WP8 – Project Coordination & Management

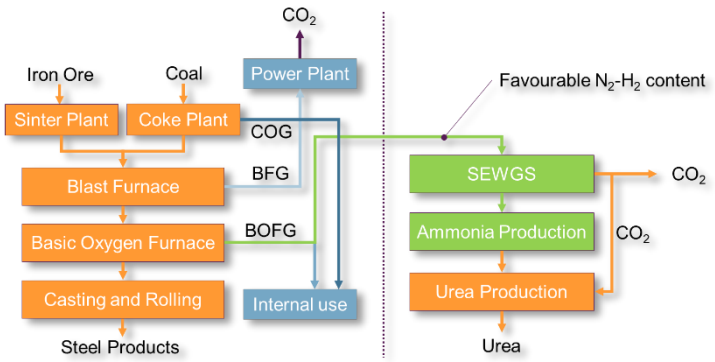
D8.3 – Progress Report M18

This Progress Report is a brief summary of the 1st Periodic Report to the EU, covering the first 18 months of the project. For the content of the Periodic Report, please refer to the report itself. In this abstract, the public summary as well as the most important findings of the reviewing process are described.

1. Public Summary

1.1. Summary of the context and overall objectives of the project

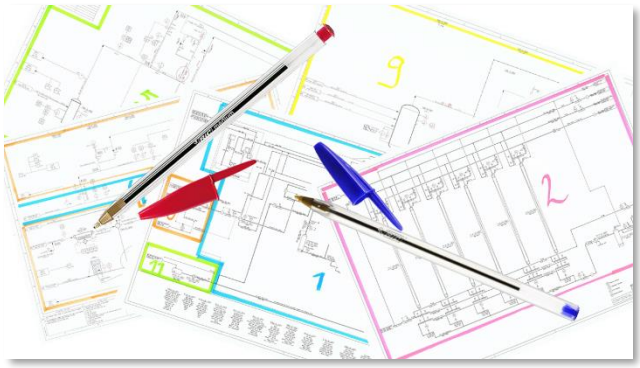
The INITIATE project couples 2 large energy intensive industrial sectors, contributing to the realization of a carbon neutral European process industry according to the 2050 SPIRE vision. Industrial symbiosis between the iron & steel sector and the ammonia & urea industry is demonstrated by transforming steel works arising gases into a feedstock for ammonia & urea production. Reuse of CO_2 is stimulated while the CO_2 surplus can be sequestrated, greatly reducing the overall carbon footprint. The project aims at a 30% decrease of primary energy use, a 40% decrease of raw material demand and up to 90% reduction in the direct CO_2 emissions. Additionally, Europe is made more independent and robust in view of increasing feedstock prices and trade uncertainties. Further benefits of this symbiotic concept are the provision of grid balancing services through flexibly using green H_2 and by proving CO_2 for circular use, accelerating the transition towards locally closed loop and integrated renewable energy systems.



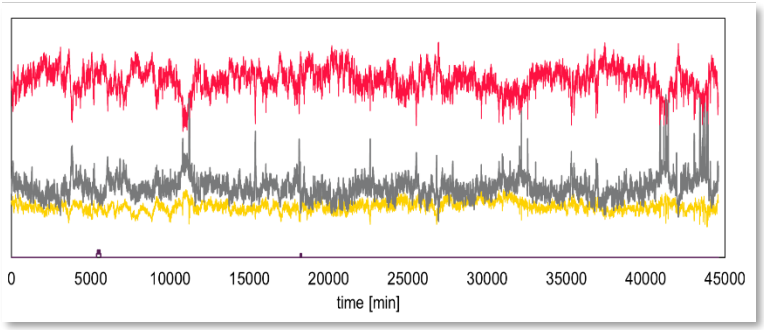
The INITIATE project will take all necessary steps to provide the basis for the roll-out of a 1st commercial size demonstrator at 50 kt/y urea in the basis of basic oxygen furnace gas (BOFG). Operational reliability of the technological innovations is demonstrated in a pilot plant at TRL-7. The energy, economic and environmental advantages are assessed via the verification of the key-performance indicators of the concept and comparing them with a reference and base cases. Next, a bankable design of the First-Of-A-Kind (FOAK) commercial plant is made to convert BOFG to AdBlue® and/or another NH3 based product. For the successful implementation beyond the FOAK plant, a long-term implementation plan is developed. The synergies on local and European scale are identified, considering industrial infrastructures and other symbiotic systems. For this, stakeholder alignment is required and licensing strategies are developed to ensure successful future deployment.

Communication and dissemination of the project results are organized through the project website, the associated newsletter and via the organization of workshops etc.

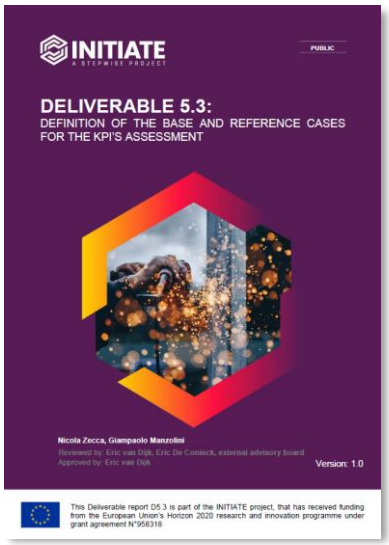
1.2. Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far



The initial 18 months of the project focused on the design of the pilot installation at TRL-7. The pilot in Lulea, Sweden, decarbonizes blast furnace gas (BFG) and basic oxygen furnace gas (BOFG) from the SSAB steel plant, optimize the intermediate product H_2/N_2 ratio and produce NH_3. For the design of the pilot the Common Design Practice, the Basis of Design and the Basic Engineering Package are finished. Detailed Engineering and procurement are in progress. The pilot lay-out is fixed. The safety and environmental aspects of NH_3 handling have been studied. To match the input-output specifications, the BOFG dynamics must be absorbed in the demonstration of the NH_3 production. Operating flexibility and reliability are based on advanced process control and by exploiting the dynamic characteristics of the enabling technologies: SEWGS (Sorption Enhanced Water Gas Shift) technology for decarbonization and the sub-stoichiometric NH_3 synthesis loop. Using historic BOFG data from AM, the control philosophy for dealing with the varying CO content of BOFG was defined. Besides upstream compensation, the dynamics of the SEWGS process and NH_3 synthesis loop are exploited. Initial process modelling shows that CO surplus as well as CO deficiency can be absorbed while maintaining operation. To further optimize control, dynamic models of the individual units are developed. The advanced control will be demonstrated in the piloting.



For the novel concept of BOFG to NH_3, the definition of catalysts and sorbents is in progress. The contaminants present in the BFG and BOFG can influence the material choice and pilot lay-out. In parallel to a literature review and the input from the expert end-users AM and SSAB, extensive contaminant measurement campaigns are performed at SSAB for BOFG, and at AM for BFG and BOFG. This resulted in a detailed overview of the type and level of contaminants that may be expected. As the pilot uses the SSAB BOFG, the pilot clean-up section upstream the ammonia loop is defined. Nevertheless, tailored investigations of the contaminants per site is mandatory as the gas composition can vary significantly, although no showstoppers have been identified.



To assess the energy, economic and environmental advantages of the INITIATE concept, the bases for the techno-economic analysis (TEA) as well as the life-cycle assessment (LCA) have been defined. For the TEA, the base and reference cases have been defined and summarized in the public deliverable D5.3. The base cases cover stand-alone iron & steel and ammonia & urea plants. In the reference cases integrated amine based decarbonization is applied to the stand-alone plants. The life-cycle-inventory as well as the boundary conditions have been established. Accordingly,

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robust bases are created for benchmarking of the INITIATE concept against next best available technologies using carefully selected key-performance indicators.

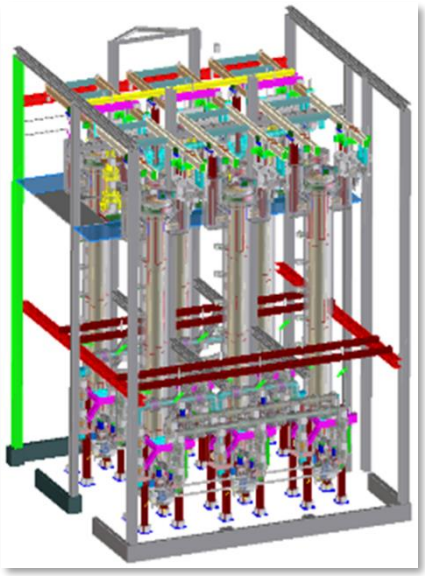
For the roll-out of the FOAK commercial plant, site identification and evaluation has begun, resulting in discussions with several commercial parties. Implementation beyond the FOAK plant requires mapping of the symbiotic potential. The potential product market combinations were listed in brainstorm sessions and interviews with different stakeholders. Next, their validity is assessed by analysing their technological and sociological key-performance-indicators.

The communication and dissemination plan was submitted, while launching the project visual identity and the website. The website highlights news a and project results and a newsletter is issued. Additionally, the 1st workshop was organized on funding opportunities for the development of CCU. With the CORALIS project mutual dissemination and communication efforts are explored.

A data management plan and a risk register were submitted. The early identification and evaluation of risks, allow adequate risk management. All partners are encouraged to actively addressed and assessed risks. 6 monthly progress meetings, separate exploitation board and executive team meetings as well as discussions with the External Advisory Board have been organized.

1.3. Progress beyond the state of the art, expected results until the end of the project and potential impacts

The start-up phase of the INITIATE project focused on the engineering of the pilot down. This is the 1st time that the SEWGS technology is demonstrated at TRL-7 scale in a multi-column system allowing the continuous production of a H_2/N_2 feed for NH_3 synthesis and capturing the CO_2. The advanced split-flow configuration for the WGS section allows to optimize the steam requirement, minimizing the energy penalty associated with CO_2 removal by SEWGS. A novel NH_3 synthesis loop concept developed by Stamicarbon will be implemented, allowing flexible H_2/N_2 feed ratio operation. Piloting within the project will demonstrate these novel concepts beyond the state of the art using advanced process control.



The impacts and wider societal implications of the project will become apparent as the associated work packages start producing results later in the project. Nevertheless, the bases has been laid. Next to the definition of base and reference cases for the TEA and the LCA, further symbiotic concepts has been listed. All these activities aim to establish a bankable design of the 1st commercial plant to be located in Europe.

2. Technical Review

The Progress Review meeting was held on-line on June 27, 2022 and was attended by the PO Catalin Perianu and external reviewer Dr. Valentina Colla.

The main observations and suggestions as mentioned in the review report are:

- The project implementation is satisfactory.
- The costs increase related to the procurement and construction of the pilot is a serious concern for the Consortium and has been defined as a project risk. The consortium is committed to elaborate some solutions and minimize the impact on the project development. Several

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mitigation actions have been already put in place. Careful consideration of the cost developments at this stage of the project is essential. Cooperation with the EU officer in the elaboration on further mitigation actions is encouraged.

- Notes on the achieved gender balance have to be included into the 2nd Periodic Reporting, as this is a required aspect to be assessed.
- In the business analysis the transferability of the proposed solution throughout Europe must eventually become apparent, considering technical aspects such gas composition aspects between locations and economical aspects such as differences of prices for energy and products.
- The coming periodic reports must focus more explanation of the interconnections among the activities developed in the different WPs and the significance of the main achieved results.

3. Financial Review

Several aspects were flagged in the financial review of the Periodic Review by the projects FO Agnieszka Krajewska. These findings have been communicated to the consortium in the Suspension of Payment Deadline Letter. The adaptations, clarifications and explanations have been incorporated into the revision of the 1st Periodic Report, submitted end of August CW35.

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