

# Ekodesigner: the Calderys tool to integrate environmental aspect in products design



**BACKGROUND**  
Customers needs



**CONCEPT**  
Calderys solution



**RESULTS**  
Example 1 :  
Iron runner



**RESULTS**  
Example 2 :  
Casting flux



**RESULTS**  
Example 3  
ladle lining system

## Motivation

The steel industry is increasingly attentive and motivated to reduce its emissions, wastes, and to improve safety of workers.

### Key facts:

- 10-20 kg of refractory are used per ton of steel
- Refractory is a vital element in all high temperature processes
- Refractory types influence the safe operation, energy consumption and final product quality
- Refractories involve a large range of raw materials requiring minerals and a large quantity of energy for their production
- Transportation over long distances is often required

The environmental burden of the production needs to be balanced with the benefits of using these refractories

## Life Cycle Assessment

In 2018, a sustainability program, aligned with the WBCSD (World Business Council For Sustainable Development) framework, was launched within Calderys to improve the environmental impact of its products and solutions.

Life cycle analysis (LCA) is material to the program

- A method was developed to calculate LCA
- It follows ISO 14040 and 14044 standards (2006) as they are recognized as the best framework
- It takes into account the full life cycle → Cradle to gate
- It gives a clear and comprehensive picture → global and objective comparison

For research and development, LCA is a critical component driving product improvement and innovation.

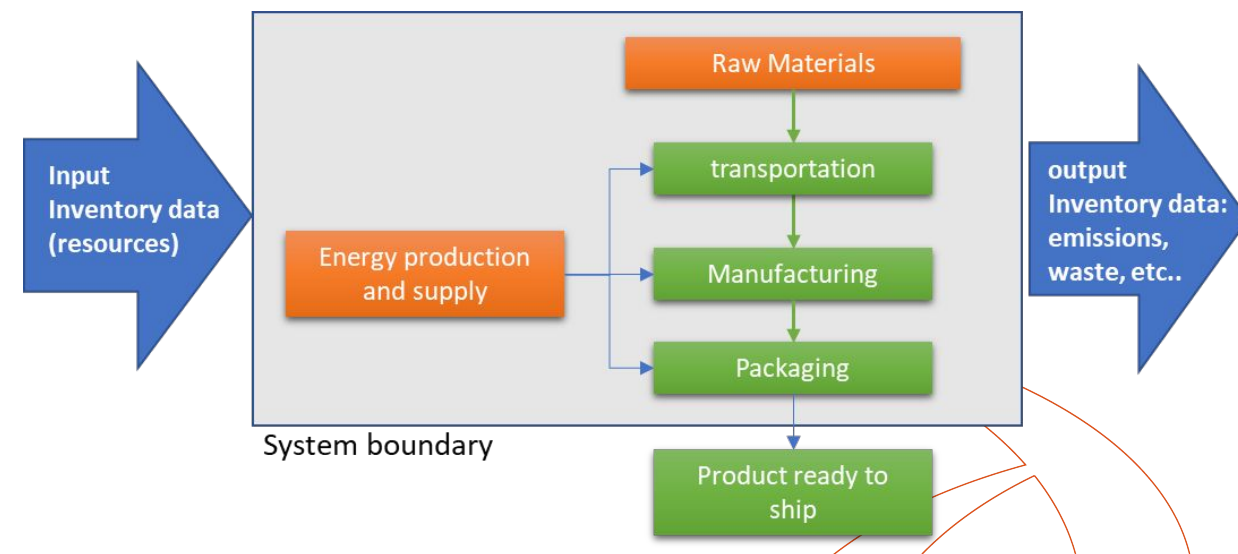
A specific tool has been developed: **Ekodesigner**.



## Calderys Solution

**Ekodesigner** allows to evaluate the LCA of the products from cradle to gate. Among all possible criteria available for such calculations, 12 were chosen as they are the focus of our organization.

Environmental impact	Unit
Land use, occupation	m <sup>2</sup> .yr
Water used (inventory)	liter
Resource use, minerals and metals (CML)	kg eq. Sb
Resource use, energy carriers (CML)	kg eq. Sb
Climate change (IPCC)	g eq. CO <sub>2</sub>
Acidification (EF)	mol H <sup>+</sup> eq
Eutrophication, aquatic freshwater (EF)	g eq. P
Photochemical ozone formation (CML)	g eq ethylene
Ozone depletion (EF)	g CFC-11eq
Human toxicity, cancer effects (EF)	CTUh
Ecotoxicity freshwater (EF)	CTUe

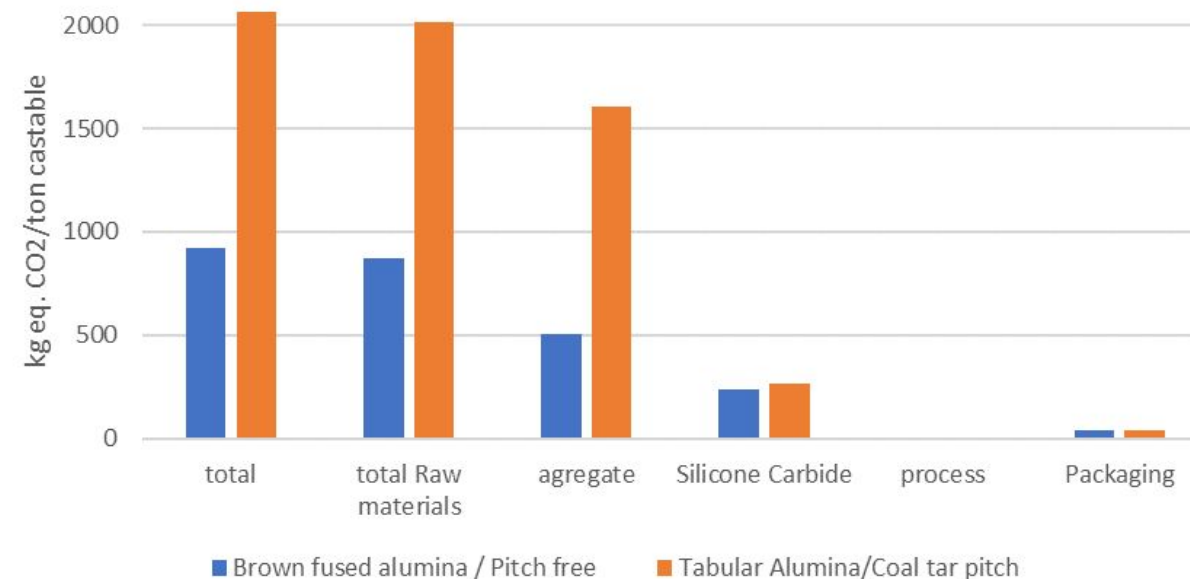


Ingredient category	Ingredient name	Proportion reclaimed (%)	Proportions of 1 kg of product (% in dry matter)	Toxicity
	<small>Erase values below for new calculation</small>	<small>Erase values below for new calculation</small>	<small>Erase values below for new calculation</small>	
Ingredient 1				
Ingredient 2				
Ingredient 3				
Ingredient 4				
Ingredient 5				
Ingredient 6				
Ingredient 7				
Ingredient 8				
Ingredient 9				
Ingredient 10				
Others				
Others				

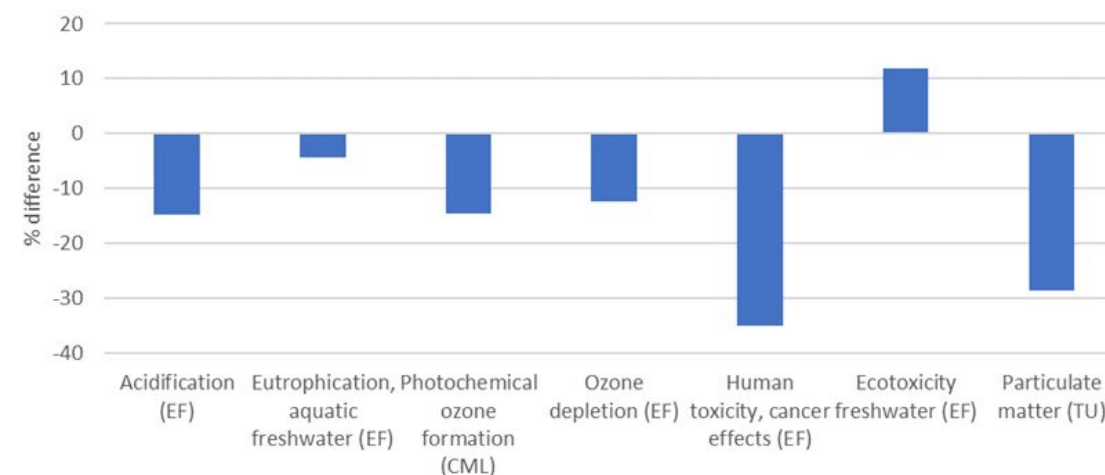
## Example 1 : Iron runner

- Two castables with different compositions are compared.
- Both are iron runner ultra-low cement castables (ULCC) with similar composition, except for the main aggregate and the carbon containing materials.
- One is based on tabular alumina and coal tar pitch (Coal tar pitch has been banned in Europe in 2020 due to its toxicity).
- The other one contains brown fused alumina (BFA) and more environmental friendly carbon compounds.

The result of the carbon footprint



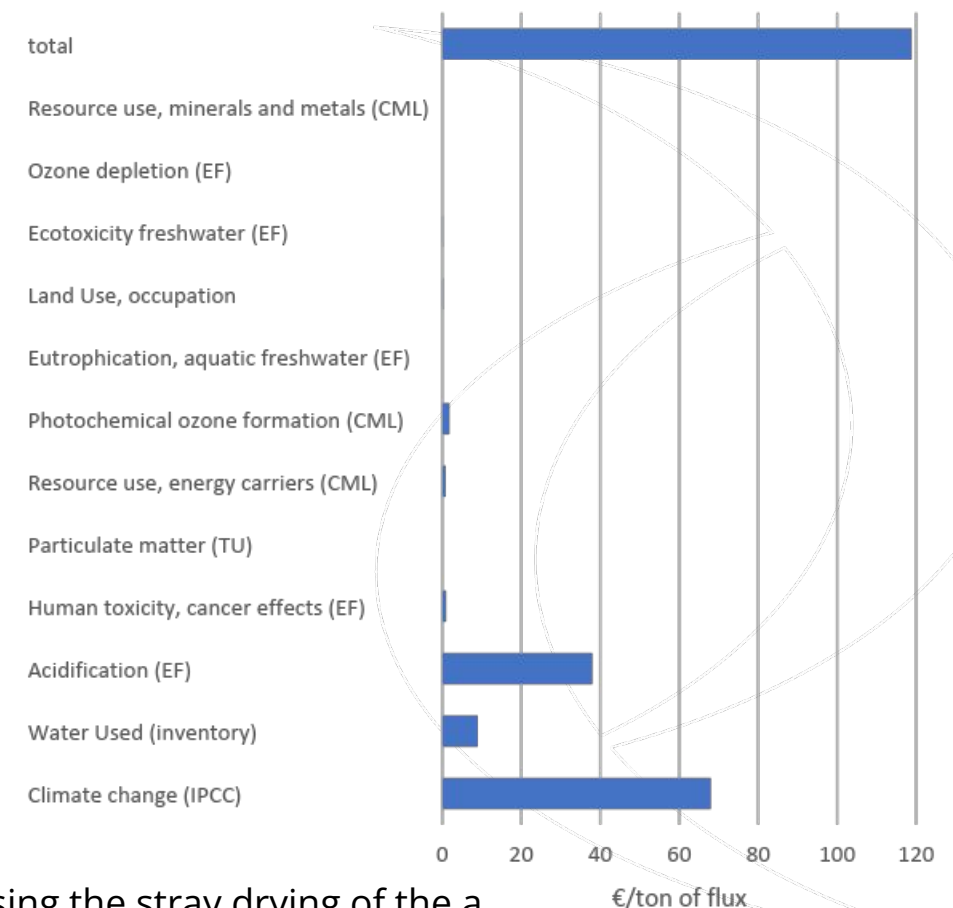
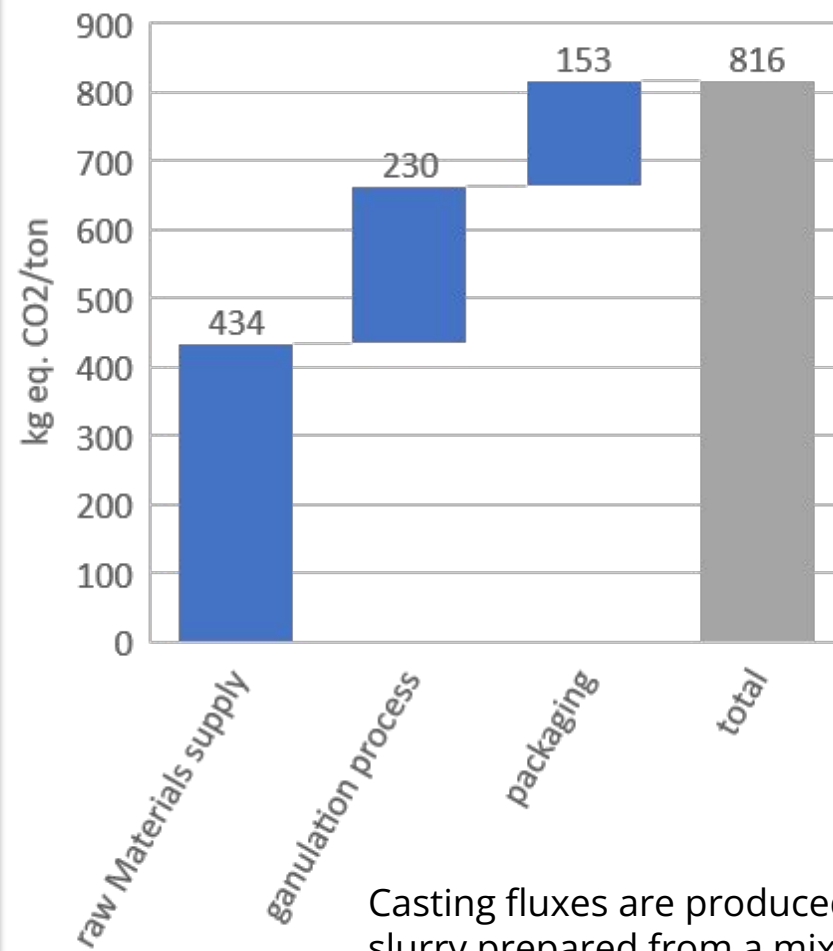
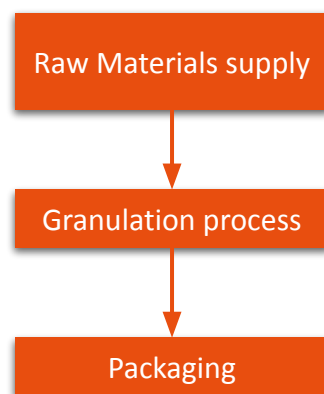
The difference on other environmental criteria, including toxicity



## Example 2: Casting flux



### Process decomposition for Life cycle assessment



Casting fluxes are produced using the stray drying of the a slurry prepared from a mix of raw materials and water. the process therefore has a higher contribution to the LCA than standard monolithic refractory. Packaging is also a significant contribution

## Example 3 : 125mt steel ladle refractory lining

### Ladle lining composition

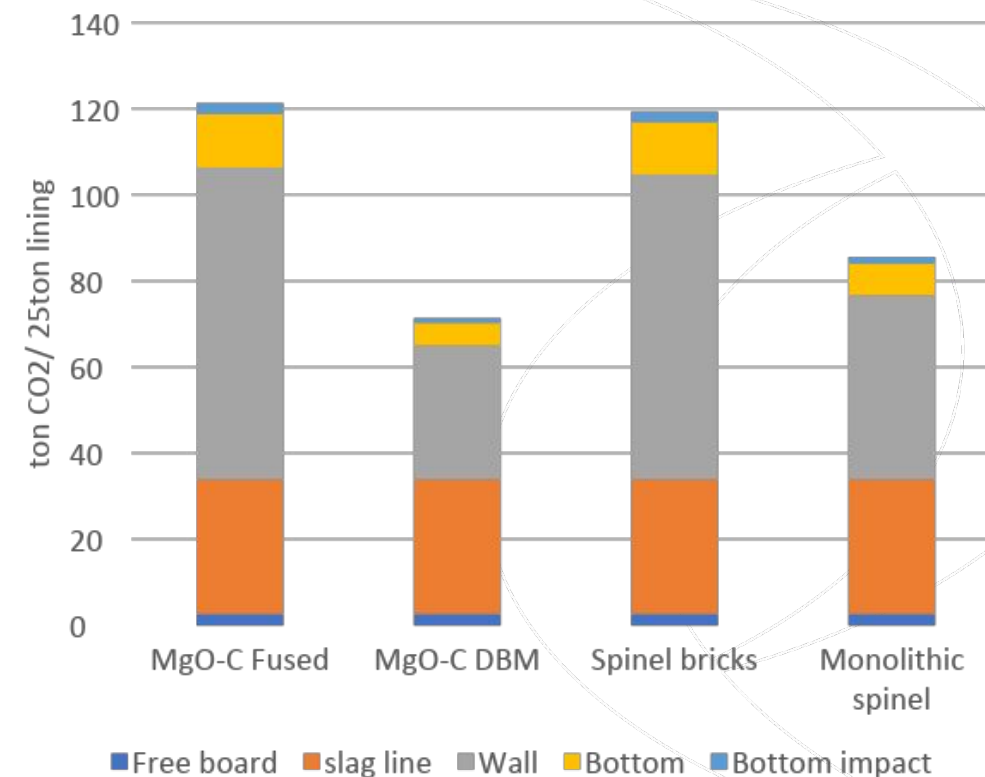
Free board	5%	MgO-C DBM
slag line	25%	MgO-C Fused
Wall	58%	
Bottom	10%	
Bottom impact	2%	
<b>Total</b>	<b>25 tons</b>	

### Material CO<sub>2</sub> footprint (kg eq. CO<sub>2</sub>/ton)

MgO-C F	4997
MgO-C DBM	2140
Spinel bricks	4881
Alumina Spinel monolithic	2950



CO<sub>2</sub> emission/steel  $\approx$  1300 kg eq./ton  
CO<sub>2</sub> from Ladle (100heats)  $\approx$  9.7 kg eq./ton





# Thank you for your attention

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