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Materials Selection

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Study contract

- 3 credits
- Evaluation:
  - Oral exam, based on assignment report
  - Assignment report
- Compulsory reading
  - Ashby: Materials Selection in Mechanical Design, 4th edition
  - Ashby: Materials and the Environment
- Additional literature
  - Jones & Ashby: Engineering Materials Volume 2, Second Edition
  - Budinski & Budinski: Engineering Materials, Properties, and Selection, 9th edition

The materials explosion

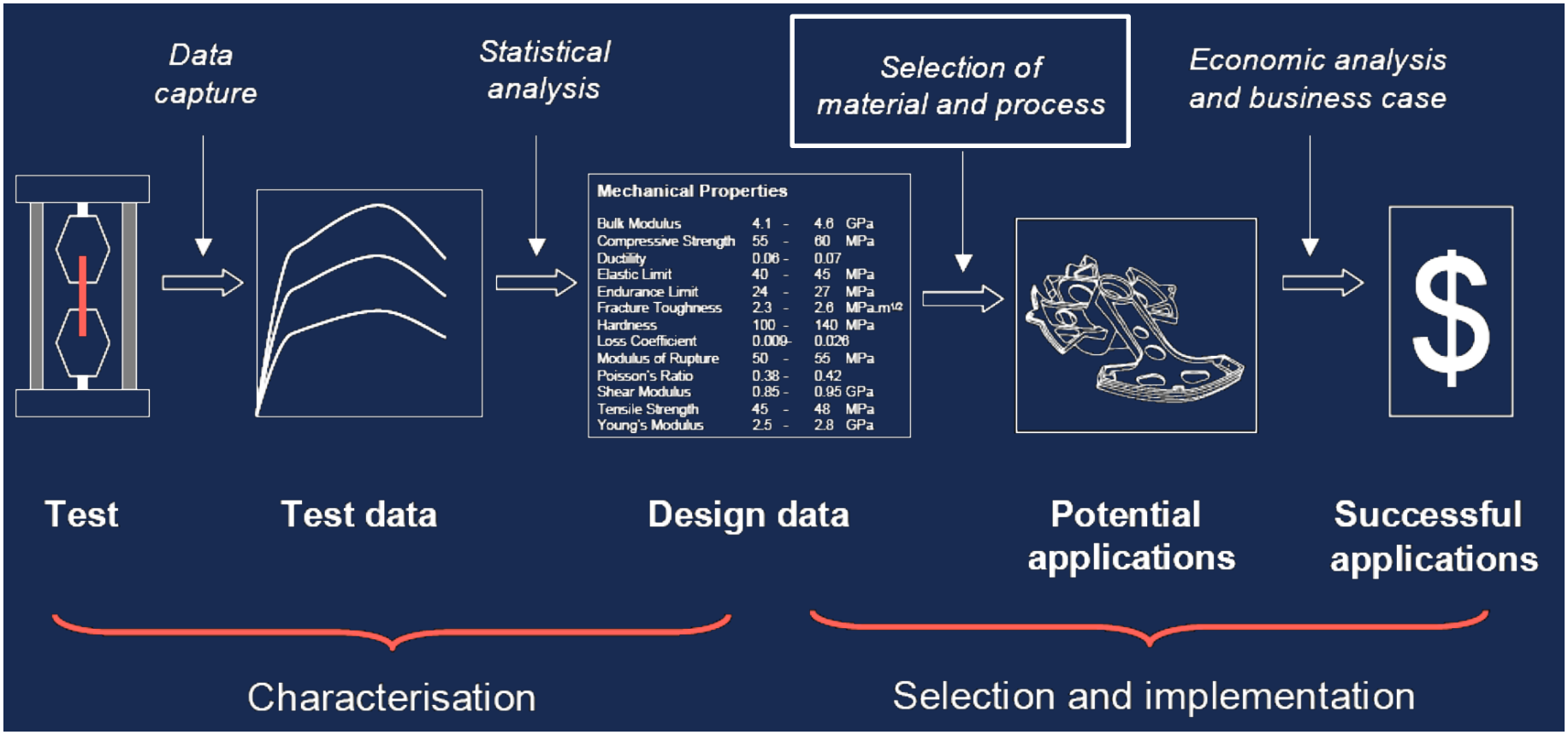

Antoni Gaudi

- At the start of the construction of the Sagrada Familia (1882):
  a few hundred materials:

- Virtually no plastics
  - Now > 45000
- No light-weight metal alloys
  - Now a few thousand
- No composites
  - Now a few hundreds

- Today: more than 160.000 materials

Goal



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Learning outcomes

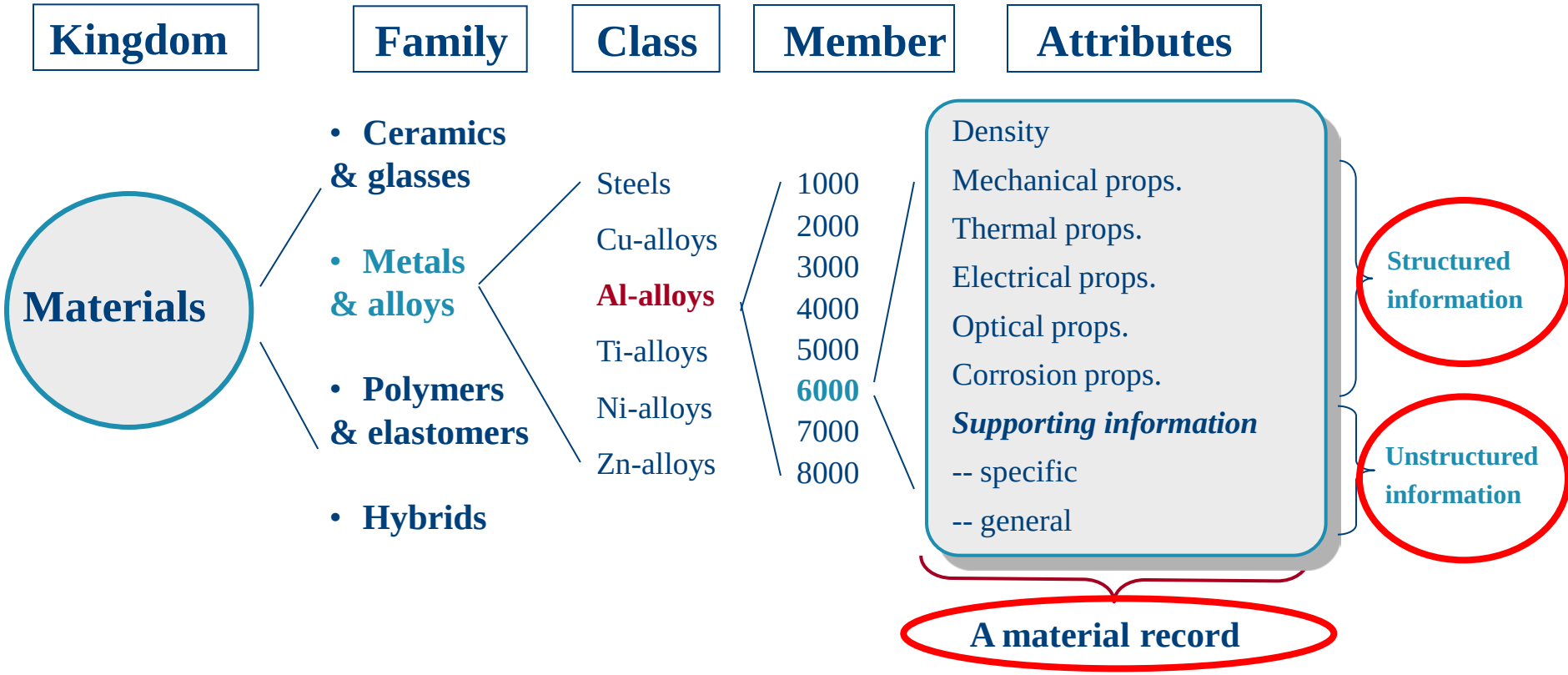
Knowledge of:

- The methodology of materials selection

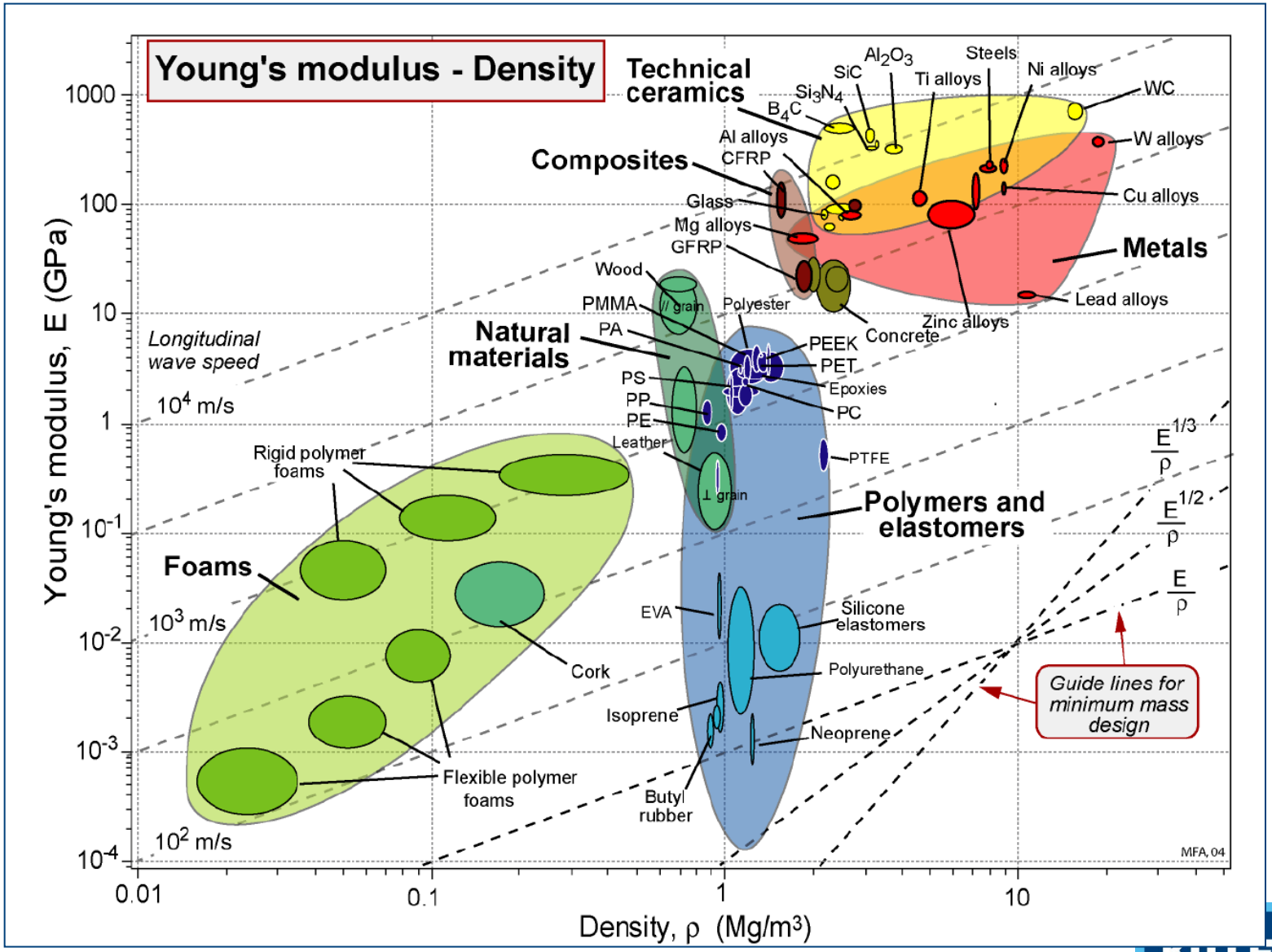
Ability to

- Formulate a set of material requirements for a technical application
- Translate the requirements into material indices
- Select a material and manufacturing method using material and process databases
- Summarize the selection process in a technical paper
- Critically assess the results of the selection process

Material properties

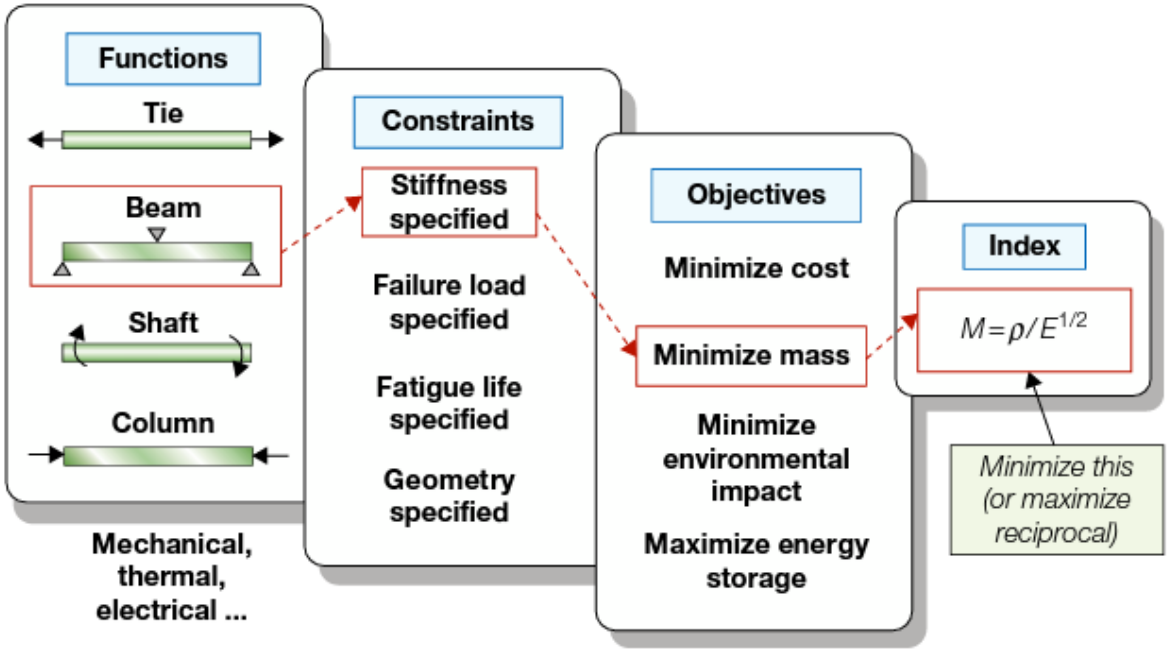


Materials charts



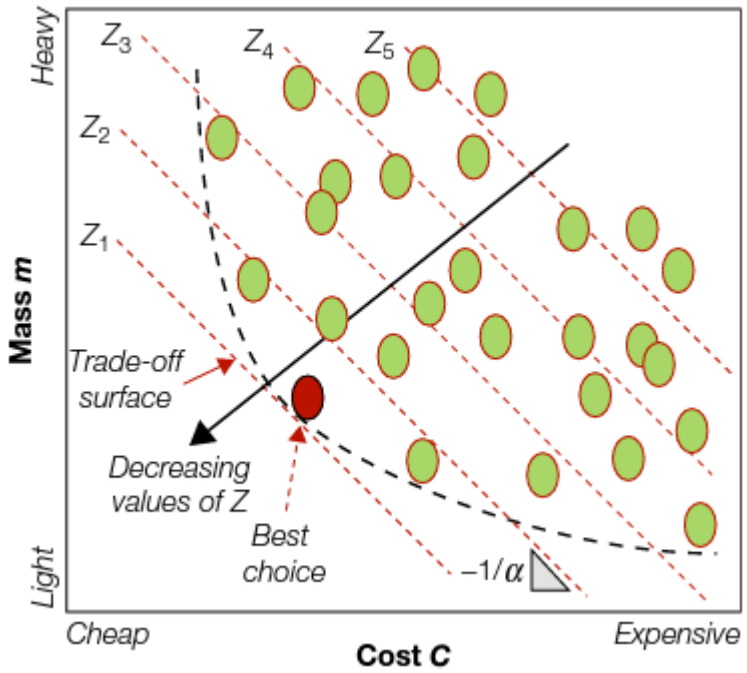
Steps in materials selection

- Information
  - Function
  - Objective
  - Free variables
  - Constraints
- Translation
  - material index
- Screening
  - Excluding constraints
- Ranking
  - Optimizing constraints
- Search
  - Gathering more information for final selection

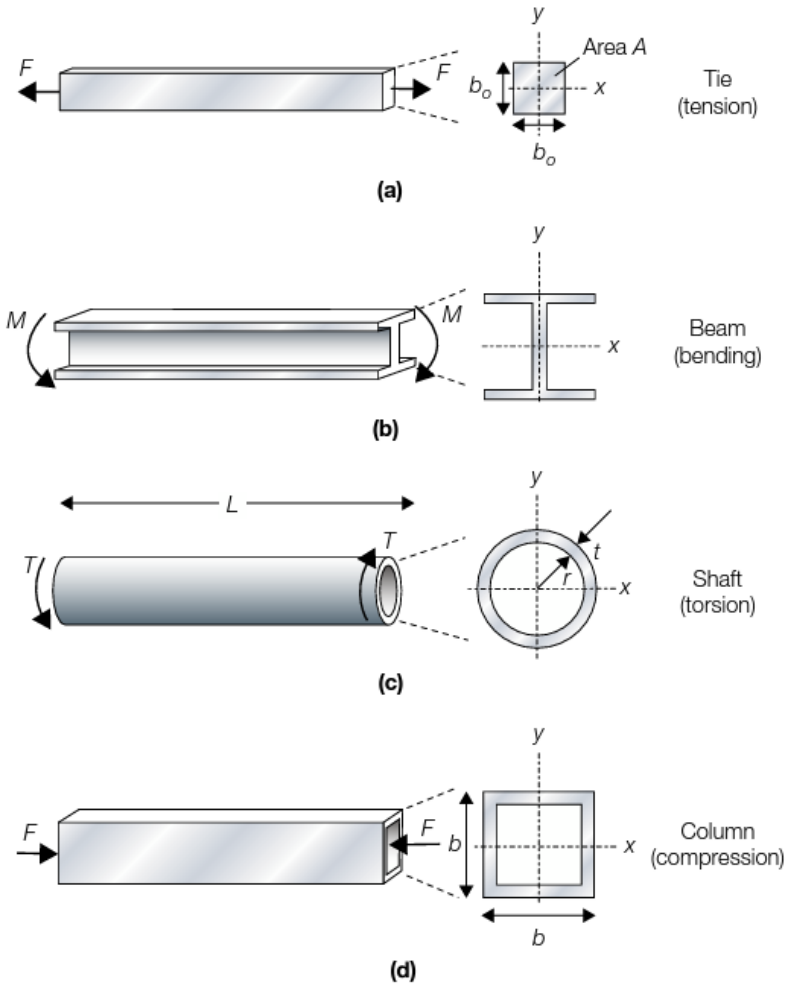


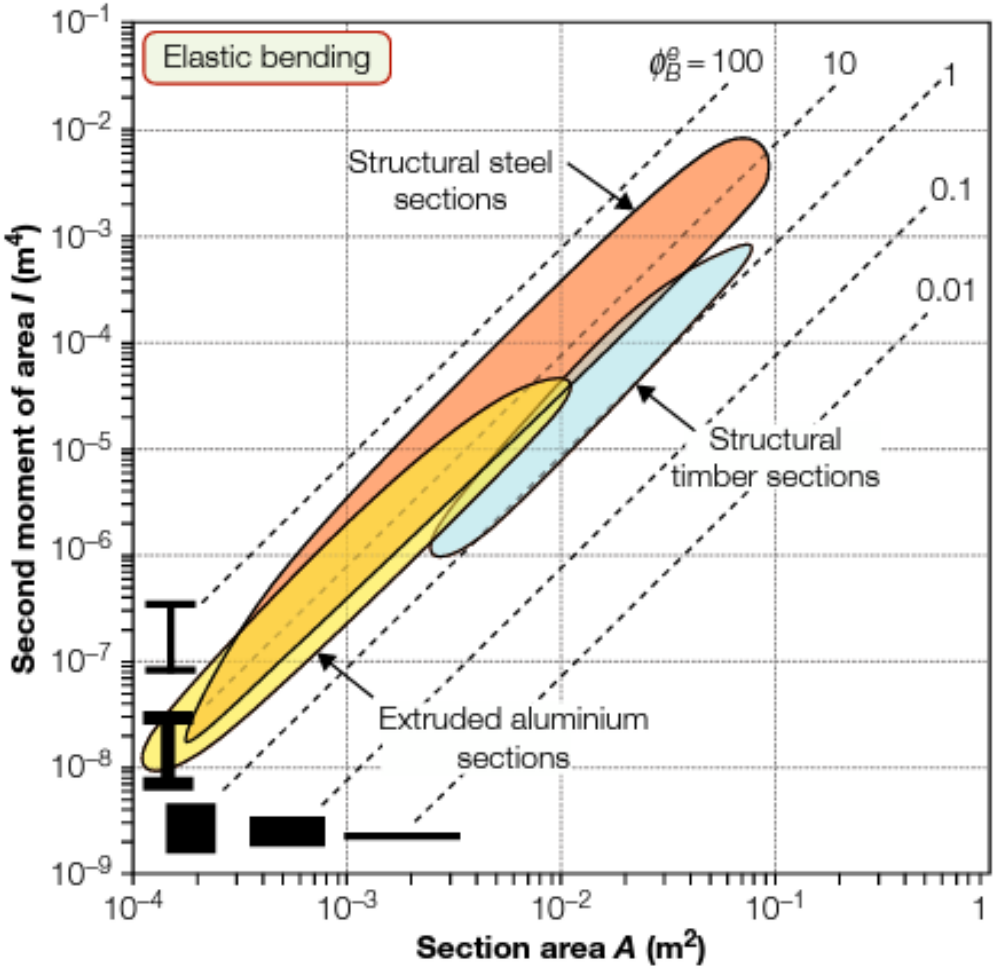
Multi-objective / multiconstraints

$$MI_{tot} = \prod_i MI_i^{\alpha}$$



Using shape





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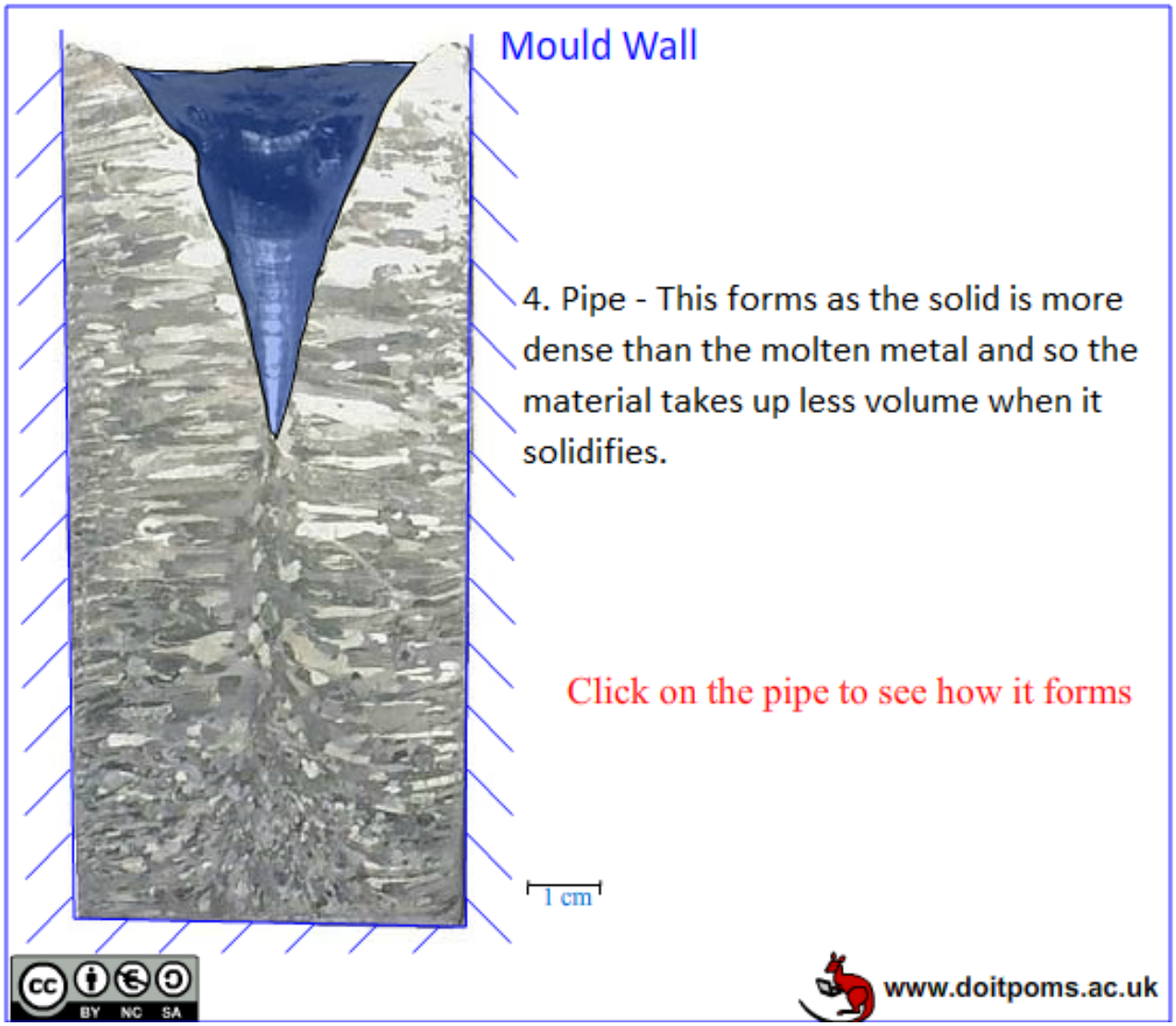
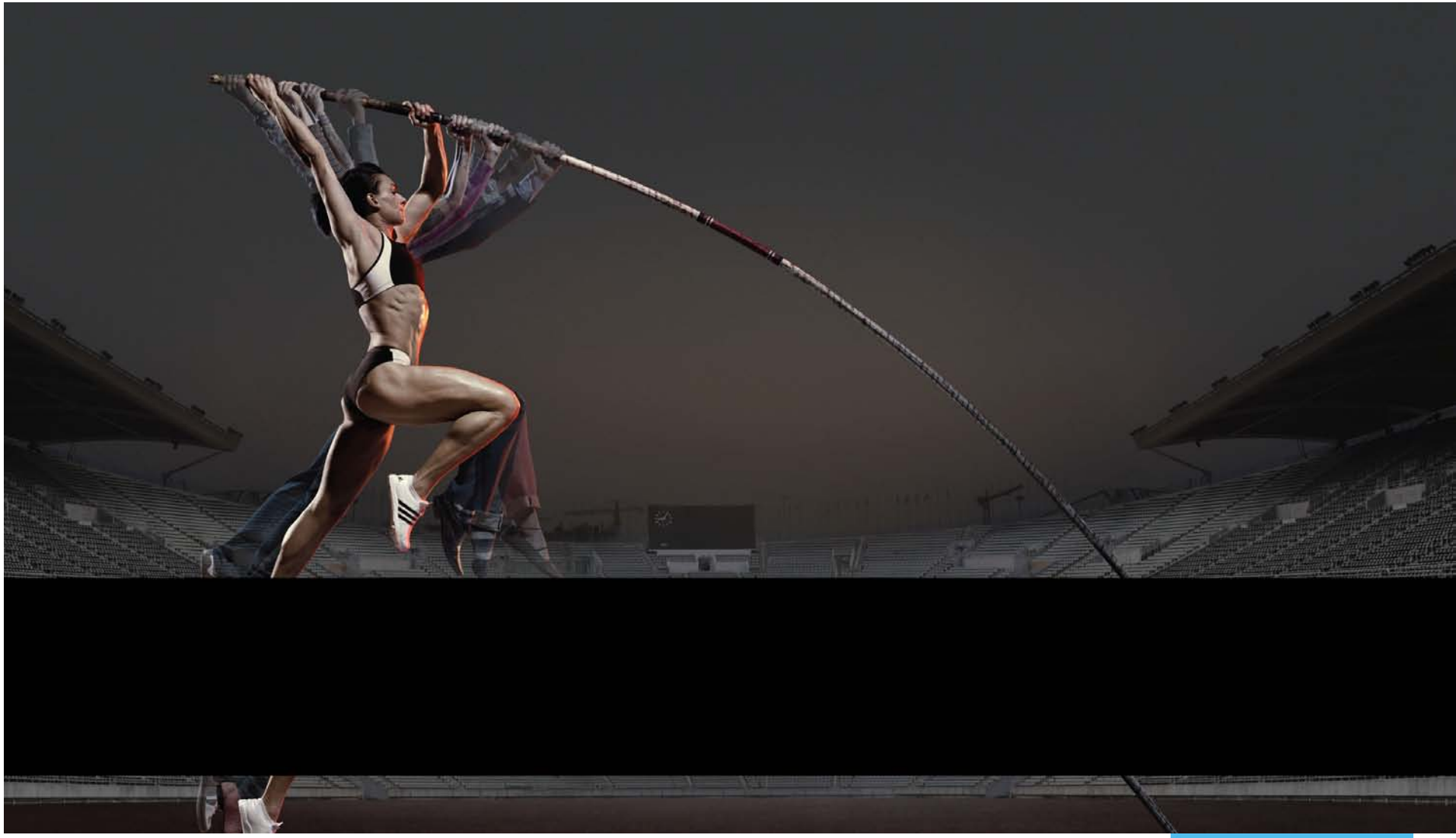
Process selection



Simple case studies



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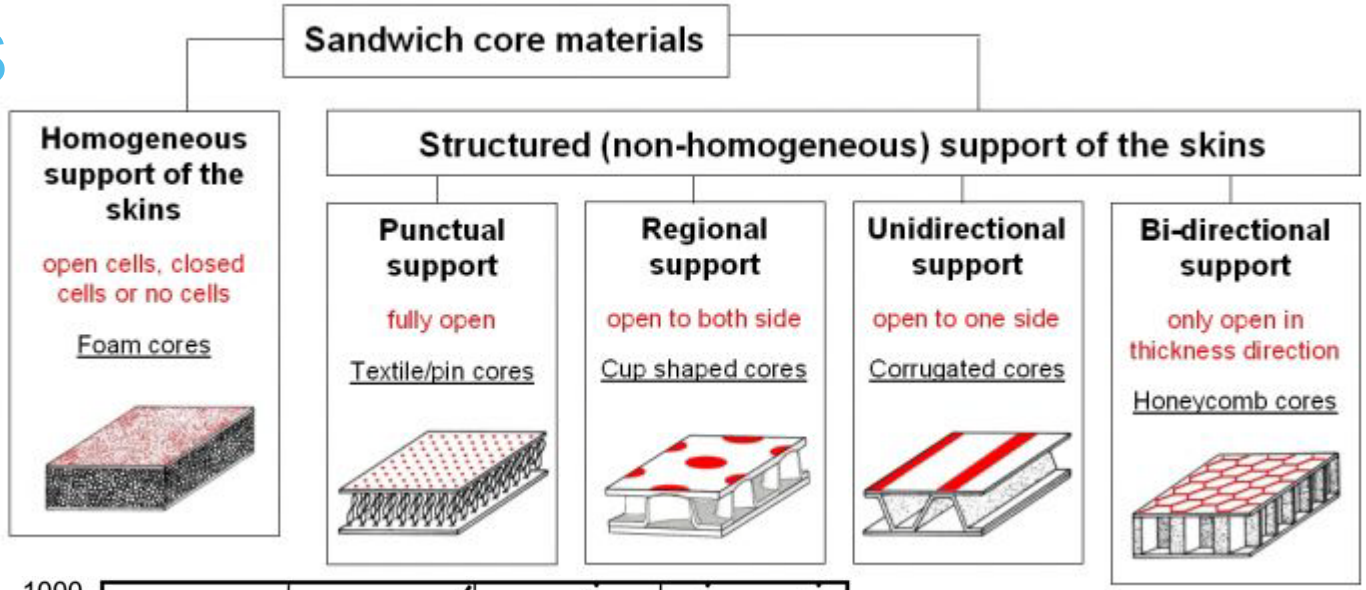
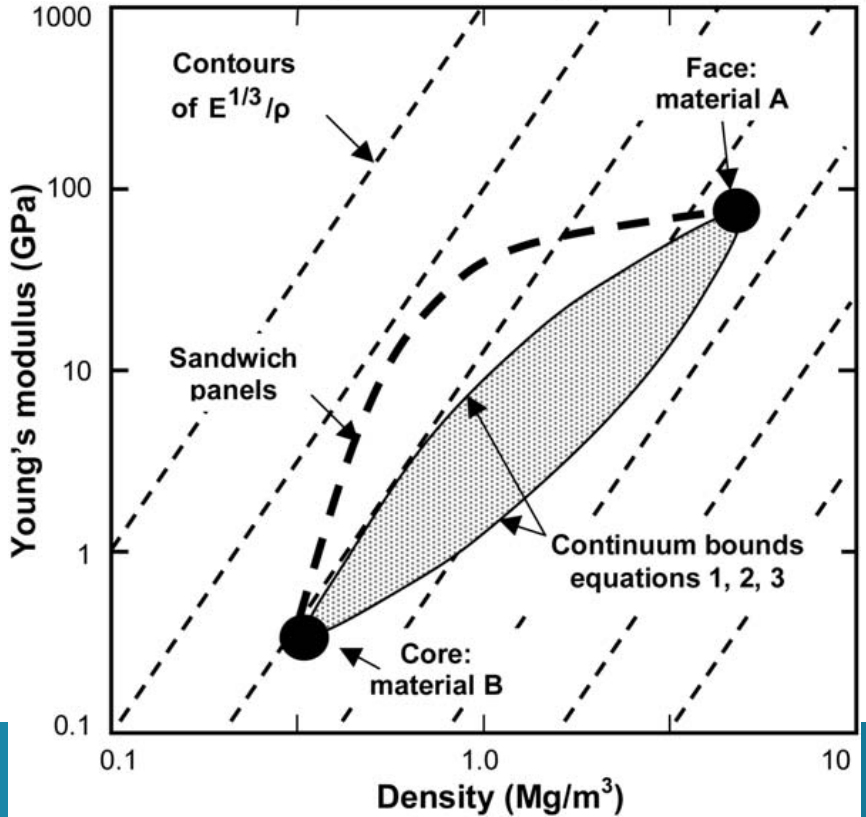
Hybrids





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LCIA

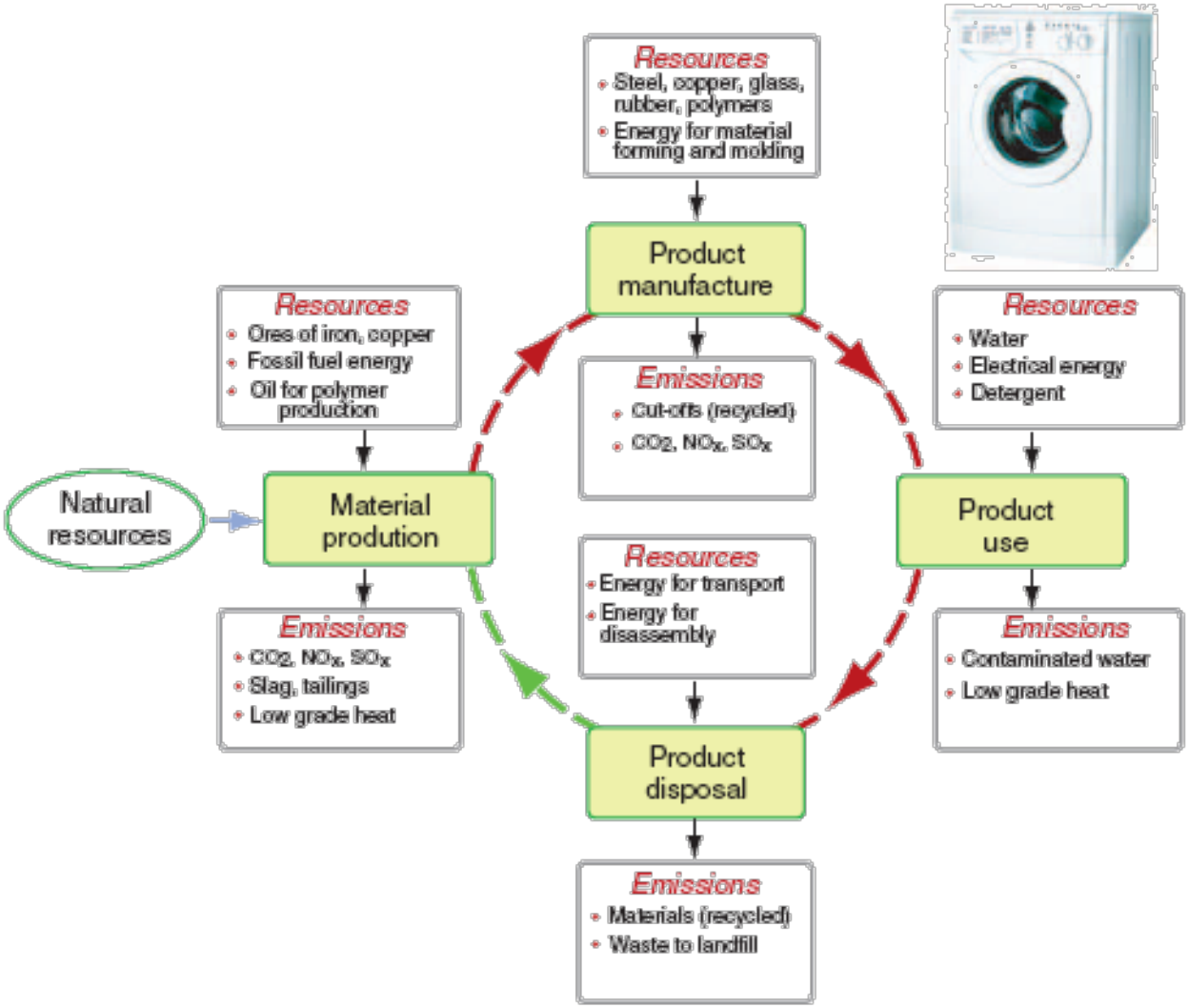

FIGURE 3.3 *The principle resource emissions associated with the life cycle of a washing machine.*

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Eco-design

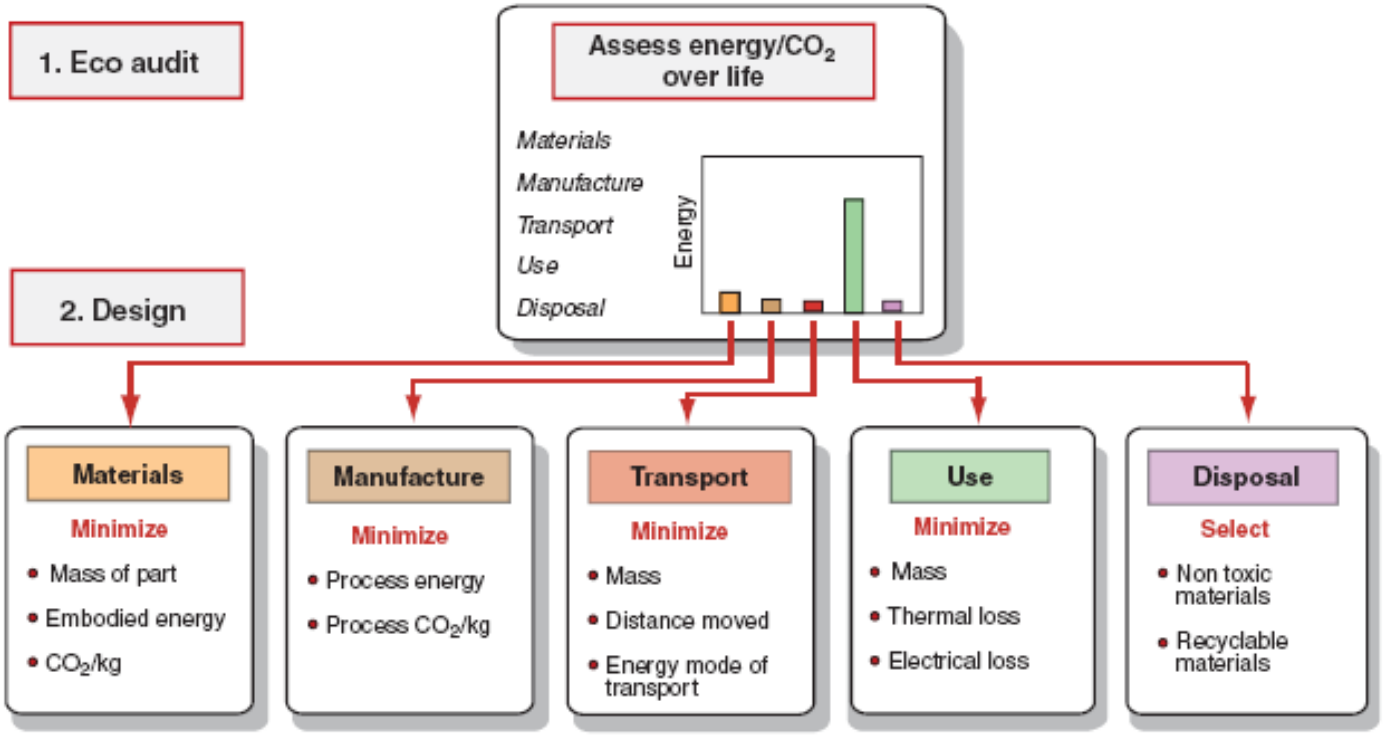

FIGURE 3.11 *Rational approaches to the ecodesign of products start with an analysis of the phase of life to be targeted. Its results guide redesign and materials selection to minimize environmental impact. The disposal phase, shown here as part of the overall strategy, is not included in the current version of the tool.*

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