest to the adaptability and flexibility of the thermochemical heat upgrade process, catering to a wide array of industrial needs.

Industry Engagement KPI 6.3: Target Industry Interest and Engagement

- **Target**: Secure interest and active engagement from key target industries, including sectors like chemical and petrochemical.
- **Rationale**: Engaging with primary industries and fostering their interest underscores the relevance and significance of the heat upgrade process in addressing contemporary industrial challenges.

Market Awareness KPI 6.4: Recognition in the European Industry

- **Target**: Achieve notable recognition within the European industry, manifested through inquiries, collaborative partnerships, or scholarly publications.
- **Rationale**: By establishing a firm foothold and gaining recognition in the European industry, the project paves the way for greater market penetration and real-world application of the thermochemical heat upgrade process.

3.2.2 TSM2: TechUPGRADE Demonstration and Technology Development

This category evaluates the progression and adaptability of the TechUPGRADE technology, which is developed via a comprehensive multi-disciplinary approach. Key focal points include diverse system configurations that consider temperature ranges, salt particle variations, and heat source integrations such as waste heat, solar thermal, and district heating. Demonstrations are planned at two critical sites: the DLR Thermochemical Upgrade Laboratory in Germany and the ABS Laboratory in Sweden, each with specific capacity targets and system configurations. Performance across varying temperatures, integration capacities, and adaptability in utilizing different heat sources form the core evaluation criteria for this category, which are summarized in Table 7.

Table 7: KPIs outlining the targets for the TechUPGRADE demonstrations and technology development across various laboratory settings.

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 7.1	Completion of TRL 5 demonstrations across designated sites.	Number of successful demonstrations conducted.	Count	2 demonstrations	February 2027
KPI 7.2	Attainment of specified power capacities during demonstrations.	Capacity achieved during demonstration.	kW	5 or 10 kW at DLR Lab; 35 kW at ABS Lab	February 2027
KPI 7.3	Ability to exhibit varied temperature ranges during demonstrations.	Range of temperatures demonstrated.	°C	150-250°C	February 2027

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 7.4	Successful integration with diverse heat sources during the testing phase.	Number of integrations with heat sources like waste heat, solar thermal, etc.	Count	At least 3 primary sources	February 2027

In the pursuit of advancing TechUPGRADE technology, several KPIs have been outlined to assess its demonstrations, capacity attainments, temperature versatility, and integrative capabilities with diverse heat sources.

Demonstrations Across Designated Sites KPI 7.1: Number of successful demonstrations conducted.

- **Target**: Successfully complete TRL 5 demonstrations across two distinct labs: DLR Thermochemical Upgrade Laboratory in Germany and ABS Laboratory in Sweden.
- **Rationale**: Demonstrating the technology in two different settings at TRL 5 showcases its adaptability and potential readiness for market introduction.

Attainment of Specified Power Capacities During Demonstrations KPI 7.2: Capacity achieved during demonstration.

- **Target**: Reach the intended demonstration capacity of 10 kW at DLR Laboratory and 35 kW at ABS Laboratory.
- **Rationale**: Achieving these capacities ensures that the technology can operate at industrial-scale, attesting to its feasibility and reliability for wider adoption.

Ability to Exhibit Varied Temperature Ranges During Demonstrations KPI 7.3: Range of temperatures demonstrated.

- **Target**: Showcase a versatile target temperature range from 150-250°C during demonstrations.
- **Rationale**: Demonstrating operation across a diverse temperature range signifies the technology's flexibility to cater to different industrial needs.

Successful Integration with Diverse Heat Sources During Testing Phase KPI 7.4: Number of integrations with heat sources

- **Target**: Integrate and test the technology with at least three primary sources of heat, including waste heat and solar thermal.
- **Rationale**: Successful integration with various heat sources verifies the solution's adaptability and relevance to current industrial infrastructures.

3.2.3 TSM3: TechUPGRADE Impact Assessment and Market Integration

This category focuses on understanding and enhancing the technology's positioning in the market by analyzing its strengths, weaknesses, opportunities, and threats, especially from the vantage point of potential end-users. The relevant KPIs are presented in Table 8.

Table 8: KPIs for Assessing TechUPGRADE's Social, Economic, and Business Impacts and Challenges in Target Industries

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 8.1	Evaluation of trade-offs	Optimization score balancing performance, economy, and sustainability	Score (0-100)	>85 (with 100 being perfect balance)	July 2026
KPI 8.2	Social Acceptance	Percentage of positive responses from end-users regarding the technology	Percentage (%)	>80% positive feedback	October 2027
KPI 8.3	Financial Advantages Quantification	Financial benefits for industrial users, lower cost of heat	Percentage (%)	≤50%	February 2027
KPI 8.4	Industry Engagement & Awareness	Successful engagement with the target industries	Achievement Status	1 (Achieved)	April 2027
KPI 8.5	Replicability & Audience Expansion	Wide industrial audience in target sectors	Achievement Status	1 (Achieved)	April 2027

Evaluation of Trade-offs KPI 8.1: Optimization score balancing performance, economy, and sustainability

- **Target**: Achieve a score greater than 85 (with 100 being the perfect balance) in the trade-off evaluation.
- **Rationale**: Ensuring an optimal balance between performance, economy, and sustainability is critical for the holistic success and acceptance of the TechUPGRADE technology in the target industries.

Social Acceptance KPI 8.2: Percentage of positive responses from end-users regarding the technology

- **Target**: Receive more than 80% positive feedback from the end-users.
- **Rationale**: Positive reception from end-users is crucial for the technology's adoption and market penetration, signifying its relevance and user satisfaction.

Financial Advantages Quantification KPI 8.3: Financial benefits for industrial users

- **Target**: Demonstrable financial benefits, either in terms of currency savings or a significant percentage improvement.
- **Rationale**: Highlighting tangible financial advantages will attract industrial users, ensuring the technology's profitability and cost-effectiveness.

Industry Engagement & Awareness KPI 8.4: Number of industries reached with awareness campaigns

- **Target**: Achieve successful engagement with the Food, Paper and Pulp, Chemical, and Petrochemical target industries.
- **Rationale**: Effective outreach and engagement with the primary target industries are essential for the technology's market penetration and industry-wide adoption.

Replicability & Audience Expansion KPI 8.5: Industry sectors showing interest

- **Target**: Garner interest from a wide industrial audience in the target sectors.
- **Rationale**: Diversified interest from multiple industry sectors reinforces the technology's applicability, versatility, and market potential.

3.3 Dissemination, Exploitation, and Communication KPIs

3.3.1 DEC: Online Outreach, Dissemination, and Engagement

This category gauges the effectiveness of TechUPGRADE's dissemination strategies across various platforms and media, encompassing both scientific and non-scientific audiences. The KPIs presented in Table 9 have been established to measure the progress, engagement, and overall impact of the TechUPGRADE project across various platforms and mediums.

Table 9: KPIs for TechUPGRADE's Digital Outreach, Dissemination, and Engagement Activities

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 9.1	Website Engagement	Total visits to TechUPGRADE website	Count	≥100,000	April 2027

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 9.2	Website Content Engagement	Number of deliverable downloads from the TechUPGRADE website	Count	≥5,000	April 2027
KPI 9.3	Social Media Reach	Combined followers across TechUPGRADE's social media channels	Count	≥10,000	April 2027
KPI 9.4	Partner's Web Reach	Average monthly visitors to partners' websites	Count	122,000	April 2027
KPI 9.5	Partner's Social Media Influence	Combined followers on partners' LinkedIn, Facebook, Instagram, etc.	Count	≥1,751,103 (across all platforms)	April 2027
KPI 9.6	Research Dissemination	Number of articles published in the listed scientific journals	Count	>25 articles	April 2027
KPI 9.7	Conference Attendance	Number of scientific conferences, congresses, and symposiums attended	Count	>20	April 2027
KPI 9.8	Video Engagement	Number of video releases and viewership	Count and Viewers	4 videos with ≥2,000 viewers	April 2027
KPI 9.9	Podcast Engagement	Number of podcast releases and streamers	Count and Streamers	5 podcasts with ≥3,000 streamers	April 2027
KPI 9.10	Press Visibility	Number of press releases and readership	Count and Readers	4 press releases with ≥100,000 readers	April 2027

ID	Criteria	Indicator	Unit	Target Value	Deadline
KPI 9.11	Print Material Engagement	Number of print dissemination designs (e.g., flyers, posters)	Count	≥50 designs	April 2027
KPI 9.12	Newsletter Impact	Number of newsletters and subscription rate	Count, Subscribers, and Opening Rate	9 newsletters with ≥5,000 subscribers and >20% opening rate	April 2027
KPI 9.13	Webinar Engagement	Number of webinars and reach	Count and Reach	4 webinars with a reach of 300 each	April 2027
KPI 9.14	International Colloquium	Number of expert attendees at the final international colloquium	Count	>50 expert attendees	April 2027
KPI 9.15	Exhibition Attendance	Number of attendees at the 14-day exhibition	Count	≥300 attendees	April 2027

Metrics in this category assess the project's digital footprint, its penetration into the scientific community and its engagement with industry and the public.

Website and Digital Engagement KPI 9.1: Total visits to TechUPGRADE website

- **Target**: Achieve a total of 100,000 or more visits on the TechUPGRADE website.
- **Rationale**: Ensuring broad awareness and engagement of the project is essential for its recognition, credibility, and eventual success.

Website Content Engagement KPI 9.2: Number of deliverable downloads from the TechUPGRADE website

- **Target**: Have at least 5,000 deliverable downloads from the website.
- **Rationale**: Active engagement and downloads of deliverables indicate a genuine interest and need for the project's outputs, enhancing its relevance and impact.

Social Media Outreach KPI 9.3: Combined followers across TechUPGRADE's social media channels

- **Target**: Garner a combined follower count of 10,000 or more across all TechUPGRADE's social media channels.

- **Rationale**: Social media provides an expansive platform for the project's visibility and engagement, influencing a broader audience range and fostering community support.

Partner's Web Reach KPI 9.4: Average monthly visitors to partners' websites

- **Target**: Record an average of 122,000 monthly visitors across all partner websites.
- **Rationale**: Engaging traffic on partner websites also enhances the visibility of TechUPGRADE, further asserting the project's relevance and strength.

Partner's Social Media Influence KPI 9.5: Combined followers on partners' LinkedIn, Facebook, Instagram, etc.

- **Target**: Amass a total of 1,751,103 followers or more across all partner's social media platforms.
- **Rationale**: The partners' influence and reach serve as a multiplier effect, amplifying the project's awareness and acceptance.

Research Dissemination KPI 9.6: Number of articles published in the listed scientific journals

- **Target**: Publish more than 25 articles in the specified scientific journals.
- **Rationale**: Publishing in recognized journals asserts the project's scientific validity, encourages scholarly discussions, and enhances its academic recognition.

Conference Participation KPI 9.7: Number of scientific conferences, congresses, and symposiums attended

- **Target**: Attend more than 20 recognized scientific conferences, congresses, and symposiums.
- **Rationale**: Active participation in conferences fosters networking, collaboration, and knowledge exchange, enhancing the project's integration in the scientific community.

Video Engagement KPI 9.8: Number of video releases and viewership

- **Target**: Release 4 videos with a viewership of at least 2,000.
- **Rationale**: Videos provide an interactive medium to communicate project achievements, and their reach indicates the audience's interest and engagement level.

Podcast Engagement KPI 9.9: Number of podcast releases and streamers

- **Target**: Release 5 podcasts with 3,000 or more streamers.
- **Rationale**: Podcasts are an emerging platform for deep dives into subjects, and their popularity can enhance the project's depth of understanding and engagement.

Press Visibility KPI 9.10: Number of press releases and readership

- **Target**: Issue 4 press releases with a readership of 100,000 or more.
- **Rationale**: Press releases in popular outlets enhance the project's visibility, credibility, and public acceptance.

Print Material Engagement KPI 9.11: Number of print dissemination designs (e.g., flyers, posters)

- **Target**: Produce 50 or more print dissemination designs.
- **Rationale**: Tangible promotional materials like flyers and posters provide an enduring reference and awareness tool, especially in physical events and locations.

Newsletter Impact KPI 9.12: Number of newsletters and subscription rate

- **Target**: Release 9 newsletters with 5,000 or more subscribers and an opening rate of more than 20%.
- **Rationale**: Newsletters are pivotal in updating stakeholders on project progress, and a high subscription and open rate indicates continuous interest and engagement.

Webinar Engagement KPI 9.13: Number of webinars and reach

- **Target**: Conduct 4 webinars, each reaching 300 individuals or more.
- **Rationale**: Webinars offer a platform for detailed discussion and engagement, and their reach indicates the project's relevance and the community's interest.

International Colloquium KPI 9.14: Number of expert attendees at the final international colloquium

- **Target**: Attract more than 50 expert attendees for the final international colloquium.
- **Rationale**: An engaging final event with expert participation is a testament to the project's significance and impact in the field.

Exhibition Attendance KPI 9.15: Number of attendees at the 14-day exhibition

- **Target**: Achieve an attendance of 300 or more during the 14-day exhibition.
- **Rationale**: Exhibitions provide a physical platform for showcasing achievements, and a high attendance indicates the tangible interest and relevance of the project's outputs.

4 Project Impact Monitoring and Assessment

The 'Project Impact Monitoring and Assessment' section aims to comprehensively track and evaluate the impacts of the TechUPGRADE project over its lifecycle. This section employs a systematic approach to collect, analyze, and interpret data related to the project's outcomes and effects. By examining key indicators and conducting rigorous assessments, we gain valuable insights into the project's contributions and identify areas for improvement. Through ongoing monitoring and periodic evaluations, we strive to ensure transparency, accountability, and evidence-based decision-making, ultimately maximizing the positive impact of the project.

4.1 The impact assessment tool

An integral part of the project's impact assessment process is the development of an impact assessment tool in the form of an Excel file. This tool serves as a comprehensive framework for evaluating and monitoring the project's impact based on the defined impact indicators outlined in the impact framework.

The impact assessment tool (see Figure 1) is designed to facilitate the systematic tracking and evaluation of the project's progress and achievements. It organizes the impact indicators into relevant categories and criteria, allowing for a structured and holistic assessment of the project's impact across multiple dimensions.

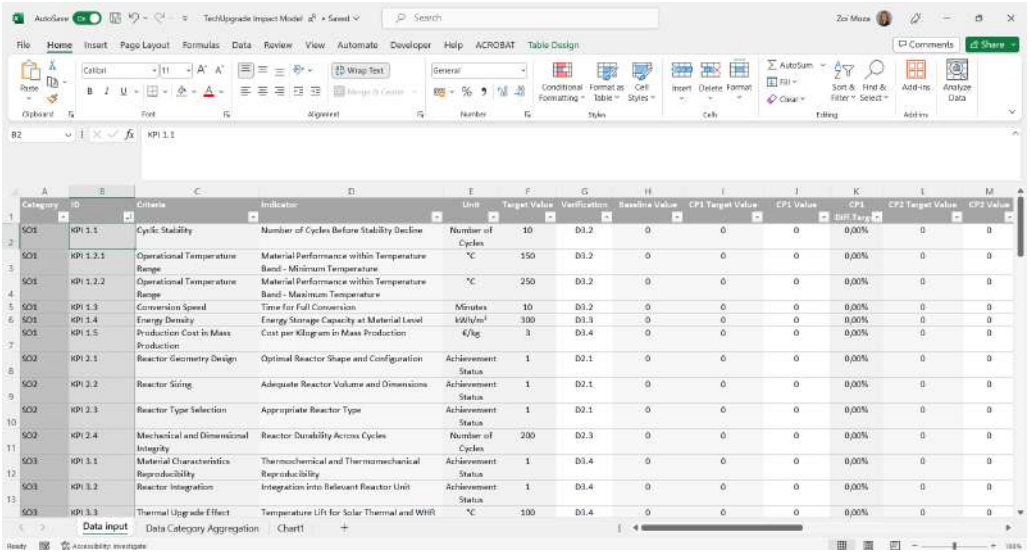

Figure 1: Data Input Worksheet of the Impact Assessment Tool

To ensure a thorough and accurate assessment, the impact assessment tool incorporates eight check points, each spanning a duration of six months (see Figure 2). These check points serve as significant milestones for evaluating the project's progress and impact at different stages of its implementation. The first check point (CP1) commences in October 2023, while the eighth check point (CP8) concludes in April 2027.

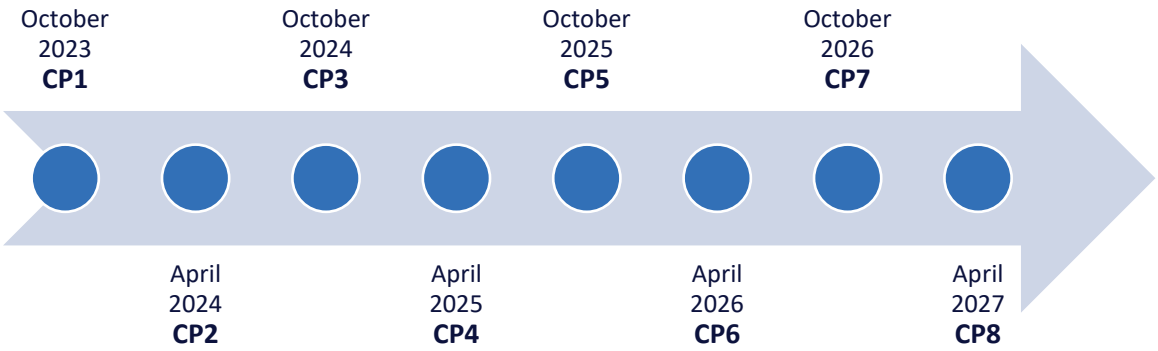

Figure 2: Project Impact Assessment Check Points Timeline

The impact assessment tool includes target values that need to be achieved at each check point. These target values are set based on the specific deadlines associated with each impact indicator. They provide clear benchmarks for measuring the project's progress and performance against the desired outcomes.

The columns in the impact assessment tool allow for tracking, comparing, and analyzing the progress of the project's impact indicators over time, providing a comprehensive overview of the project's performance and achievements. The following columns are included:

Category: Groups related indicators within the impact assessment framework to address different thematic areas of the project's impact.

Unique Identifier (ID): Assigns a distinct identifier for each indicator, facilitating individual tracking throughout the assessment.

Criteria: Pinpoints particular elements to assess the project's impact, providing context to the measurement.

Indicator: Details the specific metric used to gauge the project's impact.

Unit: Indicates the measurement unit for each indicator.

Means of Verification: This column is where users specify the relevant deliverable containing the data or information supporting the recorded values, ensuring a traceable source for each metric.

Baseline Value: Provides the starting point for each indicator before the project's launch for future comparison.

CP (Check Point) Target Values and Actual Values: From CP1 to CP8, these columns stipulate the target and observed values for each checkpoint, enabling periodic evaluations. The corresponding "Diff.Target" columns highlight any deviation from these set targets.

By utilizing the impact assessment tool, project partners can systematically evaluate the project's impact and make informed decisions based on the collected data. This tool serves as a valuable resource for project management, allowing for a comprehensive analysis of the project's performance and the identification of strengths, weaknesses, and areas for improvement. It enables the measurement of relevant KPIs for each WP, task, or deliverable, aiding the leaders in assessing their activities' impact. While a comprehensive report of the project's achieved impact is expected at the project's end (Deliverable D8.6 – Impact assessment report), the tool itself provides an overview of the impact and facilitates data-driven decision-making, ensuring accountability, and enhancing overall effectiveness.

Furthermore, the impact assessment tool supports the project's commitment to transparency and accountability by providing a structured and standardized approach to impact assessment. It helps partners gain a comprehensive understanding of the project's contributions, challenges, and areas of success, fostering a culture of learning and continuous improvement.

4.2 Data collection and analysis

The project team collects relevant data and information related to the impact indicators specified in the impact assessment tool. This data can be obtained through various methods, including internal project documentation, demonstration results, web and social media analytics, etc.

The collected data is analyzed to evaluate the project's impact based on the predefined indicators. This analysis may involve statistical techniques, qualitative assessments, and comparisons against established targets or benchmarks.

The findings from the data analysis are interpreted and synthesized to provide a comprehensive understanding of the project's impact. This involves drawing conclusions, identifying trends or

patterns, and assessing the project's strengths, weaknesses, and areas for improvement. The assessment results are compiled into a report or presentation.

The impact assessment findings are shared within the consortium. Feedback and recommendations are gathered to inform future project activities and decision-making. This iterative process helps refine and improve the project's strategies and interventions.

4.3 Responsibilities in Impact Assessment

In the process of tracking, measuring, and addressing the Key Performance Indicators (KPIs) within the impact assessment framework, clear roles and responsibilities are set to ensure that every aspect of the evaluation is appropriately managed and acted upon:

KPI Assessment:

- ***Responsible***: Deliverable Leader pertinent to each KPI.
- ***Role***: To ensure all evaluations are in harmony with the project's objectives, document the outcomes and findings in the respective deliverable, ensuring the data's relevance and accuracy.

Tracking Progress:

- ***Responsible***: Task Leader.
- ***Role***: To continuously monitor the progress of each KPI, capturing the latest data, and ensuring that checkpoints' values are timely recorded in the impact assessment tool.

Response Measures for Deviations:

- ***Responsible***: Coordinator and WP Leaders.
- ***Role***: In instances where there are deviations from target values, the Coordinator, in collaboration with WP Leaders, will be responsible for understanding the cause of the deviation, deciding upon corrective measures, and implementing actions to steer the project back towards its intended outcomes.

4.4 Contingency Framework for Impact-Related Challenges

The TechUPGRADE project places paramount importance on establishing a robust contingency framework to address challenges related to achieved impact potential and to effectively mitigate any associated risks. As part of the project's ongoing activities, the team undertakes risk evaluations to pre-emptively spot potential impact discrepancies that might surface during the project's progression. Upon recognizing such potential challenges, the team is committed to formulating effective strategies and interventions to counteract them. All identified challenges are duly logged in the Risk Management Register, as elaborated upon in Deliverable D1.3 - Quality Management Plan.

Some examples of impact achievement potential risks, along with corresponding mitigation strategies and response procedures are presented in Table 10.

Table 10: Potential Risks and Mitigation Strategies in Impact Assessment

Risk Reference Number	Potential Risk	Mitigation Strategy	Response Procedures
XXX	Inaccurate data collection leading to flawed impact assessment.	Implement rigorous data validation and verification processes.	Review and correct data sources. Engage external validation if necessary.
XXX	KPIs not capturing project's impact.	Regularly review and adjust KPIs to ensure they remain relevant and comprehensive.	Revise and update KPIs in consultation with project teams and stakeholders.
XXX	Delays in receiving data or feedback impacting assessment timelines.	Develop a clear timeline with deadlines for data submission.	Adjust the assessment schedule, communicate changes, and escalate to higher management if delays are significant.
XXX	Lack of clarity in impact assessment objectives.	Clearly document and communicate the objectives at the project outset.	Reconvene project teams to re-clarify objectives and ensure alignment across all stages of the assessment.
XXX	Potential biases in impact assessment due to conflicts of interest.	Maintain transparency in all processes and involve third-party validators if necessary.	Address the conflict immediately, involve neutral parties for objective evaluation, and if needed, redo the assessment.

5 Conclusion

This deliverable provides a comprehensive overview of the Key Performance Indicators (KPIs) that guide our progress and measure our success. Divided into three main categories, these KPIs serve as our navigational beacons, ensuring we stay aligned with our project's overarching vision.

As we continue our journey, these indicators will not only measure our achievements but also highlight areas for refinement, ensuring the TechUPGRADE project remains agile, responsive, and, most importantly, impactful. We are thankful for the collective effort of all team members, and as we look ahead, we are confident that our structured approach will yield significant benefits for both the industry and the broader community.

6 Annex: Impact Assessment Tool

The **Impact Assessment Tool** is an Excel spreadsheet designed to systematically track, measure, and evaluate the impacts of the TechUPGRADE project. This tool serves as an integral component in gauging the project's performance against its predefined objectives and benchmarks.

Key features of the file include:

Categories: These represent the various thematic areas within the impact assessment framework, grouping together related indicators and criteria that evaluate specific aspects of the project's impact.

Unique Identifiers (ID): Every impact indicator or criterion is assigned a unique ID, ensuring ease of reference and tracking throughout the project's lifecycle.

Criteria and Indicators: The tool defines specific criteria for assessing impacts and corresponding indicators that will measure and evaluate the project's outcomes.

Units of Measurement: For each indicator, the tool specifies its unit of measurement, ensuring consistent and standardized evaluations.

Baseline Values: These represent the starting values for each indicator, establishing a foundation against which progress can be measured.

Target and Actual Values for Check Points: For periodic evaluations, the tool includes columns for target values set for each check point, the actual values achieved, and the differences between these values, offering a clear picture of the project's trajectory over time.

Means of Verification: This section allows users to input relevant deliverables or sources where the information for each indicator is available.

The user-friendly layout and organized structure of the Impact Assessment Tool make it a pivotal asset for the project team, ensuring that impact evaluations are both thorough and efficient.

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Funded by the European Union

This project has received funding from European Union's Horizon Europe's Research and Innovation Program under grant agreement No. 101103966. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.