

Lecture 03

# Circularity matrix: secondary material grading and Brazilian Circular Economy approaches

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CETEM / MCTI

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# Circular economy principles and actions

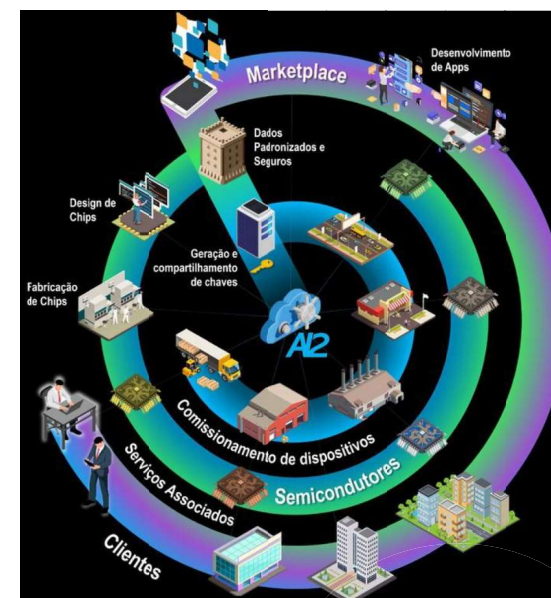
- The vision of a circular economy is to provide **adequate solutions for the reduction, efficient, and effective use of virgin resources**, and to prevent harmful releases, losses and environmental degradation when meeting consumption needs.
- The type and sequence of **activities and processes related to resources recovery are defined as the recovery pathway**. According to the way in which they are **collected, stored, sorted or handled**.

# Brazilian regulation

- **Brazilian Policy on Solid Waste** provides main requirements for waste reverse logistics management.
- Decree No 11.413/2023 establishes **reverse logistics credits** procedures and validation criteria.
- Resolution No 2/2021 of Ministry of Mine and Energy presented **the list of strategic minerals**.
- **Roadmap for the Critical and Strategic Minerals** to be presented in May 2024.
- **Brazilian Circular Economy Policy to be enacted in 2024.**

# AI 2 Project

- Next stage of Brazil ID Project.
- Concept of **Digital Product Passport (DPP)**.
- Concept of **Product as a Service (PaaS)**.
- Enable the **authentication and traceability of objects** at all stages of the distribution chains.



# Secondary materials

- **Non-destructive processes** are intended to the recovery of parts, components and co-products through reuse, repair, reconditioning and remanufacturing.
- **Destructive processes** aim to recover materials through recycling techniques, for the most part, and there is no concern with maintenance of functionality.

# Material categorization and classification

- **Categories: identification** of the type of product according to production and functionality (E.g., textiles, e-waste, vehicles);
- **Classes: qualification** according to established criteria such as the material complexity (monomaterial, multimaterial), hazardousness potential (regulation requirements), recoverability potential (embling and/or sorting capacity level), etc.

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# A FRAMEWORK FOR SECONDARY MATERIAL CIRCULARITY ASSESSMENT

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# Circularity assessment

- The circularity assessment enables the measurement of the degree of circularity by **comparative material grading**.
- The proposed weighting is based on established dimensions and criteria, providing a **customized analysis**.
- The weights and scores consider the area of analysis (region, country or municipality) to reach the **material circularity score (CS)**.

$$CS = \sum \text{dimension scores} + (\text{disassembling and sorting capacity index} * \text{material complexity level index} * \text{technological recovery solution costs})$$



# Circularity matrix

		Material and products categories																			
		Minimum or no complexity						Low to medium complexity													
Products	Paints and varnishes (aromatic compounds)																				
	Fiber Products (cartons & paper)																				
	Glass (tempered)																				
	Glass (flat)																				
	Styrofoam																				
	Oil / Cooking oil																				
	Soil (sand, clay, etc)																				
	Scrap Steel																				
	Batteries (all types)																				
	Leather																				
EoL Vehicle																					
Solar Panels																					
Beverage bottles																					
Lamps																					
Monitors and flat panels																					
Masks																					
Weight	assembling and/or sorting capacity (1-4)	1	2	1	2	1		2	2	1	2		3	2	2	3	2	1	2	3	
	Material complexity level (1-4)	1	3	1	3	3		3	1	2	1		2	3	3	3	3	3	4	2	
	Technological recovery solution costs (1-4)	2	1	1	2	2		2	1	2	1		3	1	3	4	3	2	2	3	
Dimension (1-10)	Social	1	3	7	2	13	7	13	3	5	3	2	20	8	20	38	20	8	18	20	
	Economic	2	4	2	14	8	5	14	4	4	4	4	22	10	10	40	22	10	20	22	
	Environmental	1	3	13	2	13	7	4	13	3	5	3	6	24	12	12	42	24	12	22	24
	Technological	2	4	14	3	14	8	5	14	4	6	4	4	22	10	10	40	22	10	20	22
	Regulatory	2	4	14	3	14	8	5	14	4	6	4	6	24	12	12	42	24	12	22	24
CIRCULARITY SCORE		18	62	13	68	38	23	68	18	28	18	112	52	64	202	112	52	102	112		

Figure 1. Material circularity assessment framework simulation.

# Circularity matrix

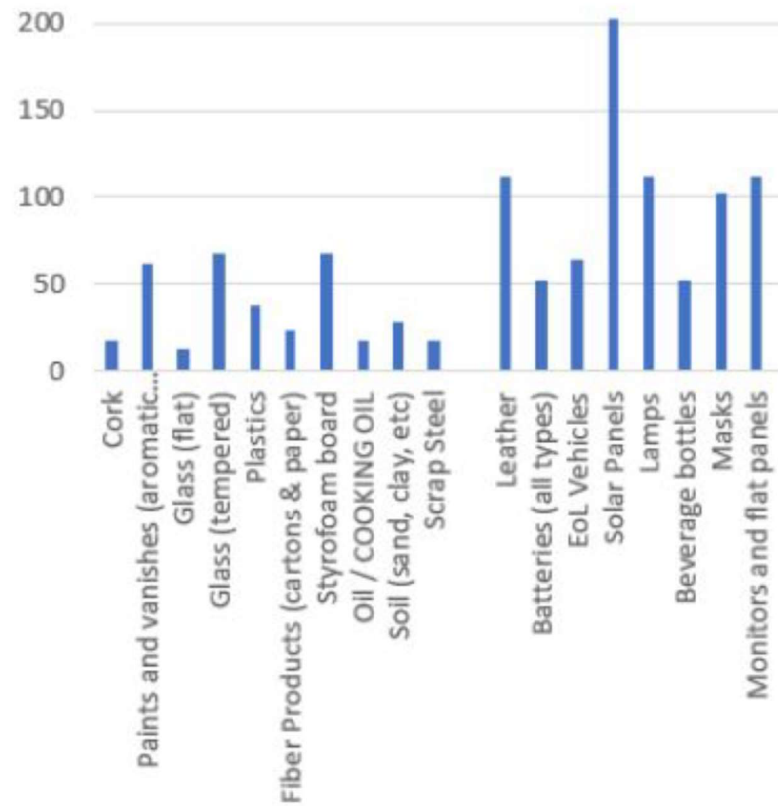


Figure 2. Material circularity scores simulation.

# Circularity matrix

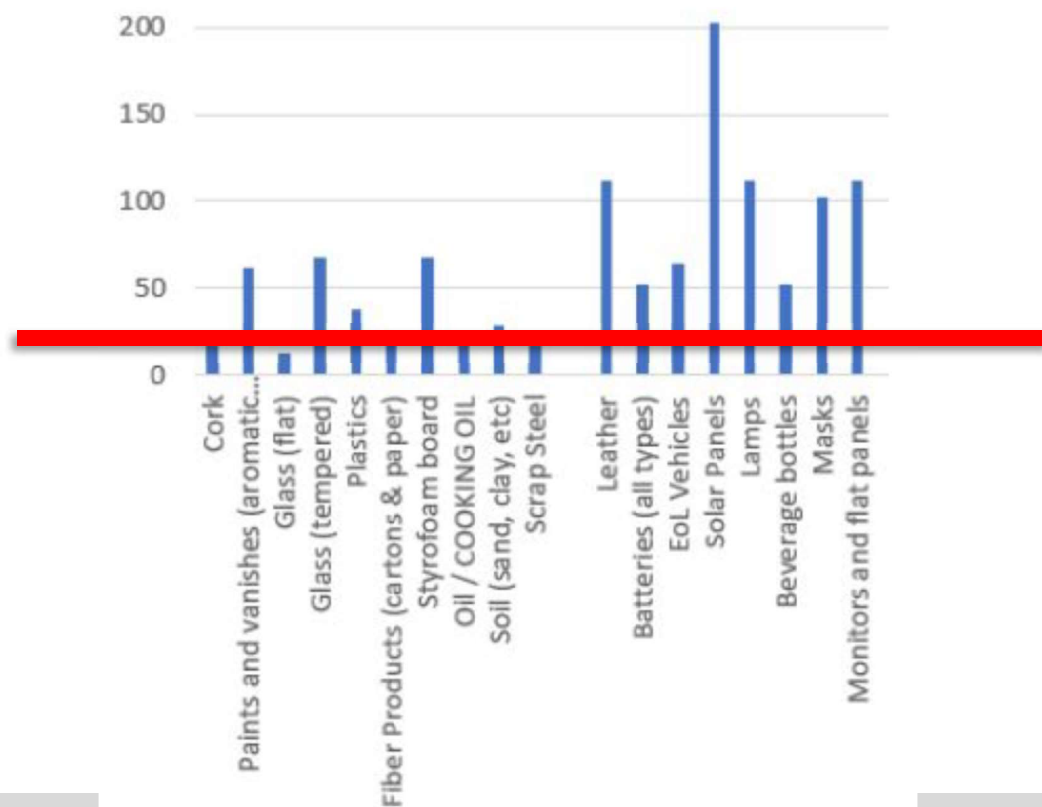


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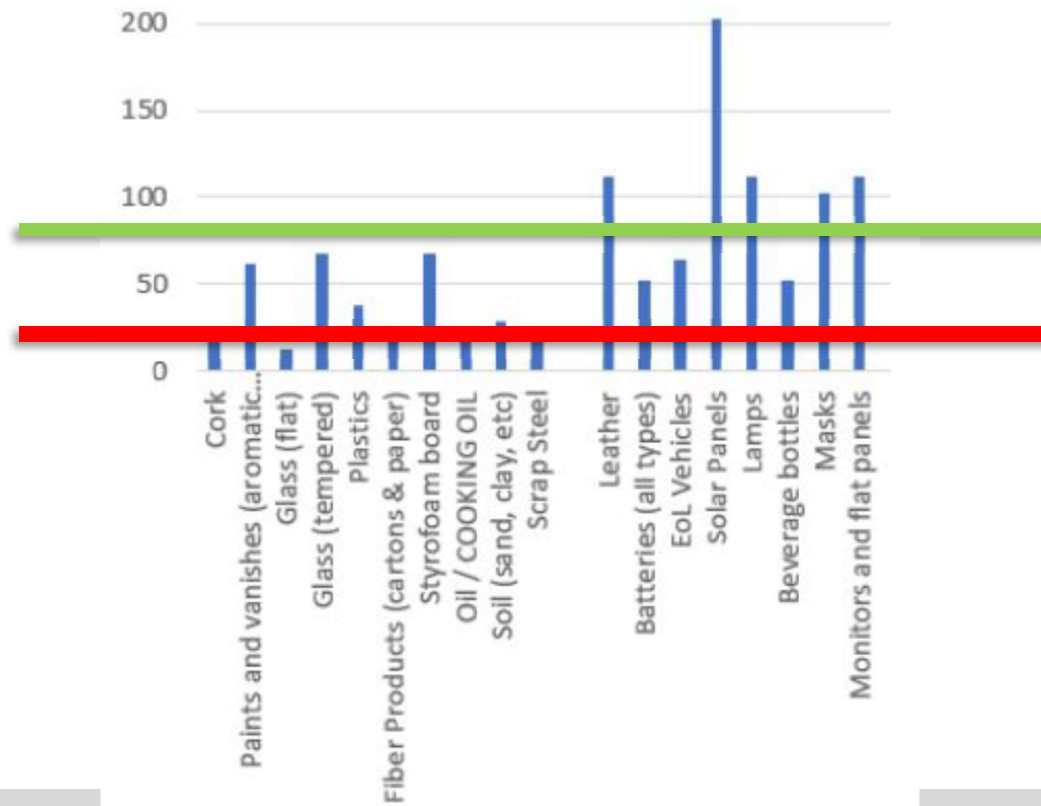


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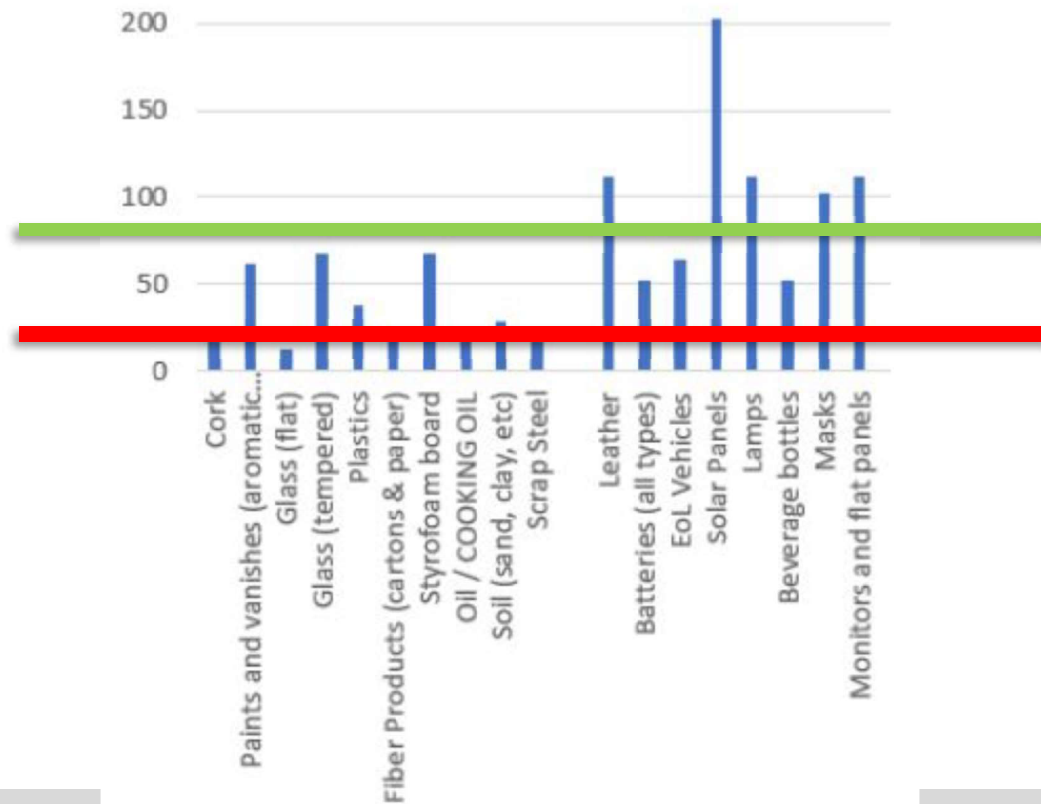


Figure 2. Material circularity scores simulation.

- Current status
- Forecasting
- Integrated value chain
- Decision and policy making support

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*Obrigada!  
Thank you!*

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