

Definition:

Embodied Energy
GHG emissions

Description

Benefit: Energy content can be used for an integrated evaluation of crops. Generally, the type of energy should be specified to distinguish between use as fuel or use as food and feed. For use as animal feed, further definitions are required to determine if lignocellulosic crops qualify. Crops with high per hectare yield will show high efficiencies in this impact area.

Resource: Under current policy targets such as the 2015 Paris Agreement or the United Nations' Sustainable Development Goals (SDG), the total amount of greenhouse gases that can safely be emitted into the atmosphere is limited. Greenhouse gas emissions can therefore be treated as a limited resource.

For this indicator, emissions of different greenhouse gases are combined by calculating carbon dioxide equivalent emissions (CO₂ eq.), based on the 100-year global warming potential (GWP) of each gas. It is necessary to define both the spatial reference (e.g. emissions per hectare) and the temporal reference (e.g. emissions per year).

Correlation with soil management

^[58] Biofuel from sweet sorghum, sugarcane, soybean and oil palm show highest reduction in GHG emission per unit of energy produced compared to fossil fuel

Strength & weaknesses pertaining to measurement of this impact area

Embodied Energy: Indicators for embodied energy are generally easy to measure and allow integration of or comparison between benefits from very different crops. However, their information value for questions of nutrition is limited because the provision of amino-acids and vitamins is not considered.

GHG Emissions: For this indicator, a number of standard values and national inventories exist. The use of the 100-year GWP enables comparability between studies and between emissions of different greenhouse gases. However, for short lived gases such as methane, this standard underestimates the contribution to global warming in the short term and overestimates their contribution in the long term.

Can be measured as

Embodied Energy:

- nutritional value (humans) [J]
- nutritional value (non-grazing livestock) [J]
- nutritional value (grazing livestock) [J]
- heating value [J]



GHG Emissions:

- total emissions [Mg CO₂ eq. ha⁻¹ yr⁻¹]

Sample Indicators











Indicator values from		Survey	
Experiment or direct measurement		Statistical- or census data	
Expert assessment		Literature values	
Model		Maps or GIS	
Stakeholder participation		Not provided	

Table 1: No Scale

Indicator	Unit	Indicator values from
[58] GHG emission indicator (Produced Energy in the biofuel and its coproducts/CO ₂ emission)	MJ * g ⁻¹	

References

ID	Citation	¹Soil type/ texture
58	de Vries, S. C., et al. (2010). "Resource use efficiency and environmental performance of nine major biofuel crops, processed by first-generation conversion techniques." <u>Biomass and Bioenergy</u> 34 (5): 588-601.	n/a

¹Soil type/ texture: If provided, what are type and texture of the soils studied in the paper?