circe
CENTRO DE INVESTIGACIÓN DE RECURSOS Y CONSUMOS ENERGÉTICOS

TECHNOLOGICAL SERVICE

CRITICAL

How to guarantee the supply and the sustainability of the materials you need?

Towards a circular economy: CIRCE has developed an own methodology that identifies the environmental and socioeconomic risks of raw materials in products, to provide eco-design recommendations in order to reduce raw material dependency, improve recyclability and minimize manufacturing costs.

Technology evolution is increasing the use of a greater quantity and diversity of new materials some of them considered critical by different governments. The criticality of these materials is basically based on economic importance for the development of strategic technologies and supply risk. The European Commission considers a score of 20 critical materials, such as rare earths (needed for the deployment of renewable energy or electrical and electronic devices), whose production is restricted to a few countries and therefore seriously conditions the development of European economies and in particular the transition towards low carbon and energy efficient technologies.

Targets of the service

- ✓ Analyze the use of raw materials requirements of a product throughout its life cycle, including the manufacturing processes, disassembly, fragmentation and recycling or reuse operations.
- ✓ Evaluate the amount of critical materials used in the product.
- ✓ Compare the impact of the demanded raw materials using Exergy as an indicator - thermodynamic property that physically assesses the quality of any resource.
- ✓ Identify which components demand more Exergy (critical materials) and evaluate their criticality in terms of geological availability, geopolitical stability and the evolution of the overall estimated demand for the given material.
- ✓ Analyze the processes carried out in different centers (decontamination and fragmentation of products) in order to identify options that improve the recyclability and recoverability of materials. (25 years vision).

Results

- Raw materials scarcity analysis in the earth's crust and through it, assessment of potential extraction costs increase and rise in prices of commodities.
- Raw materials risk assessment due to concentration of supply in geopolitical unstable regions.

- **Competition** for same resources within the sector or with other sectors → strategic importance.
- Substitution possibilities by other less critical materials.

- Reduces the **economic impact** derived from eco-design measures defined, and the substitution of materials.

Pros

Main benefits:

- ✓ Identify critical components of the product with important environmental, economic and supply risks of its raw materials.
- ✓ Define eco-design measures to reduce raw material criticality and improve the recyclability of identified components.

Secondary benefits:

- ✓ Reduce manufacturing costs and improve competitiveness.
- ✓ Avoid critical raw materials supply risks.
- ✓ Facilitate/Promote **Circular Economy**
- ✓ Define future production strategies
- ✓ Improve or create new business activities.
- ✓ Improve the **Green corporate image**

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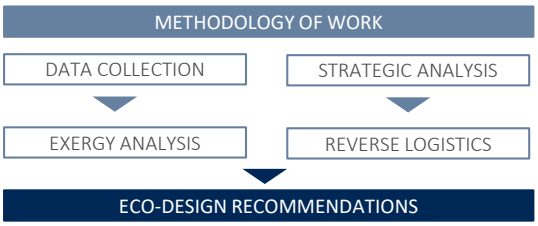
Methodology



Data Collection: Gather all the information needed to apply the exergy analysis. Process and components.

Exergy Analysis: Application of the methodology and quantification of the impact of the different raw materials used for the manufacturing of the analysed components.

Strategic analysis: Criticality Assessment based on security of supply, demand forecast, relative scarcity in the crust, economic importance within and outside the studied sector.

Reverse Logistics: Analysis of the current situation of the product's end of life to identify which materials could be recovered, recycled, which barriers hinder their recovery and how to reduce valuable materials ending in landfill.

Eco-design recommendations: for the components identified as critical, based on the exergy, strategic and recyclability analysis of the raw materials used.

Project execution is based on the application of the second law of thermodynamics and the concept of materials exergy.

Thermodynamic Indicator

CIRCE has developed an indicator, measured in energy units, named material thermodynamic rarity. This indicator enables to know the criticality of each of the parts that compose a product in order to analyze and focus eco-design efforts.

Benefits against the conventional mass analysis

Gives more importance to those substances whose scarcity and production cost are grater.

Benefits against money indicator

It is based on the physical reality of raw materials. Hence it is not volatile or subjective (as is price) and is universal.

Addressed to

All kinds of manufacturing industries regardless of the sector.

Added value

- Structures the information of each component and raw material content of the analysed product.
- Values scarcity of materials and anticipates future extraction and possible commodity price fluctuations.
- Determines security of materials supply considering social & political instabilities.
- Studies competitor's needs for same resources → strategic importance.
- Identifies possible demand increases.
- Eco-design recommendations.

Background experience

CIRCE has extensive experience in the thermodynamic and exergy analysis of energy systems, a research line initiated more than 20 years ago

Furthermore, Circe has participated in several R&D projects on this field, not only in collaborative projects but also for private entities:

- **TOP-REF** – (H2020. European Commission). The project has developed a methodology to evaluate the efficiency of raw materials use for different industries and sectors.
- **EXCITE** - (Project for SEAT) Study of the thermodynamic rarity of all the manufacturing components of vehicles.

CONTACT

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