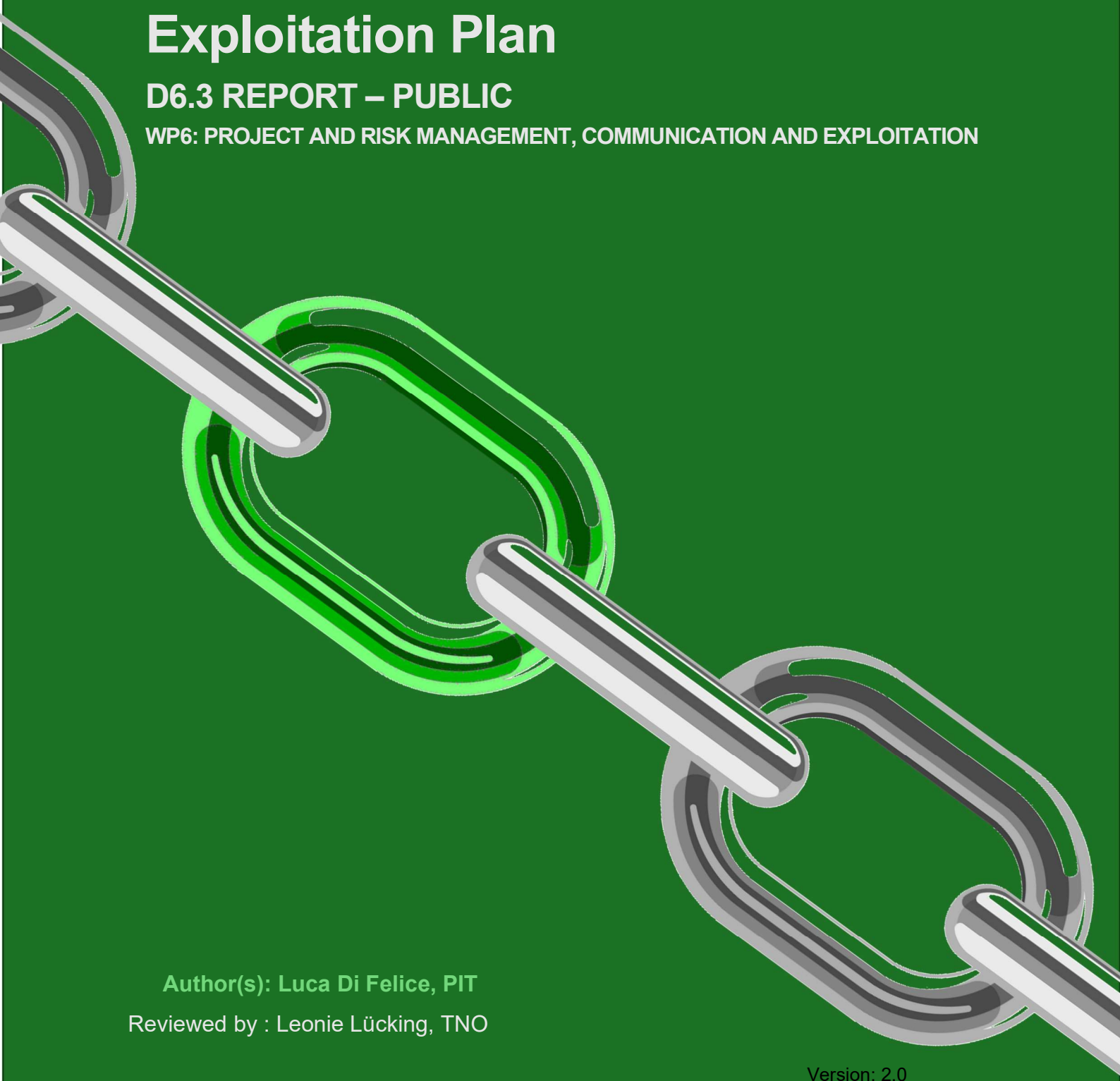
GreenSmith

PUBLIC

Exploitation Plan

D6.3 REPORT – PUBLIC

WP6: PROJECT AND RISK MANAGEMENT, COMMUNICATION AND EXPLOITATION



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Version Management

VERSION	DETAILS
V1.0	Draft report for review by consortium members
V2.0	Report after review

Disclaimer

Executive Summary

As part of the GreenSmith project, the present Exploitation Plan pre-identifies exploitable results by each Consortium partner, the types of exploitation, and the best platforms for each type of exploitation.

This deliverable's goal is to present an initial draft of the exploitation strategy that will be created over the course of the project. PIT will be in charge of the iterative, ongoing process of developing the exploitation plans, with input from all partners. Key Exploitable Results (KERs) of the GreenSmith project have been pre-defined and identified, in collaboration with partners.

Project exploitation activities will be closely linked to and aligned with dissemination activities to ensure that relevant stakeholders are contacted and involved for business purposes, including market requirements and preliminary market validation.

This initial exploitation plan clarifies initial KERs per partner, and gives an overview about the approach of the upcoming BFMULO analysis which serves as a basis for defining partners' individual exploitation plans.

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List of abbreviations

SEWGS	Sorption enhanced Water-Gas Shift
KER	Key Exploitable Result
TRL	Technology Readiness Level
CCS	Carbon capture and Storage
CCU	Carbon capture and Utilisation

1. Introduction

GreenSmith's pursuit of maximizing the chance of successful future implementations relies on a thorough analysis of technological, economic and societal insights. From this perspective, GreenSmith has identified, at proposal phase, the following preliminary exploitable business and scaling-up objectives:

1. Advancing beyond the conceptual stage, GreenSmith will develop a Basic Engineering Design Package with cost estimates for the capturing of 50 ktonCO_2/y from BFG with a TRL8 plant at ADI's site in Taranto (Italy). The package will include equipment sizing, 3D modelling, and cost-estimates based on time-resolved in-line sampling results from the relevant input streams considering future integration with a single blast furnace. The insights gained from the anticipated TRL8 installation are then expected to enable further scale-up objectives at ADI's site, where the streams from multiple blast furnaces could be treated, representing a CO_2 capture capacity of up to 2 Mt/y.
2. GreenSmith will create a comprehensive high-level qualitative European Steelmaking Heat Map by using existing public data on e.g. ore reserves and ore quality availability, CO_2 storage potential and renewable electricity availability, installed industrial capacity, geography, and work force. This evaluation will facilitate location-specific approaches for the decarbonization of the European steelmaking plants based on their unique regional characteristics, supporting the identification of suitable EU sites for exploitation.
3. In collaboration with relevant stakeholders, GreenSmith will create an overall implementation roadmap and collaborative strategy for at least one of the two implementation cases at Stegra and ADI production sites. The above-mentioned industrial scale-up objectives shall be considered by analysing and studying the complete CCS/CCU value chain, i.e. profitable use of the outlet streams from SEWGS units (CO_2, H_2) at the iron and steel plant, as well as transportation and storage solutions.

Other types of expected exploitation will lead to an improvement in innovation capacity and integration of knowledge at EU level. First, the European dimension of the GreenSmith consortium makes it possible to carry out the ambitious goals and scope of the project. The GreenSmith consortium provides an international consortium of partners that cover the necessary levels of technical resources, expertise and knowledge sharing, experimental infrastructures, and demonstration sites. Second, an integrated approach that can generate joint exploitation opportunities (e.g., TNO - Kisuma Chemicals, PIT - Acciaierie d'Italia), implying collaboration and information sharing on customers, sales channels, logistics, etc., which can diminish hurdles in exploitation. Third, an important exploitation potential of GreenSmith project comes from the large possibilities of replication of the demonstrated technologies: Acciaierie d'Italia owns several blast furnace gas facilities, a large part of which will need to be decarbonized in the following years; PIT, as engineering company, will also contribute to replication with different business models of full plants and/or plain decarbonization systems for different applications.

2. Key Exploitable Results

Key exploitable results can be considered as any output of the project (e.g. data or knowledge) that is innovative and can be used and replicated in different forms such as inventions, prototypes, services, further research activities. The aim of any exploitation plan is to maximize the use of these results for scientific, societal or economic purposes. Example of such uses are spin-off companies, commercial products, patents, licenses,

services, up to policy changes. It is therefore of utmost importance that Key Exploitable Results are properly identified as a first step to enable the exploitation route that will allow a result to impact in the society at different levels.

The GreenSmith partners have defined an initial Exploitation Plan for the foreseen key results with highest commercial significance. The resulting list of Key Exploitable Results (KERs) is shown in the next section. Considering that the project will focus on TRL 5 demonstration campaign and TRL8 design and engineering, follow-up activities and supporting actions will be planned as part of GreenSmith to move towards the commercialization of the relevant products based on these identified KERs. The list is a living document that is not meant to be exhaustive and in final form, rather will be updated continuously during the project by each partner under the coordination of the exploitation partner at PIT.

2.1. Detailed KERs characterization

Fifteen KERs have already been identified by the GreenSmith consortium partners and are described in the table below (TABLE 1).

TABLE 1. KER characterization

KER n°	KER achieved	Exploitation (use) of the KER	Intended owners(s)
1.1	Successful TRL5 demonstration of SEWGS applied to gas composition mimicking integrated BF-CH_4-DRP, and standalone H_2-DRP	Further research: campaigns needed to advance from TRL5 to TRL7-8.	TNO
		Non-specified IP generated from the Proof of concept of the integration and further	TNO
1.2	Understanding of what is needed to service the new type of steel making process enabled by GreenSmith	Service	Swerim
2.1	Novel functional materials with optimal composition for superior sorption kinetics and CO_2 selectivity	Further research: campaigns need to advance from TRL5 to TRL7-8. Production for demonstration scale (50.000 t/y) is targeted. Definition of needs TBD in a specific WP2 meeting	KC
2.2	Novel functional materials prepared with commercial shaping processes	Commercial product: commercialization of sorbent	KC
		Non-specified IP generated from shaping	TNO
2.3	Novel functional materials with better environmental footprints than SoA sorbents such as amines (LCA study). Impact on scope 3 emissions assessed	Commercial product: commercialization of sorbent. HTC will have better footprints (regarding both production and disposal) and this will make them more competitive on the market	KC
3.1	New iron-making process with integration of SEWGS in the defined case 1 and case 2 of the GreenSmith project	Internal database: From the relevant parameters that will be identified and analyzed (H&M balances, process KPIs) we will create an internal database to support technical (custom-specific) decisions	PIT

		Non-specified IP generated from the integration	TNO
3.2	TNO's model is capable of handling a multitude of different feeds, compositions, temperatures and pressures	Licensing: modelling tool for predicting SEWGS reactor performance for different integrations and applications	TNO
4.1	Technoeconomic assessment	Internal database: From the relevant parameters that will be identified and analyzed (electricity and steam consumption, CAPEX of the different units…) we will create an internal database to support future sales	PIT
4.2	Cost of plant is defined		
4.3	Life Cycle Assessment focusing on the environmental impacts of SEWGS integrations in different routes	Information/data: to drive steel producer choices to support environmental decision making at different levels (e.g. plants, units…) towards decarbonized I&S production. This includes also decisions on sorbent production and selection (see KER 2.3)	SWERIM
4.4	Scope 3 GHG emissions related to SEWAG integration opinions, particularly sorbent production, reuse and final disposal.		
5.1	Engineering of the GreenSmith process integration tailored to Taranto's site is achieved at TRL8	Pilot: GreenSmith process concept realized in Taranto's site at TRL8	PIT, AdI
		Commercial process: on the long term, GreenSmith is demonstrated and then realized at commercial scale	
5.2	Measurements & analysis of impurities in the gas streams	Further research: many chemicals to be analyzed	AdI
		Commercial process: GreenSmith plant	PIT, AdI
5.3	Safety, environmental / permits expertise for SEWGS integration at site	Commercial process: GreenSmith plant	AdI
5.4	Engineering of the GreenSmith reactors tailored to Taranto's site is achieved at TRL8	Commercial reactors: Design of SEWGS reactors at commercial scale compliant with fast-switching PSA regime and able to work under the pressure range of 1-20 barg during the consecutive CO_2-adsorption and desorption steps	PIT

For a comprehensive go-to-market analysis, further steps will be carried out to frame each KER in terms of:

- Value proposition
- Time to market
- Expected market size when reaching the market
- Cost to reach the market
- Expected product price
- Competitors
- Customers
- Background
- Foreground
- Exploitation form

- Other partners involved
- How other partners contribute

3. KERs and BFMULO analysis

After KERs identification, the next important step in the exploitation route consists in clarifying project results ownership. BFMULO analysis is often used to prepare the ground for the appropriate set up of protection of results and agreements among the Partners on the use of the foreground (results) after the project. Based on BFMULO the type of ownership of each result (single or joint ownership) will be discussed. BFMULO stands for:

- B = Background, e.g. existing knowledge or IP that a partner brings into the project
- F=Foreground, the results generated including IP rights
- M = Making and selling the products
- U = Using the result to develop new ranges of products or newer processes or further research activities, or a service
- L = Licensing the result to third parties outside the Consortium
- O = Other, any other exploitation means (e.g.: consultancy, services, etc.)

A BFMULO matrix as reported in TABLE 2 will be shared within the GreenSmith consortium partners in reference to each Key Exploitable Results identified, paving the way towards an optimal exploitation path with defined IPR protection and partners' individual exploitation plans.

Each partner will mark, in each cell, capital letters B, F, M, U, L, O in agreement with their expected placement in each specific result generated within GreenSmith.

TABLE 2. BFMULO table to be distributed among partners to protect results and support identifying ownerships.

Project partner	KER 1	KER 2	KER 3	KER 4	….			
KER title								
TNO								
PIT								
SW								
ADI								
KC								
H2GS								

4. 5 IPR management

Management of knowledge and intellectual property rights (IPR) is important in GreenSmith due to the involvement of multiple commercial organisations required for the successful deployment of the concept and preparation of commercial implementation after a TRL 8 demonstration which will include partnership between technology suppliers, material suppliers and end users. The IPR management has been reported in the CA to reflect at least the following:

- Inventor or the party who is his/her successor in title owns the IPR on the developed foreground.
- In cases results are generated jointly (i.e. where the separate parts of some results cannot be attributed to different participants), this will be jointly owned. The allocation and terms of exercising this joint ownership will be agreed in Joint Ownership Agreements.
- Non-exclusive access, free of charge, to background and foreground knowledge is granted to the other parties only as far as is required to execute the project.
- Partners are always provided with the access rights needed to exploit their results of the project either royalty-free, or under market conform conditions.
- IPR are managed subject to laws and regulations appropriate in the EU and the individual countries of the consortium members.
- Finally, prior to dissemination activities involving project results a formal approval process will be established in order to protect confidential data.

5. Conclusions

D6.3 “Exploitation plan” presents an initial roadmap to maximize the impact of the GreenSmith project, starting from the identification and characterization of Key Exploitable results from each partner. This will be followed by a BFMULO analysis that will be shared among partners. Once KERs will be fully identified and BFMULO completed, more detailed market assessment and go-to-market analysis will be defined to analyse the scenarios allowing GreenSmith outcomes to become tangible products outreaching the market after the end of the project.

In order to guarantee that appropriate stakeholders are engaged and involved for business purposes, including market requirements and preliminary market validation, project exploitation efforts will be linked to dissemination activities.