SUSTAINABILITY ASSESSMENT IN CUBAN CEMENT SECTOR- A METHODOLOGICAL APPROACH


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September, 2019
¿How to satisfy, in a sustainable way, the increasing demand for development?

**Cuban context**

- 3-5% GDP
- Investment
- Self employment
- Repairment and increase on housing

**DEMAND**

**OFFER**

- Decapitalization
- Productive and energetic inefficiency
- Use of installed capacities
- Environmental impact

**CEMENT IN CUBA**

- Efficient investment process
- Technological innovation

**Integration**

**Conclusions**

**Introduction**

**Method**

**Results**
Cuban context

Technological innovation

Efficient investment process

Pre-investment, investment, operation

Impacts assessment oriented to sustainability

Life Cycle Sustainability Assessment
LCSA = **LCA** + LCC + **S-LCA**

**ISO 14040-44**

Where:

LCSA = Life Cycle Sustainability Assessment

LCA = Life Cycle Analysis (environmental)

LCC = Life Cycle Costing

S-LCA = Social Life Cycle Analysis

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**Oeko-institut:** "Product Line Analysis"

**Kloepffer:** "LCSA Formula"

**UNEP/SETAC:** "The Methodological Sheets for Sub-categories S-LCA"

**NEUGEBAUER et al.:** "From LCC to EcLCA"

**Swarz et al. (SETAC):** "LCC code of practice"

**UNEP/SETAC:** "Towards a LCSA"
Goal, functional unit and system boundaries
Details for input data in different technologies for Cuban cement industry

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Pilot level</th>
<th>Industrial level</th>
<th>BAT level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaolinite clay distance (km)</td>
<td>150</td>
<td>60-150</td>
<td>&lt;100</td>
</tr>
<tr>
<td>Type of fuel</td>
<td>Cuban crude oil</td>
<td>Pet-coke + Cuban crude oil</td>
<td>Gas + Waste</td>
</tr>
<tr>
<td>Clinker technology</td>
<td>Wet rotatory kiln</td>
<td>4 stage pre-heater + pre-calciner</td>
<td>6 stage pre-heater + pre-calciner</td>
</tr>
<tr>
<td>Clay calcining technology</td>
<td>Wet rotatory kiln</td>
<td>Retrofitted calciner</td>
<td>Optimized flash calciner</td>
</tr>
</tbody>
</table>

**Data used for calculation**

**BACKGROUND DATA**
- [Image of IPCC logo]
- [Image of SimaPro logo]

**FOREGROUND DATA**
- Cuban cement industry
- Cuban transport means + raw materials distance
- New processes for Cuba

**CALCULATED DATA**
- **ENERGY** (MJ/t cem)
- **GLOBAL WARMING POTENTIAL** (Kg CO$_2$eq / t cem)
- **PRODUCTION COST** (USD/t cem)
**LCA results - Midpoint categories**

<table>
<thead>
<tr>
<th>Cement</th>
<th>Energy (MJ/t)</th>
<th>Emissions (kgCO₂eq/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-35</td>
<td>5292.38</td>
<td>890.63</td>
</tr>
<tr>
<td>PP-25</td>
<td>4626.33</td>
<td>764.92</td>
</tr>
<tr>
<td>LC³</td>
<td>4367.53</td>
<td>564.39</td>
</tr>
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</table>

Introduction

Method

Results

Conclusions

Integration
LCC results - Production costs

BAT Scenario
**S-LCA results- Potential of change**

<table>
<thead>
<tr>
<th>Subcategories</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insignificant</td>
<td>11%</td>
</tr>
<tr>
<td>Minor</td>
<td>11%</td>
</tr>
<tr>
<td>Moderated</td>
<td>67%</td>
</tr>
<tr>
<td>Significant</td>
<td>11%</td>
</tr>
</tbody>
</table>

- Incidence of diseases attributable to cement production
- Local employment
- Sector efforts for technological development
LCSA Results integration

![LCSA Results integration diagram]
Concluding remarks

- Cuban industry needs a recapitalization to meet growing demand
- LC$^3$ has a great potential to meet an increase in cement demand in the short term
- Environmentally speaking: LC$^3$ is better than OPC even for worst production scenario
- Up to 30% CO$_2$ reduction
- Up to 15% lower production cost (OPEX)
- Social impacts have a significant potential of change if LC$^3$ is introduced
Thank you!

Adapted from Martirena