Transdisciplinary approach for decision support of waste valorization – Ni slag case study

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INTRODUCTION

- European Union pushes forward circular economy as an important lever to mitigate greenhouse gases emissions and valorize waste.
- Life Cycle Assessment (LCA) stands as the current methodological basis for assessing carbon footprint of Circular economy.
- However, classical LCA is not adapted to the assessment of circular economy (as developed below in the problem statement section).
- The CARBOVAL project develops a new approach that is applied on the valorization of nickel slags by carbonation in New Caledonia.

PROBLEM STATEMENT

Fig 1 : The valorization process

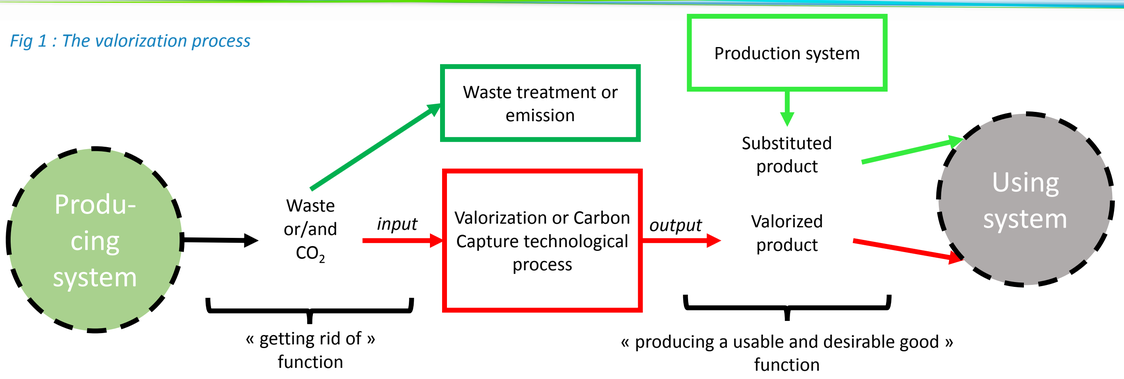


Fig 2A : Example of results at product scale from a current LCA method

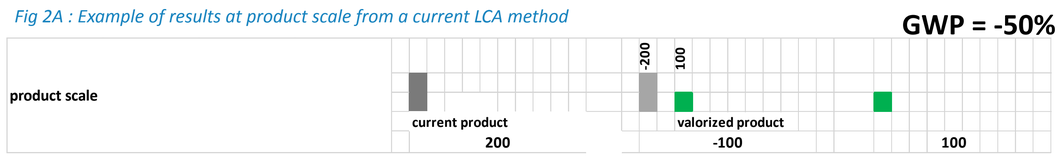


Fig 2B : Case of a large market and a competitive valorized product

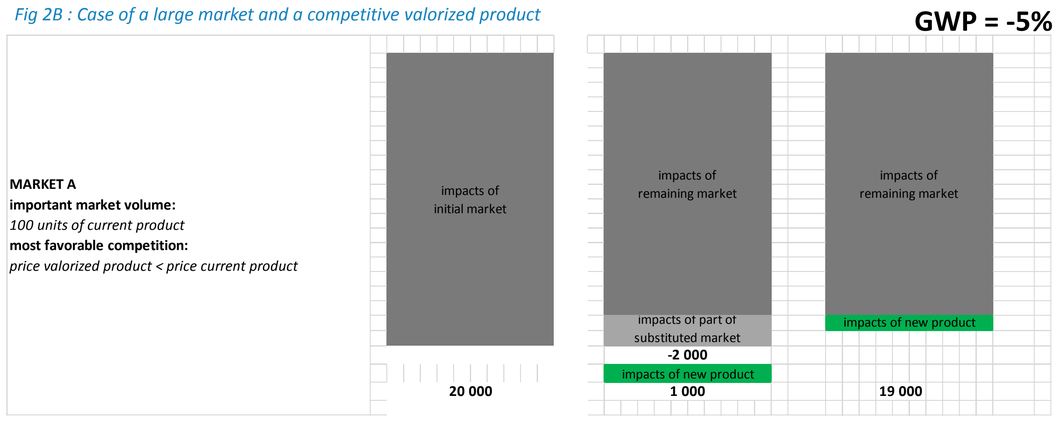


Fig 2C : Case of a small market and a competitive valorized product

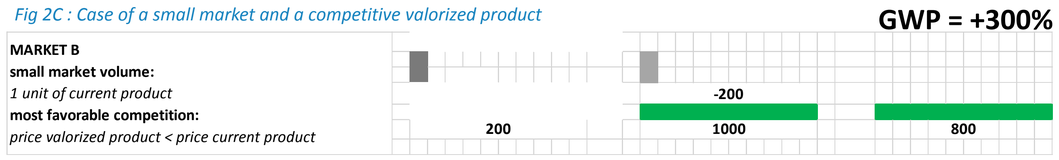


Fig 2D : Case of a small market and a non competitive valorized product

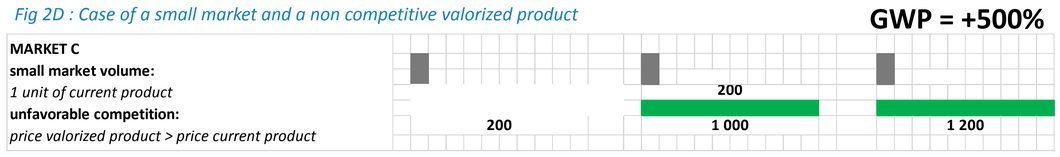


Fig.1: Valorizing a waste or CO_2 emission generates additional environmental impacts (in red on **Fig. 1**). The possible environmental benefits of these technologies can only be evaluated by comparison with both what is avoided (in dark green on Fig.1) when not valorizing carbon dioxide or waste, and what is substituted by the valorized product (in light green on **Fig. 1**).

Fig. 2A: Let's imagine that a current LCA performed at product scale finds an environmental improvement of 50%.

The amount of valorized products is not controlled by a market demand, but by the system that produces the waste (in purple on **Fig. 1**).

Fig. 2B: If the amount of valorized products is small compared to the amount of the target market i.e. using system (in grey on **Fig. 1**), the environmental benefits are significantly reduced because substitution only concerns a small part of market.

Fig. 2C: If the amount of valorized products is large compared to the amount of the target market, the environmental loads are largely increased because although there is a substitution, there is an overproduction of the valorized product without the corresponding market demand.

Fig. 2D: If the amount of valorized products is large compared to the amount of the target market, and that the valorized product is not competitive, the environmental loads are drastically increased because there is no substitution.

DEVELOPPED APPROACH

Environmental assessment must ensure that :

- The valorized product offers better environmental performance than the existing situation (current LCA)
- There are market volumes capable of absorbing the valorized product
- The valorized product is competitive in the targeted markets

Fig. 3&4: The developped approach aggregates scientific disciplines into an integrated vision

Fig 3 : case study of carbonated nickel slags

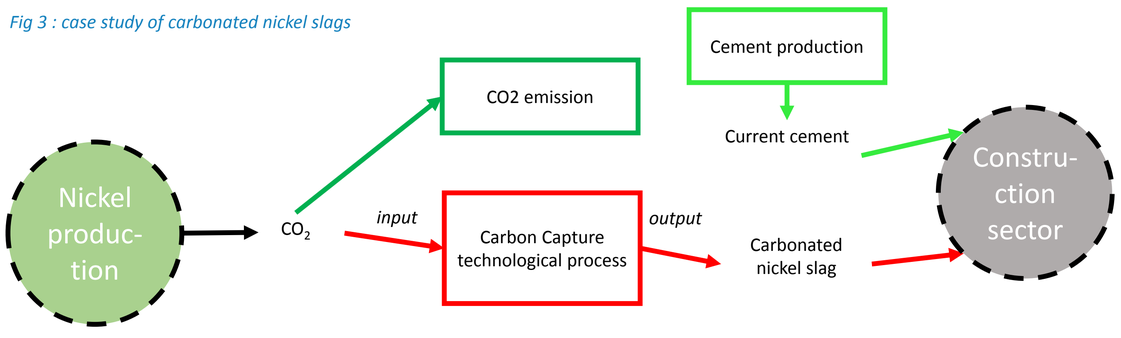
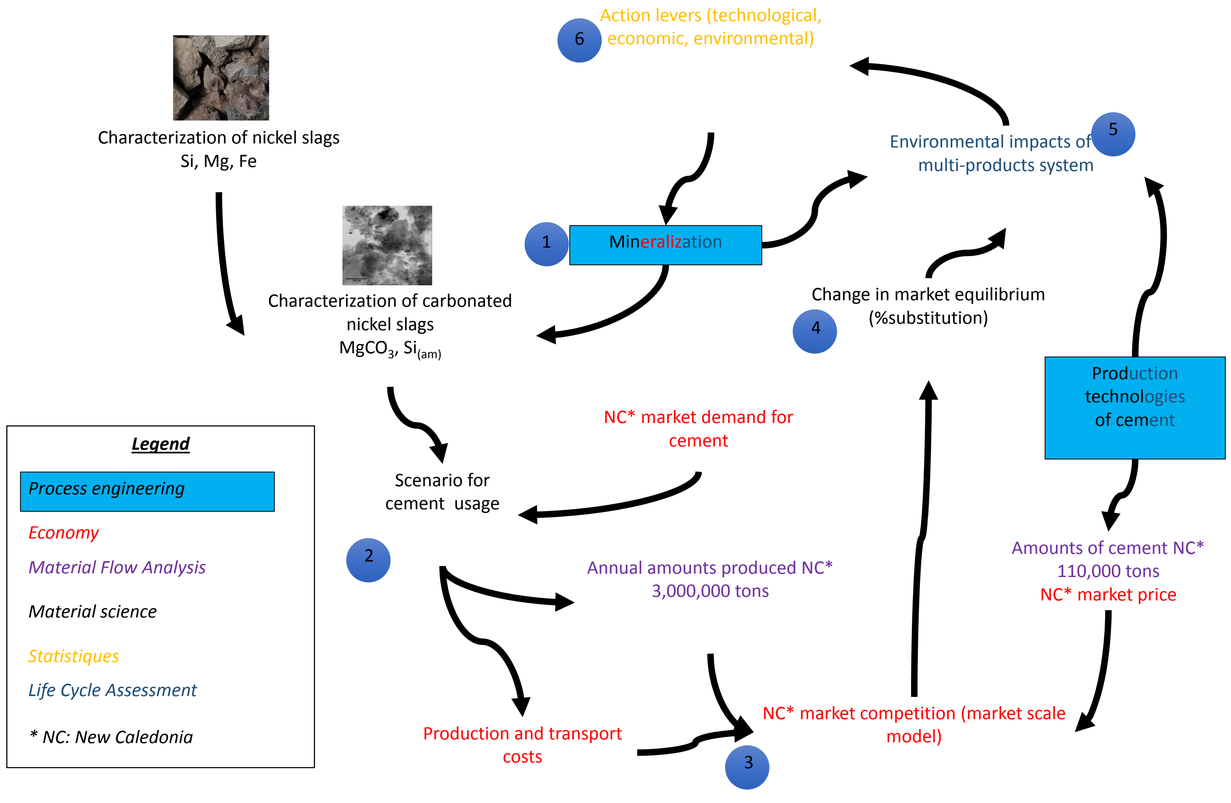


Fig 4 : The developed transdisciplinary approach in the nickel slags case study, example of substitution to cement



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