3D

DMX DEMONSTRATION IN DUNKIRK

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1 Introduction

The objective of the first task in the WP7 of the 3D project, is to coordinate and integrate the techno-economic evaluation of the whole chain of the CO_2 captured, transported and stored from the future DMX^{TM} unit to be installed in the ArcelorMittal site in Dunkirk, France.

In line with Task 7.1, the objective of the deliverable D7.1 "Methodology for the economic evaluation" report is then triple:

1) *to detail **the objectives and scope of the techno-economic evaluation** (Chap 2),*
2) ***to fix some common economic basic data** that will be used in the different scenarios (like interest rate, depreciation rate, project lifetime) (Chap.3), and*
3) *to detail **the successive methodological steps of the economic evaluation** (Chap 4), starting from the description of the Reference Scenario to the interpretation of the results and sensitivity analysis of the most interesting case.*

These common economic data and approved methodology will be used in the techno-economic evaluations of the 3D project, deliverables D7.2 and following.

Some steps in the methodology are common with Task 7.2 on Life Cycle Assessment. The methodology and tools are defined to be interlinked for both Tasks 7.1 and 7.2 and main attention is given to the boundaries of the system evaluated.

2 Objectives and scope of the technical-economic evaluation

The Greenhouse Gas (GHG) target of the European steel industry association Eurofer[1] is a high decarbonisation of the steel sector with a reduction of the GHG emissions of the sector by 80-95 % in 2050 compared to 1990.

Recently, the European Commission has proposed in the Green Deal[2] to increase the EU's GHG emissions reduction target to, at least 50% in 2030 and towards 55% compared with 1990 levels to be able to reach carbon neutrality in 2050.
Both European Commission and Eurofer targets are interlinked: the reduction of the GHG at ArcelorMittal (-30% CO_2 emissions target in 2030 and neutral in 2050[3]) will participate to the French and the European GHG target.

The main scenario of the *3D "DMX Demonstration* in Dunkirk" project aims to capture 1 million tons of CO_2 in 2025 and to ship it to an offshore storage site in North Sea. In this context, the techno-economic evaluation of the 3D CCS chain will incorporate as much as possible **financial and environmental criteria that will be detailed in the future European Innovation Fund Program[4].**

Different economic evaluation steps will be made according to the boundaries of the system (from the capture to the transport and storage sites) and the entire CCS costs evaluated. **The main objective of the DMX™ unit investment at ArcelorMittal Dunkirk site is to reduce and avoid atmospheric CO_2 emissions related to the steel production**. Accordingly, ArcelorMittal Dunkirk site will reduce its CO_2 emissions, and at the national level this investment will participate also to the national Carbon Neutral 2050 objective.

Hence, techno-economic evaluation will calculate the main Key Performance Indicators (KPIs) of the CCS value chain. These KPIs will be, first related to the amount of **CO_2 captured, transported and stored,** and secondly related to the amount of **CO_2 avoided** all along the CCS chain accordingly to 3D project. Finally, the CO_2 avoided cost of ArcelorMittal (with the DMX™ unit) is compared to its CO_2 compliance cost on the EU-ETS without the DMX™ unit (defining the Reference case).

To further details the most relevant KPIs that will be evaluated in the techno-economic study, it can be summarised as the followings:

1) The cost of CO_2 **emissions captured** at ArcelorMittal site boundaries. It is related to the CCS investment and expressed in **€/tCO_2 captured** on the entire plant.

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[1] Source Europfer :
http://www.eurofer.org/Issues%26Positions/Climate%20%26%20Energy/20191106%20EUROFER%20Low%20Carbon%20Roadmap%20FINAL.pdf [1]

[2] EUROPEAN COMMISSION, Brussels, 11.12.2019, COM(2019) 640 final, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS The European Green Deal [2]

[3] https://france.arcelormittal.com/news/2019/Dec/arcelormittal-europe-se-fixe-comme-objectif-de-reduire-ses-emissions-de-co2.aspx [3]

[4] https://ec.europa.eu/clima/policies/innovation-fund_en [4]

2) The total amount of avoided emissions per year (tCO_2/year) of the main scenario compared to the amount emitted in the Reference Case. Same evaluation on the lifetime duration of the project (20 years) and expressed in tCO_2 avoided/year, tCO_2 avoided during all the project.

3) The cost of ton of **CO_2 avoided per ton of steel produced**.

4) The techno-economic evaluation of the CCS chain will integrate the costs of the conditioning, the cost of the CO_2 transport and if public the cost of the CO_2 storage. When the cost of the CO_2 storage is not public (like in the Northern Lights project) a range of price[5] will be taken into account. The KPI's are: **€/tCO_2 conditioned, transported and stored for the different actors of the CCS chain.**

The financial gap between the CO_2 avoided cost and the reference compliance cost at ArcelorMittal site is a financial indicator of the project.

[5] A range price from 20 to 100$/$tCO_2$ stored could be applied for sensitivity analysis

3 Economic basic data

3.1 Common economic data

To realise comparable techno-economic evaluations of scenarios, it is important to fix certain common economic basic data. These economic data allow to define a common framework for each block of the CCS value chain. A preliminary check of main values transferred from blocks to blocks is then possible. A sensitivity analysis is performed for elastic data to highlight uncertainties and hotspot values.

It should be noted that some of the values suggested in Table 3.1 are not committing and could change during the project accordingly to the progress of the project, and accordingly to the Innovation Fund program requirements.

The Table 3-1 Common economic data used for the scenarios lists the basic data used for the economic evaluation of the all CCS chain :

Table 3-1 Common economic data used for the scenarios

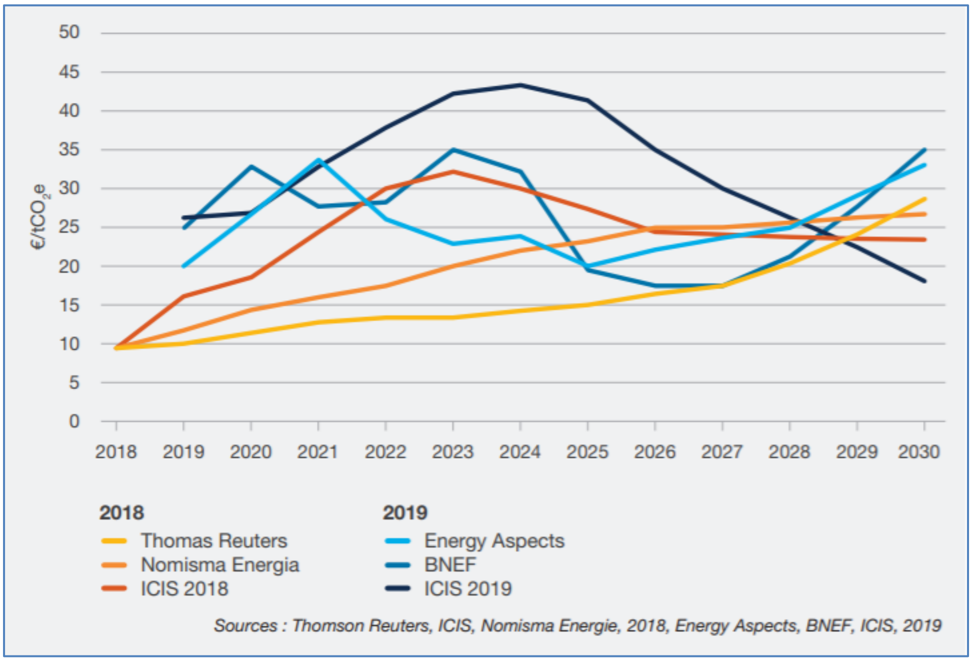
Data	Value	Unit
Cost base year	2019	year
Currency to be used	Euro	€
Construction period of the DMX	2	years
Start year construction of the DMX	2023	Year
Start year operation of the DMX	2025	Year
Project lifetime	20	Years
Depreciation	10	%/year
Tax rate	25[6]	%
Inflation	2	%/year
DMX utilisation factor first year	90	%
DMX onstream factor	8300 95	Hours/year %

[6] France : 28% corporate income tax, in 2020, becomes 25% in 2022

Investment schedule year 1	45	%
Investment schedule year 2	**55**	**%**
Electricity price*	**0.06**	**€/KWh national grid price**
Water process price*	**9.2**	**cts €/m^3**
Steam (mp) price*	**33**	**€/t**
EUAs price - Phase 4: 2021-2030	**25**	**€/tCO$_2$e**
EUAs price – 2030-2045	**60**	**€/tCO$_2$e**
Years Reference Case and scenario (for the comparison of scenarios)	**2025-2045**	**Years**

* Electricity, water process and steam price produced in ArcelorMittal's steel plant are different and will be considered when required.

Table 3-2 EU ETS allowance price forecasts from different studies[7]



3.2 CAPEX and OPEX

Total costs of the 3D CCS chain project are the sum of total CAPEX and OPEX estimations from system components which are divided by work packages or blocks (CO_2 capture, conditioning, transport and storage). Thus, the methodology to determine CAPEX and OPEX relies on each work

[7] I4CE report on Carbon Market [5]

package specific calculation with the respect of the battery limit of each process. A detailed list of CAPEX and OPEX will be retrieved to ensure the estimation of total capital requirements and operating costs.

To assemble coherent and uniform data, the following methodology would be performed:

- For CAPEX evaluation, investments are detailed for each process (i.e. Capture technology, Heat recovery system, Conditioning unit) and given by work package leaders. Exhaustive list of assumptions, if made, must be transferred in order to perform sensitivity analysis on the techno-economic evaluation and disclose uncertainties.

    - **ISBL costs (Inside Battery Limits):**
        - Process Units: provided value MM €

      ISBL costs are the cost of procuring and installing all process equipment. ISBL costs include purchasing and shipping costs of equipment, land costs, infrastructure, piping, catalysts, and any other material needed for final plant operation, or construction of the plant. ISBL costs also include any associated fees with construction such as permits, insurance, or equipment rental; even if these items are not needed once the plant is operational.

    - **OSBL costs (Outside Battery Limits):**

      OSBL costs deals with calculating costs associated with off-site developments that require the plant to run. For example, if water or electricity is being utilised from the main grid, if storage capacity is required for feedstock and infrastructure needs to be expanded.

        - Storages: provided value from the project (MM €), or 3 % ISBL,
        - Utilities: provided value from the project (MM €), or 1 % ISBL[8],
        - Buildings: provided value from the project (MM €), or 1 % ISBL,
        - Infrastructure: provided value from the project (MM €), or 15 % ISBL,
        - Engineering: provided value from the project (MM €), or 20 % ISBL+OSBL,
        - Contingencies: provided value from the project (MM €), or 10 % ISBL,

        - Direct Owner’s Costs: provided value MM € or 5 % ISBL,
        - Indirect Owner’s Costs: provided value MM € or 10 % ISBL,

Direct Owner's Costs are typically: First chemicals Load, spare parts.
Indirect Owner's Costs are typically: Process Licensor Fee, Owner Engineering, Project & Construction Management, Commissioning, Start Up, Vendor Representatives, Assistance.

[8] Assuming utilities are available on site.

- For OPEX evaluation, homogenisation of costs is a key parameter to avoid disparities between modules along the CCS value chain. Each work package will provide bulk volumes of inputs materials consumption, catalyst and chemicals and these values will be computed with common economic data to develop similar pricing/costs such as electricity prices, water costs, etc. for the whole CCS system. If the utilities are produced and not purchased a price instead of a cost should be used.

    - Fixed costs:
        - Labour costs (Manpower): provided value MM € per year or 1% ISBL
        - Fixed charges:
            - Maintenance of the plant: provided value MM € or 3% Total Fixed Costs[9],
            - Insurance: provided value MM € or 2 % TFC,
            - Corporate and Plant Overheads: provided value MM € or 1 % TFC.

[9] Total Fixed Costs : Storages + Utilities + Buildings + Infrastructure + Engineering + Contingencies costs

4 Methodology

4.1 Overview of the techno-economic evaluation steps

Different steps must be performed in a specific order to reach the techno-economic goals previously defined of the 3D CCS project.

These steps are illustrated in the Figure 4-1 : Steps of the technical-economic evaluation, and can be itemised as followed:

- Identify the **goals** and scope of the techno-economic evaluation as well as boundaries of the analysis,
- Determine the **scenario** of the CCS chain, from the capture unit to the storage that will be divided in different steps defined on technical basis: the capture including the waste heat recovery, the CO_2 conditioning, the CO_2 transport and the CO_2 storage,
- Realise a complete **inventory** of all economic (CAPEX, OPEX) and technical data required for the evaluation based on this scenario,
- Perform a **consistency** check of the different flows of energy, emissions, consumptions, units used all along the CCS chain before the economic evaluation is realised,
- The techno-economic evaluation including all the hypotheses and common basic data is performed,
- Interpretation of the results,
- Conduct a sensitivity analyses of the main economic and technical parameters.

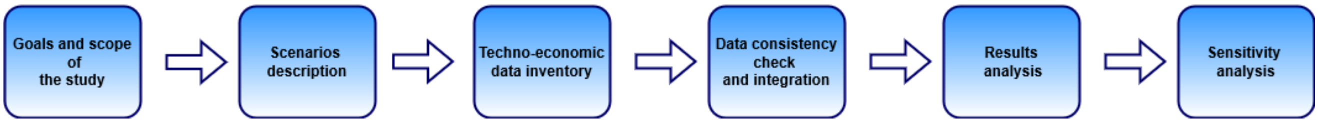


Figure 4-1 : Steps of the technical-economic evaluation

4.2 Scenarios description

A Reference Case scenario without CCS investment will be compared to the Main scenario with CCS. A reference time period could be 2025-2045 which is the start year of the project and a 20 years duration for the techno-economic evaluation.

4.2.1 Description of the Reference Case[10] scenario (without CCS)

A technical description of the Reference Case scenario is essential to compare the stake of investment in a carbon management system, in terms of GHG emissions and compliance costs.

In the Reference Case, ArcelorMittal's steel plant is globally the same as today and only investments yet decided and impacting the BF4 is included. Future investment decisions impacting BF4 emissions are not considered in the Reference Case. It allows to establish working parameters about the plant

[10] Also known as the counterfactual scenario.

such as the energy consumption, the CO_2 emissions and ArcelorMittal volume production on a business as usual basis in order to compare afterwards with the CCS scenarios. This Reference Case scenario should be the most realistic.

For techno-economic analysis, one of the major roles of the Reference Case scenario is to highlight the financial benefits of carbon penalty reduction thanks to carbon emission management with a CCS project. The Reference Case scenario can therefore be interpreted as a “Business as Usual” scenario and the base year will be defined later with ArcelorMittal.

The scheme of the Reference Case scenario to be considered for the comparison is the following, and should take into account different production investment yet decided:

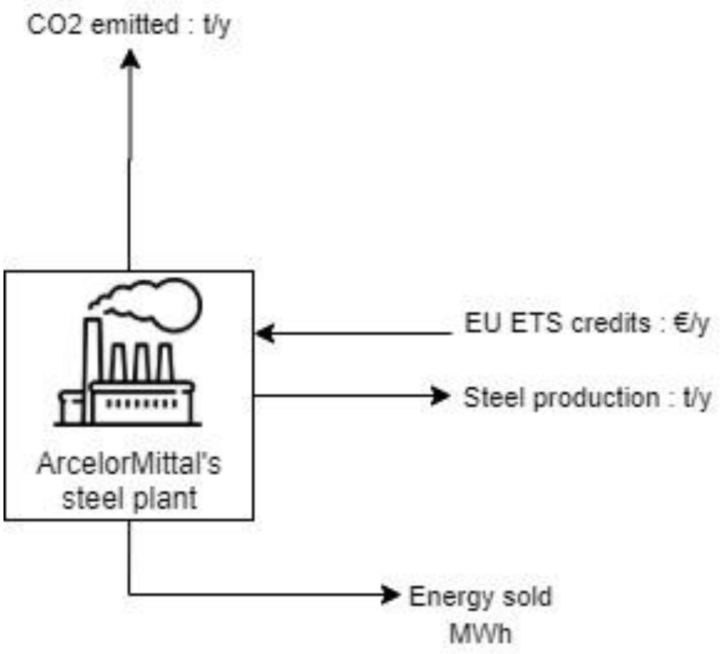


Figure 4-2 : Scheme of the Reference Case

4.2.2 Main scenario[11] with DMX^{TM} investment and Transport- Storage

The Main Case scenario will be assembled from the inputs of each module, the overall technical objective and a consistency check.

The main case is defined to capture 1 $MtCO_2$/year at ArcelorMittal Dunkirk site and transport CO_2 stream by boat to the Northern Lights storage site.

[11] Technically most likely scenario

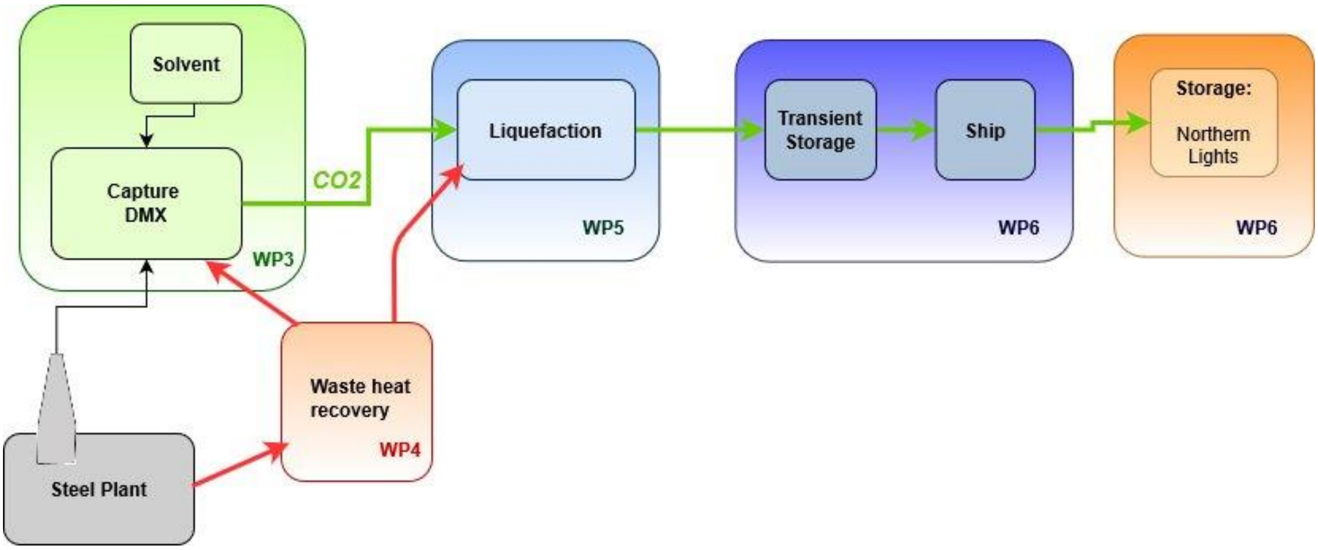


Figure 4-3 : Modules of the Main Scenario

In coherence with technical feasibilities, the main scenario presented above depicts the most likely sequences of the CCS system where:
The carbon dioxide capture technology chosen is the DMX^{TM} system developed by IFPEN and licensed by PROSERNAT. Waste heat is recovered on several locations of the steel plant to provide enough steam for the capture unit. Then, CO_2 stream is cleaned and liquefied and temporary stored in a transient storage at Dunkirk port before being shipped to North Sea. For transport, a ship specifically designed for CO_2 transport, with operating conditions compatible to Northern Lights Phase 1, will be used. The GHG footprint of the ship shall be kept at a minimum, which will also be taken into consideration with respect to fuel and ship speed. Finally, in this main scenario the CO_2 storage operation in the Northern Lights field is considered as a service (Opex) and should be paid.

The Main scenario will be compared with the Reference Case scenario for the first techno-economic evaluation.

4.2.3 Scenario alternatives

Some variant options may be proposed for certain blocks of the system as hypotheses for prospection purposes. For instance, another heat recovery scenario, or another transport means. The impact over the rest of the chain will be checked so that the variation will lead to a complete value chain definition.

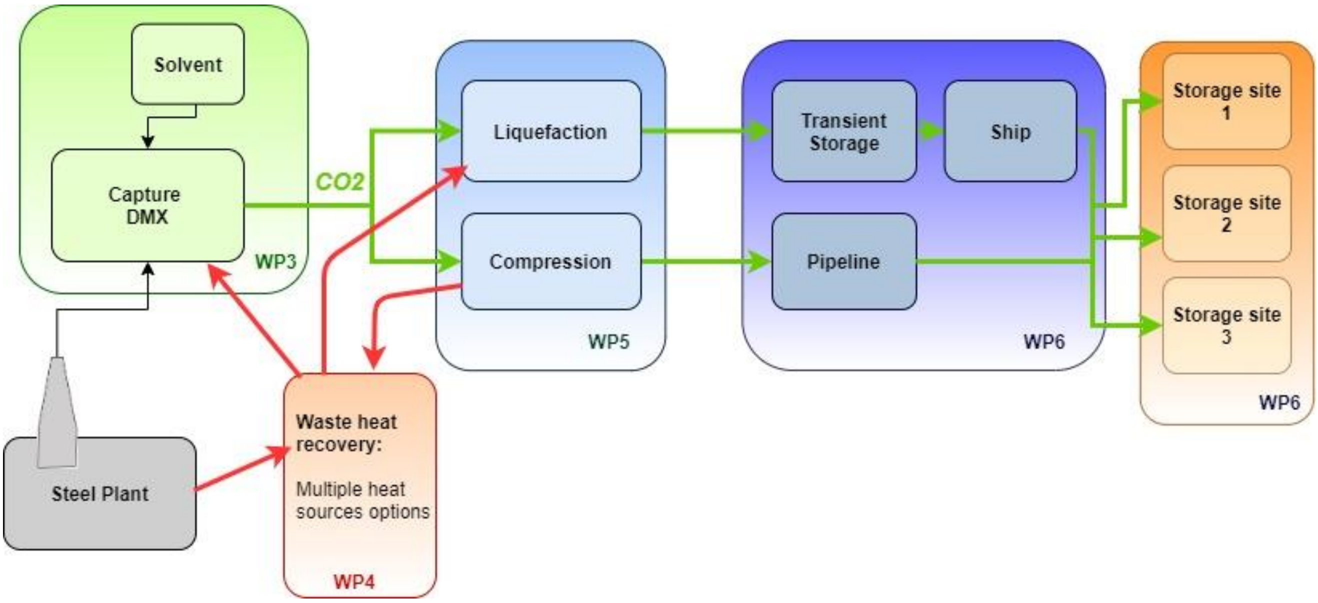


Figure 4-4 : Scenario variations description

The figure above presents variation possibilities of the CCS system that could be integrated in the main scenario of the project to develop alternatives scenarios. Among the variant options of the CCS systems, two scenarios will be assessed in the economic evaluation. The alternatives scenarios are stated below:

- The first variation scenario is composed of another heat source for the capture from the steel plant,
- The second variation scenario is composed of a transport mean by pipeline which requires an upstream compression step instead of liquefaction.

In conclusion, 3 scenarios will be studied and compared to the Reference Case scenario: The Main Scenario, the 1st variation and the 2nd variation scenarios. The above-mentioned variation scenarios may become more, technically and economically, realistic than the initial Main Scenario chosen.

4.3 Inventory data

The economic evaluation relies on the estimation of technical and economic data for each block of the CCS system. The values are collected during a phase of inventory in a complete excel file where each work package details values and assumptions.

4.3.1 Inventory data for the Reference Case (without DMX™)

To assess the relevance of the DMX™ investment in the steel plant, it is necessary to collect technical and economic data for the Reference Case. CO_2 emissions are collected from the entire steel plant.

4.3.1.1 Technical data for the Reference Case

The typical technical data to be collected for the reference case are the followings:

- GHG emissions for the base year (2019) on the entire plant,
- Volume of steel product (t/year) from 2025-2045,

- Energy consumed (kWh, Nm^3 and PCI for natural gas) linked to the DMX unit,

4.3.1.2 Economic data for the Reference Case

As the Reference Case is "Business as usual", no investment was made to reduce GHG emissions, therefore the economic data to be collected are describing the cost of emissions released:

- EUAs quotas quantity and average price paid by ArcelorMittal Dunkirk site,
- Credits price and quantity (if any)
- Compliance cost of the year 2019.

4.3.2 Inventory data Main and alternative scenarios

4.3.2.1 Technical data for Main and alternatives scenarios

Inventory of data is performed by dividing the system in smaller process blocks in order to group inputs and outputs. The methodology is used for the Main Case scenario and replicated for the different scenarios. For the CCS system, technical data of the system can be summarized by schemes in respect with system blocks.

The capture block system data are:

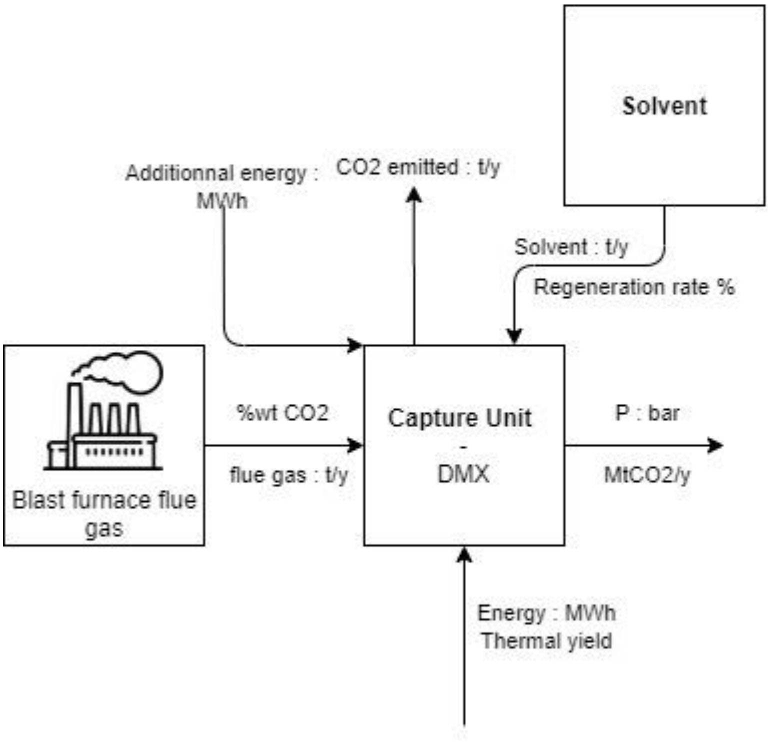


Figure 4-5 : Capture unit module

The heat recovery system data are:

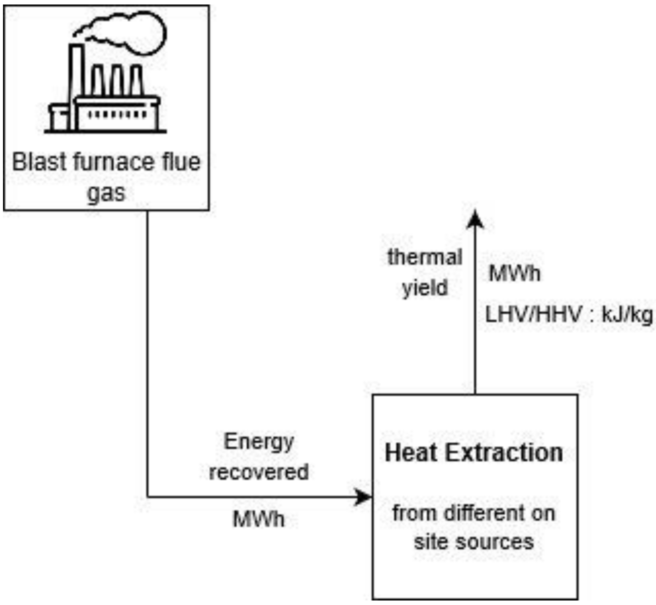


Figure 4-6 : Heat recovery unit

For variation scenarios, similar technical data must be retrieved.

The conditioning block system data are:

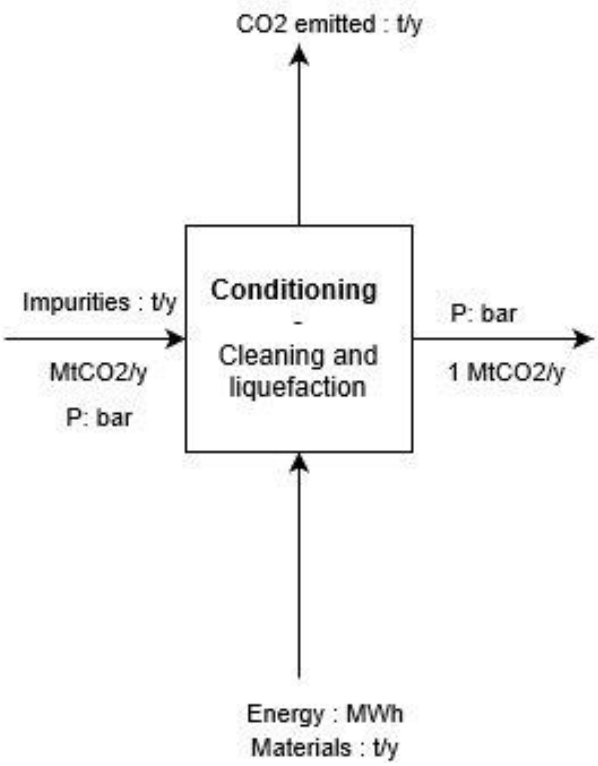


Figure 4-7 : Conditioning unit

The transient storage and onloading block system data are:

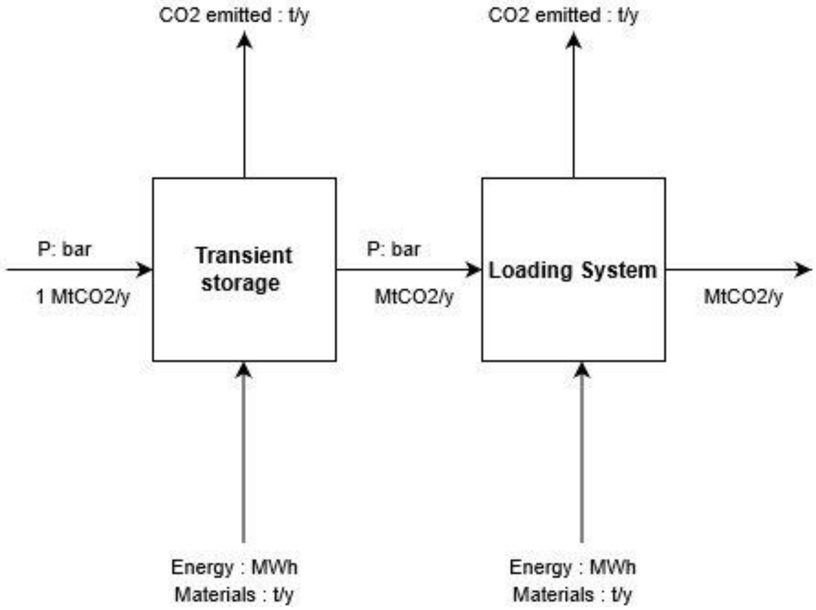


Figure 4-8 : Transient storage and loading systems

The transport block system data are:

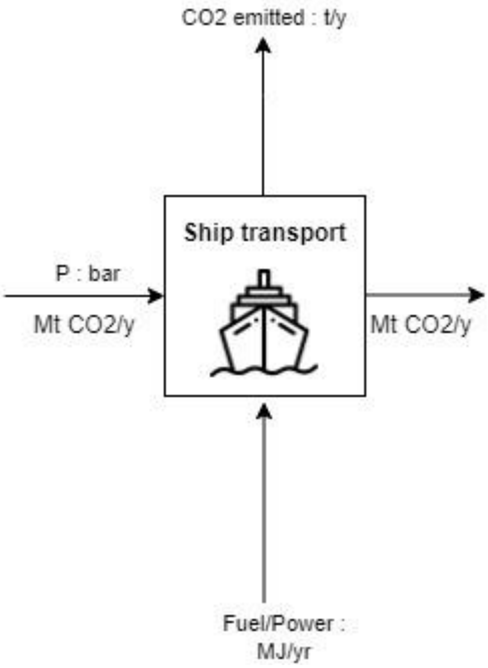


Figure 4-9 : Transport means

For the variation of the Main Case scenario, pipeline will be used as a transport mean and additional technical data must be retrieved. Typically, the length and diameter of the pipeline as well as the energy supplied are required.

Finally, in case there is no service cost for CO_2 removal, it might be relevant to describe a storage economic evaluation, therefore some of the data required are:

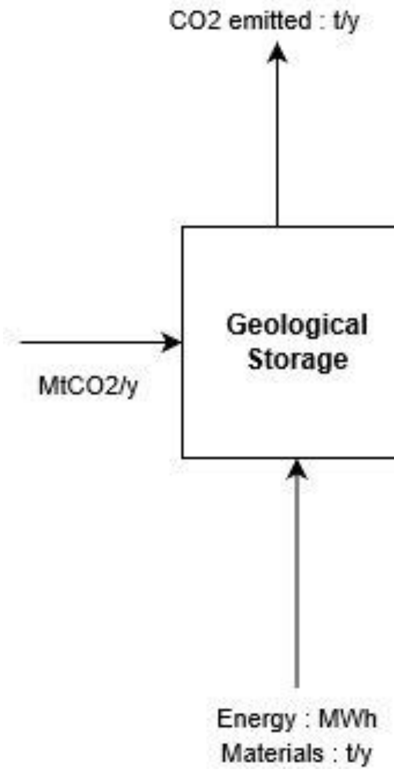


Figure 4-10 : Storage system

Geological storage location does not influence the technical data inventory on this part of the system. Nevertheless, location will impact the transport block system and the economic data.

Data on CO_2 emissions appear to be one of the key technical indicators on the CCS system and directly related to economic viability of the system by compliance of the EU ETS allowances system. It must be noted that details on the composition of GHG emissions along the system will be of great assistance for LCA assessment of the CCS implementation.

4.3.2.2 Economic data for Main and alternatives scenarios

Inventory of economic data relies on CAPEX and OPEX of the CCS blocks. An exhaustive list of major economic inputs and outputs for the Main CCS system is presented in the following scheme. It has to be noted that OPEX streams in the figure are homogenised.

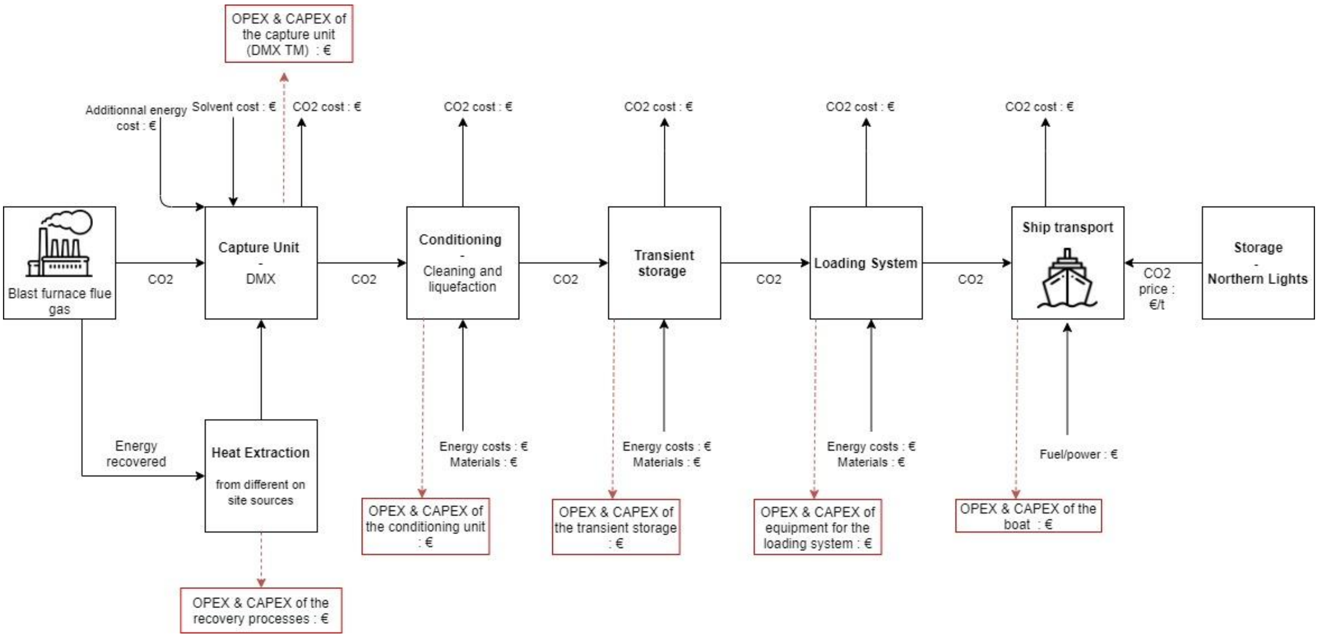


Figure 4-11 : CAPEX and OPEX overview of the CCS system

Minor modifications of the figure are observed with variation scenarios compared to the Main scenario. Carbon dioxide is sold to Northern lights for storage in the main scenario, whereas for variation scenarios CO_2 storage has CAPEX and OPEX. Similarly, OPEX for the variation of transport will differ in terms of costs related, such as equipment instead of fuel.

4.4 Consistency check of the data collected

Consistency check of the data will be performed to ensure that streams outputs correspond to inputs requirements of the following block as it is illustrated in the figures of the technical data inventory. Thus, the battery limits have to be well defined to avoid duplication or exclusion of specific data, essential for the economic evaluation of the CCS system.

The consistency check methodology should be following the next steps:

- Once the data are collected, each block will be checked to ensure respect of data units and coherence between in- and outputs for different flux: CO_2, energy consumption, materials,
- Check-up of the boundary limits of the block to avoid duplication of same utilities for example, or exclusion of utilities required,
- Final step requires to integrate data.

4.5 Techno-economic analysis

Results and analysis will be performed with IFPEN's internal economic model: **CalDev**

4.5.1 Resulting CAPEX and OPEX

After homogenisation of OPEX and collect of detailed CAPEX, costs of system blocks will be added in order to obtain OPEX and CAPEX costs for the global CCS system. Results of costs will be the starting point of the techno-economic evaluation of the project.

As it was mentioned in the report, the first techno-economic evaluation will be based on the overall costs of the Main scenario described in the preceding sections. Evaluation of variation scenarios will be assessed subsequently in the second phase.

4.5.2 Key Performance Indicators (KPIs) assessment

Relevance of the CCS system is estimated through KPIs calculation and comparison with a Business as Usual strategy illustrated by the reference scenario. The main purpose of the CCS system is to reduce the CO_2 emissions of the steel plant, therefore KPIs are referenced per amount of CO_2.
Parameters will be calculated for the reference and alternatives scenario using the following methodology.

4.5.2.1 For the Reference case

Performance of the CCS system is assessed by balancing costs of the Reference Case and Main Case.

- **Compliance costs of CO_2 emitted without DMX™**
  - ✓ Compliance costs will be calculated by applying EU quotas required per ton of CO2eq emitted on site in the reference scenario and will be specified in €/tCO2eq. It represents the cost of CO_2 emissions on the Dunkirk Site and paid by ArcelorMittal.
  - ✓ Typically, carbon system penalty has an impact on the production cost of the main product delivered by the steel plant. The system costs will be affected to the product by €/t of steel.

To estimate the system performance, the total GHG emissions of the plant in the reference scenario must be recovered.

4.5.2.2 For each CCS system scenario

- **Compliance costs of CO_2 emitted**

As explained above, the compliance costs are regulated by EU quotas and applied to the steel industry depending on their onsite emissions. The CCS system allows to reduce emitted CO_2, therefore compliance costs should be reduced as well.

  - ✓ Similarly, with the reference case, KPIs will be estimated in €/tCO_2eq and €/t steel.

- **Costs of CO_2 for each system block**

The quantity of CO_2 emitted along the CCS chain will be estimated to provide the CO_2 reduction generated in comparison with the Reference Scenario. In this section, costs are divided by blocks of the CCS system to identify the most challenging parts of the process in terms of economic returns. The parameters provide a global cost of each unit divided by the efficiency of the system to avoid CO_2 emissions.

✓ CO_2 captured costs in €/tCO_2captured.

✓ CO_2 conditioned costs in €/tCO_2conditioned.

✓ CO_2 transport costs in €/tCO_2transported.

✓ CO_2 storage costs in €/tCO_2stored.

- **Cost of avoided CO_2**

The cost of avoided CO_2 represents the additional cost of the CCS system implementation over all the life cycle divided by the cumulated CO_2 reduction. The CO_2 reduction is the mass of CO_2 emitted in the reference scenario minus the mass of CO_2 emitted by the modified plant and its CCS chain. It includes non-captured CO_2 and non-treated CO_2, the leaks along the chain, the CO_2 vented during the operations.

✓ Overall CCS costs in €/tCO2avoided.

Few additional KPIs will be estimated for the CCS scenario to give a global overview of CCS system impacts in terms of energy requirements, profitability, such as :

1) Final CO_2 emission per ton of produced steel: tCO_2/t steel with and without CCS,
2) Energy penalty for the capture unit: GJ/tCO_2 captured,
3) Total cost per ton of CO_2 avoided of the full-scale CCS chain: €/MtCO_2/year,
4) Internal Rate of Return of the CCS unit, related to the cost of CO_2 avoided,
5) Levelised cost / tCO_2 captured, transported and stored and CAPEX-OPEX /tCO_2 avoided on the whole CCS chain. The calculation of this ratio for each part of the system gives an approach of cost hotspots.

4.6 Economic sensitivity analysis on the most interesting case

A sensitivity analysis is performed based on the main economic indicators revealed by the techno-economic analysis: at least on the amount and quality of the energy price and the CO_2 price.

5 Conclusion

The report presents the methodology for economic evaluation of the CCS project implementation on ArcelorMittal’s steel plant in Dunkirk. Main objectives are to specify the scope of the study by the definition of scenario limits, and to detail the process used for data inventory and computation. The methodology proposed also to set basic economic parameters used in the different scenarios in order to homogenise data.

Coordination between actors remains one of the methodology key parameter to perform a successful techno-economic evaluation on the whole value chain of the CCS system. Battery limit definition of each unit has been chosen to ease uncertainties on the overall process regarding CAPEX as well as OPEX, and other technical data.

The most likely scenario and called the Main scenario was detailed, and variations scenarios were also suggested. It allows to ensure the consistency of the scope, in particular for the life cycle analysis of the project. In addition, KPIs were defined to assess the performance of the CCS scenarios in comparison with the Business as Usual strategy scenario in terms of emissions reduction.

It must be noted that modifications of the methodology could appear over time and project evolution.

6 References

[1] EUROFER, «Low Carbon Roadmap. Pathways to a CO_2 neutral European steel industry.,» 2019.

[2] EUROPEAN COMMISSION, «Communication from the commission to the european parliament, the European Council, The Council, The European Economic and Social Committee and the Committee of the Regions. The European Green Deal.,» Brussels, , 2019.

[3] ARCELORMITTAL, «Arcelormittal Europe se fixe comme objectif de réduire ses emissions de CO_2,» *https://france.arcelormittal.com/news/2019/Dec/arcelormittal-europe-se-fixe-comme-objectif-de-reduire-ses-emissions-de-co2.aspx,* 2019.

[4] EUROPEAN COMMISSION, «Innovation fund.,» Vols. %1 sur %2https://ec.europa.eu/clima/policies/innovation-fund_en, 2019.

[5] I4CE, «Etude du Marché du Carbone Europe,» 2019.

7 Abbreviation

CCS	Carbon Capture and Storage
ETS	Emission Trading System
EUA	European Union Allowances
GHG	Greenhouse Gases
ISBL	Inside Battery Limits
KPI	Key Performance Indicators
OSBL	Outside Battery Limits

8 Acknowledgment

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