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Environmental assessment of light weighting solutions for automotive components: results, trade-off and challenges from real case studies

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ALMA MATER STUDIORUM
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ECI Conference: Life Cycle Assessment and other Assessment Tools for Waste Management and Resource Optimization

Summary

- Magneti Marelli SpA: Business line & Products
- Magneti Marelli Commitment for a Sustainability Development
- Magneti Marelli Products Portion of Incidence on a Vehicle
- Automotive Sector: Improvement Drivers From Environmental Perspective
- LCA: A Product-Oriented Method for Sustainability Analysis
- LCA Development Projects and Lightweigh Drivers
- LCA Projects: Alternative Technology for Product Manufacturing
- LCA Projects: Alternative Raw Materials
- LCA Projects: Alternative Technology and Raw Materials
- Vehicle End of Life Process Flowchart: ISO 22628:2002
- Results and Consideration

Magneti Marelli SpA: Business Line & Products

Magneti Marelli is an international Group committed to the **design and production of hi-tech systems and components for the automotive sector**.

AUTOMOTIVE LIGHTING

POWERTRAIN

ELECTRONIC SYSTEMS

SUSPENSION SYSTEMS

Exhaust Systems

PLASTIC COMPONENTS AND MODULES

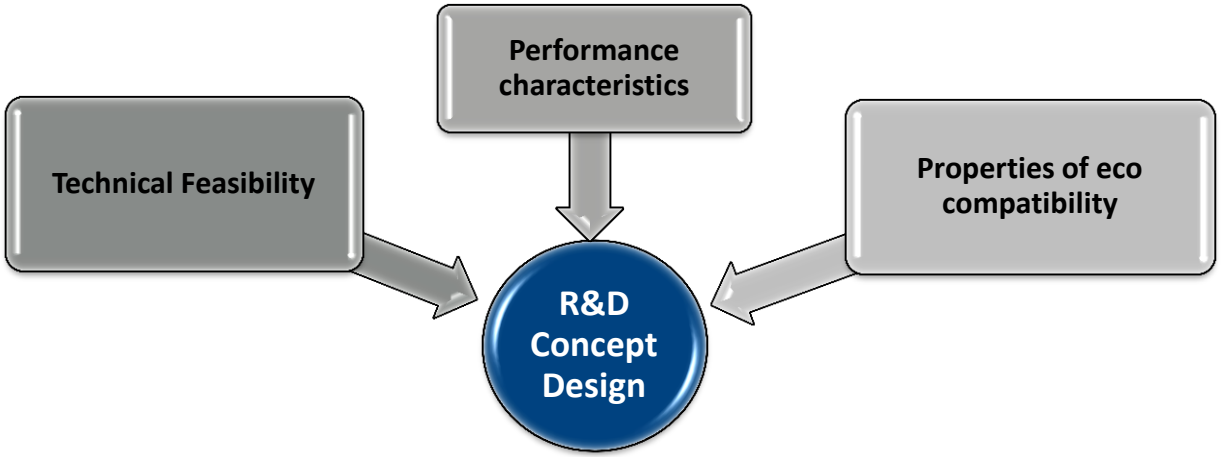
AFTERMARKET PARTS & SERVICES

MOTORSPORT

Magneti Marelli Commitment for a Sustainability Development

Magneti Marelli is committed to develop its product with the aim of reducing the impact caused by the effect of its products on the environment

Towards a Green Automotive Industry



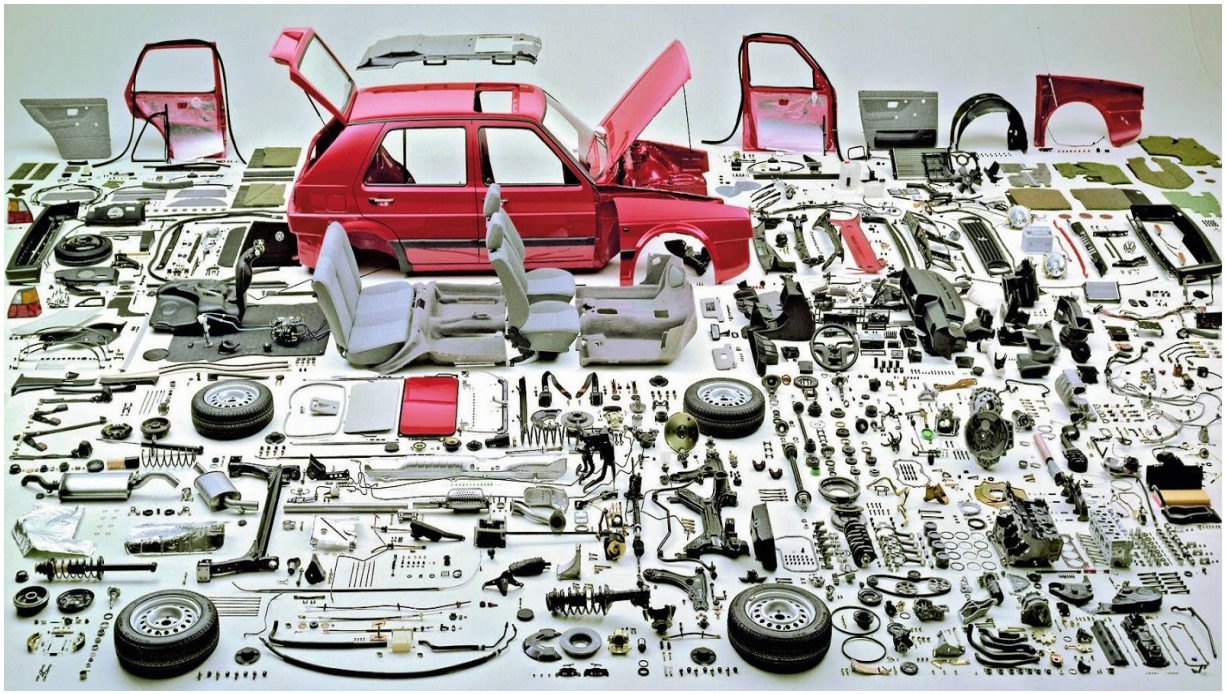
Magneti Marelli Products Portion of Incidence on a Vehicle

PLASTIC COMPONENTS
35 Kg

AUTOMOTIVE LIGHTING
10 – 12 Kg

MECHANICAL CONTROL SYSTEMS
5 Kg

POWERTRAIN
10 – 11 Kg



EXHAUST SYSTEMS
20 Kg

SHOCK ABSORBERS
20 Kg

SUSPENSION SYSTEMS
60 Kg

If all the components of a midsize vehicle were produced by Magneti Marelli, therefor the total contribution would be **170 kg weight**

15% on the total weight

Automotive Sector: Improvement Drivers from Environmental Perspective

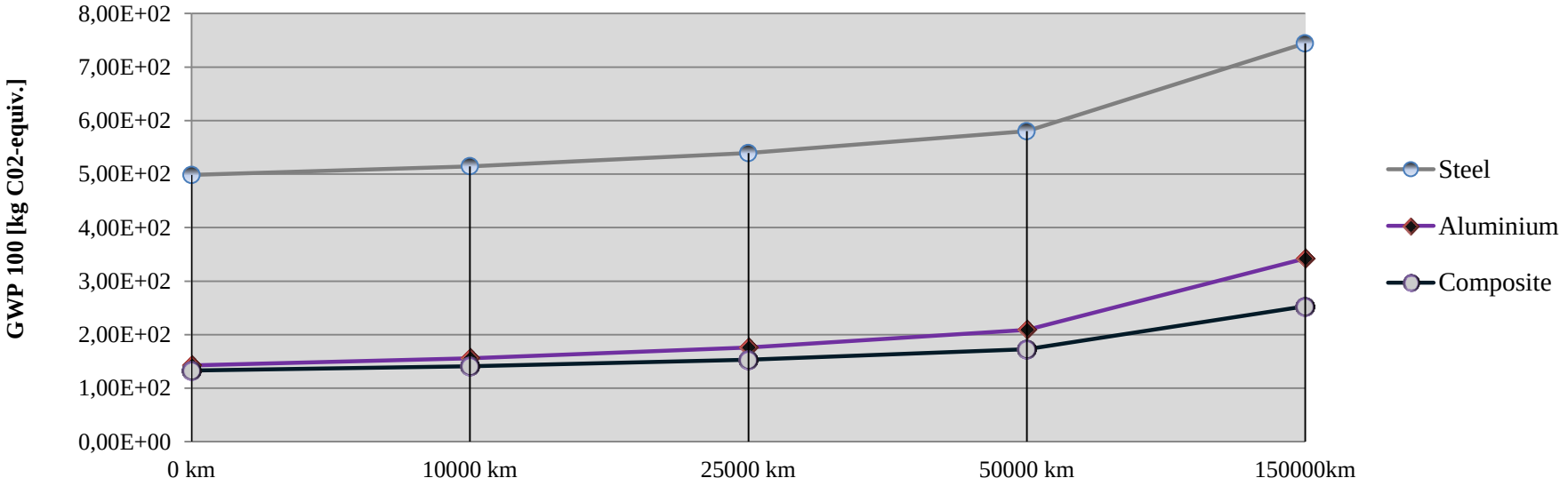
Reduction of exploitation of fuel consumptions

LIGHTWEIGHTING

Reduction of Green Greenhouse Gas Emissions (GHG)

Case study highlight on a bulk component : crossmember

	Weight reduction	GWP_{100} reduction over lifetime of 150000 km	Fuel Consumption over lifetime of 150000 km (kg)
Aluminium	~- 18%	~- 19%	~-19%
Plastic Composite	~- 51%	~- 51%	~-51%



LCA: A Product-Oriented Method for Sustainability Analysis

LCA System Boundaries:
«Cradle to Grave» approach

LCA Impact categories: *CML 2001 – April '15*

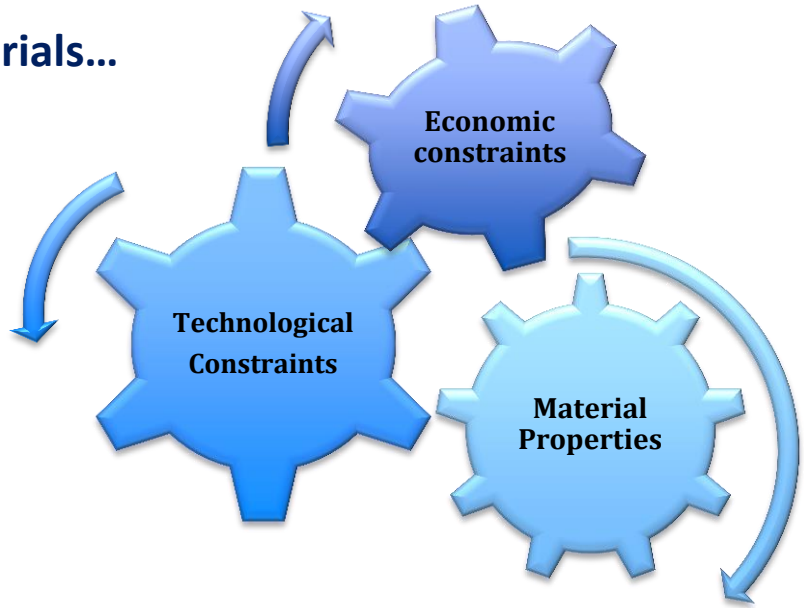
INPUT:		**OUTPUT:**	
Abiotic Depletion Elements (ADP elements)	*[kg Sb-Equiv]*	Global Warming Potential (GWP 100 years)	*[kg CO2-Equiv.]*
Abiotic Depletion Fossils (ADP fossils)	*[MJ]*	Acidification Potential AP)	*[kg SO2-Equiv.]*
		Eutrofication Potential (EP)	*[kg Phosphate-Equiv.]*
		Ozone Depletion Potential (ODP, catalytic)	*[kg R11-Equiv.]*
		Freshwater Aquatic Ecotoxicity Potential (FAETP)	*[kg DCB-Equiv.]*
		Human Toxicity Potential (HTP)	*[kg DCB-Equiv.]*
		Marine Aquatic Ecotoxicity Potential (MAETP)	*[kg DCB-Equiv.]*
		Photochemical Ozone Creation Potential (POCP)	*[kg Ethene-Equiv.]*
		Terrestric Ecoxicity Potential (TETP)	*[kg DCB-Equiv.]*

✓ Primary energy demand from renewable and non renewable resources (gross cal. value) *[MJ]*

LCA Development Projects and Lightweigh Drivers

- Production Technology
- Materials Substitution
- Production Technology and Materials Substitution

Choice of materials…

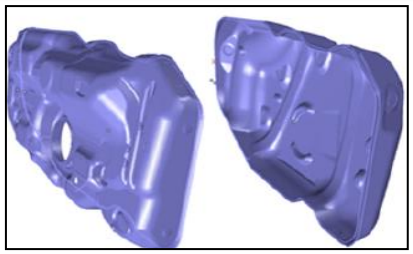


LCA Projects: Alternative Technology for Product Manufacturing

2K Fuel Tank

Extrusion Blow-molding

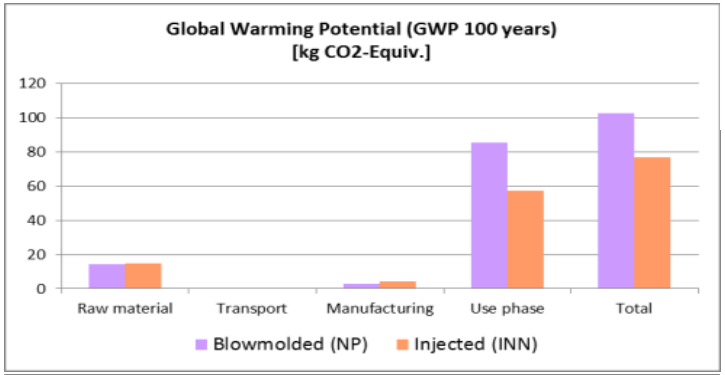
VS

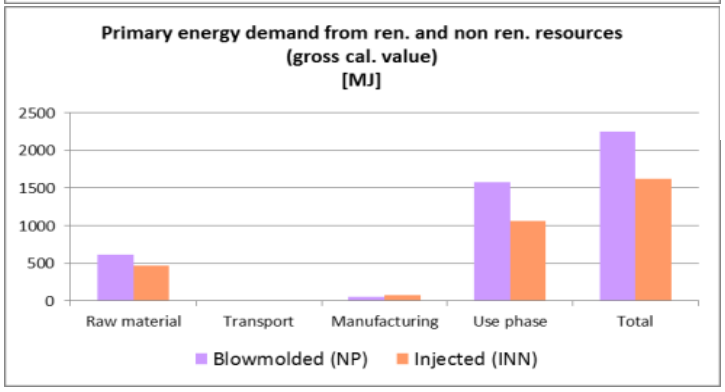


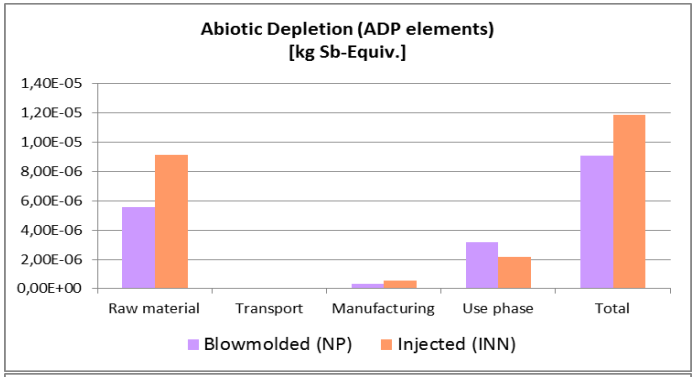
Injection

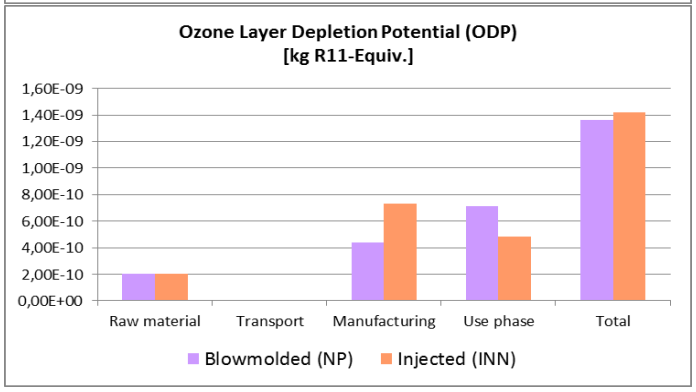
(Weight reduction -33%)

Results







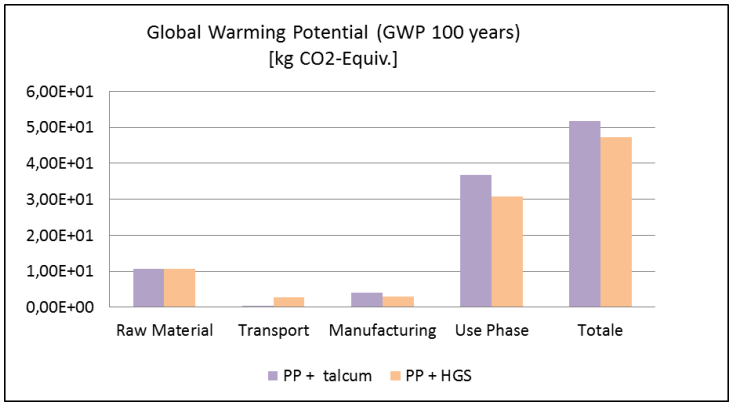


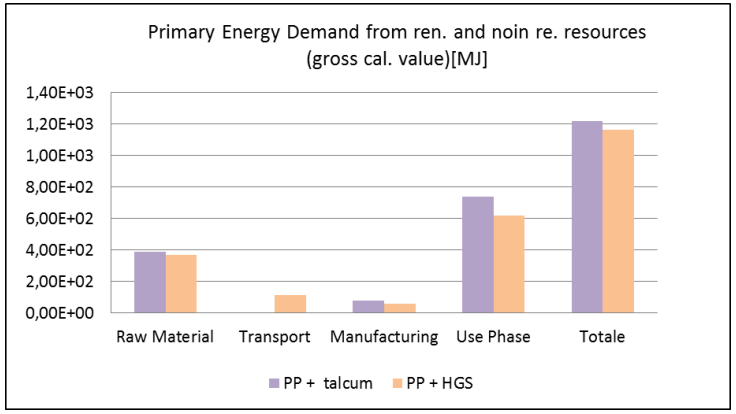
LCA Projects: Alternative Raw Materials

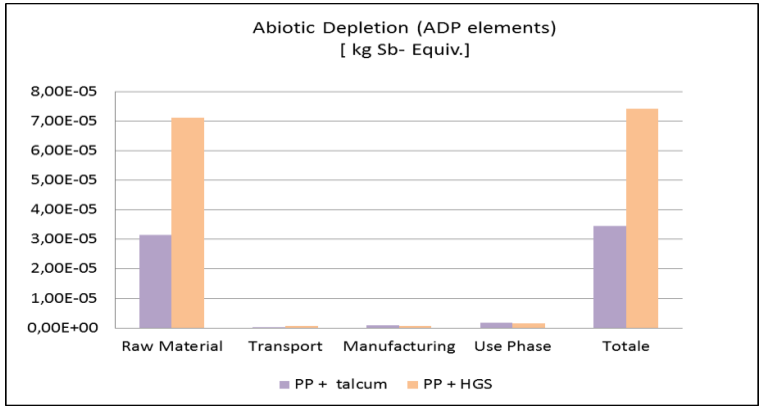
Dashboard

PP + Talcum ***VS*** **PP + Hollow Glass Spheres** ***(Weight reduction -30%)***

Results

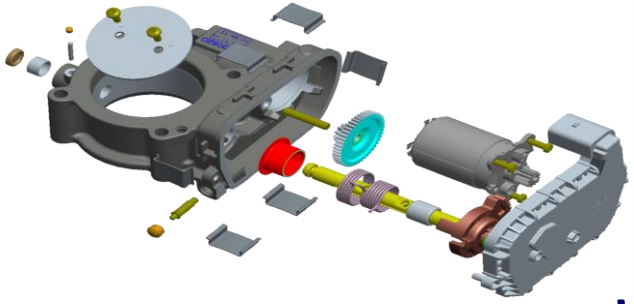




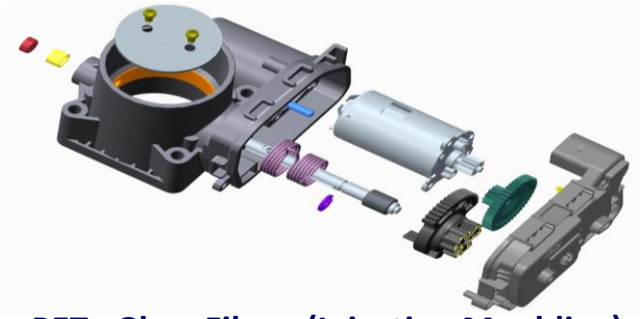


LCA Projects: Alternative Technology and Raw Materials

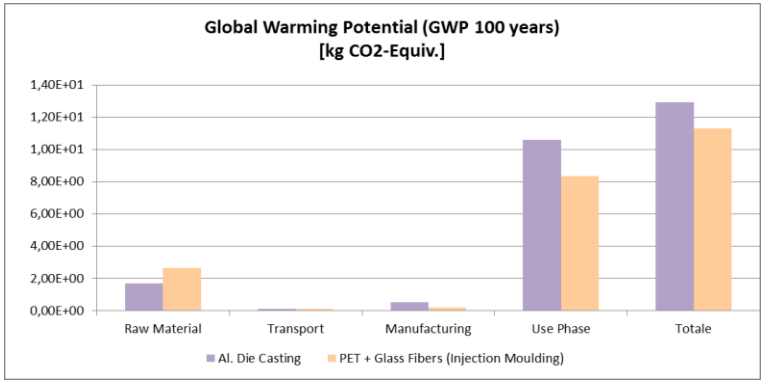
Throttle Body Housing

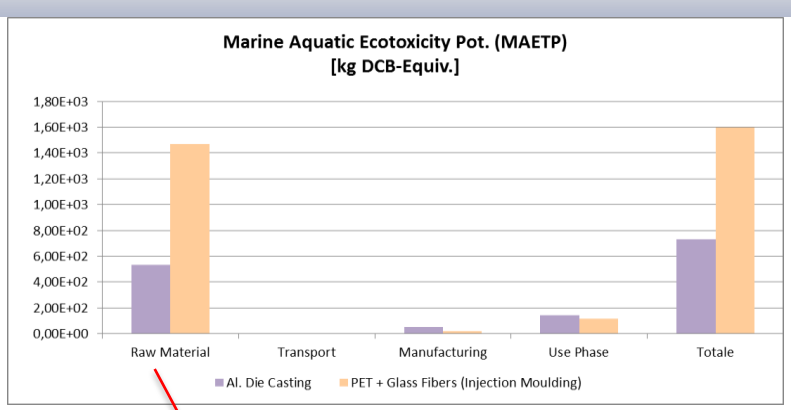


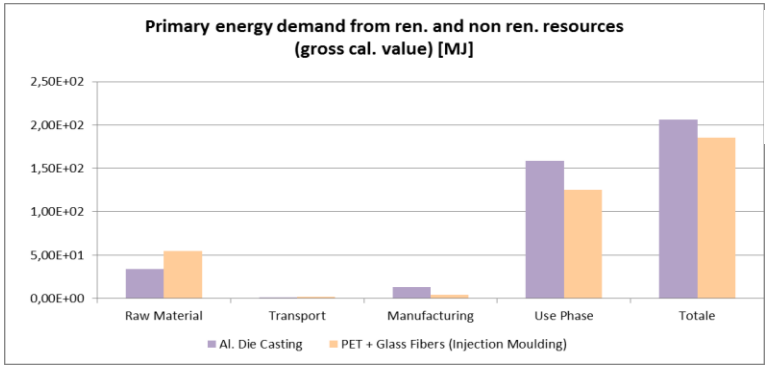
Secondary Aluminum (Die Casting) **VS** PET+ Glass Fibers (Injection Moulding) ***(Weight reduction -22%)***

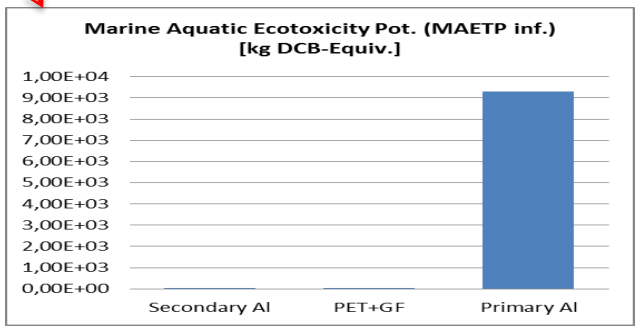


Results









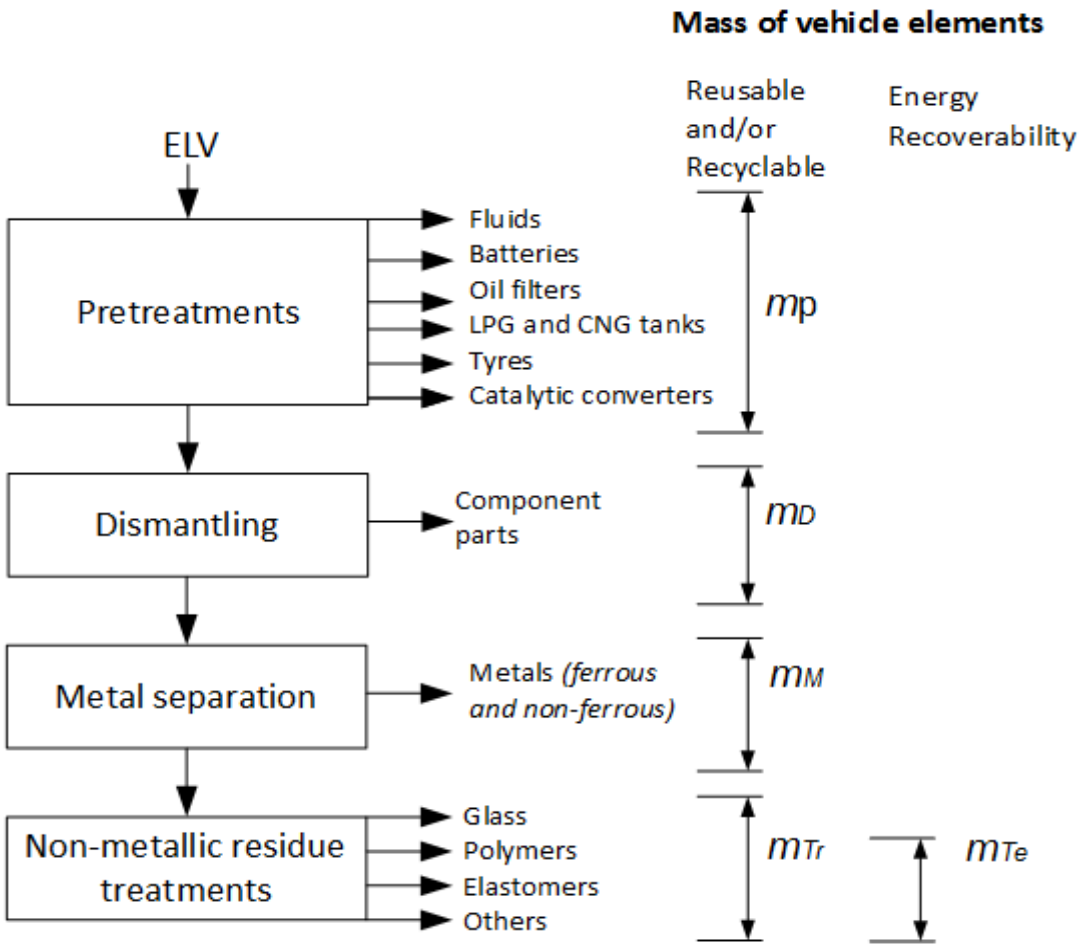
Vehicle End of Life process flowchart: ISO 22628:2002

«What are the material implication associated with the vehicle weight reduction on ELV treatments?»

Material's typology affect process efficiencies and hence their recoverability expressed in % of mass fraction through the following indices:

$$\mathbf{R_{cyc}}\ (\%) = \frac{mp+mD+mM+mTr}{mtot} \times 100$$

$$\mathbf{R_{cov}}\ (\%) = \frac{mp+mD+mM+mTr+mTe}{mtot} \times 100$$



Results and Consideration

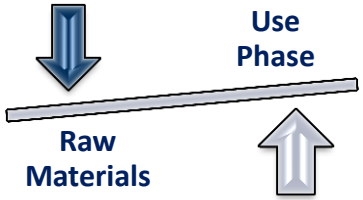
Lightweighting approach significantly reduces the environmental impacts during the **products utilization** on vehicle

But …

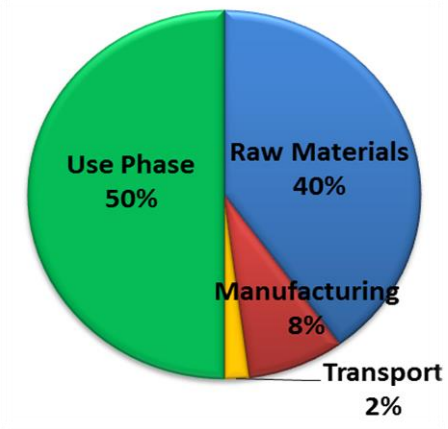
Light weight materials (fillers for plastic compound), could worsen the effect on Raw Materials Impact

Reduce the quantity of impacting plastic filler or replace with less impacting filler

Balance between…



Raw Materials and **Use Phase** account for **~ 90%** portion of incidence on life cycle total impact



Replace **Virgin Materials** with **Recycled**

Consider Product End of Life Recovery and Reuse

Thank you for your attention

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