ALLOCATIONS AND END OF LIFE MANAGEMENT IN LCA: HOW TO DECIDE?

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INNOVATION GATEWAY

IRT M2P Research project « ACV-Recyclage »:

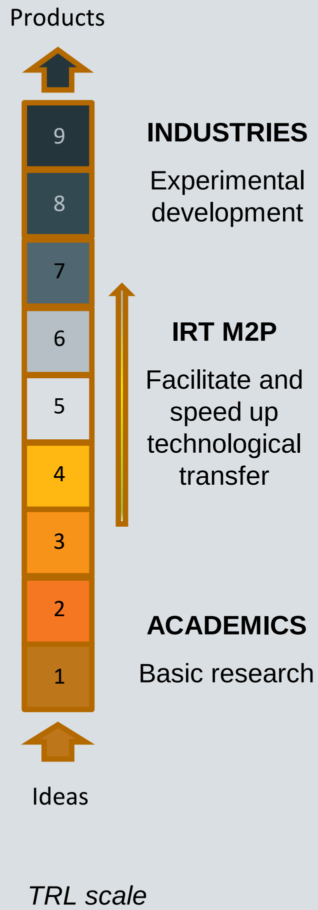
IRT M2P

M2P : Materials – Metallurgy and Processes

Metals, alloys, composites and multi-materials

- Accelerating innovation and growth for industrial companies
- Developing key technologies, shared amongst major industrial sectors
- Providing technological platforms to industries

IRT M2P
Innovation gateway



1. Context – Recycling in LCA

A recyclable product has 2 functions:

- Its own primary function
- Material resources for future products

→ Need for allocations to distribute the benefits (& burdens) of the recycling between 2 life cycles

BUT

Many methods and allocation rules exist, defined in the past 20 years

- End of Life (EoL) approach → Benefits recyclable products
- Recycled Content (RC) approach → Benefits products made ouf of recycled material
- 50/50 approach → Compromise between EOL & RC approaches

→ Leading to different results…

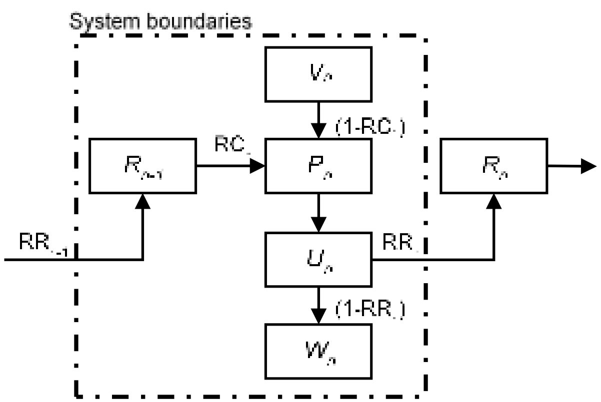
→ … & without uniformity and consensus (PEF methodology, EN 15804, etc.)

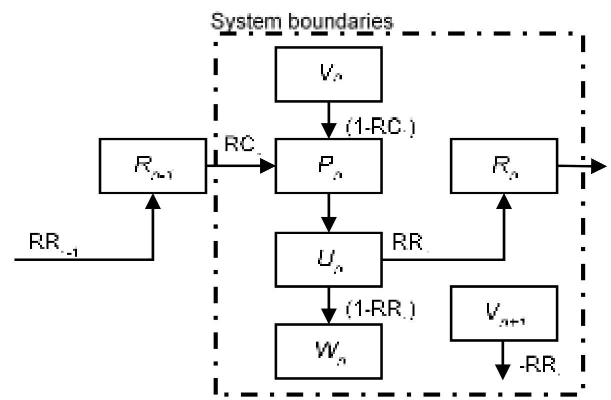
Which approach should be used?

2. State of the art

Review and translation into mathematical formulas of 9 approaches available in the literature

« Recycled Content » approach	« End of Life » approach
$C_{RC,n} = P_n + U_n + V_n(1 - RC_n) + R_{n-1}RC_n + W_n(1 - RR_n)$	$C_{EoL,n} = P_n + U_n + V_n - V_{n+1}RR_n + R_nRR_n + W_n(1 - RR_n)$ if $V_n = V_{n+1}$: $C_{EoL,n} = P_n + U_n + V_n(1 - RR_n) + R_nRR_n + W_n(1 - RR_n)$





3. Sensitivity analyses

Standard sensitivity analyses of these formulas

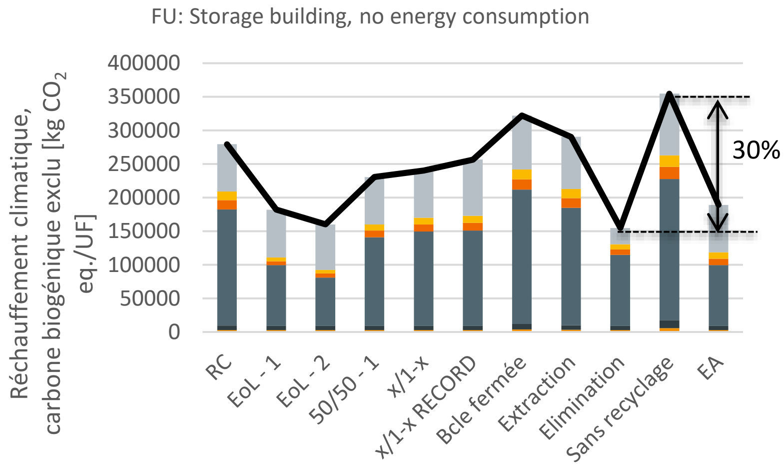
Application on multi-material case studies

Existing methods:

- RC
- EOL
- Net scrap
- 50/50
- x/1-x
- Closed loop
- Loss of quality
- Extraction load
- Disposal load
- PEF (Product Environmental Footprint)
- …

Sensitivity analysis:

- Materials, substitution rate
- Recycled Content (RC)
- Recycling Rate (RR)
- Nb of cycles
- Qulaity loss (Q)
  - Definition
  - Quantification



Main conclusions:

- Approach choice influences:
  - Environmental performances of product
  - Material choice at design phase
- Some parameters are hard to define (+ subjectivity)
- Each material and sector has its own technical specificities

4. Methodology

How can we choose? Why should we choose?

→ To improve current state

Imposing allocation approach = promotion of recycling & production practices

→ Apply existing approaches ("RC", "EoL" and "50/50") by material, considering the sector, using multiple criteria, on the basis of reliable data

Materials	Sectors	Scores according to criteria						
		Market	Technological	Temporal	Regulation	Environmental	Logistic	**Average**
Metals	Packaging							
	EEE							
	Automotive							
	Mech. engin.							
	Other transp.							
	Building							
Plastics	Packaging							
	EEE							
	Automotive							
	Mech. engin.							
	Other transp.							
	Building							

5. Criteria definition and calculation

Criteria	Answers	Grades	Approach	Wght. coef.
Market *Are there enough secondary materials to meet the demand?*	< 1	5	EoL	~20%
	1 ≤ x ≤ 1.1	2.5	50/50	
	> 1.1	0	RC	
Technological *Based on the material recyclability by the current technologies*	Non existing, non-developed	0	RC	~20%
	Under development	1	RC	
	At laboratory scale	2	50/50	
	Existing but not practiced	3	50/50	
	Leading to downcycling	4	EoL	
	At industrial scale	5	EoL	
Temporal *Related to the product lifespan*	Packaging (0 – 5 years)	5	EoL	~6% (vague)
	EEE (5 – 10 years)	5	EoL	
	Automotive (10 – 15 years)	5	EoL	
	Mech. engin. (15 – 20 years)	2.5	50/50	
	Other transp. (20 – 30 years)	2.5	50/50	
	Building (+30 years)	2.5	50/50	

6. Results

Materials	Sectors	Scores according to criteria						
		Market	Tech.	Temp.	Reg.	Envir.	Log.	**Average**
Metals	Packaging	5	5	5	0	5	5	4.1
	EEE		5	5	0	5	5	4.1
	Automotive		5	5	0	5	5	4.1
	Mech. engin.		5	2.5	2.5	5	5	4.4
	Other transp.		5	2.5	2.5	5	5	4.4
	Building		5	2.5	0	5	5	3.9
Plastics	Packaging	5	5	5	0	5	5	4.1
	EEE		5	5	0	5	5	4.1
	Automotive		1	5	0	5	5	3.3
	Mech. engin.		0	2.5	2.5	5	0	2.5
	Other transp.		2	2.5	2.5	5	5	3.8
	Building		0	2.5	0	5	5	3.0

Legend:

EoL (> 3.5)
50/50
RC (< 1.5)

→ Feasibility checked and first results

7. Discussions & conclusions

Allocations and End of Life Management: How to decide?

Our suggestion: apply existing approaches (“RC”, “EoL” or “50/50”)

→ By material and by sector,

→ On the basis of six criteria,

→ Using quantified and reliable data

No wish to change what was undertaken before!

→ Close to the Circular Footprint Formula

→ Good addition to define the A factor of the CFF (based on market criterion)

Our goal: provide clues for discussions on future evolutions

Perspectives:

- Publication in process and calculation sheet should be made available
- Further studies to define the relevance of chosen criteria