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COMPENDIUM OF SELECTED INDICATORS

for Measuring and Monitoring the Transition of Rural Agrifood Firms to the Circular Economy and Sustainable Development

Including the Overall Monitoring Circular Economy and Sustainability Index (OMCESI)

Common core for meat, dairy, and juice/vegetable processing

DELIVERABLE No: R2.3

CERAS: Advancing Circular Economy and Sustainability in Rural Business Activities. Skills for the Future

Vassiliki Kazana, Vasilis Plakandaras, Dimitrios Raptis, Feliu López Gelats, Miquel Monés, Laura Domingo, Mònica Furtet, Mercè Molist, Dorjan Marku, Cerasela Crişan, Elena Nechita, Liliana Topliceanu, Tajana Tošš

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1. Purpose and Use of the Compendium

This compendium consolidates the 24 indicators finally selected through the developed methodology in the CERAS project and adds the Overall Monitoring for Circular Economy & Sustainability Index (OMCESI) as the aggregating composite indicator. It is intended as an operational reference for rural agrifood businesses, trainers, project partners and other users applying the CERAS monitoring framework to meat processing, dairy processing, and fruit/vegetable and juice processing businesses.

The compendium preserves the definitions, units, formulas, data requirements, reporting frequencies and directions of improvement recorded in the CERAS indicator dataset, of the uploaded CERAS Methodology Report R2.4 (https://ceras.ub.ro). OMCESI content is based on Chapter 4 of the uploaded Report R2.4.

1.1 Monitoring architecture

The selected core is deliberately balanced across three sustainability dimensions and four logic-chain levels. Each dimension contains two Input, two Process, two Output and two Impact indicators, producing 24 core indicators in total. OMCESI aggregates normalized performance while retaining Environmental, Social and Economic dimension scores.

Dimension	Input	Process	Output	Impact
Environmental	ENV01 - Total Water Input ENV02 - Total Energy Input	ENV03 - Heat recovery rate ENV04 - Separate collection and traceable segregation	ENV05 - Total waste generated ENV06 - Refrigeration leakage factor	ENV07 - Water scarcity footprint ENV08 - Transport emission per raw material collection
Social	SOC01 - Occupational, Health and Safety (OHS) investment per FTE SOC02 - Share of permanent employment	SOC03 - Traceability and Transparency Process for Circular Inputs SOC04 - Agrifood business symbiosis governance	SOC05 - Share of employees trained SOC06 - Active CE partnerships maintained	SOC07 - Employee retention rate SOC08 - Skills Competence Attainment
Economic	ECON01 - Resource Cost Dependency ECON02 - Investment in reusable packaging / reverse logistics systems	ECON03 - Quality assurance protocol for secondary/by-product inputs ECON04 - Material flow cost accounting (MFCA) / cost-to-serve accounting implemented	ECON05 - Share of agri-food sales through Short Food Supply Chains (SFSC) ECON06 - Waste disposal dependency	ECON07 - Material productivity ECON08 - Value added per Full-Time-Equivalent (FTE)

1.2 Core-plus-module principle

The 24 indicators are the common core for the three processing subsectors. Sector-specific modules may be added where a hotspot requires more detailed monitoring. The methodology report identifies, for example, mortality before slaughter and transport stress for meat; cleaning-in-place water intensity, internal water reuse/recirculation and whey/by-product valorisation for dairy; and food donation, organic-residue valorisation, packaging and food-loss indicators for fruit/vegetable and juice processing.

2. Quick Reference: Finally Selected Core Indicators

Domain	Level	Code	Indicator
Environmental	Input	**ENV01**	Total Water Input
Environmental	Input	**ENV02**	Total Energy Input
Environmental	Process	**ENV03**	Heat recovery rate
Environmental	Process	**ENV04**	Separate collection and traceable segregation
Environmental	Output	**ENV05**	Total waste generated
Environmental	Output	**ENV06**	Refrigeration leakage factor
Environmental	Impact	**ENV07**	Water scarcity footprint
Environmental	Impact	**ENV08**	Transport emission per raw material collection
Social	Input	**SOC01**	Occupational, Health and Safety (OHS) investment per FTE
Social	Input	**SOC02**	Share of permanent employment
Social	Process	**SOC03**	Traceability and Transparency Process for Circular Inputs
Social	Process	**SOC04**	Agrifood business symbiosis governance
Social	Output	**SOC05**	Share of employees trained
Social	Output	**SOC06**	Active CE partnerships maintained
Social	Impact	**SOC07**	Employee retention rate
Social	Impact	**SOC08**	Skills Competence Attainment
Economic	Input	**ECON01**	Resource Cost Dependency
Economic	Input	**ECON02**	Investment in reusable packaging / reverse logistics systems
Economic	Process	**ECON03**	Quality assurance protocol for secondary/by-product inputs
Economic	Process	**ECON04**	Material flow cost accounting (MFCA) / cost-to-serve accounting implemented
Economic	Output	**ECON05**	Share of agri-food sales through Short Food Supply Chains (SFSC)
Economic	Output	**ECON06**	Waste disposal dependency
Economic	Impact	**ECON07**	Material productivity
Economic	Impact	**ECON08**	Value added per Full-Time-Equivalent (FTE)

3. OMCESI - Overall Monitoring Circular Economy and Sustainability Index

The OMCESI is the composite index used to aggregate the 24 selected CERAS indicators into one 0-100 monitoring score, while preserving separate Environmental, Social and Economic scores. It is calculated from normalized business-level indicator scores and the calibrated weights, which have been derived by using the Fuzzy Analytic Hierarchy Process (AHP) and the Fuzzy Inverse of Column Sum Method (FICSM) [see Methodological source, section 7.2 of the current document].

Indicator type	Composite aggregating index
Scale	0-100 after normalization of business-level indicator scores
Reporting outputs	Total OMCESI score; Environmental, Social and Economic scores; indicator contributions; data-quality and coverage diagnostics
Use	Baseline diagnosis, annual monitoring, benchmarking within comparable contexts and transition planning
Important condition	Use the same index version, boundaries, normalization rules and weights when comparing businesses or years

3.1 Minimum information required before calculation

Before the index is calculated, the user must define the organizational boundary, reporting period, baseline year, functional unit and data sources. The same boundary and functional unit must be kept stable across monitoring periods. Missing information must be recorded as missing data, not automatically as zero performance.

3.2 Calculation sequence

Step	Action
1	Confirm sector module, reporting year and organizational boundary
2	Collect raw data for the 24 core indicators

3	Check units, functional units, boundaries and completeness
4	Convert each raw value to a normalized 0-100 score
5	Apply local weights inside each dimension
6	Apply dimension weights
7	Report coverage and indicator contributions

3.3 Normalization of indicator values

Raw values use different units and cannot be aggregated directly. Each raw value is first converted into a 0-100 performance score. Benchmarks and targets must be fixed for the relevant subsector and functional unit, documented by OMCESI version, and kept identical for businesses included in the same comparison.

For higher-is-better indicators:

$$s_i = 100 \times (x_i - x_{min}) / (x_{target} - x_{min})$$

For lower-is-better indicators:

$$s_i = 100 \times (x_{max} - x_i) / (x_{max} - x_{target})$$

Binary or process indicators may use 0/100 scoring, while maturity indicators may use a predefined 0-25-50-75-100 rubric. Scores should be capped at 0 and 100 outside the benchmark range. In the equations, x_i is the observed value, x_{min} and x_{max} are the lower and upper reference anchors, and x_{target} is the best-practice value. Indicative subsector-specific reference anchors for normalization of the 24 OMCESI core indicators are included in Table 3.3a of the Compendium Appendix.

3.4 Hierarchical aggregation

The index is calculated in two levels. First, local indicator weights are applied within each dimension. Then the three-dimension scores are combined using the calibrated dimension weights.

$$Score_d = \sum_i (w_{d,i} \times s_{d,i})$$

$$OMCESI = 0.3926 \times Score_{ENV} + 0.3379 \times Score_{SOC} + 0.2695 \times Score_{ECON}$$

$$Global\ weight_{d,i} = W_d \times w_{d,i}$$

$$Contribution_{d,i} = Global\ weight_{d,i} \times s_{d,i}$$

where s_{di} is the normalized 0-100 score, $w_{d,i}$ is the local weight of indicator *i* within dimension *d*, W_d is the dimension weight, and $Score_d$ is the dimension score. The global indicator weight is $W_d \times w_{d,i}$; therefore, the parent dimension weight is applied only once.

Dimension	Weight	Role in OMCESI
Environmental	0.3926	Highest parent dimension weight
Social	0.3379	Substantial contribution to the overall score
Economic	0.2695	Explicit economic viability and resilience component

3.5 Weights and scoring direction for the 24 indicators

The following table gives the operational weights needed for calculation. Local weights are used inside each dimension; global weights indicate the direct contribution of each indicator to the total OMCESI score. Global weights are calculated from unrounded local weights; small differences may therefore remain after displayed values are rounded.

Code	Indicator	Dimension	Direction	Local w	Global W
ENV07	Water scarcity footprint	Environmental	Down	0.1677	0.0659
ENV05	Total waste generated	Environmental	Down	0.1677	0.0658
ENV02	Total Energy Input	Environmental	Down	0.1652	0.0649
ENV01	Total Water Input	Environmental	Down	0.1398	0.0549
ENV04	Separate collection and traceable segregation	Environmental	Up	0.1165	0.0458
ENV06	Refrigeration leakage factor	Environmental	Down	0.0966	0.0379
ENV03	Heat recovery rate	Environmental	Up	0.0751	0.0295

Code	Indicator	Dimension	Direction	Local w	Global W
ENV08	Transport emission per raw material collection	Environmental	Down	0.0713	0.0280
SOC05	Share of employees trained	Social	Up	0.1658	0.0560
SOC01	OHS investment per FTE	Social	Up	0.1638	0.0553
SOC08	Skills Competence Attainment	Social	Up	0.1447	0.0489
SOC02	Share of permanent employment	Social	Up	0.1332	0.0450
SOC03	Traceability and Transparency Process for Circular Inputs	Social	Up	0.1180	0.0399
SOC07	Employee retention rate	Social	Up	0.1029	0.0348
SOC06	Active CE partnerships maintained	Social	Up	0.0924	0.0312
SOC04	Agrifood business symbiosis governance	Social	Up	0.0792	0.0268
ECON01	Resource Cost Dependency	Economic	Down	0.1725	0.0465
ECON07	Material productivity	Economic	Up	0.1719	0.0463
ECON06	Waste disposal dependency	Economic	Down	0.1398	0.0377
ECON03	QA protocol for secondary/by-product inputs	Economic	Up	0.1262	0.0340
ECON02	Investment in reusable packaging / reverse logistics systems	Economic	Up	0.1100	0.0296
ECON05	Share of sales through SFSC	Economic	Up	0.0981	0.0264
ECON08	Value added per FTE	Economic	Up	0.0927	0.0250
ECON04	MFCA / cost-to-serve accounting implemented	Economic	Up	0.0887	0.0239

3.6 Missing data and data coverage

If an indicator is missing, report it as missing and calculate the share of dimension weight covered by valid data. The re-normalized local weight is denoted $w^{*}_{d,i}$. Re-normalization requires at least 65% of dimension weight; this provisional threshold is conservatively informed by the JRC-COIN 65% data-coverage rule of thumb and should be sensitivity-tested after piloting. Below 65%, the dimension and total OMCESI should be flagged as incomplete.

$$Coverage_{\,d} = \sum_{i} w_{d,i} \quad for\ indicators\ with\ valid\ data$$

$$w^{*}_{d,i} = w_{d,i} \,/\, Coverage_{\,d}$$

$$Score_d(valid) = \sum_{i} (w^{*}_{d,i} \times s_{d,i})$$

3.7 Interpretation and safeguards

The OMCESI score should always be reported together with the three-dimension scores, data coverage and the largest indicator contributions. The latest expert-weighting analysis showed significant agreement mainly for the Environmental block; therefore, the calibrated weights should be interpreted as an aggregated expert-priority model rather than as evidence of strong consensus across all blocks. Very small weight differences should be interpreted as priority clusters rather than strict ordinal dominance. Euro-denominated indicators should be benchmarked within comparable national/subsector contexts or adjusted to a documented common price basis before cross-country comparison.

OMCESI score	Indicative interpretation
0-20	Very weak transition performance or very limited evidence
21-40	Early-stage transition with major improvement needs
41-60	Moderate transition performance with mixed strengths and weaknesses
61-80	Advanced transition performance in several areas
81-100	Very strong performance against the adopted scoring framework

These classes are monitoring categories, not regulatory or certification thresholds.

4. Environmental Indicators

The environmental block covers resource inputs, operational circularity, waste and emissions, and environmental impacts.

ENV01 - Total Water Input

Domain **Environmental**	Logic-chain level **Input**	Code **ENV01**
Definition		Total external water withdrawn/received for on-site operations during the reporting period, normalized by functional unit.
Category		Resource Input (Water)
CE & sustainability relevance		CE: water re-circulation and reduced withdrawals; S: Water efficiency & reduced freshwater stress
Unit		m^3 / functional unit (e.g., m^3/tonne output)
Data requirements		External water volumes by source (mains/ground/surface/delivered); functional output data.
Calculation / formula		Total Water Input (m^3/FU) = (Mains + Groundwater + Surface water + Delivered water) / Functional Units
Recommended frequency		Monthly
Direction of improvement		Down
Boundary / interpretation notes		Counts external inflows only. Do not include internally reused/recycled water in ENV01; report internal reuse separately or in the relevant sector module.

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ENV02 - Total Energy Input

Domain **Environmental**	Logic-chain level **Input**	Code **ENV02**
Definition		Total on-site energy consumed during the reporting period, regardless of whether it is purchased or self-generated.
Category		Resource Input (Energy)
CE & sustainability relevance		CE: reduction in energy consumption; S: Energy efficiency & GHG mitigation
Unit		KWh/functional unit
Data requirements		Utility bills; on-site generation/meter records; fuels used; functional output data.
Calculation / formula		Total Energy Input (kWh/FU) = total on-site energy consumed from electricity, purchased heat/steam and fuels ÷ functional units.
Recommended frequency		Monthly
Direction of improvement		Down
Boundary / interpretation notes		Include self-generated energy consumed on-site and exclude exported energy. Avoid double counting fuels used to generate electricity/heat already included. Report the self-generated renewable share separately.

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ENV03 - Heat recovery rate

Domain **Environmental**	Logic-chain level **Process**	Code **ENV03**
Definition		Share of thermal energy captured and reused from industrial processes compared to total heat demand, reflecting energy efficiency and circular energy use.
Category		Process (Management Practices and Operational Controls)
CE & sustainability relevance		CE: energy cascading & efficiency; S: lower fossil energy demand
Unit		% recovered heat
Data requirements		Total heat demand; recovered/reused heat energy from metering or documented engineering estimation.
Calculation / formula		(Recovered heat energy ÷ Total heat demand) × 100
Recommended frequency		Monthly
Direction of improvement		Up
Boundary / interpretation notes		Count only heat reused internally; exclude theoretical recovery potential. Metered values are preferred; documented engineering estimates are permitted when identified as estimated.

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ENV04 - Separate collection and traceable segregation

Domain Environmental	Logic-chain level Process	Code ENV04
Definition		% of target waste/material streams that are both source-separated and traceably recorded through handover.
Category		Management Practices and Operational Controls
CE & sustainability relevance		CE: higher-quality recycling, reduced contamination, improved recovery rates; S: pollution prevention & compliance
Unit		% coverage
Data requirements		Target stream list; segregation SOP/map; records/tickets by stream.
Calculation / formula		Coverage (%) = (Number of target streams meeting both separation and traceability requirements ÷ Total target streams) × 100
Recommended frequency		Monthly
Direction of improvement		Up
Boundary / interpretation notes		Define “target streams” (e.g., paper/cardboard, plastics by type, metals, glass, organics, hazardous). “Traceable” = documented quantities by stream (internal logs and/or contractor weigh tickets).

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ENV05 - Total waste generated

Domain **Environmental**	Logic-chain level **Output**	code **ENV05**
Definition		Total mass of waste generated from on-site operations during the reporting period, normalized by functional unit (includes hazardous + non-hazardous; exclude product/by-product intended for sale/use).
Category		Resource outflows and waste
CE & sustainability relevance		CE: waste prevention and reduced disposal; S: pollution prevention & resource efficiency
Unit		kg (or tonnes) / functional unit
Data requirements		Waste transfer notes/weighbridge tickets by waste stream; internal waste logs; functional output data.
Calculation / formula		Formula (simplified): Total Waste (kg/FU) = Total waste generated (kg) ÷ Functional Units
Recommended frequency		Monthly
Direction of improvement		Down
Boundary / interpretation notes		Report hazardous and non-hazardous waste separately and avoid double counting internally reused scrap. In dairy processing, whey sold or valorized as a product/by-product is excluded from waste and reported separately; whey disposed of as waste is included.

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ENV06 - Refrigeration leakage factor

Domain **Environmental**	Logic-chain level **Output**	Code **ENV06**
Definition		Annual loss of refrigerant gases from cooling systems relative to total refrigerant charge, indicating potential climate impact from fugitive emissions.
Category		Energy & Climate impact
CE & sustainability relevance		CE: improved cooling system management; S: GHG reduction
Unit		% refrigerant charge / year
Data requirements		Refrigerant charge in system; refrigerant refilled or lost annually
Calculation / formula		(Annual refrigerant refilled or lost ÷ Total refrigerant charge) × 100
Recommended frequency		Annually
Direction of improvement		Down
Boundary / interpretation notes		Calculate annually using maintenance refill records; include accidental leaks and servicing losses.

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ENV07 - Water scarcity footprint

Domain **Environmental**	Logic-chain level **Impact**	Code **ENV07**
Definition		Water consumption weighted by local scarcity factors, per functional unit.
Category		Water impact
CE & sustainability relevance		CE: reduced net withdrawals via reuse/re-circulation; S: reduced water-stress impacts
Unit		m^3 world-eq / functional unit
Data requirements		Water consumption by source/location (m^3 = withdrawals − returns); basin/location factor set; functional output data.
Calculation / formula		Water scarcity footprint (m^3 world-eq/FU) = (Water consumption X Aware Characterization Factor) ÷ Functional Units
Recommended frequency		Annually
Direction of improvement		Down
Boundary / interpretation notes		Use water consumption (not only withdrawal). Apply the local AWARE Characterization factor. See the Compendium Appendix. ENV07 adds location-specific scarcity context to water consumption and should be interpreted alongside ENV01, particularly for single-site time series.

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ENV08 - Transport emission per raw material collection

Domain **Environmental**	Logic-chain level **Impact**	Code **ENV08**
Definition		GHG emissions from upstream collection of raw materials from suppliers/farms to the processing facility, per functional unit.
Category		Energy & Climate impact
CE & sustainability relevance		CE: optimized supply chains; S: transport decarbonization
Unit		kg CO_2e / functional unit (e.g., kg CO_2e/1000 L milk)
Data requirements		Collection-route distance; vehicle type; load transported; fuel consumption where available; functional output data; approved emission factors.
Calculation / formula		Transport GHG Emissions (kg CO_2-eq/FU) = Σ(Distance × Load Transported × Emission Factor) ÷ Functional Units Produced.
Recommended frequency		Monthly
Direction of improvement		Down
Boundary / interpretation notes		Scope is upstream raw-material collection only; downstream distribution is excluded. Distance × load × emission factor is the default method. Complete route-specific fuel data may be used consistently instead. Record emission-factor source, version and year.

5. Social Indicators

The social block covers occupational health and safety, employment quality, traceability, partnerships, skills and workforce resilience.

SOC01 - Occupational, Health and Safety (OHS) investment per FTE

Domain **Social**	Logic-chain level **Input**	Code **SOC01**
Definition		It measures the average financial amount a company spends on safety, health, and well-being initiatives for each employee. It tracks the financial resources allocated to preventing workplace injuries and improving employee safety.
Category		Health, Safety & Well-being
CE & sustainability relevance		Circular processes (e.g., waste sorting, bioenergy handling) often require new safety considerations
Unit		€/FTE (Full-Time Equivalent)
Data requirements		OHS expenditure, Total number of FTE
Calculation / formula		OHS Investment per FTE = Total OHS costs /Total number of FTE employees
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		Total OHS Expenditure includes costs for safety equipment, training, medical check-ups, safety staff, and protective clothing.

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SOC02 - Share of permanent employment

Domain **Social**	Logic-chain level **Input**	Code **SOC02**
Definition		The indicator measures the percentage of employees holding contracts with no specific end date, compared to the total number of employees (including temporary staff). A higher share indicates greater labor market stability and job security, while a lower share suggests flexible, short-term work arrangements.
Category		Employment and job quality
CE & sustainability relevance		Indicates employment stability in rural regions
Unit		% of employees
Data requirements		Total number of employees, Total number of employees with permanent contracts
Calculation / formula		Share of permanent employment (%) = (Number of employees with permanent contracts/Total Number of employees) X 100
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		Employees aged 15+, typically 15-65/67.

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SOC03 - Traceability and Transparency Process for Circular Inputs

Domain **Social**	Logic-chain level **Process**	Code **SOC03**
Definition		Measures the share of total material input represented by circular inputs whose origin, processing, and destination are systematically traceable. Traceability includes unique batch identifiers and documentation of source, production conditions, and shipping routes.
Category		Governance for CE networks
CE & sustainability relevance		Management practices enabling social sustainability & CE
Unit		% of total material input
Data requirements		Mass of Traced Circular Inputs, Total Mass of Material Input
Calculation / formula		Traceable circular input coverage (%) = (Mass of Traced Circular Inputs / Total Mass of Material Input) X 100
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		This indicator is expressed as a share of total material input; it therefore measures the coverage of traceably documented circular inputs within the firm's overall material input, rather than a standalone maturity score for the traceability system. Use a consistent material boundary across reporting periods.

SOC04 - Agrifood business symbiosis governance

Domain Social	Logic-chain level Process	code SOC04
Definition		The indicator refers to the mechanisms, strategies, and institutions, such as local authorities, regulations, and partnerships, which facilitate collaboration between businesses of the agrifood sector to exchange materials, energy, and by-products (e.g., meat plant sending heat to nearby greenhouse).
Category		Governance for CE networks
CE & sustainability relevance		Management practices enabling social sustainability & CE
Unit		Count (Absolute number of symbiotic partnerships)
Data requirements		Active contracts or MoUs with other firms
Calculation / formula		SUM of the number of symbiotic partnerships
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		For OMCESI normalization, use project-defined targets/thresholds by firm size class so absolute partnership counts do not systematically disadvantage micro and small firms. SOC04 is restricted to symbiotic arrangements involving exchange of materials, energy, or by-products; the same underlying partnership activity should not also be counted under SOC06.

SOC05 - Share of employees trained

Domain **Social**	Logic-chain level **Output**	Code **SOC05**
Definition		Share of workforce completing CE and sustainability related training
Category		Internal capacity building
CE & sustainability relevance		Supports social sustainability & CE practices
Unit		% of the total workforce
Data requirements		Number of employees trained in CE & Sustainability, Total number of employees
Calculation / formula		Employees trained in CE & Sustainability (%) = (Number of employees trained in CE & Sustainability / Total Number of employees) X 100
Recommended frequency		Annually or after a major training campaign
Direction of improvement		Up
Boundary / interpretation notes		This indicator is crucial for assessing internal capacity building. A common indicator in ESG reporting.

SOC06 - Active CE partnerships maintained

Domain **Social**	Logic-chain level **Output**	Code **SOC06**
Definition		The indicator measures the number of ongoing, collaborative relationships between the firm and organizations, governments, or stakeholders focused on implementing circular or sustainable business models. It highlights the collaborative, socio-institutional efforts required to CE transition
Category		CE territorial outputs
CE & sustainability relevance		Supports rural sustainability & CE practices
Unit		Count (absolute number of formal or informal partnerships)
Data requirements		Signed active MoUs, or contracts of partnership agreements or documented collaborative activities
Calculation / formula		SUM of all active, functional partnership agreements
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		Partnerships are active if at least one documented joint activity occurred during the reporting year. For OMCESI normalization, use project-defined targets/thresholds by firm size class. SOC06 covers active CE partnerships other than the symbiotic resource-exchange activity counted under SOC04; avoid duplicate counting of the same underlying activity.

SOC07 - Employee retention rate

Domain **Social**	Logic-chain level **Impact**	Code **SOC07**
Definition		Percentage of employees present at the start of the reporting period who remain employed at its end, excluding new hires from the numerator.
Category		Work resilience
CE & sustainability relevance		It supports social sustainability by fostering HR retention; it reflects rural skills scarcity
Unit		%
Data requirements		Number of employees at start of period, number of employees at end of period, number of new hires during period
Calculation / formula		Employee retention rate (%) = [(No. of employees at end of period−No. of new hires during period)/Number of employees at start of period] X 100
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		Example: if the company starts with 100 employees, ends with 95 and hired 5 new employees, retention = [(95−5)/100] × 100 = 90%. If turnover is also reported, treat it as a separate complementary indicator.

SOC08 - Skills Competence Attainment

Domain **Social**	Logic-chain level **Impact**	Code **SOC08**
Definition		The indicator assesses the level of knowledge, skills, and attitudes an individual has acquired at a specific point in time. It validates the successful mastery and application of skills to meet specific standards, such as CE & sustainability related tasks, rather than just measuring years of schooling.
Category		Human capital & capability
CE & sustainability relevance		Supports social sustainability & CE practices
Unit		% of workforce certified/competent in CE tasks
Data requirements		Number of employees certified/competent in CE tasks over a specified period, Total number of employees
Calculation / formula		Skills Competence Attainment (%) = (Number of employees attained competency in CE tasks/ Total number of employees) X 100
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		Data for this indicator is often gathered through performance evaluations, skill-use assessments, and competency-based questionnaires.

6. Economic Indicators

The economic block covers resource-cost exposure, circular investment, quality assurance, material accounting, local market outputs, waste-disposal dependency, productivity and value added.

ECON01 - Resource Cost Dependency (RCD)

Domain **Economic**	**Logic-chain level** **Input**	**Code** **ECON01**
Definition		Cost of energy, water, and waste disposal per unit of output.
Category		Resource Operating Cost
CE & sustainability relevance		Tracks exposure to resource price volatility
Unit		€ / tons of output
Data requirements		Total energy cost, water cost and waste-disposal cost; production volume (tonnes).
Calculation / formula		RCD [€/tons of output] = (cost of energy + cost of water + cost of waste disposal) [€]/ production volume [tons]
Recommended frequency		Monthly
Direction of improvement		Down
Boundary / interpretation notes		Calculate consistently for the same reporting boundary and production basis. Transport cost is excluded from RCD in this version unless the definition and formula are formally revised.

ECON02 - Investment in reusable packaging / reverse logistics systems

Domain **Economic**	**Logic-chain level** **Input**	**Code** **ECON02**
Definition		Tracks the capital expenditure (CAPEX) allocated to purchasing reusable assets (e.g., crates, kegs, bottles) and the infrastructure to retrieve them (reverse vending, washing lines).
Category		Circular procurement
CE & sustainability relevance		High. This input metric predicts future circular capability. Without upfront investment in the "Reverse Loop," a firm cannot shift from single-use to reuse. It demonstrates financial commitment to "Closing the Loop."
Unit		% (Ratio) of total investment
Data requirements		Investment in reusable assets and reverse-logistics systems (€); total packaging/logistics CAPEX (€).
Calculation / formula		[Investment in reusable assets & reverse-logistics systems (€) / Total packaging/logistics CAPEX (€)] × 100
Recommended frequency		Annually or rolling 12-month
Direction of improvement		Up
Boundary / interpretation notes		Includes reusable packaging, washing/retrieval infrastructure and reverse-logistics systems; excludes OPEX. If total packaging/logistics CAPEX is zero, report N/A rather than zero.

ECON03 - Quality Assurance protocol for secondary/by-product inputs

Domain Economic	Logic-chain level Process	Code ECON03
Definition		Tracks the existence of specific Quality Assurance (QA)/ Quality Control (QC) procedures for inspecting incoming recycled materials or by-products.
Category		Economic Management Practices enabling Circularity
CE & sustainability relevance		"Perceived Risk" is the #1 barrier to reuse. Without a formal QA protocol (e.g., testing recycled plastic for toxins or food waste for pathogens), procurement managers will revert to virgin materials.
Unit		Yes / No
Data requirements		Documented QA standard for secondary inputs (e.g., "Spec Sheet for Recycled PET"); Evidence of batch testing.
Calculation / formula		Documenting quality standards in company records; these have to indicate the type of quality system already required by HACCP (Hazard Analysis Critical Control Point) and ISO 22000 standards.
Recommended frequency		Annually or upon change
Direction of improvement		Up
Boundary / interpretation notes		Secondary inputs have high variability (impurities, contamination).

ECON04 - Material flow cost accounting (MFCA) / cost-to-serve accounting implemented

Domain **Economic**	**Logic-chain level** **Process**	**Code** **ECON04**
Definition		Assigns financial costs to waste streams.
Category		Economic Management Practices enabling Circularity
CE & sustainability relevance		A "leading indicator" identifying where money is lost in waste streams.
Unit		Yes / No (or % coverage)
Data requirements		Documents attesting to the implementation of MFCA in the company's operations
Calculation / formula		Audit of waste streams with assigned monetary values.
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		MFCA focuses on identifying and reducing waste to improve resource efficiency

ECON05 - Share of agrifood sales through Short Food Supply Chains (SFSC)

Domain **Economic**	**Logic-chain level** **Output**	**Code** **ECON05**
Definition		The proportion of agrifood sales achieved via short food supply chains (direct sales, local cooperatives, farmers' markets, local farm-to-fork schemes) in total agrifood sales.
Category		Circular business models / Local valorisation (SFSC)
CE & sustainability relevance		Short food supply chains reduce intermediary steps, support local valorisation, and can decrease losses/waste and the logistical footprint.
Unit		% of total agrifood sales
Data requirements		Numerator: company sales through SFSC during the reporting period. Denominator: the same company's total agrifood sales during the same reporting period.
Calculation / formula		SFSC % = (sales through short food supply chains ÷ total agrifood sales) × 100,
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		Numerator and denominator must refer to the same company, reporting period and measurement basis (value or volume).

ECON06 - Waste disposal dependency

Domain Economic	Logic-chain level Output	Code ECON06
Definition		Proportion of total waste that requires external disposal instead of reuse or recovery.
Category		Resource Operating Cost
CE & sustainability relevance		High dependency signals a linear model; reduction indicates circular transition.
Unit		% of total waste disposed
Data requirements		Mass of waste disposed externally (kg), Total waste generated (kg)
Calculation / formula		(Waste disposed externally ÷ Total waste generated) × 100
Recommended frequency		Monthly
Direction of improvement		Down
Boundary / interpretation notes		It includes all organic and inorganic residues generated during handling, processing and packaging.

ECON07 - Material productivity

Domain **Economic**	Logic-chain level **Impact**	Code **ECON07**
Definition		Economic value generated per unit of material input.
Category		Circular business models / Local valorisation (SFSC)
CE & sustainability relevance		Captures decoupling between economic performance and resource use.
Unit		€ gross value added / kg of raw materials
Data requirements		Gross Value Added (GVA, €); raw-material consumption (kg).
Calculation / formula		Material productivity = Gross Value Added (€) ÷ Raw-material consumption (kg)
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		Higher values indicate greater economic value created per unit of physical material input. Use a consistent GVA definition and physical mass denominator across businesses and years.

ECON08 - Value added per Full-Time-Equivalent (FTE)

Domain **Economic**	**Logic-chain level** **Impact**	**Code** **ECON08**
Definition		The indicator measures the economic value or net output (revenue minus non-labor costs) generated by each standardized full-time employee, including part-time staff adjusted to full-time hours. It serves as a key productivity metric, with higher values indicating greater efficiency and stronger human capital utilization.
Category		Economic Sustainability & Resilience
CE & sustainability relevance		Critics argue Circular Economy (CE) relies on low-wage labor. This metric proves if your CE model drives productivity (doing more with better skills) rather than just adding bodies.
Unit		€ / FTE
Data requirements		Gross Value Added (Revenue − Cost of Goods/Services bought) [GVA]; Full-Time Equivalent employees (FTE) for the reporting period.
Calculation / formula		Value added per FTE = GVA (€) ÷ FTE
Recommended frequency		Annually
Direction of improvement		Up
Boundary / interpretation notes		Value Added is a better measure than Revenue because it strips out the cost of inputs, isolating the value created by the firm's labor and capital. It serves as a key productivity metric, with higher values indicating greater efficiency and stronger human capital utilization.

7. Implementation and Reporting Rules

System boundaries

Use the same organizational and value-chain boundary across reporting periods. State whether the indicator covers one site, all company sites, owned logistics, outsourced activities, upstream suppliers and/or downstream distribution.

Functional unit

Where an indicator is normalized by a functional unit, define it before data collection and keep it stable across years. Cross-business benchmarking requires the same subsector-specific unit. For the dairy pilot, 1,000 L processed raw milk is a provisional common unit informed by EU EnReMilk reporting per unit of processed milk and IDF functional-unit guidance; confirm after piloting. Other subsector units should be fixed before comparison.

Data traceability

Prefer traceable business records such as invoices, utility meters, production records, waste transfer documentation, maintenance records, HR systems, contracts and partnership documentation.

Baseline and frequency

Set a baseline year and follow the frequency specified in each indicator profile. For OMCESI comparisons over time, use the same scoring rules, thresholds and weights or clearly version any changes.

Missing data

Do not automatically interpret missing data as zero performance unless absence of data itself represents non-compliance. Report weight-based data coverage with OMCESI.

Quality statement

Each OMCESI result should distinguish measured data, data estimated from records, and expert-judgement estimates. The total score should always be accompanied by dimension scores and data-quality notes. HR-derived indicators should be reported only in aggregate and suppressed at site level where a very small workforce could permit re-identification. Where possible, underlying data should be reused across CERAS and relevant VSME, ESRS, GRI or ISO 59020 reporting.

7.1 Recommended business-level workflow

Step	Action	Output
1	Confirm sector module and reporting period	Scope statement
2	Collect raw indicator data	Indicator dataset
3	Validate units, boundaries and completeness	Cleaned dataset
4	Normalize raw values	0-100 indicator scores
5	Apply local and dimension weights	Dimension and total OMCESI scores
6	Review data quality and contribution analysis	Interpretation dashboard
7	Define improvement actions	Transition action plan

7.2 Source traceability

Methodological source:

Kazana, V., Plakandaras, V., Raptis, D., Furtet, M., Molist, M., López-i- Gelats, F., Monés, M., Marku, D., Crişan, C., Nechita, E., Topliceanu, L. and Toš, T. (2026). Methodology for identifying and selecting indicators to monitor transition progress to circular economy and sustainability of rural agrifood businesses. CERAS Deliverable R2.4, July 2026. Project website: https://ceras.ub.ro.

Additional operational evidence for the provisional coverage threshold and dairy pilot functional unit: JRC-COIN, EnReMilk and IDF guidance.

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COMPENDIUM APPENDIX

Table 3.3a. Indicative subsector-specific reference anchors for normalization of the 24 OMCESI core indicators

Values are expressed as x_{min} / x_{target} / x_{max}. For lower-is-better indicators, values at or below x_{target} represent best/target performance, while x_{max} represents the poor-performance anchor. For higher-is-better indicators, x_{min} represents the lower-performance anchor and x_{target} represents full target attainment; values above the target are capped at 100. x_{max} is retained as an upper plausibility/reference ceiling.

Code	Indicator and unit	Direction	Meat processing: x_{min} / x_{target} / x_{max}	Dairy processing: x_{min} / x_{target} / x_{max}	Juice/vegetable processing: x_{min} / x_{target} / x_{max}
ENV01	Total Water Input, m³/FU	Down	0 / 3.0 / 5.0 m³/t raw material	0 / 0.5 / 5.0 m³/1,000 L raw milk*	0 / 3.5 / 9.0 m³/t product
ENV02	Total Energy Input, MWh/FU	Down	0 / 0.25 / 2.60 MWh/t raw material	0 / 0.10 / 0.60 MWh/t raw milk*	0 / 0.15 / 2.40 MWh/t product **
ENV03	Heat recovery rate, %	Up	0 / 30 / 100	0 / 90 / 100	0 / 70 / 100
ENV04	Separate collection and traceable segregation, % target streams	Up	0 / 100 / 100	0 / 100 / 100	0 / 100 / 100
ENV05	Total waste generated, kg/FU	Down	0 / 5 / 100 kg/t	0 / 2 / 20 kg/t	0 / 10 / 100 kg/t
ENV06	Refrigeration leakage factor, % charge/year	Down	0 / 1 / 5	0 / 1 / 5	0 / 1 / 5
ENV07	Water scarcity footprint, m³ world-eq/FU	Down	0 / WT × CF / WM × CF [CF = applicable AWARE2.0 characterization factor; WT = approved target water consumption; WM = upper water-consumption reference]	0 / WT × CF / WM × CF [CF = applicable AWARE2.0 characterization factor; WT = approved target water consumption; WM = upper water-	0 / WT × CF / WM × CF [CF = applicable AWARE2.0 characterization factor; WT = approved target water consumption; WM = upper water-consumption reference]

				consumption reference]	
ENV08	Raw-material collection emissions, kg CO_2e/FU	Down	0 / 40 / 100 kg CO_2e/t	0 / 10 / 30 kg CO_2e/1,000 L	0 / 10 / 50 kg CO_2e/t
SOC01	OHS investment per FTE, €/FTE	Up/ Target	0 / B_OHS / 1.25×B_OHS	0 / B_OHS / 1.25×B_OHS	0 / B_OHS / 1.25×B_OHS
SOC02	Share of permanent employment%	Up	50 / 90 / 100	60 / 90 / 100	40 / 75 / 100
SOC03	Traceability and transparency for circular inputs, % material input	Up	0 / 100 / 100	0 / 100 / 100	0 / 100 / 100
SOC04	Agrifood business symbiosis governance, active symbiotic partnerships	Up	Firm-size benchmark	Firm-size benchmark	Firm-size benchmark
SOC05	Share of employees CE/sustainability trained, %	Up	0 / 100 / 100	0 / 100 / 100	0 / 100 / 100
SOC06	Active CE partnerships maintained, count	Up	Firm-size benchmark	Firm-size benchmark	Firm-size benchmark
SOC07	Employee retention rate, %	Up	60 / 90 / 100	65 / 90 / 100	50 / 80 / 100
SOC08	Skills Competence Attainment, % workforce	Up	0 / 80 / 100	0 / 80 / 100	0 / 80 / 100
ECON01	Resource Cost Dependency, €/t output	Down	0 / P25 / P90	0 / P25 / P90	0 / P25 / P90
ECON02	Investment in reusable packaging/reverse logistics, % packaging/logistics CAPEX	Up	0 / 40 / 100	0 / 40 / 100	0 / 40 / 100
ECON03	QA protocol for secondary/by-product inputs, Yes/No	Up	0 / 1 / 1	0 / 1 / 1	0 / 1 / 1

ECON04	MFCA/cost-to-serve accounting implemented, Yes/No	Up	0 / 1 / 1	0 / 1 / 1	0 / 1 / 1
ECON05	Share of sales through Short Food Supply Chains, %	Up	P10 / P75/P95	0 / 30 / 100	0 / 40 / 100
ECON06	Waste disposal dependency, % total waste	Down	0 / 10 / 100	0 / 10 / 100	0 / 10 / 100
ECON07	Material productivity, € GVA/kg raw material	Up	P10 / P75 / P95	P10 / P75 / P95	P10 / P75 / P95
ECON08	Value added per FTE, €/FTE	Up	0,5XEU mean / 1,25 XEU mean / 100	0,5XEU mean / 1,25 XEU mean / 100	0,5XEU mean / 1,25 XEU mean / 100

The values presented in Table 3.3a constitute **indicative OMCESI v1 normalization anchors** and should not be interpreted as regulatory limit values unless explicitly identified as BAT-derived. Where direct subsector benchmarks were available, particularly for water use, energy consumption, and refrigerant leakage, the anchors were informed by EU BAT/BREF evidence. Where no robust quantitative external benchmark was identified, provisional CERAS targets or empirical percentile rules were proposed. These provisional values should be sensitivity-tested during pilot implementation and subsequently recalibrated using observed distributions from comparable rural agrifood SMEs. Changes to benchmark values should result in a new OMCESI version so that changes in index scores over time reflect genuine business performance rather than changes in the normalization protocol. This is consistent with the Compendium requirement to maintain stable functional units, boundaries, thresholds, and scoring rules across monitoring periods.

BENCHMARK BASIS - STATUS

Environmental indicators

ENV01 — Water

For meat processing, the EU Food, Drink and Milk BREF reports approximately **3–5 m³/t** water consumption. Therefore, it is suggested x_{target} = 3 and x_{max}= 5.

For dairy, water consumption varies substantially by product. The current FDM BREF reports approximately **0.33–12.61 m³/t raw material for market milk, 0.24–4.90 for cheese, 0.50–4.27 for powder, and 1.91–17.23 for fermented milk**. Therefore, **0.5/5.0 is only a generic dairy-pilot**

anchor. Where the firm's production is dominated by one product, it is recommended replacing it with the relevant product-specific lower and upper BREF values.

For fruit and vegetable processing, the BREF reports around **2.5–4.0 m³/t for canned fruit, 3.5–6.0 for canned vegetables, 5.0–8.5 for frozen vegetables, and 6.5 for juice**. The proposed 3.5/9.0 therefore provides a practical common anchor. For a **juice-only** pilot, it would instead be used approximately x_{target} **= 3.5** and x_{max}**= 6.5 m³/t product**.

ENV02 — Energy

The FDM BAT conclusions give **0.25–2.6 MWh/t raw material for meat processing**.

For dairy, the corresponding BAT performance levels are **0.10–0.60 MWh/t raw material for market milk, 0.10–0.22 for cheese, 0.20–0.50 for powder, and 0.20–1.60 for fermented milk**. Thus, the table's 0.10/0.60 should be used for a general or market-milk-oriented pilot; a cheese, powder, or fermented-milk processor should use its own BAT range.

For fruit/vegetable processing, EU BAT levels include **0.15–2.4 MWh/t product for tomato processing and 1.0–2.1 for potato processing**. Juice/nectar production has a much narrower range of **0.01–0.035 MWh/hl product**, approximately 0.10–0.35 MWh per m³ of product. Therefore, **a juice-only operation** should preferably use **0 | 0.10 | 0.35**, rather than the generic fruit/vegetable range.

ENV03 — Heat recovery

The strongest benchmark exists for dairies. Modern High- Temperature Short-Time (HTST) milk pasteurization typically recovers approximately **90–95% of heat** through regeneration. The 90% target is therefore defensible.

For juice, experimental and modern regenerative thermal systems can also achieve approximately 90–95% recovery, although this is process-specific. Therefore, it is recommended a more conservative **70% common juice/vegetable target** until pilot data show which thermal processes are actually present.

No equivalent defensible industry-wide percentage for meat processors was found. Therefore, the proposed **30%** is a **CERAS pilot target**, not an external BAT threshold, pending empirical calibration.

ENV04 — Separate collection and traceable aggregation

The bench marks should be considered **CERAS normative targets.** Full coverage of the defined target waste/material streams is treated as best performance. The indicator itself is defined as percentage coverage in the Compendium.

ENV05 — Waste

A JRC review found manufacturing/processing food waste values ranging from **2 to 101 kg/t production**, with most studies between **2 and 22 kg/t** and two considerably higher observations. Because CERAS ENV05 excludes by-products intentionally sold or valorised, the proposed targets

are deliberately toward the lower end of this distribution. They should be recalibrated once CERAS pilot-firm waste data are available.

ENV06 — Refrigerant leakage

The EU slaughterhouse BAT conclusions give an indicative refrigerant-loss level of **<1–5% of total refrigerant charge**, assessed as a rolling three-year average. Thus: x_{target} **= 1%** and x_{max} **= 5%.**

For dairy and juice/vegetable refrigeration in CERAS it is considered as a useful engineering benchmark, applied provisionally as a cross-sector transfer and not as a legally applicable BAT threshold.

ENV07 — Water scarcity footprint

Site-specific rather than a universal numerical benchmark. CF = applicable AWARE2.0 characterization factor; WT = approved target water consumption; WM = upper water-consumption reference. WULCA provides basin, country, regional and subnational CFs. **There is no one fixed numerical EU benchmark**. The AWARE method recommended by WULCA (https://wulca-waterlca.org/what-is-aware/download-aware-factors/) (see the following BOX 1) is explicitly spatial: Characterization Factors (CF) depend on the basin and period. WULCA now provides AWARE2.0 factors at basin, country, region and subnational levels. The original AWARE scale ranges from **0.1 to 100**, with 1 representing approximately world-average scarcity.

Therefore, for each site:

x_{target}**(ENV07) = water-consumption target × local AWARE CF**

and

x_{max}**(ENV07) = water-consumption upper anchor × local AWARE CF.**

This preserves the intended location sensitivity of ENV07 and is much preferable to assigning the same m^3-world-eq benchmark to Greece, Romania, Slovenia, Albania and Catalonia.

BOX 1

WULCA and **AWARE 2.0** are closely connected, and they are useful for the **ENV07 – Water Scarcity Footprint** indicator because they allow water consumption to be weighted according to the actual water scarcity of the location where it occurs.

WULCA stands for **Water Use in Life Cycle Assessment**. It originated as an international working group under the UNEP/SETAC Life Cycle Initiative and brought together researchers, industry representatives and public institutions to develop harmonized methods for evaluating freshwater use within Life Cycle Assessment (LCA). Its objective has been to provide a consistent framework for measuring and comparing the environmental impacts associated with freshwater consumption.

AWARE stands for **Available WAter REmaining**. It is the consensus-based water-scarcity impact-assessment method originally developed through WULCA. The central idea is that consuming 1 m^3 of water does not have the same environmental significance everywhere. Water consumed in a water-rich basin has a smaller potential impact than the same amount consumed in a highly water-stressed basin.

AWARE therefore estimates the amount of **water remaining available in a watershed after the requirements of humans and aquatic ecosystems have been considered**. The smaller the remaining water availability, the greater the potential for additional water consumption to deprive other users or ecosystems.

What is AWARE 2.0?

AWARE 2.0 is the latest official version of the AWARE method, published in 2025. It updates the original method using more recent hydrological data and improves several methodological aspects, including basin representation, environmental water requirements, treatment of river deltas and inland sinks, and the definition of water consumption. It is based consistently on WaterGAP 2.2e hydrological modelling.

AWARE 2.0 provides C**haracterisation Factors (CFs)** at different geographical resolutions, including river-basin level, country and regional level; and subnational level.

The official datasets are made available by the AWARE/WULCA team, including Excel and GIS files (https://wulca-waterlca.org/what-is-aware/download-aware-factors/)

How the AWARE factor works

Conceptually, the water scarcity footprint is:

Water Scarcity Footprint=Water Consumption×AWARE Characterization Factor

The resulting unit is normally expressed as: m3 world-eq or in CERAS m3 world-eq/functional unit This is consistent with the definition already used for **ENV07** in the Compendium: water consumption weighted by local scarcity factors per functional unit.

A simple example

Suppose two dairy plants each consume **500 m^3 of water**.

If Plant A is located in a relatively water-abundant basin with: CF=2

then: 500×2=1,000 m3 world-eq

If Plant B is in a highly water-stressed basin with: CF=20

then:500×20=10,000 m3 world-eq

Although both plants consume exactly the same volume of water, Plant B has a **ten-times larger water-scarcity footprint**.

That is precisely why ENV07 adds information that ENV01 – Total Water Input cannot provide. ENV01 measures how much external water the business uses, while ENV07 measures how significant that water consumption is given local water scarcity. So, a company could improve ENV01 by reducing water withdrawals, while ENV07 additionally reveals whether those withdrawals occur in a **water-stressed**

location. There is one further important distinction: for AWARE it should ideally be used **water consumption**, not simply water withdrawal. In simplified terms:

Water consumption=water withdrawn−water returned to the same watershed

What does an AWARE factor mean?

In the original AWARE formulation, the factors are relative scarcity indicators. The scale was constrained between approximately **0.1 and 100**, with higher factors indicating greater scarcity pressure. A value of 10, for example, represents substantially less available water remaining per unit area than the world-reference situation.

In CERAS the AWARE 2.0 method should be used as the preferred characterization method for ENV07. The applicable characterization factor should preferably correspond to the river basin in which the processing facility is located. Where basin-level identification is not feasible, the most appropriate available subnational or country-level AWARE 2.0 factor may be used. The geographic resolution, AWARE version, factor year and source should be recorded and kept constant for longitudinal comparison. This would strengthen ENV07 considerably, because for example **a Greek dairy processor in a water-stressed Mediterranean basin should not necessarily receive the same water-scarcity weighting as a dairy processor in a relatively water-abundant Slovenian basin**.

ENV08 — Transport

For dairy, an EU study reported approximately **9–12 kg CO_2e per 1,000 L of milk** for farm-to-processor milk transport, supporting an x_{target}≈ 10 kg CO_2e/1,000 L (Alliance Environnement 2008).

For meat, a large recent cattle-transport study (Dias et al. 2025) reported a median around **50 kg CO_2e/t carcass**, with efficient configurations around 36–38 kg/t and upper quartiles approaching 98 kg/t. Hence **40/100 kg CO_2e/t** is a reasonable provisional anchor pair, although route structure differs from Europe.

For fruit/vegetable collection, it is suggested initially to use a **route-based CERAS scenario**, e.g. x_{target} = 10 and x_{max} = 50 kg CO_2e/t. The actual calculation should use ISO 14083/GLEC-compatible fuel or tonne-km factors. GLEC explicitly provides the freight-emission calculation architecture for fuel, vehicle and temperature-controlled transport (https://co3.io/news/iso-14083-vs-glec-framework, ,https://smartfreightcentre.org/page/homepage)

Social indicators

Unlike energy and water, most social indicators have **no accepted meat/dairy/juice-specific numerical BAT benchmark**. Consequently, these should be treated as CERAS monitoring thresholds and then recalibrated empirically.

SOC01- OHS investment/FTE

A risk-based CERAS benchmark is used is suggested. A fixed cross-country €/FTE target, such as €500/FTE or €1,000/FTE is not recommended, because OHS costs differ with machinery, slaughtering

activities, refrigeration, chemical handling, national wage levels, national prices and previous capital investment. More spending is also not automatically better. **SOC01 should ideally become a target-based indicator rather than a simple "higher-is-better" indicator,** because attainment of a risk-based OHS programme is what matters. Therefore, it is suggested to define:

B_OHS = OHS expenditure/FTE required to implement 100% of the approved annual risk-control action plan.

This makes the target linked to actual risk reduction rather than spending capacity. It also respects the compendium's warning that euro-denominated indicators should be benchmarked within comparable national/subsector contexts.

SOC02 - Permanent employment

Eurostat reports that temporary employment represented **11.0% of EU employment in 2024**, implying an approximate EU-wide permanent-contract share of 89% among permanent/temporary employees. This supports an approximate **90% target** for meat and dairy. The lower **75% target for juice/vegetable processing is a CERAS adjustment**, recognizing the greater seasonal character of this subsector. it should be tested empirically.

SOC03- Traceability and Transparency for Circular Inputs

A normative target of 100 is used because all circular inputs entering the defined material boundary should be traceably documented. The Compendium defines SOC03 explicitly as percentage coverage.

SOC04- Agrifood business symbiosis governance

Firm-size-specific targets should be used because absolute partnership counts can disadvantage micro firms. The following are **suggested**:

Firm size	x_{min}	x_{target}	x_{max}
Micro (<10 employees)	0	**1**	2
Small (10–49)	0	**2**	4
Medium (50–249)	0	**3**	6

SOC05- Employees trained

A normative target of 100 is used**.** Full workforce coverage receives 100 points. Where only CE-relevant functions require specialized training, an alternative denominator of "employees in relevant roles" can be adopted before the pilot and then kept fixed.

SOC06- Active CE partnerships

For **SOC06**, which covers broader active CE collaborations, not the resource-exchange relationships counted in SOC04, the compendium again specifically recommends firm-size thresholds. It is suggested **0/2/4 for micro, 0/3/6 for small, and 0/5/10 for medium sized firms**.

SOC07- Employee retention

Provisional pilot anchor values are used. Lower juice/vegetable target accommodates greater seasonal workforce turnover. These should be replaced by empirical country × subsector SME distributions after piloting.

SOC08- Skills Competence Attainment

Provisional pilot target values are used**.** An 80% competent/certified workforce is used as the full target attainment while preserving headroom to 100%. Indicator definition and formula are already percentage based.

Economic indicators

The economic block requires particular caution because **€-based benchmarks should not be compared directly across countries without controlling for price levels, energy prices, wages and purchasing power**.

ECON01 — Resource Cost Dependency

It is not recommended fixing a single Europe-wide €/t value. Electricity, gas, water and waste-disposal prices differ substantially among the CERAS countries.

For each **country × subsector × size class**, it can be used:

x_{target}= 25th percentile (P25) of Resource Cost Dependency

x_{max} = 90th percentile (P90) of Resource Cost Dependency

x_{min}= 0

If no peer dataset exists during the first pilot, a temporary time-series rule could be:

x_{target} = 0.80 × baseline RCD

x_{max} = 1.20 × baseline RCD

This effectively treats a 20% reduction from the baseline as the provisional transition target. It should later be replaced by empirical peer percentiles.

ECON02 — Reusable packaging/Reverse logistics

The proposed **40% target** although it has a policy rationale, it is a provisional value. The EU Packaging and Packaging Waste Regulation requires, from 2030, at least **40% of specified transport packaging to be reusable within a reuse system**, with 70% as an aspirational 2040 level.

However, **CERAS ECON02 measures the percentage of CAPEX invested in reusable packaging/reverse logistics—not the percentage of packaging that is reusable**. Therefore, 40% should be described as a **transition-aligned CERAS proxy**, not as an EU legal threshold for this indicator.

ECON03 and ECON04

These are best handled as binary indicators:

No = 0 points; Yes = 100 points

If ECON04 is later converted from Yes/No to percentage of material flows covered by MFCA, it is recommended:

x_{min} = 0%, x_{target} = 75%, x_{max} = 100%

This would provide substantially more differentiation among firms.

ECON05 — SFSC sales

No official EU best-practice percentage appropriate for the processing agrifood businesses of interest was identified. Therefore, the following empirical subsector distribution (**country × subsector × size class)** can be used:

x_{min}= 10th percentile (P10) of Share of Agrifood sales through SFSC

x_{target}= 75th percentile (P75) of Share of Agrifood sales through SFSC

x_{max} = 95th percentile (P95) Share of Agrifood sales through SFSC

Until sufficient pilot data are available, the following maturity rubric or a documented baseline-relative improvement target can be used:

ECON05 share	OMCESI maturity score
0%	0
>0–10%	25
>10–25%	50
>25–50%	75
>50%	100

ECON06 — Waste Disposal Dependency

Because the indicator measures the proportion of generated waste sent to disposal rather than reuse/recovery, the following values are recommended:

x_{min} **= 0%;** x_{target} **= 10%;** x_{max}**= 100%**

The target is intentionally demanding: a company achieving ≤10% disposal dependence receives full points. This is a project circularity criterion rather than a legally mandated threshold.

ECON07 — Material Productivity

Absolute €/kg values depend heavily on product mix: cheese, juice, fresh vegetables and meat products have very different value-to-mass relationships. A single numerical benchmark would therefore introduce a strong product-mix bias.

It is recommended using within each **country × NACE subsector × size class**:

x_{min} **= P10;** x_{target} **= P75;** x_{max} **= P95**

During the first pilot, if there are not enough firms to estimate these percentiles, an interim time-series target of approximately **+20% material productivity relative to the baseline** is preferable to an arbitrary €/kg threshold.

At this stage, there is no basis for stating that +20% is the standard or optimal material-productivity improvement for European meat, dairy or juice/vegetable processors. The **20% value is proposed as a practical pilot ambition level**, for three reasons. First, it is large enough to represent a **meaningful improvement**, rather than normal year-to-year variation of a few percentage points. Second, it is still potentially achievable over a multi-year CE transition period through material-loss reduction, by-product valorisation, higher-value outputs, better process

yields and reductions in virgin material requirements. Third, it provides a simple benchmark while CERAS is still building the empirical dataset needed to establish proper subsector distributions.

ECON08 — Value Added per FTE

Provisional ECON08 reference anchors are derived from EU subsector labour-productivity averages. The applied multipliers are methodological calibration assumptions rather than externally established thresholds and must be replaced by empirical subsector percentiles following pilot implementation. Therefore, at this stage it is suggested:

x_{min} = 50% of mean; x_{target} = 125% of mean; x_{max} = 100

interpreted as follows:

- 50% of mean = poor performance
- EU mean = normal/average performance
- 125% of mean = strong target performance
- values ≥125% simply cap at 100 OMCESI points

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