



**LAND MANAGEMENT, ENVIRONMENT & SOLID-WASTE:
INSIDE EDUCATION AND BUSINESS IN CENTRAL ASIA
ERASMUS-EDU-2023-CBHE Project Number: 101129032**

MICRO-CREDENTIAL

**CIRCULAR ECONOMY FOR LAND AND WASTE
MANAGEMENT**

**13.- Assessment Tools and Indicators of Circular
Economy**

Activity 1

Indicator-selection task for a local CE case



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Objective

The objective of this activity is to help students select appropriate indicators for evaluating a local circular economy case.

Students should learn that indicator selection must be linked to:

- the objective of the circular intervention;
- the material, water or energy flows involved;
- the environmental pressures that should be reduced;
- the spatial and temporal scale of assessment;
- the availability and quality of data;
- possible rebound effects and burden shifting;
- the distinction between activities, outputs and real outcomes.

The activity should demonstrate that a circular economy project cannot be evaluated through a single indicator. A robust assessment normally requires a combination of **resource-flow, environmental, economic and social indicators**.

Background

Circular economy initiatives are often described using simple activity indicators such as:

- tonnes recycled;
- percentage of waste diverted from landfill;
- number of products repaired;
- volume of water reused;
- amount of compost produced;
- number of companies participating in an industrial symbiosis network.

These indicators are useful, but they do not necessarily prove that the intervention creates a net environmental benefit.

For example:

- A recycling facility may process more waste but consume large amounts of energy and water.
- A water-reuse project may reduce freshwater abstraction but increase soil salinity.

- Compost production may increase, but poor-quality compost may introduce plastics or contaminants into agricultural soil.
- A company may increase the proportion of recycled material while total material consumption continues to grow.
- Waste-to-energy may reduce landfill disposal but destroy materials that could have been reused or recycled.

Therefore, circular economy assessment should ask not only:

What circular activity has increased?

but also:

What environmental pressure has actually decreased, and what unintended effects may have appeared elsewhere?

Local case options

Students must select one local or regional circular economy case.

Possible options include:

1. Municipal organic waste composting.
2. Anaerobic digestion of livestock manure.
3. Plastic recycling facility.
4. Construction and demolition waste recovery.
5. Reuse of treated wastewater in agriculture.
6. Industrial symbiosis between two or more companies.
7. Repair and reuse centre for electronic equipment.
8. Agricultural residue recovery system.
9. Landfill diversion programme.
10. Food waste prevention initiative.
11. Circular irrigation system.
12. Reuse of excavated soil or construction materials.
13. Another case approved by the instructor.

The selected case may be real, hypothetical or based on a local activity familiar to the student.

Step 1. Define the circular economy case

Students should briefly describe:

- location;
- activity;
- main material or resource flow;
- current linear practice;
- proposed circular intervention;
- intended environmental benefit;
- main stakeholders.

A good case definition should be specific.

For example:

Too broad: Improving waste management in Central Asia.

Appropriate: Introducing source-separated collection and composting of market and household organic waste in a medium-sized city to reduce landfill disposal and produce compost for peri-urban agriculture.

Step 2. Define the assessment question

Before choosing indicators, students must define what they want to know.

Examples include:

- Has the project reduced virgin raw-material consumption?
- Has landfill disposal actually decreased?
- Has groundwater pollution risk been reduced?
- Has the use of synthetic fertiliser been replaced by recovered nutrients?
- Has total water consumption decreased?
- Has product lifetime increased?
- Has the intervention reduced greenhouse-gas emissions?
- Has circularity improved without transferring pollution elsewhere?

The assessment question should guide indicator selection.

Step 3. Distinguish between indicator categories

Students should select indicators from at least four categories.

A. Input indicators

These measure resources entering the system.

Examples:

- tonnes of virgin raw material used;
- freshwater abstraction;
- mineral fertiliser consumption;
- fossil energy use;
- imported feed or biomass.

B. Process or activity indicators

These measure what circular activities are being implemented.

Examples:

- tonnes of waste collected separately;
- number of products repaired;
- quantity of wastewater treated;
- number of firms participating in industrial symbiosis.

C. Output indicators

These measure immediate products or results.

Examples:

- tonnes of recycled material produced;
- cubic metres of reclaimed water generated;
- tonnes of compost produced;
- electricity generated from biogas.

D. Outcome indicators

These assess whether the intervention has actually improved environmental or resource performance.

Examples:

- reduction in virgin material consumption;
- reduction in landfill disposal;
- lower greenhouse-gas emissions;
- lower nitrate concentrations in groundwater;
- lower water consumption per unit of production;
- longer product lifetime;
- reduced land occupation for disposal.

E. Impact indicators

These examine longer-term environmental, economic or social consequences.

Examples:

- improved soil organic carbon;
- lower ecosystem pressure;
- reduced public-health risk;
- increased local employment;
- reduced dependence on imported materials;
- improved resilience of local supply systems.

The relationship among these categories can be simplified as:

Inputs → Activities → Outputs → Outcomes → Long-term impacts

A key objective of this activity is to prevent students from confusing **more circular activity** with **better environmental performance**.

Step 4. Complete the indicator-selection matrix

Table 1. Indicator-selection matrix for a local circular economy case

Indicator category	Proposed indicator	Unit	Why matters it	Data source	Desired trend
Resource input					
Circular activity					
Immediate output					
Environmental outcome					
Waste prevention					

Land-use effect					
Water effect					
Energy / climate effect					
Economic effect					
Social or governance effect					

Students should select **8–12 indicators** in total.

Step 5. Test each indicator for quality

Each selected indicator should be evaluated using the following questions:

1. Is it directly linked to the objective?
2. Can it be measured reliably?
3. Is the unit clear?
4. Can a baseline be established?
5. Can it show change over time?
6. Is it sensitive to the circular intervention?
7. Could it be manipulated or misinterpreted?
8. Does it reflect real environmental performance?
9. Could another indicator be needed to detect trade-offs?
10. Is data collection realistic?

Example: municipal organic waste composting

Suppose a city starts separate collection and composting of organic waste.

A weak assessment might use only:

Tonnes of compost produced per year.

This shows activity, but not necessarily success.

A stronger indicator set would include:

Table 2. Example indicators for municipal organic waste composting

Dimension	Indicator	Interpretation
Waste prevention	Organic waste generated per capita	Shows whether total waste generation is changing
Collection	Share of organic waste separately collected	Measures participation and collection performance
Contamination	Percentage of plastics and other impurities	Evaluates feedstock quality
Recovery	Tonnes of marketable compost produced	Measures useful output
Landfill diversion	Tonnes of organic waste no longer landfilled	Measures avoided disposal
Climate	Net GHG emissions per tonne managed	Assesses climate performance
Soil	Organic matter returned safely to land	Measures soil-resource benefit
Quality	Compost compliance with quality standards	Prevents pollutant transfer
Market	Share of compost actually used	Distinguishes production from real use
Transport	Average transport distance	Detects possible logistics burdens

This example shows that **one circular project may require several complementary indicators to demonstrate real performance.**

Step 6. Identify possible misleading indicators

Students should identify at least three indicators that could create an incomplete or misleading impression.

Examples include:

- Recycling rate

A high recycling rate may coexist with increasing total material consumption.

- Waste diverted from landfill

Waste may be diverted to incineration rather than genuinely kept in productive use.

- Reclaimed water volume

High reuse may be environmentally problematic if salinity or contaminants accumulate.

- Compost production

High output does not demonstrate quality or actual agricultural use.

- Number of repaired products

Repairs may have little effect if products are replaced anyway.

- Percentage of recycled content

A higher share can coexist with growing total production and absolute virgin-material use.

Step 7. Include at least one absolute and one relative indicator

Students should distinguish between:

Absolute indicators, such as:

- tonnes of virgin plastic consumed per year;
- cubic metres of freshwater abstracted per year;
- tonnes of waste landfilled.

and **relative indicators**, such as:

- kilograms of material per unit of product;
- litres of water per kilogram of crop;
- percentage recycled.

Both are necessary.

A company may reduce material intensity by 10% per product while doubling production. In that case, total material consumption still increases.

Warning: efficiency improvement does not necessarily mean absolute resource reduction. Always check whether total consumption, waste or emissions are also decreasing.

Step 8. Identify rebound and burden-shifting risks

Students must identify at least one possible:

- Rebound effect

Efficiency gains reduce costs and indirectly increase consumption.

Example: cheaper recycled material encourages greater overall material use.

- Burden shifting

One environmental impact decreases while another increases.

Example: less landfill disposal but more energy consumption and polluted wastewater from recycling.

- Spatial displacement

Environmental pressure moves to another location.

Example: waste is exported for recycling without adequate information on treatment conditions.

- Temporal displacement

Today's circular solution creates a future problem.

Example: contaminated secondary materials are incorporated into long-lived products and become difficult future waste.

Student task

Students should submit:

1. A description of the selected local CE case.
2. One clear assessment question.
3. A completed **Table 1** with 8–12 indicators.
4. At least:
 - one input indicator;
 - one activity indicator;
 - two outcome indicators;
 - one long-term impact indicator;
 - one absolute indicator;
 - one relative indicator.
5. Three potentially misleading indicators.
6. One rebound or burden-shifting risk.
7. A 600–800 word justification of the selected indicator set.
8. A final answer to the question: **Would these indicators be sufficient to demonstrate real circularity? Why or why not?**

Suggested assessment criteria

Criterion	Description
Case definition	The selected CE case is specific and clearly described
Indicator relevance	Indicators match the intervention objectives
Outcome orientation	Student goes beyond activity and output indicators
Environmental completeness	Material, waste, land, water and/or energy effects are considered
Absolute performance	At least one absolute indicator is included
Trade-off awareness	Rebound and burden shifting are considered
Measurability	Indicators have clear units and realistic data sources
Critical reasoning	Student identifies limitations and misleading indicators
CE relevance	Indicator set demonstrates meaningful circular economy performance

Expected learning outcome

After completing the activity, students should be able to select a balanced set of indicators for a local circular economy case and distinguish between:

- what a project **does**
- what it **produces**
- what environmental pressure it actually **reduces**
- and what long-term impacts it creates