European Commission

Including Resource Security of Supply in LCA: a proposal

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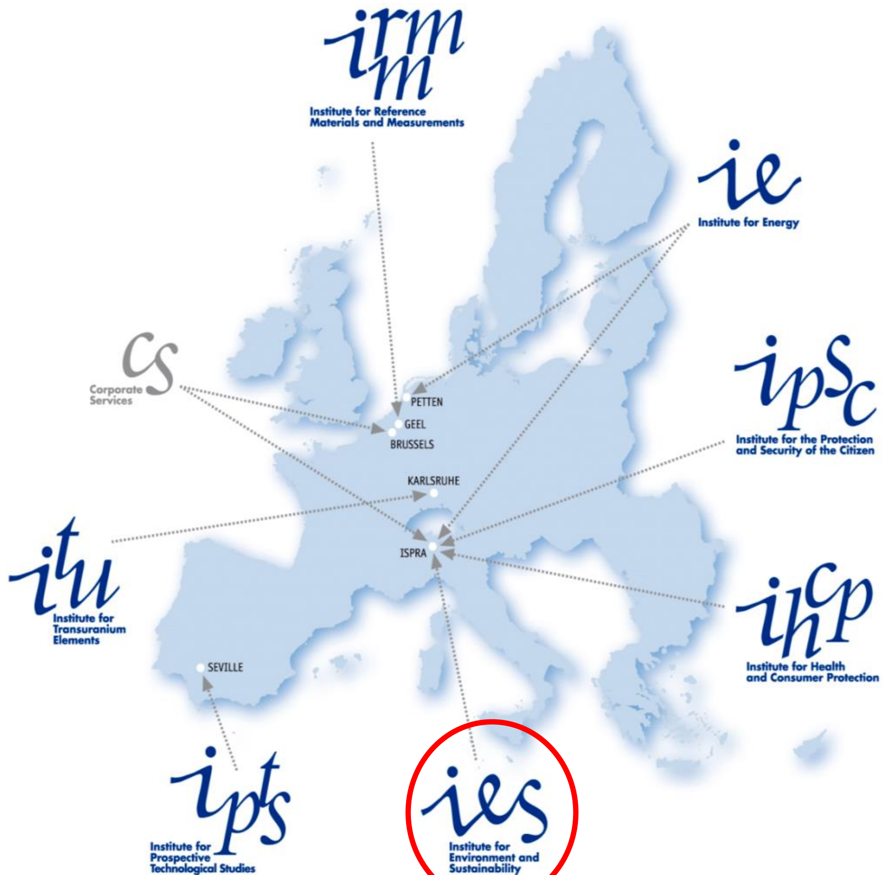
Introduction:
The JRC inside the European Commission

European Commission,

Joint Research Centre (JRC),

Institute for Environment and Sustainability (IES)

"The mission of the IES is to provide scientific-technical support to the European Union's policies for the protection and sustainable development of the European and global environment"



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The "Sustainability Assessment" Unit

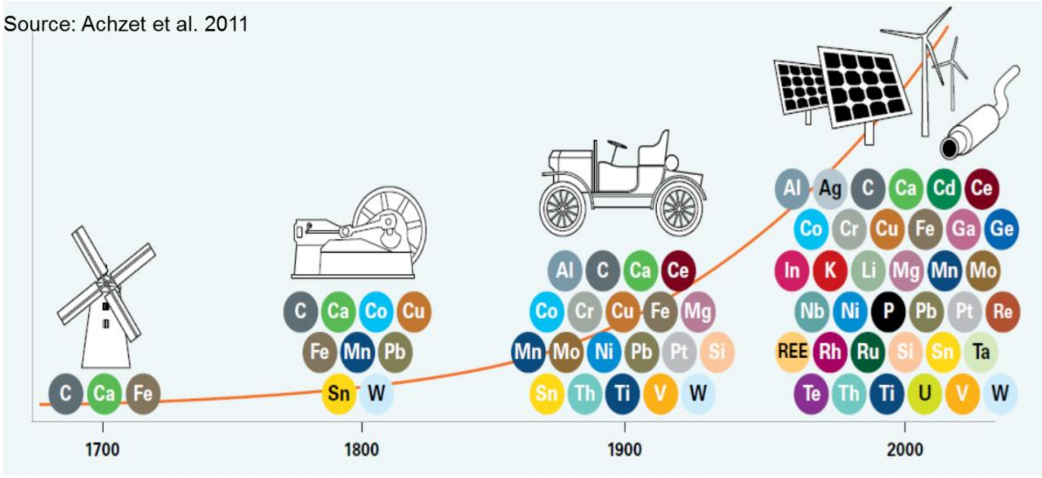
The Sustainability Assessment Unit fosters sustainability principles in EU policies by developing an integrated assessment framework towards environmental quality and socio-economic viability in the decision making process.

Two existing integrative platforms are at the core of the development:

- The Land Use Modelling Integrated Sustainability Assessment Platform (LUMP/LUISA)
- The European Platform on Life Cycle Assessment (EPLCA).

Background: raw materials resources

- Raw Materials def.: ***product of the primary production sectors relying on the transformation of natural resources through growing, harvesting, mining and/or refining*** (Dewulf et al. 2014)
- Importance of raw materials for human societies and evolution of their use
- Importance of assessing availability and access to resources within supply chain sustainability analysis



Elements widely used in energy pathways

Main challenges related to raw materials

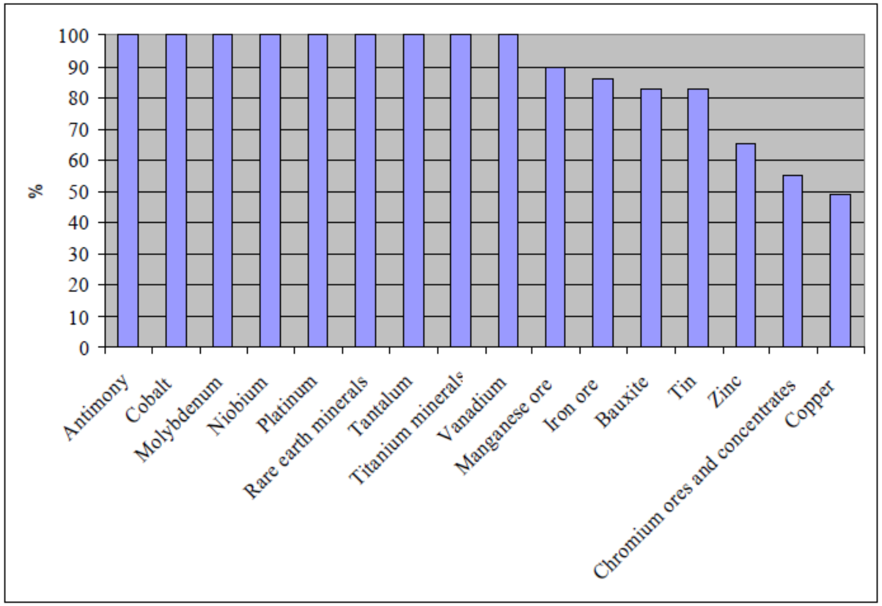
- Availability vs. Increasing demand worldwide -> **Scarcity**
- **Efficiency** in use –> recycling sector, circular economy, etc.
- **Environmental** impacts related to RM extraction and processing
- **Social** impacts along the RM supply chain and competition for the use of resources (incl. **conflict minerals**)
- Resource **security** of supply

Inclusion in supply chain sustainability assessment

Resource security of supply

Recurrent issue over history, linked to:

- Import dependence
- Access to resources
- Concentration of supply in countries with low governance and political stability
- Political use of natural resources and market distorsions and trade barriers
- Impact on economic competitiveness of EU enterprises



Metal ores and concentrates -Net import dependence of EU as % of apparent consumption

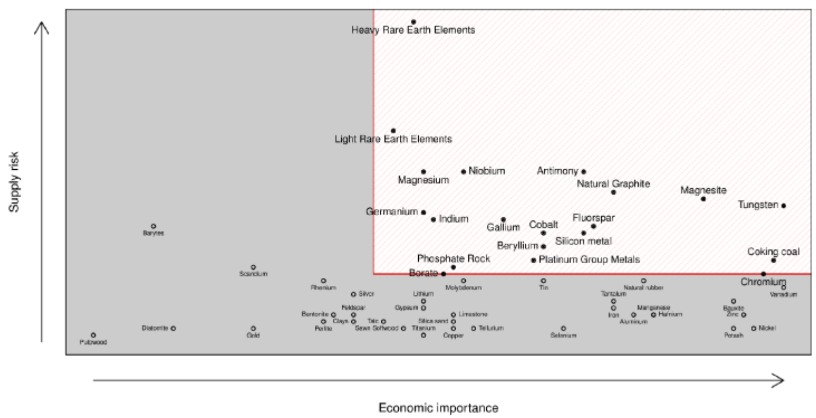
Source: SEC (2008) 2741

Critical Raw Materials for EU

- **First assessment:** 2010 – 14 CRM
- **Updated list:** 2014 – 20 CRM
- **Assessment components:**
  - **Economic importance**: added value of the economic sector using the raw material as an input;
  - **Supply risk**:
    - Level of supply concentration
    - Political and economic stability
    - Potential of substitution
    - Recycling rate

Dataset on 54 raw materials including single sub-components data

Source: http://ec.europa.eu/enterprise/policies/raw-materials/critical/index_en.htm



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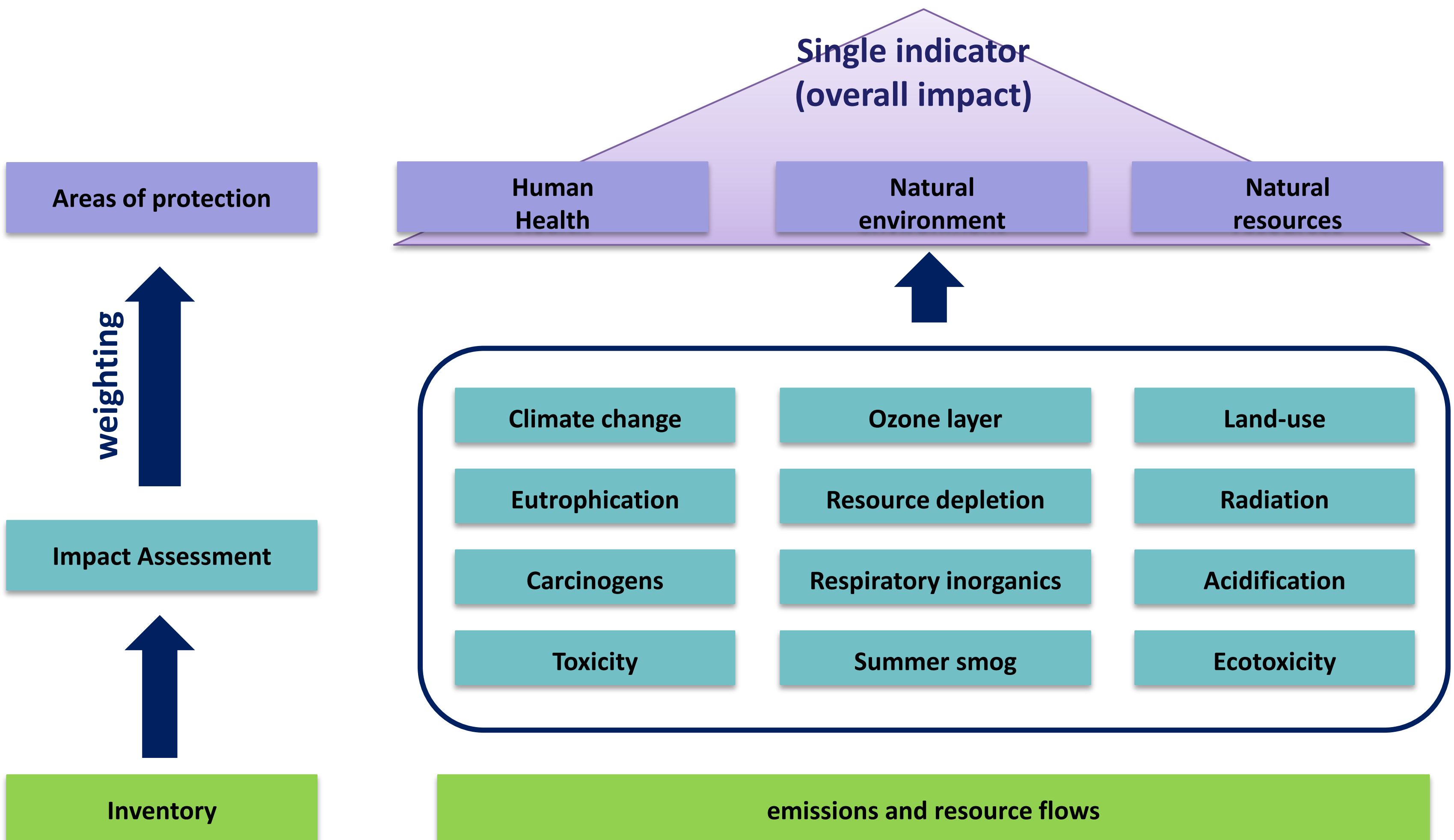
Life Cycle Assessment



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Life Cycle impact assessment of Resources

- Current focus on resource **depletion**
- **Variety of methods** (no consensus)
- **Security of supply** is overlooked
- Debate and ongoing research on better consideration of **critical minerals**

- **Scarcity/mass based: CML** (Guinee/Heijungs 1995; van Oers et al. 2002) and **EDIP** methods (Hauschild/Wenzel 1998) ILCD
- **Economic Resource Scarcity Potential (EPS):** (Schneider et al. 2014)
- **Exergy**: (Dewulf et al. 2007)
- **Surplus energy**: **Eco-Indicator 99** (Goedkoop/Spriensma 2001) and **IMPACT 2002+** (Jolliet et al. 2003)
- **Marginal cost**: **ReCiPe** methodology (Goedkoop et al. 2009)
- **Willingness-to-pay: EPS 2000** (Steen 1999)
- **Distance to target**: **EcoPoints** method (Frischknecht et al. 2008)

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Inclusion of criticality in supply chain analysis

- Use of data from criticality assessment for the impact assessment of raw materials in a «**resource security**» impact category
- Methodological hurdles: reduce subjectivity and relativeness (i.e. EU perspective), low variability of the dataset
- Choice of the aggregate indicator: *Supply risk due to low governance* (SR_{WGI})

I. indicators composing the SR_{WGI} are mainly at global level (and not at EU level)
II. no thresholds or other subjective elements are included in this indicator
III. frequent updates of the CFs could provide consistent assessments.

Implementation and calculation of CFs

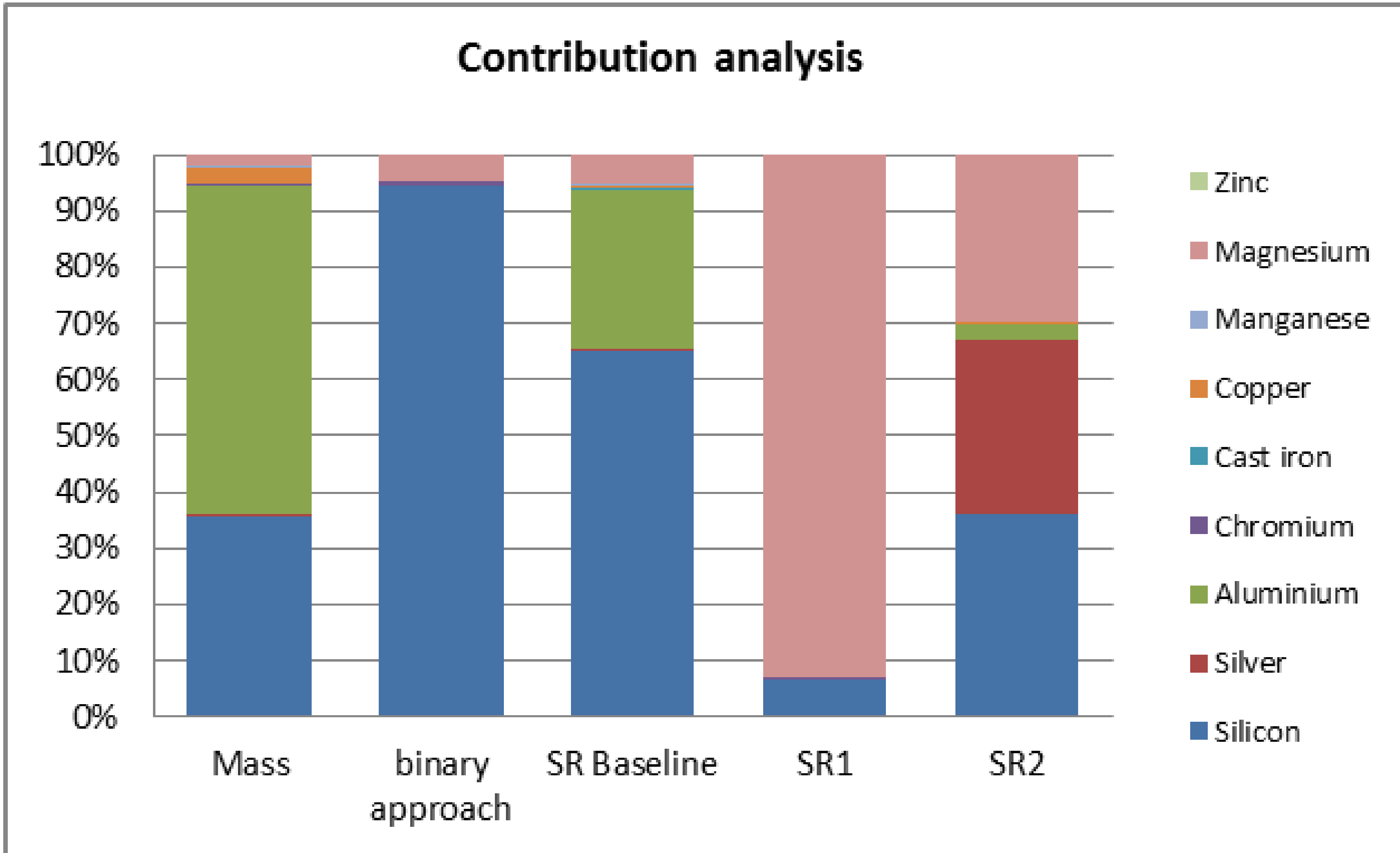
- Need to increase the **variability** of the dataset in order to represent the relative difference between materials in terms of security
- **methodological options**:
  - baseline option: SR_{WGI} values as such
  - option SR1: $(SR_{WGI})^6$
  - option SR2: SR_{WGI}/world mine production in 2011
  - option 3: apply a binary variable as CF, that assign the value 1 for the materials included in the list as critical and 0 to the non-critical ones.
- Data on mine production: US Geological Survey 2011
- Testing product: **photovoltaic (PV) panel**; including the following raw materials: *silicon, silver, aluminium, chromium, cast iron, copper, manganese, magnesium, zinc*

Results

	Input flow	*resource security impact*				*characterization factors*		
Material	mass (kg)	Baseline	SR1	SR2	binary	CF baseline	CF1	CF2
Silicon*	1.545	2.52	**28.98**	**3.15E-07**	**1.545**	1.63	1.88E+01	1.40E-11
Silver	0.009	0.01	0.23	**2.73E-07**	0	0.73	1.51E-01	8.42E+00
Aluminum	2.537	1.09	0.01	2.47E-08	0	0.43	6.32E-03	2.53E-05
Chromium	0.008	0.01	1.64	3.37E-10	0	1.01	1.06E+00	4.43E-04
Cast iron	0.011	0.01	0.02	1.91E-12	0	0.5	1.56E-02	1.66E-06
Copper	0.115	0.03	0.00	1.58E-09	0	0.22	1.13E-04	2.50E-03
Manganese	0.013	0.01	0.01	4.10E-10	0	0.43	6.32E-03	2.35E-05
Magnesium*	0.080	0.20	**405.27**	**2.60E-07**	**0.08**	2.53	2.62E+02	2.48E-06
Zinc	0.005	0.00	0.01	1.94E-10	0	0.45	8.30E-03	3.65E-03

*** CRM for EU**

Results


Contribution analysis
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Mass
binary approach
SR Baseline
SR1
SR2
Zinc
Magnesium
Manganese
Copper
Cast iron
Chromium
Aluminium
Silver
Silicon

Conclusions

- Sustainability assessment of resources involves the consideration of **economic, social and environmental issues**
- LCA is well positioned to include resource **criticality** considerations; essentially a socio-economic indicator, because raw material flows are already accounted in LC inventories
- Scores resulting from criticality analysis can be applied in **the impact assessment**
- More implementation examples are needed to make a **choice** on the best methodological option (not empirically verifiable)
- Contribution to the discussion on the **inclusion of criticality in LCA** and on the role of LCA vs. SLCA

THANK YOU!

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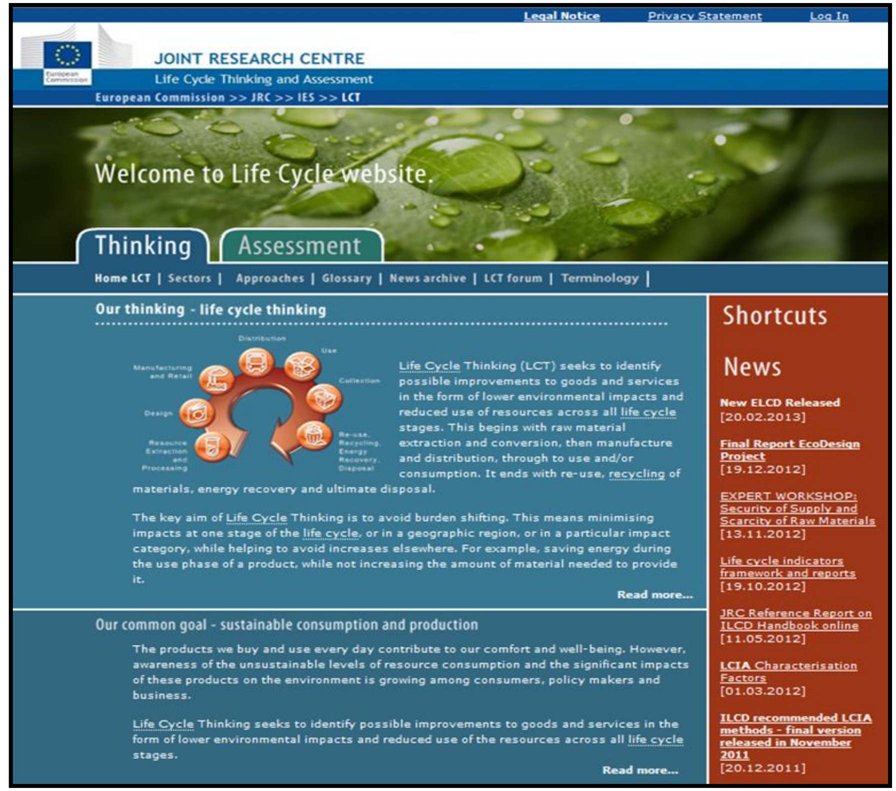

EPLCA website:
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