Carbon Footprint analysis to guide climate change mitigation strategy

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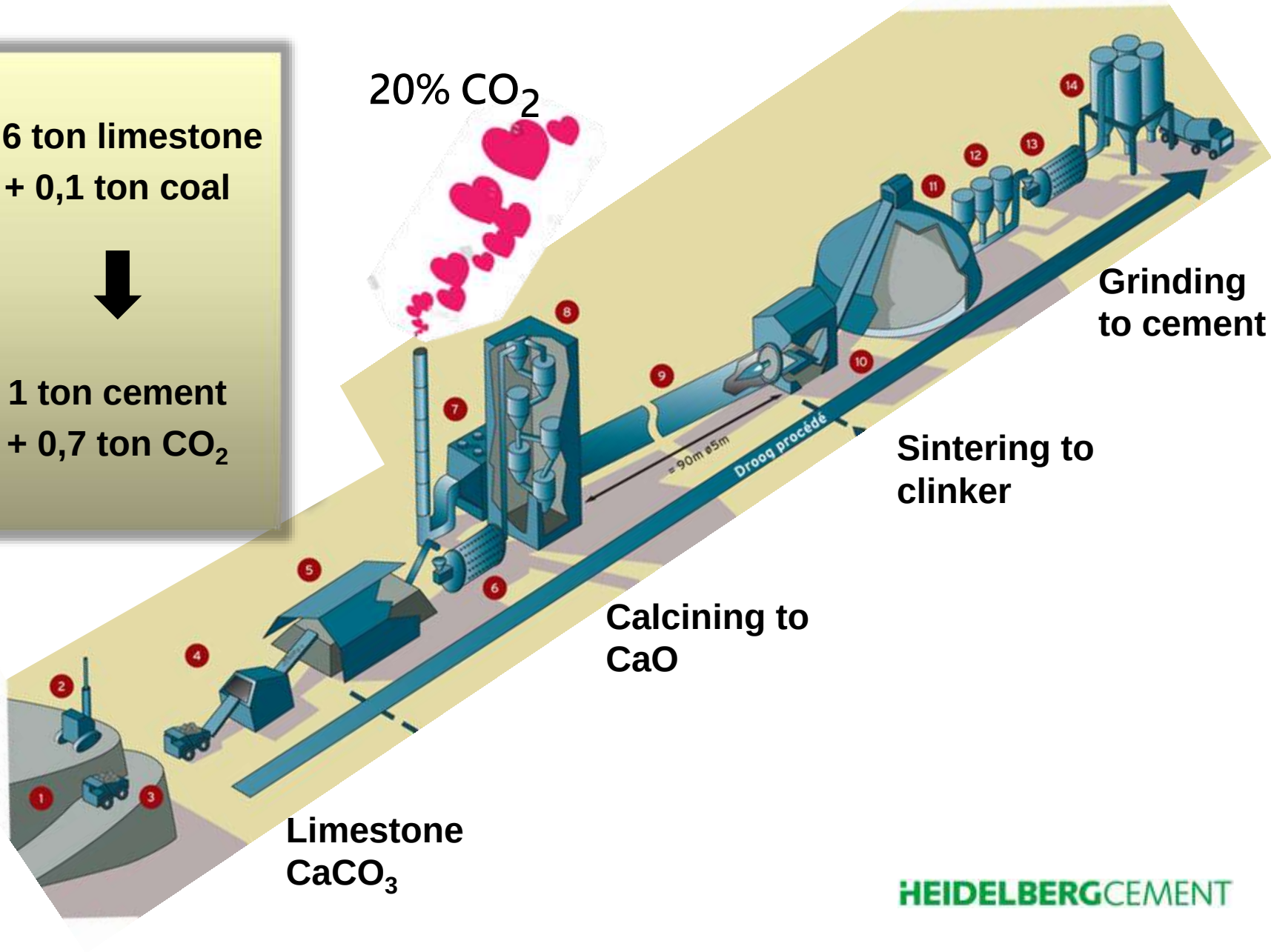
Snapshot of Cement manufacturing

1,6 ton limestone
+ 0,1 ton coal

1 ton cement
+ 0,7 ton CO_2



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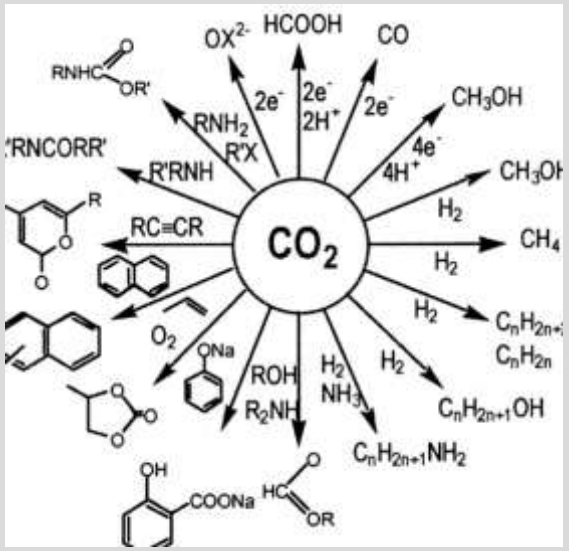
Carbon Capture and Utilization: building partnerships



CO₂ VALUE EUROPE

www.greenwin.be/faq/2-pager.pdf

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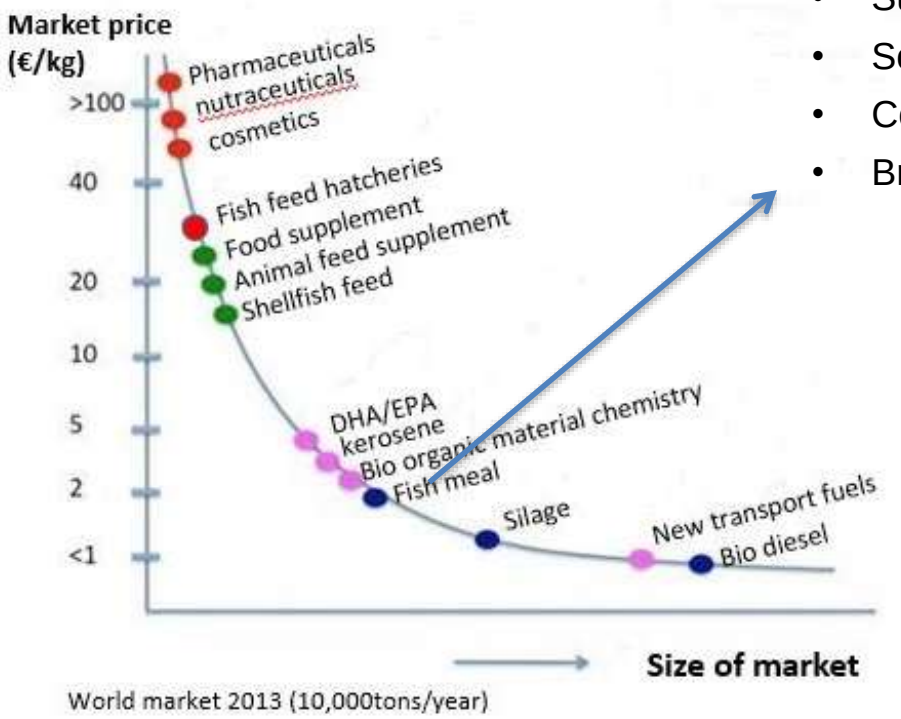
CO_2-uptake by micro-algae to produce animal feed



Fish meal

- Substantial market
- Solid market, clear specifications
- Competitive cost achievable within few years
- Bridge to larger market of animal feed

Feed market has good potential at achievable price!

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LCM – assessment: three comparable fish feed ingredients

Micro-algae

Quality

Protein, Carbohydrates, Fat*
*often called Lipids

Key for CF

* CO_2-uptake at production
* High power consumption → use of renewables key

Other parameters

* No pesticides
* Only use seawater

Soybean

Quality

Protein, Carbohydrates, Fat

Key for CF

* CO_2-uptake at production
* Need for arable land → Land-Use-Change key

Other parameters

* Pesticides
* Rain-/ground water

Herring-meal

Quality

Protein, Carbohydrates, Fat

Key for CF

* No CO_2-uptake
* Fuel boat catching fish
* Energy when processing

Other parameters

* Herring is human food and is degraded to fish-feed

A semi-industrial scale project: micro-algae production in Safi (Morocco)

Installation - 4 Hectare	Type of material	CO_2 footprint per unit	Unit	Quantity	Min. life span	kg CO_2eq /ton Algae
Disposable bags	LDPE	2.1	kg CO_2/kg	15360	2	**79**
Foil below bags + piping	PVC	2.2	kg CO_2/kg	5600	10	**6**
Shade cover + vessels	HDPE	1.9	kg CO_2/kg	14400	15	**9**
Pumps + container	Steel	3.3	kg CO_2/kg	5680	15	**6**
Nutrients	mix Fe, P, N	3.4	kg CO_2/kg	13000	1	**223**
Chemicals	H_2O_2 solution	1.1	kg CO_2/kg	100	1	**1**
Water	seawater	0.030	kg CO_2/m3	28000	1	**4**
Electricity	PV-panels	0.040	kg CO_2/kWh	800000	1	**160**
Total						488

CO_2-emission at production:

488 kg CO_2eq / ton algae

CO_2-load due to Land Use Change:

0 CO_2eq / ton algae

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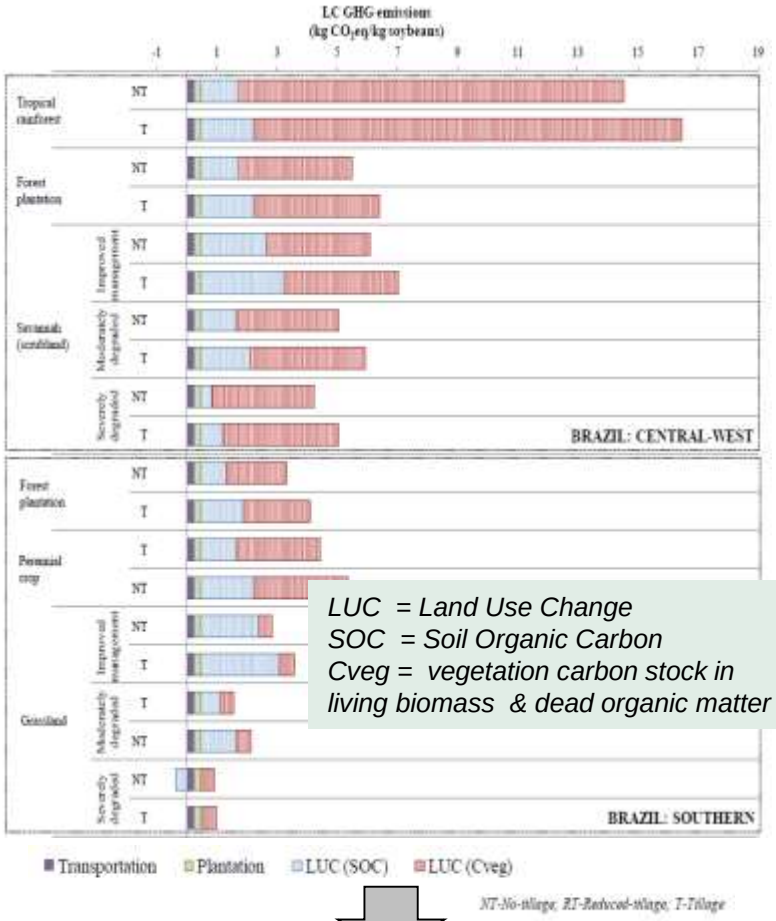
Soybean production in Brazil

Installation - 4 Hectare	Type of material	CO_2 footprint per unit	Unit	Quantity	Min. life span	kg CO_2eq /ton Algae
Lime	CaO	0.75	kg CO_2/kg	1332	1	68
Seed		0.61	kg CO_2/kg	184	1	8
Fuel Tractor	diesel	2.79	kg CO_2/l	120	1	23
Electricity	grid	0.50	kg CO_2/kWh	72	1	2
Fertilizer	mix N, P, K	0.8	kg CO_2/kg	728	1	42
Crop residues	e.g. N2O	0.16	kg CO_2/kg	5575	1	60
Pesticides	mix H, F, I	5.4	kg CO_2/kg	23	1	8
Tractor equipm	steel	3.3	kg CO_2/kg	20000	0.0002	0.8
Total				728		213



LUC = Land Use Change
SOC = Soil Organic Carbon
Cveg = vegetation carbon stock in living biomass & dead organic matter

CO_2-emission at production:

213 kg CO_2eq / ton soybean

CO_2-load due to Land Use Change:

500 – 17000 kg CO_2eq / ton soybean

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Carbon Footprint on a like-for-like basis

Micro-algae Morocco

CF	kg CO_2/kg dry
photosynthesis	-1,8
production	+0,5
land use change	0
Total	**- 1,3**

Soybean Brazil

CF	kg CO_2/kg dry
photosynthesis	-1,3
production	+0,2
land use change	+1,5
Total	**+ 0,4**

Herring-meal Average

CF	kg CO_2/kg dry
photosynthesis	0
fishing	+0,3
processing	+0,2
land use change	0
Total	**+ 0,5**

Micro-algae production Morocco gives large CO_2-saving

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Applicable measures to accelerate deployment

- Develop uniform accepted CF-template for micro-algae, taking into account:
  - Location
  - Production method
- Stimulus package for (fish) feed producers /users to gradually reduce CO_2-footprint of feed materials
- Check if the regulatory framework is adequate for micro-algae based feed production and use
- Define the CO_2-reduction factor allocated to the CO_2-generator in relation to MRV rules (e.g. in the EU-ETS)

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