State of the Art, Challenges and Future Development of Environmental Assessments of Magnesia Supply Chain

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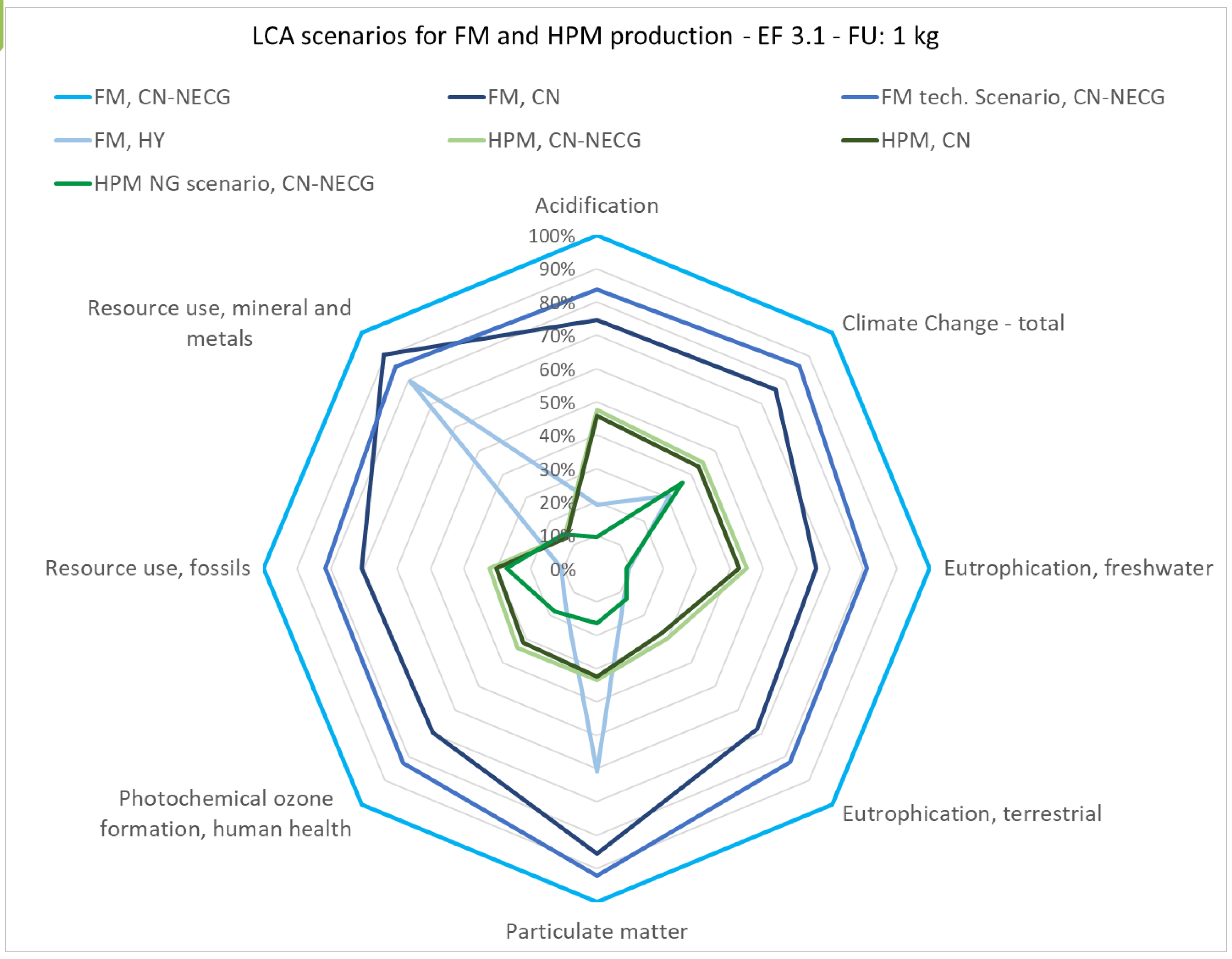
Funded by the European Union

Magnesia for refractory application, context and goals

- **Context**
  - Current literature: 1 inventory, 1 LCA (life cycle assessment), 3 CF (carbon footprint)
  - Raw materials are responsible of the main impacts in refractory production
- Literature gaps
  - Lack of LCA
  - Technical parameters and new technologies (old data)
  - Materials quality assessment and definition of functional unit (FU)
- **Goal**: Analysis of dry-route production of fused (FM) and sintered (HPM) magnesia for refractory application
- Issues addressed in this poster
  - Environmental hotspots and key impact categories
  - Characterization factor for resource depletion of magnesite
  - Comparison of magnesia products
  - Scenarios for technical improvement

LCA scenarios of FM and HPM production

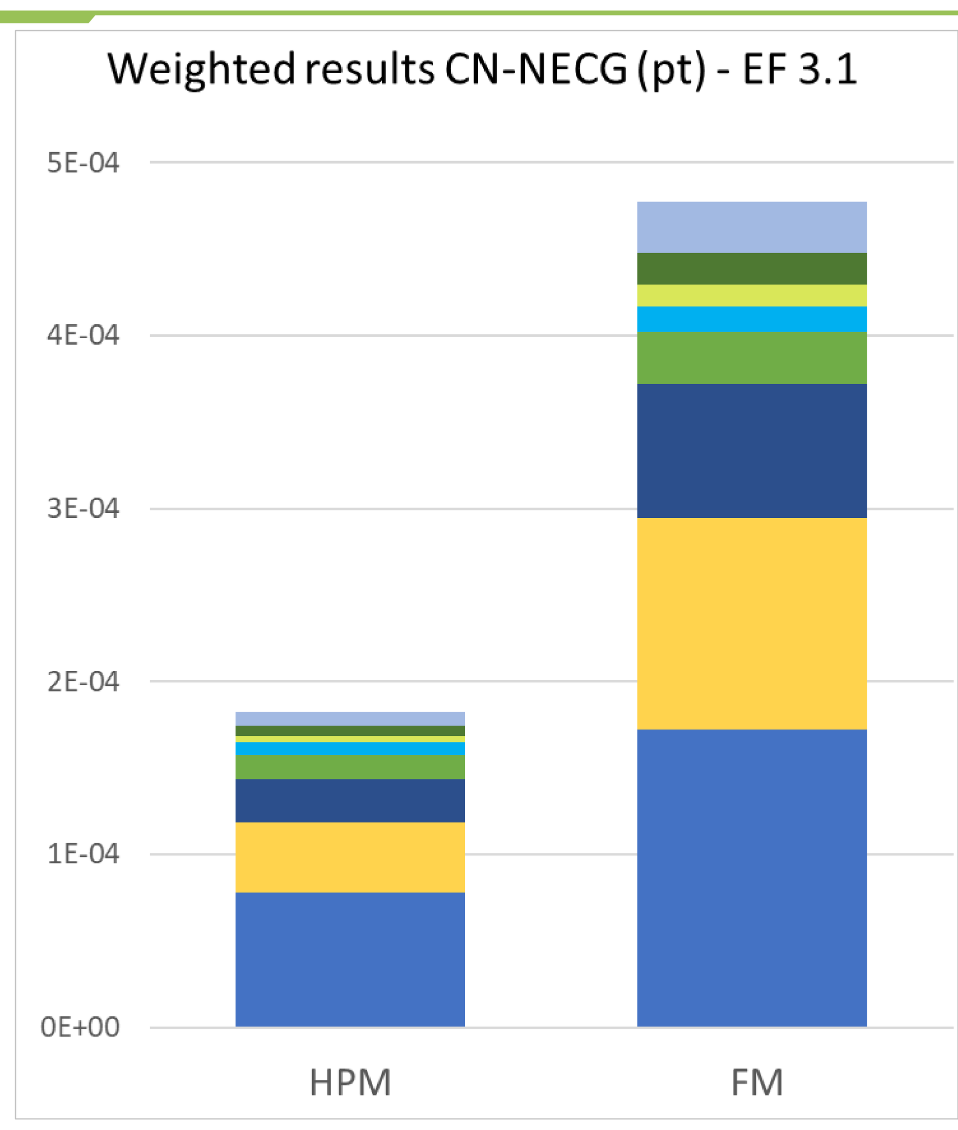
- Cradle-to-gate comparison of sintered and fused magnesia production



Scenarios description	
FM	Fused magnesia
HPM	High purity magnesia (sintered)
CN-NECG	Chinese regional electricity mix
CN	Chinese national electricity mix
HY	Electricity mix 87% hydro
Tech. scenario	High-power (~5000 KVA) furnace
NG scenario	Gas fired kiln

- Better environmental performance of HPM over FM in China
- Energy mix is the key parameter to reduce impacts
- Technology improvements' effects depend on energy efficiency and fuel choice
- Primary data needed to improve current dataset (technology, energy consumption)

Identification of the most relevant impact categories



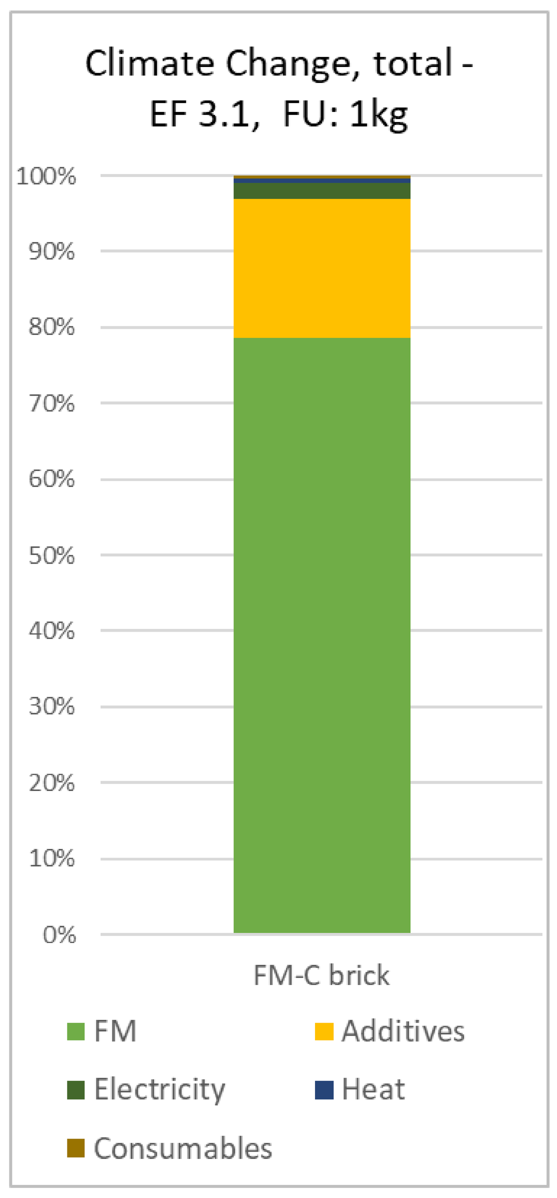
- Most relevant impact categories: climate change, resource use fossils, particulate matter

LCA characterisation results – EF 3.1, FU 1 kg	HPM, CN-NECG	FM, CN-NECG
Acidification [Mole of H+ eq.]	1.3E-02	2.7E-02
Climate Change - total [kg CO2 eq.]	2.8	6.2
Eutrophication, freshwater [kg P eq.]	3.9E-04	8.6E-04
Eutrophication, terrestrial [Mole of N eq.]	1.8E-02	5.9E-02
Particulate matter [Disease incidences]	2.72E-07	8.15E-07
Photochemical ozone formation, human health [kg NMVOC eq.]	5.3E-03	1.6E-02
Resource use, fossils [MJ]	19.5	60.3

Effect on downstream processes: use of magnesia

- Refractory application: MgO-C brick
  - Magnesia is responsible of the main impacts
  - Substitution of materials with equivalent performance
    - Magnesia performance depends on its quality
      - Need for updated and improved inventories

LCA scenarios of MgO-C brick production – EF 3.1, FU 1 kg	FM	HPM	% comparison
Climate Change - total [kg CO2 eq.]	6.3	3.6	57%
Particulate matter [Disease incidences]	7.5E-07	3.2E-07	42%
Resource use, fossils [MJ]	73.7	41.1	56%
Ionising radiation, human health [kBq U235 eq.]	9.9E-02	3.5E-02	35%
Eutrophication, freshwater [kg P eq.]	1.1	0.7	66%
EF 3.1 Eutrophication, terrestrial [Mole of N eq.]	63.9	30.5	48%



Resource use and materials quality

- Context: lack of ADP characterisation factor for magnesite and low quality datasets

Abiotic Depletion [kg Sb eq.] – CML2001 (Aug. 2016), FU 1kg					
Tot. HPM production	Magnesite transport	Magnesite extraction	Mining activity	HPM electricity	HPM fuels
4.11E-07	6.4%	0.3%	6.1%	37.8%	49.4%

- The impact of magnesite mining is neglectable: low relevance of the deposit quality
- Substitute approximated dataset (100% purity) with primary data
  - Track MgO purity along the processes (concentration step, waste, products quality)

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Thibault Champion – Saint-Gobain

Acknowledgements:

This project has received funding from the European Union's Horizon Europe research and innovation program under grant agreement no.101072625

Beneficiaries