ECODESIGN ON FATIGUE4LIGHT

LCA Strategy

Fatigue modelling and fast testing methodologies to optimise part design and to boost lightweight materials deployment in chassis parts

PRESENTER: VIOLETA VARGAS
EMAIL: violeta.vargas@eurecat.org
DATE: Feb 9th, 2023

INDEX

Fatigue4Light

Fatigue modelling and fast testing methodologies to optimize part design and to boost lightweight materials deployment in chassis parts

Objectives

- 24-30% weight reduction
- 12-15% weight savings from structural vehicle weight, and also increase EV safety due to reduced sprung mass.
- Materials solutions with high fatigue performance (AHSS, stainless steel, Al alloys and hybrid metal-FRP materials),
- Development of new computer modelling with high fatigue prediction accuracy
- New experimental methodologies that reduce the testing time for new materials.
- Enhanced affordability and sustainability based on eco-design approach supported by LCA and LCC

Design for Circularity

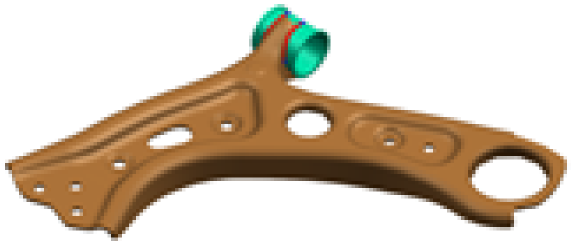
Life Cycle Assessment

Life Cycle Costing

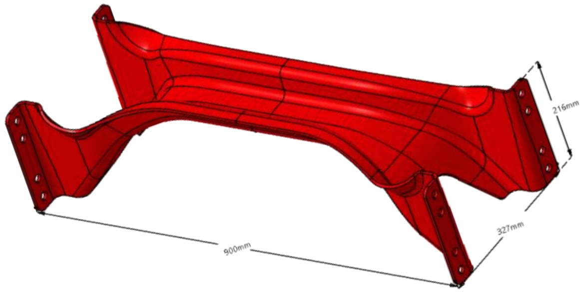
Study cases

Demonstrators

Lower Control Arm

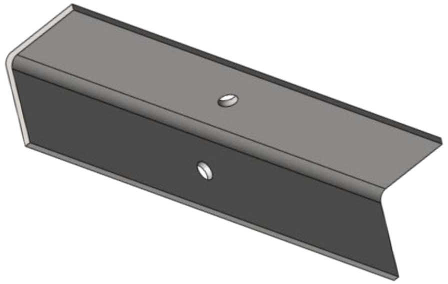


Cross beam member



Wheel

Lab scale demonstrator



Ecodesign methodology applied to EV lightweighting

Four main steps (left: Deming Cycle PDSA; right: F4L Eco-design Cycle)

STEP 1: Identification of Hotspots and Life Cycle Stages

STEP 2: Establishment of the most properly eco-design strategies based on STEP 1

STEP 3: Re-adaption of technological procedures to the selected strategies

STEP 4: Definition of concrete eco-design actions

FATIGUE 4LIGHT

ECODESIGN: A methodological framework development - Step 1

STEP 1: Identification of Hotspots and Life Cycle Stages

STEP 2: Establishment of the most properly eco-design strategies based on STEP 1

STEP 3: Re-adaption of technological procedures to the selected strategies

STEP 4: Definition of concrete eco-design actions

- Based on a benchmark analysis for conventional products/stages/materials…
- With the application of the LCA/LCC in a simplified manner at the beginning of the project/action/task

Hotspots have been identified and correlated with life cycle stages

ECODESIGN: A methodological framework development - Step 2

STEP 1: Identification of Hotspots and Life Cycle Stages

STEP 2: Establishment of the most properly eco-design strategies based on STEP 1

STEP 3: Re-adaption of technological procedures to the selected strategies

STEP 4: Definition of concrete eco-design actions

- Focused mainly on lightweighting
- Others aligned with project objectives and coupled to technical actions:
  - Design for maintainability
  - Lifetime extension
  - Use of CRM’s substitutes
  - Considering second-market resources

A repository of strategies in “datasheet format” for electric automotive sector has been compiled

FATIGUE 4LIGHT

ECODESIGN: A methodological framework development - Step 3

STEP 1: Identification of Hotspots and Life Cycle Stages

STEP 2: Establishment of the most properly eco-design strategies based on STEP 1

STEP 3: Re-adaption of technological procedures to the selected strategies

STEP 4: Definition of concrete eco-design actions

- To procure adapt the technical perspective to the environmental sphere *(and vice versa)*
- Direct contact with technical experts

Manage a webinar/workshop where all parties involved begin to be familiarized with eco-design concepts

ECODESIGN: A methodological framework development - Step 4

STEP 1: Identification of Hotspots and Life Cycle Stages

STEP 2: Establishment of the most properly eco-design strategies based on STEP 1

STEP 3: Re-adaption of technological procedures to the selected strategies

STEP 4: Definition of concrete eco-design actions

- *From the strategy to action,* in other words: define clearly what technical specific activities are proposed and “translate it” into environmental sphere
- Evaluation through a score matrix

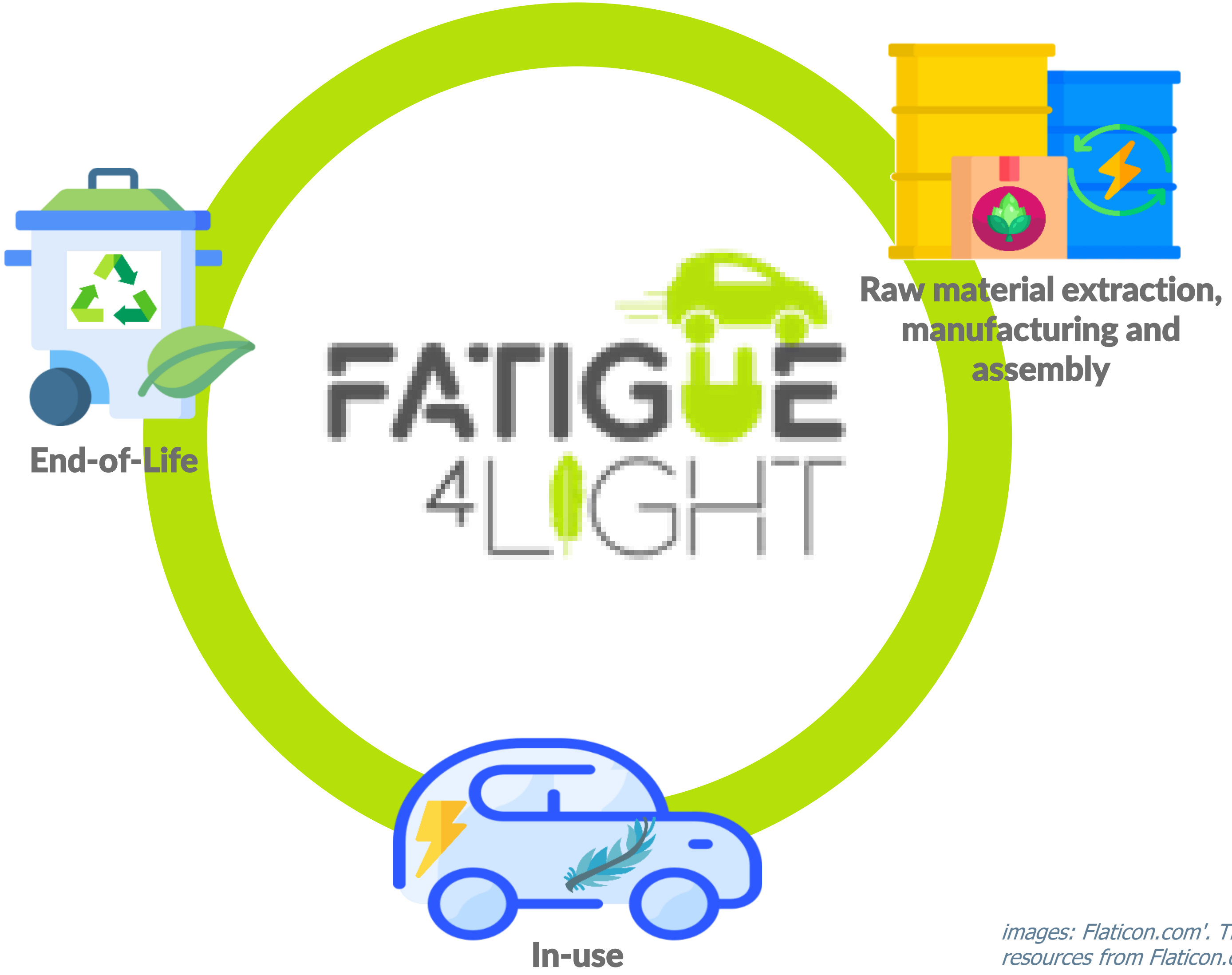
Define the matrix based on both technical and sustainability expertise and rank actions (AHP) at webinar

FATIGUE 4 LIGHT

ECODESIGN: A methodological framework development - Results

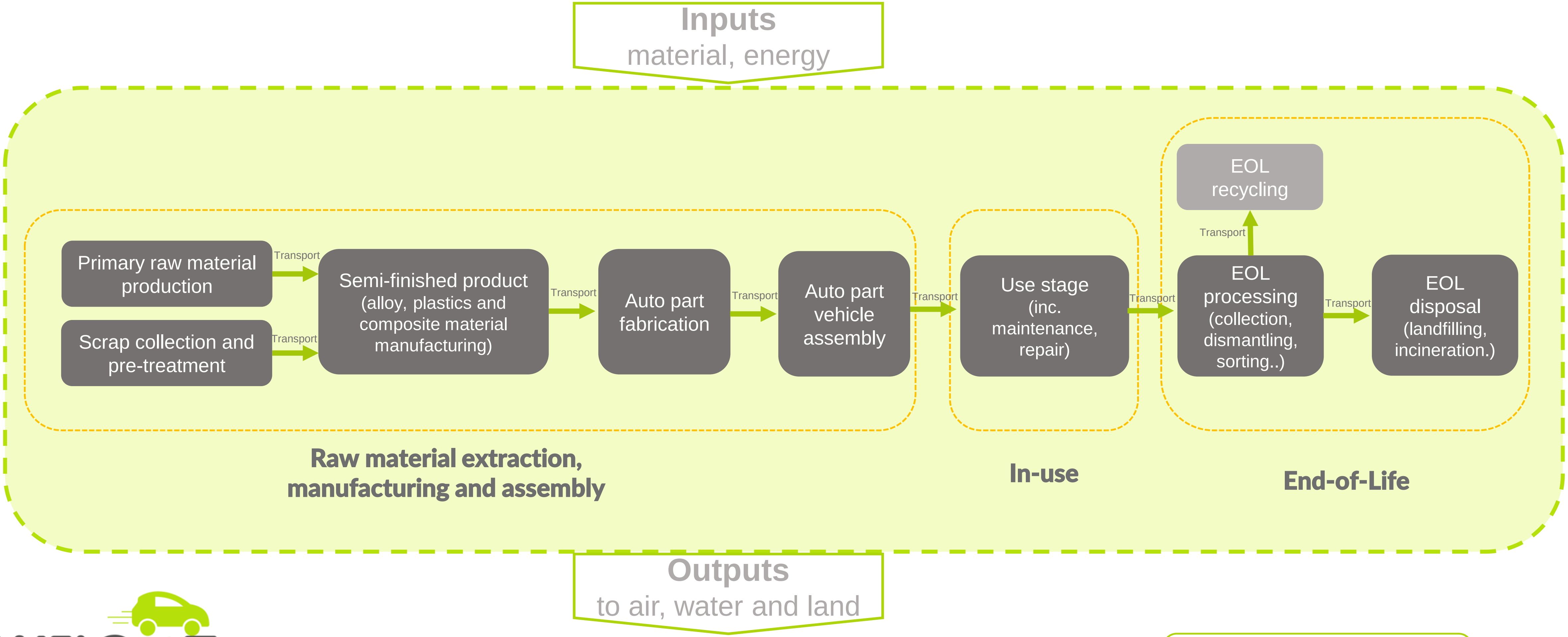
Strategy	Strategy score	Actions		Action score	Final score
A beneficial material selection	0,155	Use of recycled and recyclable materials for the different demonstrators	5	0,021	0,003
		Reduction of Critical Raw Materials from alloys	6	0,019	0,003
Considering the origin of the materials	0,055	Adopt a lifecycle perspective to obtain longer term choices and improve the entire EV environmental impact	4	0,096	0,005
Design for lightweight	0,177	Use of lightweight materials to reduce whole EV weight, e.g. HSS steel to reduce chassis weight	2	0,047	0,008
		Introduce optimal design for lightweight, e.g. consider the type of vehicle and its use pattern to design optimized parts of the EV	1	0,049	0,009
Numerical strategies	0,119	Use numerical modelling to optimize part design. E.g. topology optimization	7	0,014	0,002
Design for maintainability	0,110	Introduce optimal design for life extension, e.g. material coating for prolonged life and improved maintainability, Increase of fatigue properties of welded assemblies…	3	0,060	0,007
Design for End-of-Life (reuse and recycling)	0,110	Adopt a "design for recycling” approach by using easy recoverable and recyclable materials e.g. one family of aluminium alloy	8	0,022	0,002
Value Return	0,122	Adopt a "design for disassembly" approach by including the use joining elements that can easily be removed	9	0,029	0,001
Unity	0,152				

Scope



images: Flaticon.com'. These covers has been designed using resources from Flaticon.com

Functional Unit and System boundaries



Functional Unit
1 km

LCI Data Collection

Raw material extraction, manufacturing and assembly

Inventory for 1 part processed

Weight per unit	

Short process step description (images encouraged)

Process time (minutes)	

Inputs	Quantity	Unit	Cost	Cost unit	Supplier	Supplier city/country origin	Transport 1	Transport 2	Comment
Raw material 1		kg							
Raw material 2									
Raw material 3									
Raw material 4 (consumables)									
Natural gas		m3							
Fuel									

Water		m3			
Electricity		kWh			

Inputs	Quantity	Unit	Cost	Cost
Labour time		min		

Inputs	Energy consumpti	Unit	Technical Life	Investment cost	Annual maintenance cost	Cost unit
Equipment/Machine 1		kWh				
Equipment/Machine 2		kWh				
Equipment/Machine 3		kWh				

Outputs	Quantity	Unit	Waste management		Comment
Waste *(connect to material in*		kg/%			
Wastewater		m3			
Other					

LCI Data Collection

Use stage

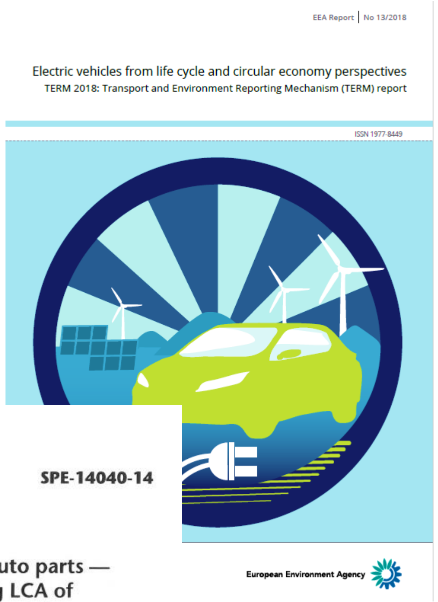
Based on literature

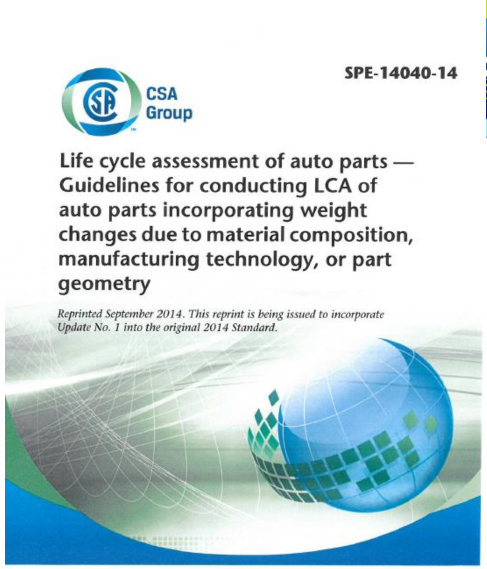
- Use stage model – energy consumption 15-21 kWh/100 km
- Lifetime driving distance
  - 250,000 km
  - 180,000 km (EV)

EoL stage

Based on literature

- Recycling %
- Landfill %
- Energy recovery %





ECODESIGN ON FATIGUE4LIGHT

LCA Strategy

Fatigue modelling and fast testing methodologies to optimise part design and to boost lightweight materials deployment in chassis parts

PRESENTER: VIOLETA VARGAS
EMAIL: violeta.vargas@eurecat.org
DATE: Feb 9th, 2023