TRansition paths to sUstainable legume-based systems in Europe

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Environmental Pillar

Description and metrics of indicators

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Indicator Structure and Theme ratings for the Environmental sustainability pillars

PRODUCTION (En1) Scale: Low(-); Medium; High(+)				
THEME	**SUB-THEME**	**Sub-sub theme**	**Sub-sub-sub-theme**	**INDICATOR**
Abiotic Scale: Low(-); Medium; High(+)	Atmosphere emissions Scale: High(-);Medium; Low(+)			GHG Balance
				Emission of Air Pollutants
	Emission of Water Pollutants Scale: High(-);Medium; Low(+)			P balance
				N balance
	Resource depletion Scale: High(-);Medium; Low(+)	Resource use Scale: High(-);Medium; Low(+)	SynFertilisers Scale: High(-);Medium; Low(+)	SynP fertilisers
				SynN fertilisers
				Ground and Surface Water Withdrawals
		Energy Efficiency Scale: Low(-); Medium; High(+)		SynN fertilisers
				Diesel consumption
Ecosystem impact Scale: High(-);Medium; Low(+)				Land use
				Land sharing/habitat provision
				Soil Organic Matter

PROCESSING (En2) Scale: Low(-); Medium; High(+)		
THEME	**SUB-TEME**	**INDICATOR**
Energy Scale: High(-);Medium; Low(+)	Energy Efficiency Scale: Low(-); Medium; High(+)	Electricity
		Other fuels
	Renewable Energy % Scale: Low(-); Medium; High(+)	Renewable electricity
		Renewable other sources
	Atmosphere emissions Scale: High(-);Medium; Low(+)	GHG Balance
		Emission of Air Pollutants
Waste generation Scale: High(-);Medium; Low(+)		Food Loss and Waste Reduction
		Waste Disposal
Resource use Scale: High(-);Medium; Low(+)		Renewable and Recycled packaging
		Ground and Surface Water Withdrawals

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TRANSPORT AND DISTRIBUTION (En3) Scale: Low(-); Medium; High(+)	
THEME	**INDICATOR**
Environmental sustainability-Transportation Scale: Low(-); Medium; High(+)	Transport intensity
	Atmosphere emissions
	Loss of products

MARKETS AND RETAILERS (En4) Scale: Low(-); Medium; High(+)	
THEME	**INDICATOR**
Waste Scale: High(-);Medium; Low(+)	Food Loss and Waste Reduction
	Waste Disposal
Energy Scale: High(-);Medium; Low(+)	Energy Efficiency
	Renewable Energy %
	Emission of Air Pollutants
Resource use Scale: High(-);Medium; Low(+)	Renewable and Recycled Materials
	Packaging specification

CONSUMERS (En5) Scale: Low(-); Medium; High(+)	
THEME	**INDICATOR**
Waste Scale: High(-);Medium; Low(+)	Food Loss and Waste Reduction
	Waste Disposal
Energy Scale: High(-);Medium; Low(+)	Cooking intensity
	Renewable Energy %
Water use	

Table of Indicators for the Environmental sustainability pillars

LEGEND:	
En	Environmental Pillar for the Agri-food Chain
1	Production link
2	Processing link
3	Transport and Distribution link
4	Markets and Retailers link
5	Consumers link

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DESCRIPTION AND METRICS OF ENVIRONMENTAL INDICATORS

INDICATOR NAME: **GHG Balance**
SUB-THEME: Atmosphere emissions
THEME: Abiotic
LINK: Production (En1)

DESCRIPTION

Crop production contributes to climate change via the emission of greenhouse gases (GHGs), primarily from use of synthetic nitrogen fertilisers (SNF) that require considerable amount of fossil energy to produce, and that give rise to soil emissions of nitrous oxide following application. Meanwhile, depletion or enhancement of soil carbon (C) stocks can results in significant emission to, or sequestration from, the atmospheric pool of carbon dioxide (CO_2) that influences temperature forcing (and thus climate change).

The primary metric proposed for this environmental aspect of crop production is GHG emissions per tonne (Mg) of produce. GHG emissions intensities can be: (i) derived through application of a life cycle assessment (LCA) to specific crop cultivation stages, most simply by using an open source footprint calculator such as the Cool farm Tool (https://coolfarmtool.org/) or AgreCalc (https://www.agrecalc.com/); (ii) obtained from secondary sources, including LCA (e.g. Ecoinvent & AgriFootprint) databases and published food LCA studies (e.g. Poore and Nemecek 2018).

Results should be expressed per tonne (Mg) of dry matter (DM) of the main product, to ensure standardized units. This may require knowledge of moisture content at harvest, and possibly also allocation of crop cultivation burdens across multiple co-products (e.g. grain and straw) based on relative economic values. GHG emissions should be aggregated as kg CO_2 equivalent based on IPCC (2013) global warming potentials over a 100-year timeframe (GWP_{100}). Changes in soil C stocks may be included in net emissions balances, as per standard reporting guidelines for land use and land use change emissions (BSI 2011; IPCC 2006b).

Note that for this and all subsequent environment metrics, harvested products include co-products (e.g. straw) alongside the main product (e.g. grain) harvested from the cropping system.

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METRICS

The use of an appropriate carbon calculator such as Cool Farm Tool is the 'gold standard' approach to represent GHG emission performance in primary production as per the thresholds set out below, and is necessary for animal systems. However, for cropping systems, where it is not feasible to enter data into a carbon calculator, an alternative approach is to use nitrogen fertiliser application rate as a proxy of GHG emissions. Approximately 80% of crop emissions (up to the farm gate) originate from nitrogen fertiliser manufacture and nitrous oxide emissions that arise in proportion to nitrogen application rates. Thus, it is the single most relevant proxy for pre farm gate GHG emissions. The same thresholds are proposed for this metric as for the energy intensity of primary production indicator. The following scales are provisionally suggested based on range of crop footprint values (Wernet et al. 2016), and may need calibrating.

RATINGS

The following scales are provisionally suggested based on range of crop footprint values (Wernet et al. 2016), and may need calibrating.

Low:	Less than 250 kg CO_2 eq. Mg^{-1} DM harvested product
Medium:	Between 250 and 500 kg CO_2 eq. Mg^{-1} DM harvested product
High:	Over 500 kg CO_2 eq. Mg^{-1} DM harvested product

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INDICATOR NAME: **Emission of Air Pollutants**
SUB-THEME: Atmosphere emissions
THEME: Abiotic
LINK: Production (En1)

DESCRIPTION

The application of SNF, especially in urea format, and organic fertilisers, also give rise to emissions of ammonia (NH_3), which contributes to air pollution, human health and ecosystem damage. Through a reduction in requirements for SNF and organic fertilisers, legumes may be associated with lower atmospheric emissions than conventional crops.

Given the difficulty of obtaining precise data for the ideal metric of NH_3 emission per Mg DM, the primary metric proposed for this environmental aspect of crop production is based on the intensity of activities giving rise to ammonia emissions – primarily mineral and organic fertilizer applications. Information on typical rates of fertilizer application (e.g. fertilizer recommendations) and yields for particular crops (e.g. EuroStat and FAO Stat) can provide a strong indication of the overall GHG- and ammonia- intensities of production. The application of urea and manure provide simpler metrics relating to the likely intensities of ammonia emissions.

METRICS

Applications of SNF and organic fertilisers, in abated or unabated forms, expressed per Mg DM of harvested product (Misselbrook, TH; Gilhespy, SL; Cardenas, LM; Williams, J; Dragosits 2015; Webb and Misselbrook 2004).

RATINGS

Low:	No SNF, animal manures nor biogas digestate applied.
Medium:	SNF or organic N fertilisers applied, at rates less than 10 kg N Mg^{-1} DM in non-abated urea, manure or biogas digestate form.
High:	Over 10 kg N Mg^{-1} DM applied in non-abated urea, manure or biogas digestate form.

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INDICATOR NAME: **P balance**
SUB-THEME: Emission of Water Pollutants
THEME: Abiotic
LINK: Production (En1)

DESCRIPTION

Phosphorus (P) is a limiting nutrient in many freshwater systems. Loss of P from cropping systems into water courses is a major cause of eutrophication (excessive nutrient enrichment) and associated algal blooms and biodiversity loss in freshwater bodies. It is related to the application of P in mineral and organic fertilisers, and soil erosion. A useful indicator of risk of P loss to water is P surplus. Usually, this is expressed as kg surplus (kg P in outputs minus kg P in inputs) per hectare.

METRICS

[kg ha-1 P in outputs minus kg P ha-1 in inputs)/ kg P ha-1 in inputs] x 100%. Determine and quantify all types of crops (by area and yield) and animals (by heads or places and performance) in the operation. Quantify all imports and exports of nutrient-containing materials, such as fertilizers, feed and agricultural produce. Using an established method and recognized standard values, calculate the nitrogen and phosphorus supply and demand of the operation. Correct the nitrogen balance for volatile and, if possible, for liquid losses (leaching). Rate the nitrogen and the phosphorus balance of the operation by comparing effective supply with demand (SAFA "Nutrient balance (E 5.1.2)")

RATINGS

High (-):	>20%
Medium:	10-20%
Low (+):	<10%

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INDICATOR NAME: **N balance**
SUB-THEME: Emission of Water Pollutants
THEME: Abiotic
LINK: Production (En1)

DESCRIPTION

Nitrogen (N) is a limiting nutrient in some freshwater and many coastal marine ecosystems. Leaching of N from cropping systems into water courses is a major cause of eutrophication (excessive nutrient enrichment) and associated algal blooms and biodiversity loss in freshwater and coastal marine water bodies. N leaching is closely related to total N application in SNF and organic fertilisers. A useful indicator of resource (in)efficiency and risk of N loss to water is N surplus. As for P surplus, we propose that N surplus is initially calculated as kg N outputs minus kg N inputs per hectare, then expressed as a percentage of inputs (see "Nutrient balance (E 5.1.2)" of the SAFA Indicator recommendations).

METRICS

[kg ha-1 N in outputs minus kg N ha-1 in inputs)/ kg N ha-1 in inputs] x 100%. Determine and quantify all types of crops (by area and yield) and animals (by heads or places and performance) in the operation. Quantify all imports and exports of nutrient-containing materials, such as fertilizers, feed and agricultural produce. Using an established method and recognized standard values, calculate the nitrogen and phosphorus supply and demand of the operation. Correct the nitrogen balance for volatile and, if possible, for liquid losses (leaching). Rate the nitrogen and the phosphorus balance of the operation by comparing effective supply with demand. See SAFA "Nutrient balance (E 5.1.2)"

RATINGS

Scale: High(-); Medium; Low (+)

High (-): >20%

Medium: 10-20%

Low (+): <10%

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INDICATOR NAME: **SynP fertilisers**
SUB-SUB-SUB-THEME: Syn Fertilisers
SUB-SUB-THEME: Resource use
SUB-THEME: Resource depletion
THEME: Abiotic
LINK: Production (En1)

DESCRIPTION

Mineral P fertilizer is produced from finite reserves of phosphate rock, proven reserves of which are forecast to be depleted by the end of the century (Cordell, Drangert, and White 2009). High rates of mineral P fertilizer use is therefore a hotspot for abiotic resource depletion within crop production systems. Here, we propose the absolute rate of mineral P fertilizer application (excluding P in manures and biofertilzers) per Mg DM harvested product as a useful indicator of comparative resource depletion across crop production systems.

METRICS

Kg mineral P fertilizer application per Mg DM harvested product. Examples of crop-specific nutrient requirements and recommended fertiliser application rates can be found in nutrient management guidelines, e.g. AHDB (2017).

RATINGS

Low:	< 2 kg P Mg^{-1} DM harvested product
Medium:	2-5 kg P Mg^{-1} DM harvested product
High:	> 5 kg P Mg^{-1} DM harvested product

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INDICATOR NAME: **SynN fertilisers**
SUB-SUB-SUB-THEME: Syn Fertilisers
SUB-SUB-THEME: Resource use
SUB-THEME: Resource depletion
THEME: Abiotic
LINK: Production (En1)

DESCRIPTION

Synthetic N fertilizer manufacture requires large amounts of energy, usefully in the form of natural gas or other finite fossil fuels. Fertilizer manufacture is a major driver of energy consumption in the life cycle of crop production. Here, we propose the absolute rate of SNF application (excluding N in manures and biofertilzers) per Mg DM harvested product as a useful indicator of comparative resource depletion across crop production systems.

METRICS

Kg SNF applied per Mg DM harvested product. Examples of crop-specific nutrient requirements and recommended fertiliser application rates can be found in nutrient management guidelines, e.g. AHDB (2017).

RATINGS

Low:	< 5 kg N Mg^{-1} DM harvested product
Medium:	5-15 kg N Mg^{-1} DM harvested product
High:	> 15 kg N Mg^{-1} DM harvested product

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INDICATOR NAME: Ground and Surface Water Withdrawals
SUB-SUB-THEME: Resource use
SUB-THEME: Resource depletion
THEME: Abiotic
LINK: Production (En1)

DESCRIPTION

Globally, agriculture is responsible for over 70% of freshwater abstraction, often at rates in excess of natural recharge, leading to lowering of water tables and representing a fundamentally unsustainable practice. This challenge is likely to be exacerbated by climate change. However, data on water abstraction are often not collated, and here we propose a simple indicator of *potential* water stress based on irrigation practice. Where no irrigation is needed, water stress induced by cropping is assumed to be minor. Where irrigation is required, practices are differentiated into "advanced" methods that maximise water use efficiency, such as drip irrigation and deficit (control) irrigation, and less efficient (basic) irrigation methods such as flood irrigation and sprinkler irrigation.

METRICS

Type of irrigation practice implemented for the crop (Antonopoulos et al. 2014).

RATINGS

High (-):	Sprinkler/flood irrigation employed
Medium:	Advanced irrigation employed (e.g. drip irrigation, deficit irrigation, etc).
Low (+):	None

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INDICATOR NAME: **SynN fertilisers**
SUB-SUB-THEME: Energy Efficiency
SUB-THEME: Resource depletion
THEME: Abiotic
LINK: Production (En1)

DESCRIPTION

Synthetic N fertilizer manufacture requires large amounts of energy, usefully in the form of natural gas or other finite fossil fuels. Fertilizer manufacture is a major driver of energy consumption in the life cycle of crop production. Here, we propose the absolute rate of SNF application (excluding N in manures and biofertilzers) per Mg DM harvested product as a useful indicator of comparative resource depletion across crop production systems.

METRICS

Kg SNF applied per Mg DM harvested product. Examples of crop-specific nutrient requirements and recommended fertiliser application rates can be found in nutrient management guidelines, e.g. AHDB (2017).

RATINGS

Low: < 5 kg N Mg^{-1} DM harvested product

Medium: 5-15 kg N Mg^{-1} DM harvested product

High: > 15 kg N Mg^{-1} DM harvested product

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INDICATOR NAME: Diesel consumption
SUB-SUB-THEME: Energy Efficiency
SUB-THEME: Resource depletion
THEME: Abiotic
LINK: Production (En1)

DESCRIPTION

The main on-farm use of energy in cropping systems is usually the combustion of diesel to power agricultural machinery. If fuel is used for e.g. on-farm grain drying, then this fuel consumption may be included in the proposed metric, which is simply the volume (L) of fossil fuel consumed per Mg DM harvested product. For the purposes of this simple metric, it is not necessary to differentiate by type of fossil fuel (petrol/diesel/liquid petroleum gas). However, biofuels should be excluded from the volumes.

METRICS

Fuel consumption, L Mg-1 harvested product. The following scales are provisionally suggested based on range of crop footprint values (Wernet et al. 2016), and may need calibrating.

RATINGS

High (-):	>18L Mg^{-1} DM harvested product
Medium:	12-18L Mg^{-1} DM harvested product
Low (-):	<12L Mg^{-1} DM harvested product

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INDICATOR NAME: Land use
THEME: Ecosystem impact
LINK: Production (En1)

DESCRIPTION

Agriculture utilizes 70% of global land area. Land occupation by agriculture is a major driver of habitat loss and soil degradation. Here, we propose a simple metric based on the area required overt time to produce one Mg DM of harvested product. The metric is m^2.yr. Crucially, if multiple crops are harvested in one year on a particular area of land, then this should be represented within the metric by dividing the area by the fraction of year allocated to the crop in question. For example, if two soybean crops are cultivated within one year in a particular region, then the yield-derived m^2 Mg^{-1} required for each crop may be divided by 2 to produce the final specific time-weighted area (m^2.yr Mg^{-1} DM). This metric provides an indication of land use efficiency and therefore could be used to identify "land sparing" opportunities, or pressures driving agricultural expansion that may ultimately lead to undesirable (indirect) land use change (Searchinger et al. 2018).

METRICS

M^2.yr Mg^{-1} DM harvested product. The following scales are provisionally suggested based on range of crop yields (FAO 2018), and may need calibrating.

RATINGS

High (-):	> 2000 m^2.yr Mg^{-1} DM harvested product
Medium:	1000-2000 m^2.yr Mg^{-1} DM harvested product
Low (+):	< 1000 m^2.yr Mg^{-1} DM harvested product

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INDICATOR NAME: **Land sharing/habitat provision**
THEME: Ecosystem impact
LINK: Production (En1)

DESCRIPTION

Land occupation for agriculture, as measured in the preceding metric, provides an important indication of pressure on natural habitats. However, agriculturally utilized land, such as extensive livestock grazing on low-input pastures, can support high nature value (Haddaway, Styles, and Pullin 2014). This metric therefore represents the extent to which land utilized for agricultural purposes is able to deliver a wider suite of ecosystem services (outside of food provisioning) – i.e. "land sharing".

METRICS

Determine the total area of the ecosystems used in the operations and directly affected by these operations. Determine the share of land or aquatic and marine habitat, where the structural diversity of habitats – aquatic and terrestrial – is at least as high as in natural ecosystems of the region. Structural diversity pertains to the vertical layering and horizontal heterogeneity of habitats at the patch and landscape levels (SAFA indicator E4.1.3, 2013).

RATINGS

High (+): Structural diversity on the complete utilized and adjacent land is at least as high as in natural ecosystems of the same region. Polyculture is practiced both in land and in aquatic (i.e. multitrophic) operations.

Medium: Different areas of land affected by relevant operations can be categorized as both High and Low.

Low (-): All utilized and adjacent land/aquatic habitat is covered by monocultures with a single habitat layer and no substantial horizontal heterogeneity, although the landscape would be structurally diverse without human influence.

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INDICATOR NAME: Soil Organic Matter
THEME: Ecosystem impact
LINK: Production (En1)

DESCRIPTION

Soil organic matter (SOM) has been declining for decades on cropland soils across Europe, and has been proposed as a useful proxy indicator for soil quality (Mila, RomanyÃ, and Cowell 2007). SOM is closely related to biological activity, water retention and general fertility of cropland soils. However, SOM varies considerably depending on factors outside of farmer management practises, including climate and soil type. Here, we propose SOM concentration (FAO 2013) in the topsoil (0-10 cm) of fields producing the assessed crop as a metric of soil quality. This metric applies only to cropland soils, as grassland soils have higher SOM. Often, SOM is reported in terms of soil organic carbon (de Brogniez et al. 2015); typically, SOM is twice the mass of soil organic carbon (IPCC 2006a).

METRICS

SOM concentration, expressed as a percentage weight of dried soil, in soil samples taken from top 10 cm of topsoil.

RATINGS

Low (-): <2% SOM content in top 10 cm of soil.

Medium: 2-4% SOM content in top 10 cm of soil.

High (+): >4% SOM content in top 10 cm of soil.

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INDICATOR NAME: **Electricity**
SUB-THEME: Energy Efficiency
THEME: Energy
LINK: Processing (E2)

DESCRIPTION

Typically, the main direct source of energy consumed in crop processing is electricity. Generation of electricity using fossil fuels gives rise to GHG emissions and air pollution, whilst depleting finite fossil fuel reserves. Electricity consumption is usually measured at site level for billing purposes, but may be monitored at a smaller scale (building or process scale) in some cases. The metric proposed here is simply the quantity of electricity used to process one tonne (Mg) DM product. For sites processing just one main crop/commodity, total site-level electricity consumption over a given time period can simply be divided by <u>output</u> of processed product over that same time period. For sites processing multiple commodities, site level electricity consumption may be allocated across products based on weight (unless more accurate splits are possible based on known intensities of processing). Similarly, electricity consumption may be allocated across co-products based on e.g. relative mass, gross energy value or economic value (Finkbeiner et al. 2006). Note that product <u>output</u> (rather than throughput) excludes waste streams arising from production.

METRICS

Total electricity consumption, kWh Mg^{-1} DM product output (includes renewable electricity).

RATINGS

Scale: High (-); Medium; Low (+)

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INDICATOR NAME: Other fuels
SUB-THEME: Energy Efficiency
THEME: Energy
LINK: Processing (E2)

DESCRIPTION

In addition to electricity use, a considerable amount of energy may be required in the form of fuels for heating during crop/commodity processing – e.g. for drying, boiling, etc. A range of fuel types may be used, the most common being kerosene, natural gas and liquified petroleum gas (LPG). The efficiency metric here requires all fuels to be compared in terms of their lower heating value (LHV). The LHV of common fuel types can be found in (DEFRA 2019), and should be summed across all types of fuel consumed on site. Total fuel consumption, expressed as MJ LHV, may then be allocated to the main product output as described above for electricity consumption.

METRICS

Total fuel consumption, MJ / Mg^{-1} DM product output (includes renewable fuels such as biogas and wood pellets).

RATINGS

Scale: High (-); Medium; Low (+)

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Renewable electricity**
SUB-THEME: Renewable Energy %
THEME: Energy
LINK: Processing (E2)

DESCRIPTION

The previous metric on total electricity consumption provides an indication of energy efficiency. The environmental impact generated by that electricity consumption is heavily dependent upon the type of electricity used. Fossil fuel electricity drives large environmental impact, whilst electricity generated from renewable sources such as wind, solar photovoltaic and hydro- drives much lower environmental impact. This metric therefore assesses the sustainability of the specific electricity supply. In order to avoid double-counting of renewable electricity generation in the grid mix, only onsite or dedicated additional renewable electricity generation is considered here, as per carbon footprint guidelines (BSI 2011). Thus, the purchase of renewable electricity from the grid does not count as dedicated renewable electricity in this metric.

METRICS

Percentage share of dedicated (non-grid) renewable electricity consumption in relation to total electricity consumption.

RATINGS

Share of dedicated renewable electricity consumption

Low (-): <20%

Medium: 20-50%

High (+): >50%

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INDICATOR NAME: Renewable other sources
SUB-THEME: Renewable Energy %
THEME: Energy
LINK: Processing (E2)

DESCRIPTION

As with electricity use, it is important to determine what proportion of other fuel use originates from more sustainable, renewable sources. These may include biogas and wood pellets. The proportion of these sources in the fuel mix can be calculated as a percentage based on MJ of LHV (DEFRA 2019).

METRICS

Percentage share of renewable fuels in relation to total (non-electricity) onsite fuel consumption.

RATINGS

Share of onsite fuel consumption that is renewable.

Low (-): <20%

Medium: 20-50%

High (+): >50%

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **GHG Balance**
SUB-THEME: Atmosphere emissions
THEME: Energy
LINK: Processing (En2)

DESCRIPTION

The significant energy inputs required for processing often give rise to GHG emissions via use of fossil fuels as energy carriers. For example, the generation of electricity used in processing, or the direct combustion of natural gas or oil in boilers to generate heat onsite. These emissions are highly variable, depending on the source of energy and the quantities used, which depend on the type of food products being produced. In addition, leakage of refrigerants from cooling systems can contribute significantly to GHG emissions. Whilst the ideal metric for GHG emissions from processing would combine information on energy use and energy source to estimate total GHG emissions, these data are rarely available, and processing covers such as wide range of activities that it is impossible to propose universally applicable thresholds. Thus, a simplified approach is to use the main source of energy (accounting for than 50% of energy inputs) as a proxy for the GHG intensity of energy. Coal and oil are the most GHG-intensive energy sources per MJ, followed by gas, and then renewables as the least GHG-intensive sources of energy per MJ. The GHG intensity of electricity strongly depends on national grid profiles, but it reducing strongly across EU member states in line with various EU policies. Therefore, electricity is proposed as an intermediate GHG-intensive source of energy, unless it can be demonstrated that national grid average electricity generation in the relevant country where processing takes places is less than 0.3 kg CO2 eq. per kWh.

METRICS

Grids with low GHG generation would include France, Sweden, Norway, possibly also UK now, and some others

RATINGS

High: Most energy comes from coal and oil

Medium: Most energy comes from natural gas or electricity

Low: Most energy comes from renewable (or electricity is from a national grid with low GHG intensity generation)

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INDICATOR NAME: **Emission of Air Pollutants**
SUB-THEME: Atmosphere emissions
THEME: Energy
LINK: Processing (En2)

DESCRIPTION

Combustion of fuels onsite for heat is the main source of polluting emissions to air during processing. Emissions of particular concern regarding human health and ecosystem damage include nitrogen oxides (NOx), volatile organic compounds (VOCs) and particulate matter (PM). Solid fuels including coal and wood, and oil, are responsible for much higher emissions of these species than natural gas. If no solid or fossil fuels are combusted, then onsite emissions will be negligible. Use of renewable sources of heat, or use of electricity for heating., can avoid onsite emissions, but may incur upstream emissions. These are almost always much lower owing to better combustion control and abatement technologies for large-scale power generation compared with smaller boilers. Given that these emissions cannot be easily measured in small-scale processing factories, a simple indicator based on the type of fuel combusted onsite is proposed.

METRICS

Type of fuel combusted onsite for process heat.

RATINGS

High:	High-solid fuels or oil
Medium:	Gas
Low:	Non

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INDICATOR NAME: Food Loss and Waste Reduction
THEME: Waste generation
LINK: Processing (En2)

DESCRIPTION

Loss of food through the processing value chain not only creates waste that needs to be managed, incurring environmental impact, but also generates wider environmental pressure by driving additional production to compensate for foregone useful output. A simple metric is proposed here, based on the percentage of commodity entering a processing chain, expressed on a dry matter basis, that exits the processing chain as (a) useful product(s).

METRICS

Percentage of dry matter entering processing chain that leaves the chain as (a) product(s) for onward transport to distribution for consumption.

RATINGS

Low (-): <80% inputs as products

Medium: 80-90% inputs as products

High (+): >90% inputs as products

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INDICATOR NAME: **Waste Disposal**
THEME: Waste generation
LINK: Processing (En2)

DESCRIPTION

Some waste is inevitably generated during processing, and the way in which this waste is managed determines the environmental pollution associated with it, and the overall resource efficiency of the value chain. Organic waste arising from the processed commodity may be reused or recycled according to the following waste hierarchy (most efficient option first): animal feed, anaerobic digestion, composting (Tufvesson, Lantz, and Börjesson 2013). Packaging and other waste may be reused or recycled via e.g. return of pallets for reuse, separation and diversion of plastics, metals, paper, glass from residual waste streams into recycling streams. This metric reflects the percentage of waste generated, by mass, that enters a reuse or recycling stream rather than the residual waste stream.

METRICS

Percentage of total waste, by mass, that is separated and sent for reuse or recycling.

RATINGS

Percentage mass of total waste generated that is sent for reuse or recycling:

Low (-): <50% recycling

Medium: 50-80% recycling

High (+): >80% recycling

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Renewable and Recycled packaging**
THEME: Resource use
LINK: Processing (En2)

DESCRIPTION

Packaging is a significant source of waste and non-renewable material use within food value chains. Crucially, it is a major source of single-use plastic that is increasingly recognized for its contribution to littering and ecosystem pollution (Dris et al. 2015). The previous metric addresses the management of waste arising in the processing chain. Packaging waste usually arises at the consumption stage of the value chain, but is heavily influenced by the actions of processors and retailers who package products and specific packaging requirements, respectively. Therefore, this metric places an onus on processors to use renewable (e.g. bioplastic: Álvarez-Chávez et al. 2012) and recycled materials in their packaging. A subsequent metric, aimed at market actors who determine packaging specifications, relates to the quantity of packaging used.

METRICS

Percentage of packaging material, by mass, that is recycled or renewable material.

RATINGS

Percentage of packing by weight that is either renewable (e.g. paper, bioplastics) or recycled.

Low (-):	<50% renewable or recycled
Medium	50-80% renewable or recycled
High (+):	>80% renewable or recycled

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Ground and Surface Water Withdrawals**
THEME: Resource use
LINK: Processing (En2)

DESCRIPTION

Processing foods involves use of water as an ingredient, for cooking, for rinsing produce and for general cleaning. Water may also be needed for cooling. The impact of water use is heavily dependent on where it is sourced from, whether or not it is returned to a nearby waterbody in a clean state, and how water stressed the local region is. An ideal indicator for water stress would be the Available Water Remaining method for water foot-printing (Boulay et al. 2018). However, this method involves a considerable amount of data and effort. Therefore, a simple metric of total water used for processing divided by the tonnes of product produced is proposed.

METRICS

M3/tonne of product

RATINGS

High (-):

Medium:

Low (+):

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Transport intensity**
THEME: Transport and Distribution
LINK: Transport and Distribution (En3)

DESCRIPTION

Whilst there has been a lot of focus on "food miles" as a proxy for the environmental footprint of consumed food, it has been shown that transport typically accounts for a small share of the carbon footprint of many food products (Edwards-Jones et al. 2008). The distance travelled is therefore not a useful indicator of sustainability, given that e.g. tomatoes imported to the UK in winter have a lower environmental footprint than tomatoes grown in heated greenhouses in the UK (Antonopoulos et al. 2014). The mode of transport strongly influences environmental impact, with air freight generating up to 500 times more CO_2 eq. per tonne.km travelled than ocean transport over long distances (DEFRA 2019). Therefore, we propose mode of transport, and local vs global transport, as two important components of environmental sustainability (local supply chains within Europe are likely to be subject to higher levels of environmental regulation than global supply chains). Where products comprise multiple ingredients, this metric relates to the most environmentally intensive mode across any of the ingredients accounting for more than 10% by mass of the final product(s).

METRICS

Highest intensity scale and mode of transport applicable to any ingredient accounting for >10% by mass of final product(s)

RATINGS

Low (-):	Global airfreight
Medium/low:	Global ocean
Medium/high:	Within EU transport
High (+):	Local (+)

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: Atmosphere emissions
THEME: Transport and Distribution
LINK: Transport and Distribution (En3)

DESCRIPTION

The mode of transport can have a very significant influence on GHG and related air pollutant emissions. GHG emissions from transport can be estimated based on the main mode(s) and distances of transport for each tonne of product (or preceding ingredient). The aforementioned databases for LCA (Wernet et al., 2016) and carbon factors for company reporting (DEFRA, 2019) contain information on CO_2 intensities per tonne-km for various transport modes. Therefore, users can sum distances travelled by different transport modes multiplied by respective CO_2 intensities.

METRICS

Kg CO_2e/t product dry matter (DM). Here is a link to the calculation tool (GHG Emissions from Transport or Mobile Sourcesand) and the DEFRA (2019)

RATINGS

High (-):	>100 kg CO_2e/t DM
Medium:	20-100 kg CO_2e/t DM
Low (+):	<20kg CO_2e/t DM

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INDICATOR NAME: **Loss of products**
THEME: Transport and Distribution
LINK: Transport and Distribution (En3)

DESCRIPTION

A significant proportion of some perishable products may deteriorate during transport, leading to wastage. As with processing waste, this has downstream environmental implications in terms of waste management and upstream environmental implications in terms of additional (excess) production requirement. This metric represents the proportion of product that enters the transport and distribution stage of the value chain that is lost as waste – i.e. that is not successfully conveyed as product to the next (market) stage of the value chain.

METRICS

Percentage, by weight, of product transported that is lost from the value chain as waste

RATINGS

Low (-):	>5% loss (-)
Medium:	2-5% loss
High (+):	<2% loss (+)

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: Food Loss and Waste Reduction
THEME: Waste
LINK: Markets and Retailers (En4)

DESCRIPTION

Loss of food through the retail and market stage of the value chain not only creates waste that needs to be managed, incurring environmental impact, but also generates wider environmental pressure by driving additional production to compensate for foregone useful output. A simple metric is proposed here, based on the percentage of food stuffs purchased by retailers, expressed on a dry matter basis, that does not reach the consumer (via sales or donation to food banks).

METRICS

Percentage of food by weight purchased by the retailer that does not reach the consumer, but is instead disposed of as waste.

RATINGS

Low (-):	>5% food disposed of as waste
Medium:	2-5% food disposed of as waste
High (+):	<2% food disposed of as waste

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Waste Disposal**
THEME: Waste
LINK: Markets and Retailers (En4)

DESCRIPTION

The way in which retail and market waste is managed determines the environmental pollution associated with it, and the overall resource efficiency of the value chain. Organic waste may be reused or recycled according to the following waste hierarchy (most efficient option first): animal feed, anaerobic digestion, composting (Tufvesson, Lantz, and Börjesson 2013). Packaging and other waste may be reused or recycled via e.g. return of pallets for reuse, separation and diversion of plastics, metals, paper, glass from residual waste streams into recycling streams. This metric reflects the percentage of waste generated, by mass, that enters a reuse or recycling stream rather than the residual waste stream.

METRICS

Percentage of waste, by mass, that is sent for reuse or recycling.

RATINGS

Percentage mass of total waste generated that is sent for reuse or recycling:

Low (-): <50% recycling

Medium: 50-80% recycling

High (+): >80% recycling

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Energy Efficiency**
THEME: Energy
LINK: Markets and Retailers (En4)

DESCRIPTION

Wholesalers and retailers consume a considerable amount of energy across store lighting, heating ventilation and air conditioning and chilling or freezing food stuffs (Schoenberger, Galvez-Martos, and Styles 2013). Energy consumption for wholesale and retail of food stuffs is strongly related to the storage and display temperature, with substantial amounts of energy required for chilling and freezing (Galvez-Martos, Styles, and Schoenberger 2013). It can be difficult to isolate the specific energy consumption required for this purpose from other forms of onsite energy demand at storage and sales outlets. Therefore, this metric relates the intensity of energy demand to the type of storage and display.

METRICS

Category of storage/display.

RATINGS

The type of food storage and display:

Low (-): Frozen

Medium: Refrigeration

High (+): Ambient

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Renewable Energy %**
THEME: Energy
LINK: Markets and Retailers (En4)

DESCRIPTION

The main form of energy used in the retail sector is electricity (Galvez-Martos, Styles, and Schoenberger 2013). Therefore, the share of electricity generated from dedicated additional renewable sources is the principle metric proposed here, and follows the same calculation as described for Renewable Electricity in the processing stage.

METRICS

Percentage of total electricity consumption that is met by electricity generated from dedicated additional renewable sources (e.g. onsite renewable sources not counted in the grid mix).

RATINGS

Scale:

Low: <20% (-)

Medium: 20-50%;

High: >50% (+)

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Emission of Air Pollutants**
THEME: Energy
LINK: Markets and Retailers (En4)

DESCRIPTION

Combustion of fuels onsite for heat is the main source of polluting emissions to air from the retail and market stage of the value chain. Emissions of particular concern regarding human health and ecosystem damage include nitrogen oxides (NOx), volatile organic compounds (VOCs) and particulate matter (PM). Solid fuels including coal and wood, and oil, are responsible for much higher emissions of these species than natural gas. If no solid or fossil fuels are combusted, then onsite emissions will be negligible. Use of renewable sources of heat, or use of electricity for heating., can avoid onsite emissions, but may incur upstream emissions. These are almost always much lower owing to better combustion control and abatement technologies for large-scale power generation compared with smaller boilers. Given that these emissions cannot be easily measured in small-scale processing factories, a simple indicator based on the type of fuel combusted onsite is proposed.

METRICS

Main fuel types combusted onsite.

RATINGS

Low:	Oil, solid fuel combustion
Medium:	Gas combustion
High:	No on site combustion

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Renewable and Recycled Materials**
THEME: Resource use
LINK: Markets and Retailers (En4)

DESCRIPTION

Retailers have a strong influence on product and packaging specification. Therefore, the metric for renewable and recyclable materials used in packaging specified in the processing stage is also included here.

METRICS

As per processing sector.

RATINGS

Scale:

Low: <50% renewable recycled (-)

Medium: 50-80% renewable recycled

High: >80% renewable recycled (+)

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Packaging specification**
THEME: Resource use
LINK: Markets and Retailers (En4)

DESCRIPTION

To reflect the strong influence of retailers on packaging specification during process and also final display, this metric assesses the amount of packaging on final marketed products. A simplified approach is taken where the number of layers of packaging on the displayed product represent packaging intensity. For example, fruit and vegetables displayed loose on shelves would be associated with no layers of packaging.

METRICS

Number of layers of packaging of displayed products.

RATINGS

Low (-):	More than one layer (-)
Medium:	One layer
High (+):	No packaging

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: Food Loss and Waste Reduction
THEME: Waste
LINK: Consumer (En5)

DESCRIPTION

In industrialized countries, the majority of the circa 40% of food that is wasted arises at the final consumer stage of the food value chain. The metric proposed here is a simple percentage of food, by weight, that is not consumed but ends up being discarded.

METRICS

Percentage of food not consumed but discarded.

RATINGS

Low (-): >25% product wasted

Medium: 10-25% product wasted

High (+): <10% product wasted

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INDICATOR NAME: **Waste Disposal**
THEME: Waste
LINK: Consumer (En5)

DESCRIPTION

Some waste is inevitably generated during processing, and the way in which this waste is managed determines the environmental pollution associated with it, and the overall resource efficiency of the value chain. Organic waste arising from the processed commodity may be reused or recycled according to the following waste hierarchy (most efficient option first): animal feed, anaerobic digestion, composting (Tufvesson, Lantz, and Börjesson 2013). Packaging and other waste may be reused or recycled via e.g. return of pallets for reuse, separation and diversion of plastics, metals, paper, glass from residual waste streams into recycling streams. This metric reflects the percentage of waste generated, by mass, that enters a reuse or recycling stream rather than the residual waste stream.

METRICS

Percentage of waste, by mass, that is sent for reuse or recycling.

RATINGS

Percentage mass of total waste generated that is sent for reuse or recycling:

Low (-): <50% waste recycled

Medium: 50-80% waste recycled

High (+): >80% waste recycled

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: Cooking intensity
THEME: Energy
LINK: Consumers (En5)

DESCRIPTION

Large quantities of energy may be consumed at the final step of food preparation, especially for cooking. Based on the cooking duration and energy intensities of different cooking methods (Hager and Morawicki 2013), we propose a metric based on the type of cooking (if any) required.

METRICS

Type of cooking required.

RATINGS

Low (-):	Pot boiling
Medium-low:	Oven baking
Medium-high:	Pan
High (+):	No cooking

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INDICATOR NAME: Renewable Energy %
THEME: Energy
LINK: Consumer (En5)

DESCRIPTION

Consumers use electricity for cooling food and for cooking, alongside natural gas which is also commonly used for cooking. The share of electricity (or gas) generated from dedicated additional renewable sources is the principle metric proposed here. It is unlikely that consumers have a source of biogas, so the majority of renewable energy will be in the form of electricity. This could be sourced from e.g. onsite solar photovoltaic panels or micro wind turbines. As described for Renewable Electricity in the processing stage, the renewable electricity must be additional to that already installed and accounted for in the grid mix.

METRICS

Percentage of energy used for food storage and preparation that originates from dedicated additional (e.g. onsite) renewable sources.

RATINGS

Scale:

Low: <20% (-) renewable

Medium: 20-50% renewable

High: >50% (+) renewable

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TRansition paths to sUstainable legume-based systems in Europe

INDICATOR NAME: **Water use**
THEME: Water use
LINK: Consumers (En5)

DESCRIPTION

Domestic and commercial kitchens are a significant source of potable water use. Water use during food consumption is driven by food preparation, cooking and cleaning cooking equipment and dishes (Styles, Schoenberger, and Galvez-Martos 2015). The main differentiating factor across different types of food will be food preparation and cooking. Therefore, this metric combines "hotspot" processes for those steps to generate rankings of performance.

METRICS

Type of food preparation and cooking required.

RATINGS

Use of water for:

High (-): Cleaning /soaking and boiling

Medium: Cleaning / soaking or boiling

Low (+): No cleaning/soaking nor boiling required

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DESCRIPTION AND METRICS OF SOCIAL THEMES AND SUBTHEMES

PRODUCTION (En1)

The environmental pillar of the Production node is separated into Abiotic effects and Ecosystem impacts.

THEME: **En1.1 Abiotic**
NODE: Production (En1)

DESCRIPTION

Abiotic effects relate to the consumption of resources, such as fertilisers and fossil fuels, and associated emissions to the air and water. Thus, three sub-themes are classified below Abiotic effects: Atmosphere emissions; Emissions of water pollutants; Resource depletion.

RATINGS

Scale: Low (-); Medium; High (+)

SUB-THEME: **En1.1.1 Atmosphere emissions**
THEME: Abiotic (En1.1)
NODE: Production (En1)

DESCRIPTION

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TRansition paths to sUstainable legume-based systems in Europe

Within the Abiotic theme, the Atmosphere emissions subtheme comprises the major emissions to air that drive two major environmental impacts: climate change, represented by the GHG balance indicator, and air pollution, represented by the Emissions of air pollutants indicator. The GHG balance can represent carbon offset via sequestration, whilst the Emissions of air pollutants is dominated by a few gases but represents a wide range of associated human health and ecosystem damage impacts.

RATINGS

Scale: High (-); Medium; Low (+)

SUB-THEME: **En1.1.2 Emission of Water Pollutants**
THEME: Abiotic (En1.1)
NODE: Production (En1)

DESCRIPTION

The Emissions of water pollutants theme represents the primary drivers of environmental water quality impact associated with agriculture, namely losses of nutrients that cause nutrient enrichment (eutrophication) and associated loss of biodiversity within water bodies. This subtheme is represented by two indicators: P balance and N Balance. Although not directly representing losses to water, they are easy to calculate metrics that correlate strongly with risk of nutrient loss to water.

RATINGS

Scale: High (-); Medium; Low (+)

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SUB-THEME: **En1.1.3 Resource depletion**
THEME: Abiotic (En1.1)
NODE: Production (En1)

DESCRIPTION

The Resource depletion subtheme within the Abiotic theme represents the primary non-renewable inputs to agricultural production systems, primarily fertilisers and fossil energy. This subtheme is represented by two further subthemes: Resource use and Energy efficiency.

RATINGS

Scale: High (-); Medium; Low (+)

SUB-SUB-THEME: **En1.1.3.1 Resource use**
SUB-THEME: En1.1.3 Resource depletion
THEME: Abiotic (En1.1)
NODE: Production (En1)

DESCRIPTION

The Resource use subtheme within the Resource depletion subtheme represents the non-energy inputs to agricultural production, primarily fertilisers and irrigation water. Although water is a renewable resource, it is often extracted from groundwater at rates in exceedance of natural recharge rates; therefore, use of groundwater for irrigation can represent unsustainable use of this renewable resource. Resource use is represented by the Synthetic fertilisers subtheme, and the Ground and Surface water withdrawals indicator.

RATINGS

Scale: High (-); Medium; Low (+)

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SUB-SUB-SUB-THEME: **En1.1.3.1.1 Syn Fertilisers**
SUB-SUB-THEME: En1.1.3.1 Resource use
SUB-THEME: En1.1.3 Resource depletion
THEME: Abiotic (En1.1)
NODE: Production (En1)

DESCRIPTION

The Synthetic fertilisers sub-sub-sub theme represents use of finite resources and fossil energy to produce non-renewable fertilisers, including N fertilisers produced using large amounts of fossil fuel and P fertilisers produced from finite phosphate rock. This subtheme has two simple indicators: Synthetic P fertilisers and Synthetic N fertilisers.

RATINGS

Scale: High (-); Medium; Low (+)

SUB-SUB-THEME: **En1.1.3.2 Energy Efficiency**
SUB-THEME: En1.1.3 Resource depletion
THEME: Abiotic (En1.1)
NODE: Production (En1)

DESCRIPTION

The Energy efficiency subtheme with the Resource depletion subtheme represents the main measurable processes responsible for most energy consumption within agricultural production, both directly and indirectly. The subtheme is represented by two indicators: Synthetic N fertilisers and Diesel consumption. The Synthetic N fertilisers indicators is repeated from the Synthetic fertilisers subtheme, because it represents multiple environmental impacts. In this case, synthetic N fertiliser is the major (indirect) driver of fossil energy consumption in cropping systems.

RATINGS

Scale: Low (-); Medium; High (+)

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TRansition paths to sUstainable legume-based systems in Europe

THEME: **En1.2 Ecosystem impact**
NODE: Production (En1)

DESCRIPTION

Ecosystem impacts relate to wider land management and land degradation associated with agricultural production. These effects are less easy to quantify than Abiotic depletion, and are represented by three broad indicators: land use; Land sharing/habitat provision; Soil organic matter.

RATINGS

Scale: High (-); Medium; Low (+)

PROCESSING (En2)

The main environmental themes within the Processing node are Energy, Waste generation and Resource use.

THEME: **En2.1 Energy**
NODE: Processing (En2)

DESCRIPTION

Energy use is a major driver of environmental impact from food processing operations. This theme represents the amount of energy used, the source of that energy, and the air emissions impacts associated with the energy. Energy use is represented by three subthemes: Energy efficiency; Renewable energy; Atmosphere emissions.

RATINGS

Scale: High (-); Medium; Low (+)

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TRansition paths to sUstainable legume-based systems in Europe

SUB-THEME: **En2.1.1 Energy Efficiency**
THEME: Energy (En2.1)
NODE: Processing (E2)

DESCRIPTION

Within the Energy theme, the Energy efficiency subtheme represents the amount of energy that is required to process food products. It is represented by two indicators for the major types of energy consumed: Electricity, and Other fuels.

RATINGS

Scale: Low (-); Medium; High (+)

SUB-THEME: **En2.1.2 Renewable Energy %**
THEME: Energy (En2.1)
NODE: Processing (E2)

DESCRIPTION

The Renewable energy subtheme quantifies the share of total energy consumption that is provided from additional renewable resources. Thus, after being assessed on their efficiency in the use of energy, processors are then assessed in relation to how sustainably that energy is produced. As with the Energy subtheme, indicators are divided by energy source: Electricity, and Other fuels.

RATINGS

Scale: Low (-); Medium; High (+)

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TRansition paths to sUstainable legume-based systems in Europe

SUB-THEME: En2.1.3 Atmosphere emissions
THEME: Energy (En2.1)
NODE: Processing (E2)

DESCRIPTION

Energy use is a major driver of GHG and air pollutant emissions. The Atmosphere emissions subtheme therefore represents the contribution of energy use to emissions that drive climate change and, via air pollution, health and ecosystem damage. This subtheme is represented by two indicators: GHG balance, and Emission of air pollutants.

RATINGS

Scale: High (-); Medium; Low (+)

THEME: En2.2 Waste generation
NODE: Processing (En2)

DESCRIPTION

Waste generation is another important environmental aspect of food processing. A significant share of commodity ingredients, and associated packaging, may be disposed of during processing. This subtheme is represented by two indicators that reflect the amount of waste generated, and the management of that waste: Food loss and waste reduction, and Waste disposal.

RATINGS

Scale: High (-); Medium; Low (+)

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THEME: En2.3 Resource use
NODE: Processing (En2)

DESCRIPTION

Resource use relates to the use of non-energy resources captured under the Energy subtheme. For processing, these mainly comprise non-renewable packaging materials and water used for processing and cleaning operations. This subtheme is represented by the following two indicators: Renewable and recycled packaging, and Ground and surface water withdrawals.

RATINGS

Scale: High (-); Medium; Low (+)

TRANSPORT AND DISTRIBUTION (En3)

There are no main environmental themes within the Transport and Distribution node.

THEME: Transport and Distribution (En3)
NODE: Transport and Distribution (En3)

RATINGS

Scale: Low (-); Medium; High (+)

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MARKETS AND RETAILERS (En4)

As with the processing node, environmental aspects pertinent to the markets & retailers node are covered by three themes: Waste, Energy & Resource use.

THEME: **En4.1 Waste**
NODE: Markets and Retailers (En4)

DESCRIPTION

The Waste theme represents the proportion of food purchased by retailed that does not end up with consumers, and the management of that waste. It is represented by two indicators: Food loss and waste reduction, and Waste disposal.

RATINGS

Scale: High (-); Medium; Low (+)

THEME: **En4.2 Energy**
NODE: Markets and Retailers (En4)

DESCRIPTION

The Energy theme represents the main environmental aspects that can be readily documented and over which retailers have a high degree of control in relation to the source of energy and the associated emissions to air. Thus, this theme is represented by two indicators: Renewable energy, and Emission of air pollutants.

RATINGS

Scale: High (-); Medium; Low (+)

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THEME: **En4.3 Resource use**
NODE: Markets and Retailers (En4)

DESCRIPTION

The Resource use theme represents the aspects of resource use over which retailers have direct control, outside of energy resources which are represented in the Energy theme. This theme primarily addresses resources used by retailers, or specified by retailers, for packaging. The theme is represented by two indicators that reflect the pathways of influence that retailers have on direct operations and via specifications provided to suppliers: Renewable and recycled materials, and packaging specification.

RATINGS

Scale: High (-); Medium; Low (+)

CONSUMERS (En5)

Consumers at the end of the value chain play an important role in driving demand, generating waste and using energy and water during food storage and preparation. This node is therefore represented by two themes, Waste and Energy, and one direct indicator, Water use.

THEME: **En5.1 Waste**
NODE: Consumers (En5)

DESCRIPTION

The Waste theme represents first the proportion of purchased food that is not consumed, but instead discarded, and secondly the management of that discarded food waste. This theme indicates pressure on food production, through demand increases linked with waste, in addition to pressure on waste management systems. It is therefore an important theme within the overall value chain, and is represented by two indicators: Food loss and waste reduction, and Waste disposal.

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RATINGS

Scale: High (-); Medium; Low (+)

THEME: **En5.2 Energy**
NODE: Consumers (En5)

DESCRIPTION

The Energy theme is less important than the waste theme in terms of overall value chain environmental impact, and is more difficult to quantify owing to lack of submetering (smart meters) of energy consumption in most homes. However, it is represented by two indicators that are easy to quantify and that give a good indication of the amount of energy required, and the environmental intensity of the source of that energy: Cooking intensity, and Renewable energy %.

RATINGS

Scale: High (-); Medium; Low (+)

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Pathfinder
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Jozef Stefan Institute

with project partners
from

True project

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