LIFE SMART AGROMOBILITY

LIFE 2019

SMART **AGROMOBILITY**

Biomethane from liquid manure for the automotive industry.

Project co-financed by the European Union – LIFE19CCM-ES-001206

LIFE SMART AGROMOBILITY

Index

1. Project purposes
2. Project process
3. LCA methodology
4. Results and discussion

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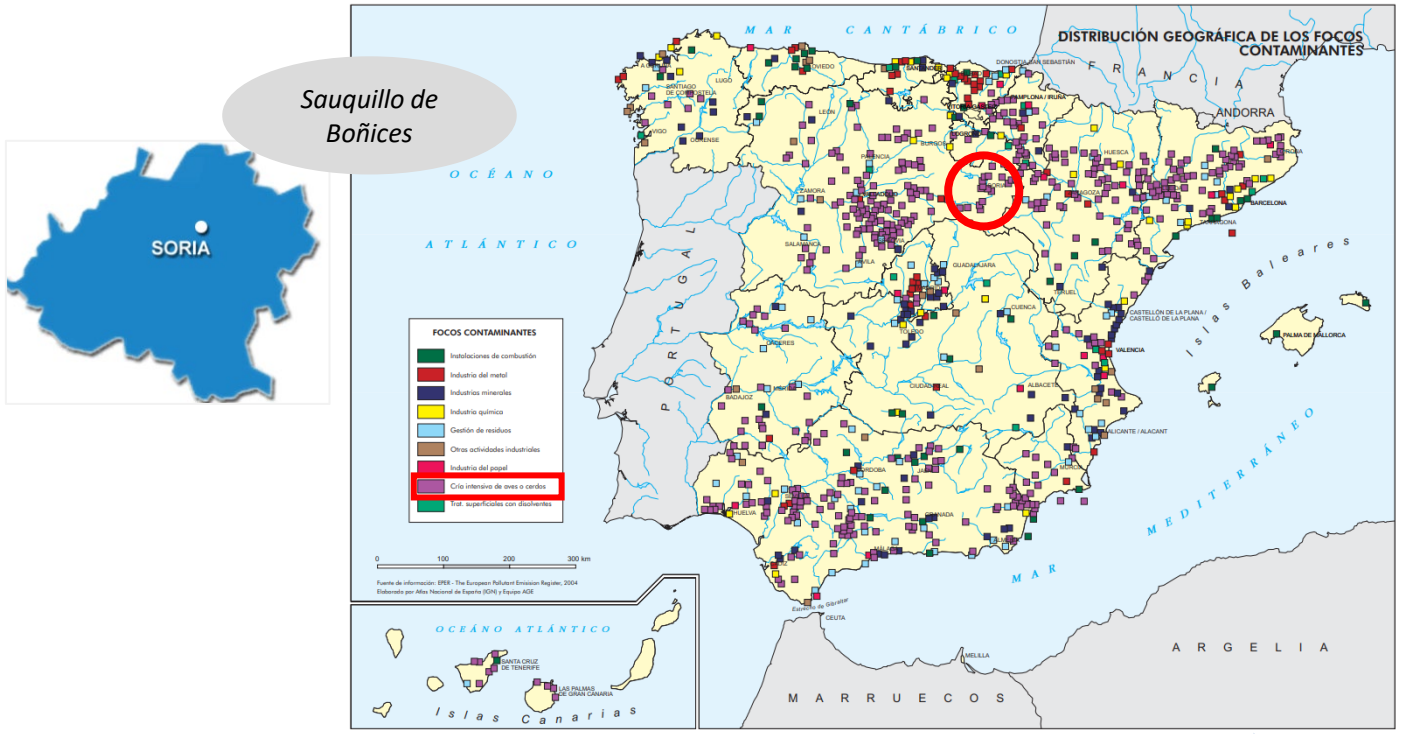
1. Project purposes

- Circular economy
- Emissions reduction
- Action towards an issue in sectors: livestock, fertilizer and transport fuels industry
- Waste treatment and obtaining autochthonous, renewable and competitive biofuel

Source: IGN, "Geographical distribution of pollution sources".



3,450 head fattening pig farm with 5,666 m^3/year of slurry generation

6,771 kg/year of biomethane for automotive use

233,200 km for DISI ICE vehicles or **285,500 km** for MHEV Hybrid vehicles

Source: A. Huss *et al.*, *JEC Tank-To-Wheels report v5: Passenger cars,* 2020.

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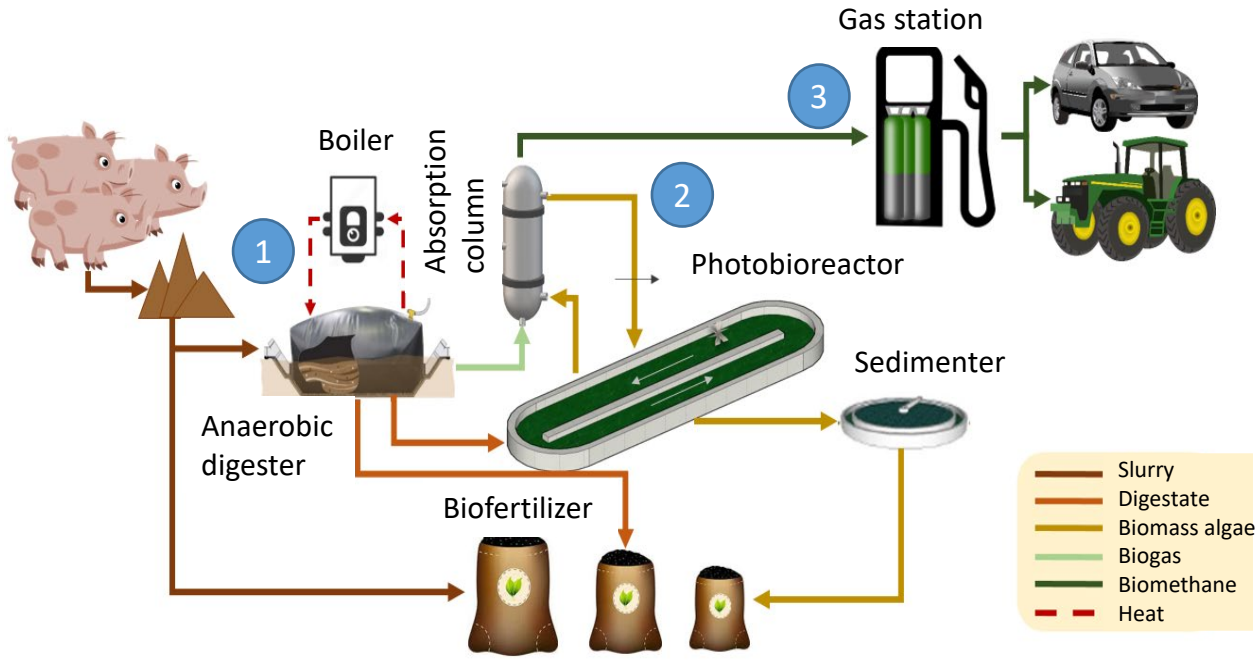
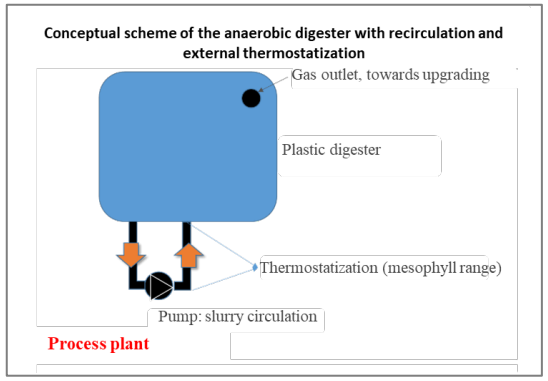
2. Project process



1. **Anaerobic digestion (low-cost):** distributed biogas generation.
2. **Refining:** removal of CO_2 (and some trace gases, H_2S).
3. **Compression and supply:** CH_4 conditioning (standard PD01) use of biomethane in automotive industry.

1



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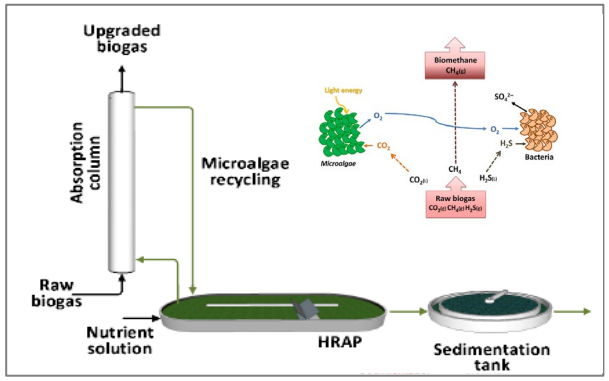

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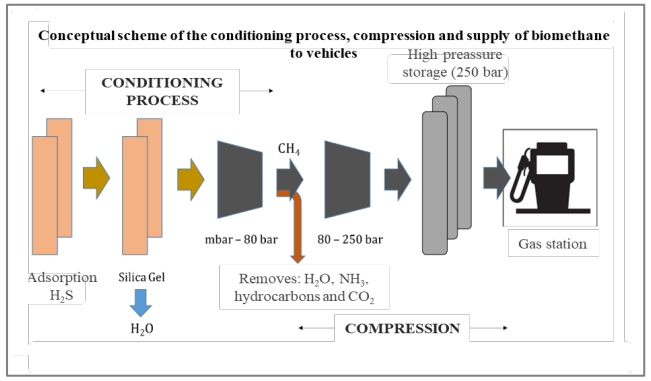


3. LCA methodology

LCA methodology: ISO 14040:2006 standard (ISO, 2006a), ISO 14044:2006 standard (ISO, 2006b) Guidelines ILCD Handbook (JRC-IES,2000). Guide EF data (JRC, 2020)

Goal and Scope: Find the best practices for obtaining biomethane according to the LIFE AgroMobility process.

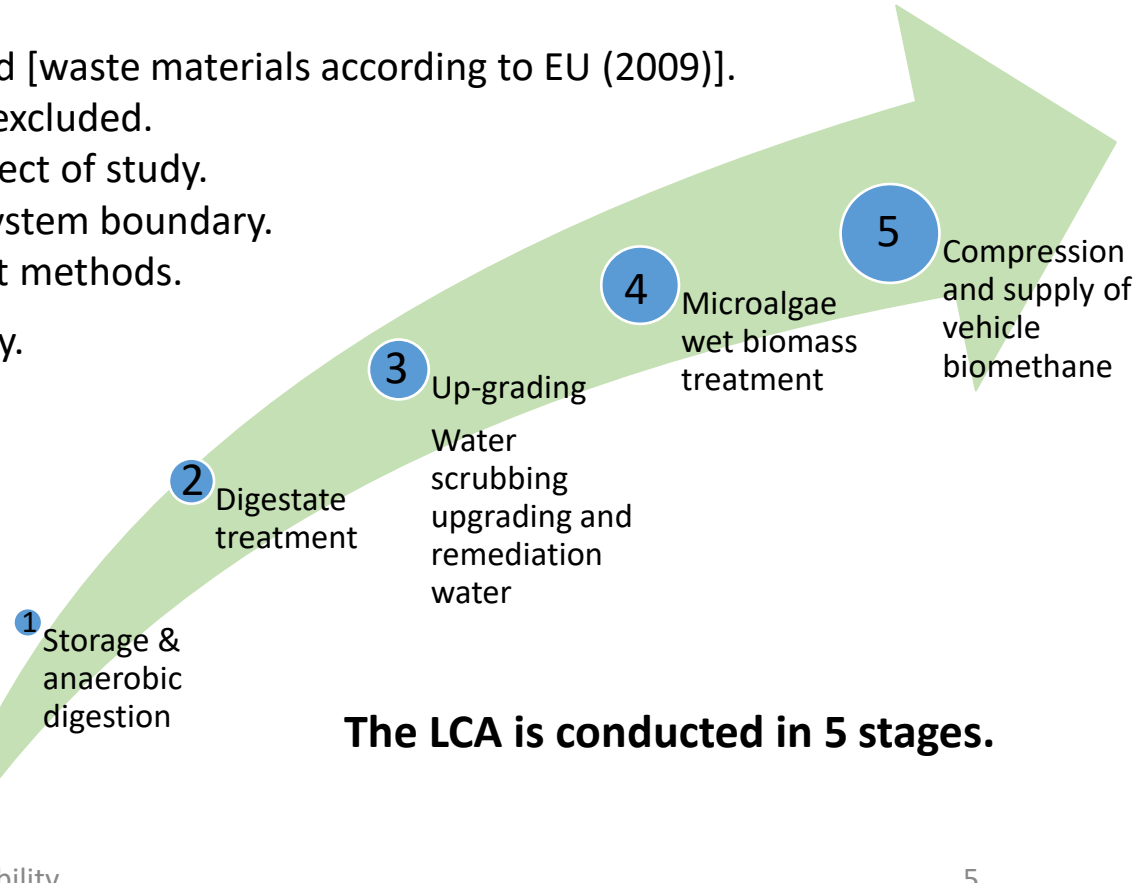
Functional Units: MJ_{energy} (Compressed biomethane).

System description and boundaries

- Generation phases of slurry and co-feedstocks are not included [waste materials according to EU (2009)].
- Generation and collection are in-situ, so the transportation is excluded.
- Digestate and microalgae biomass application are not the subject of study.
- Infrastructure and facility construction is not included in the system boundary.
- Factors of biogenic CO_2 equal to 0, EU Environmental Footprint methods.

LCA attributional and **energy allocation** to solve multifunctionality.

Stages	Products & co-Products	Allocation	LHV (mass)
1	Raw biogas (62% CH_4) Wet Digestate	43% 57%	13.7 MJ/kg 17 MJ/kg dry
3	Biomethane (91% CH_4) Wet microalgae	80% 20%	42.1 MJ/kg 18.26 MJ/kg dry
5	Biomethane (97% CH_4)	100%	46.1 MJ/kg



The LCA is conducted in 5 stages.

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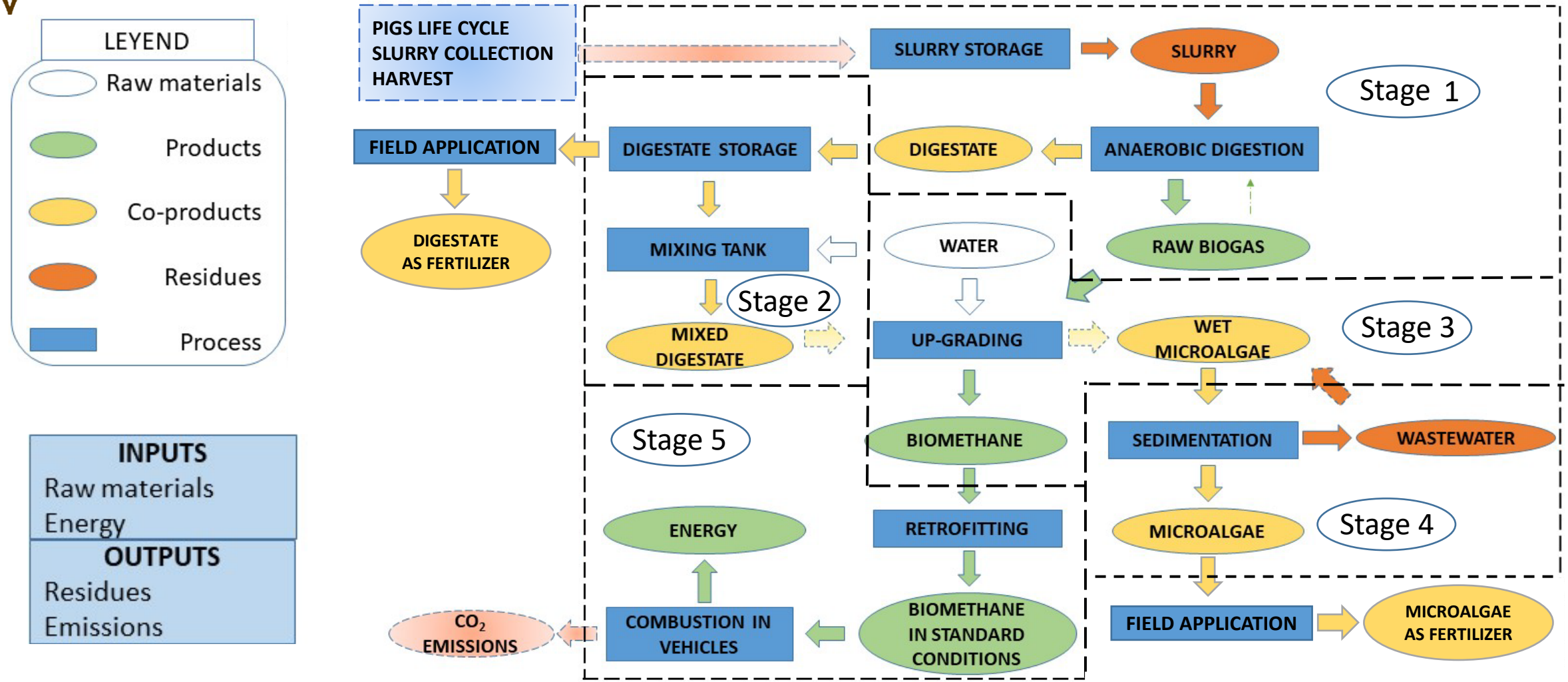
3. LCA methodology



3. LCA methodology

Inventory Analysis - feedstock characteristics (n=52)

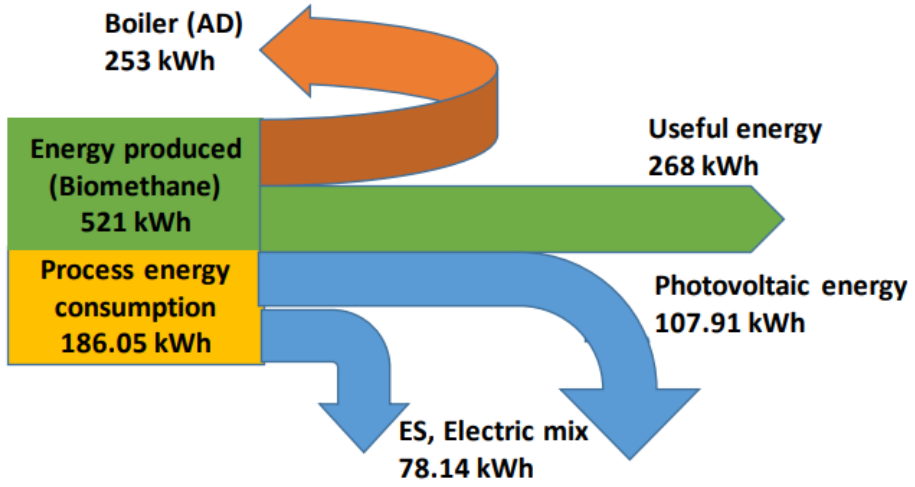
Laboratory sample data update by LIFE SMART AgroMobility.

Ecoinvent v. 3.8 database (Ecoinvent, 2021).

Parameters	Medium	Minimum	Maximum
Density (g cm^{-3})	1,02	1,00	1,09
Dry matter (g kg^{-1})	42,53	4,17	199,50
Organic matter (g kg^{-1})	31,81	2,61	160,66
NH_4-N (g kg^{-1})	2,43	0,65	10,26
Inorg-N (g kg^{-1})	3,31	0,89	10,78
Org-N (g kg^{-1})	0,88	0,13	6,82
Total-N (g kg^{-1})	4,08	1,07	12,19

Source: (Sánchez and González, 2005).

Daily energy balance



Emission factors

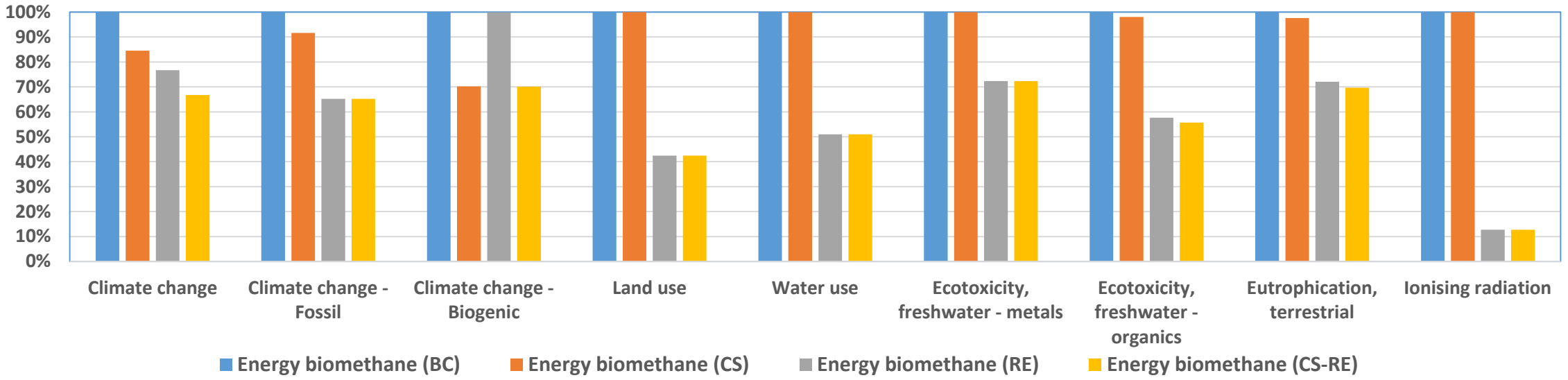
- Slurry is considered a zero burden.
- Manure storage emissions during open storage (IPCC, 2006b), based on the national GHG inventory.
- Biogenic emissions of CHP (AD) in the biogas plant is based on Danish measurements. (Kristensen et al., 2004).
- Emissions due to digestate in open storage.
- 3% loss during up-grading in the absorption column.
- Microalgae during photosynthesis is capable of fix CO_2 (biogenic and atmospheric), up to 2 kg CO_2 per kg of microalgal biomass produced.

4. Results and discussion

LCA - 1 MJ compressed biomethane

Different scenarios represented: Base Case (**BC**), Closed digestate Storage (**CS**), Renewable Energy (**RE**),Close digestate Storage - Renewable energy (**CS-RE**)

Environmental Footprint 3.0 (EF) method. SimaPro 9.3.0.3. program. (Results characterization table, back-up slide).



Closed digestate storage scenario, a significant reduction in climate change is achieved. Expanding the on-farm **renewable energy** capacity, the impact will be lower in categories such as ionization, water and land use, and climate change (fossil).

4. Results and discussion

Discussion highlights

- **How to allocate environmental burdens between the co-products?**
  In existing standards and guidelines, recommendations on how to handle multifunctionality differ and there is a lack of definition of different methods to deal with multifunctionality.

- **ISO 14040/44 clearly specifies how to model biowaste feedstocks?**
  No, there are different studies for the same product with different waste modelling. Waste may come free of or with environmental burden (and credits/carbon uptake).

- **Is ISO 14040/44 sufficient for a comparative analysis?**
  There is 'freedom' to choose an impact assessment method. Different methods give different results, so in order to be able to compare, all of them should be compared with the same impact assessment method.

A **pathway of categorised rules for biofuels** at the international level is called for, so that valid comparisons can be made.

Questions?

LIFE SMART AgroMobility

"The heart of mobility, powering natural resources"

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