LCA-studies of electrical and electronic components in the automotive sector

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Automotive electrical and electronic systems (EES) comprise an area that has grown steadily in importance in the past decades and will continue to gain relevance in the foreseeable future. For this reason, the SEES project aims to contribute to a cost and eco-effective EES by defining sustainable scenarios for the recovery of automotive EES by taking into consideration the required improvements in EES design and the development and implementation of new recovery technologies. The research project SEES (Sustainable Electrical & Electronic System for the Automotive Sector) is funded by the European Commission (Contract nº TST-CT-2003-506075) within the Sixth Framework Programme, priority 6.2. In order to analyse the influence of all life cycle steps Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) case studies are applied within the SEES project. These case studies are conducted for two different EES components. Different Design-alternatives as well as different End-of-Life (EOL) scenarios are analysed within the case studies. The long-term objective is the determination and comparison of potential environmental impacts of the alternative product system scenarios.

When performing an LCA the collection of qualitative and quantitative information for all the processes over the life cycle is necessary in order to model the product system. Based on the goal and scope definition various assumptions have to be made, particularly with regards to complex products. Assumptions within the system definition are for example the technologies of processes, which must be modelled over the product's life cycle. However, analysing the influence of several assumptions and model choices within the product system on the overall result is an important issue of an LCA. Apart from that, information is needed on the robustness of results, if the LCA is to be used as a decision-making tool. Therefore, the influence or results of variations of process data, model choices and other variables have to be detected.

We will outline in our presentation the first result of the LCA case studies for analysed EES components. In a first step the basic assumptions for the analysed status quo scenarios will be presented. An engine wire harness and a smart junction box produced by LEAR are chosen as representative EES components. The collection of qualitative and quantitative information and also the modelling of the product system has been a major part of the work after establishing the goal and scope definition. New design alternatives for the electric and electronic components are based on recommendations from the results of the status quo scenario.

The influence of already identified sensitive parameters on the overall results in the form of a sensitivity analysis will also be described. Sensitive parameters within the status quo scenario for the analysed EES components are for example, the assumed separation rate after the shredding process in the EOL scenario. This is in particularly relevant for the separation rate of copper. Moreover, the inventory data set for copper has a significant affect on the indicator results in the acidification impact category. The influence and results of variations of the inventory data will also be shown.

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SEES Project

Funded by the European Community within the SIXTH FRAMEWORK PROGRAMME; PRIORITY 6.2 Sustainable Surface Transport Advanced Design and Production Techniques

Project acronym:	SEES
Project full title:	Sustainable Electrical & Electronic System for the Automotive Sector
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Contract no.:	TST3-CT-2003-506075
Homepage:	http://www.sees.eu.com

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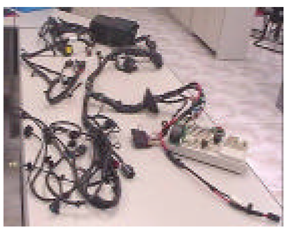
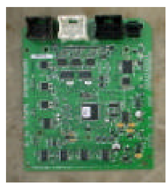
Automotive EES

The electrical system of a car encompass the devices that produce, store, transmit and transform electric energy
The electronic systems of a car consist of units of sensors and controllers to manage the different car functions.

WHAT does it contain?





- Vehicle wire harness (to distribute the power and the signal to the different car functions)
- Passive and electronic junction boxes (to protect and manage the system)
- The different devices (lights, comfort and infotainment devices, safety devices, etc.).

Main Objectives

Development of prototypes and dismantling/recycling processes for a sustainable, clean, cost- and eco-effective EES in order to increase the recovery and reuse rate of vehicles.

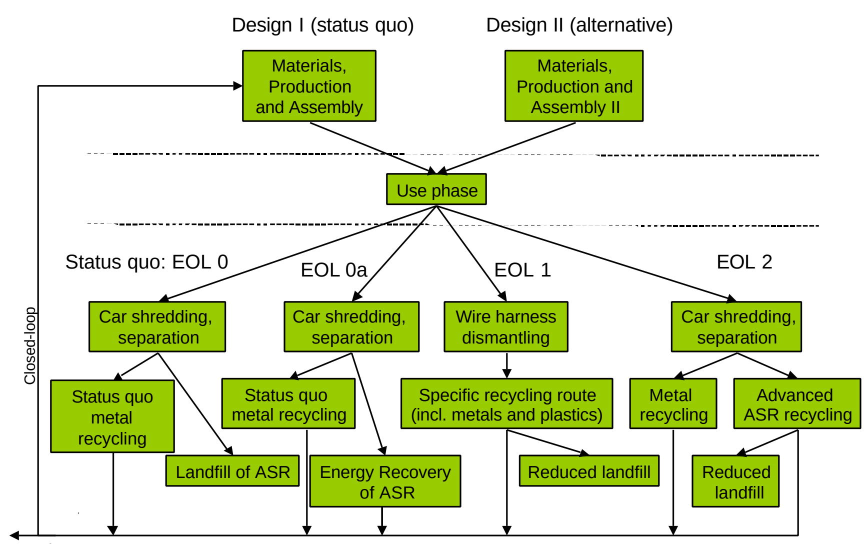
Funded by the European Commission

The entire life cycle of the product is covered!!

LCA and LCC Studies in SEES: Objectives

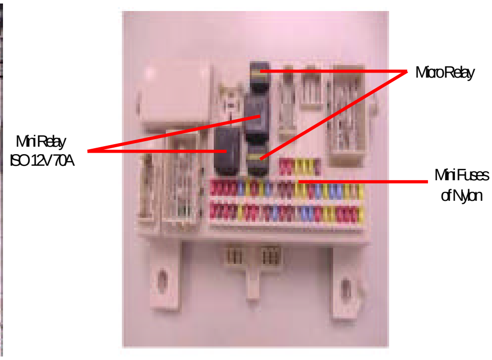
- Identify the environmental and economical impacts of the automotive EES • to define the optimum recycling scenario & eco-design solutions
- Quantify the improvement achieved by new scenarios • contrary to the present situation
- Guarantee the life cycle perspective.

Schematic Representation of Design and EOL-Scenarios



Engine Wire Harness (WH) & Smart Junction Box (SJB)

produced by LEAR, assembled in a Ford-Focus C-Max



Smart Junction Box (front view)

Material Composition of WH & SJB

WH

	Mass [g]	Mass [%]
Copper	3539,73	48,2
Ferrous Metals	149,46	2,0
Non-Ferrous Metals	21,52	0,3
Plastics	2339,32	31,9
Others (incl. Elastomers)	1293,33	17,6
Total	**7343**	**100,0**

SJB

	Mass [g]	Mass [%]
Copper	321,96	24,1
Ferrous Metals	55,37	4,1
Non-Ferrous Metals	76,77	5,7
Plastics	884,00	66,1
Total	**1338**	**100,0**

Assumptions for the Use Phase and EOL 0

- Total driving range of 150.000 km in 12 years
- Fuel mix of 44 % diesel and 56 % gasoline engines. Fuel consumption C_{veh} of 5.4 l per 100 km for diesel engines and 7.0 l for gasoline engines
- No service or maintenance is included because the WH and SJB are not typically serviced
- Separation rates from shredder are based on averages from literature values and estimations from Müller-Guttenbrunn. Cu-fraction: 80 %, Fe-fraction: 98 %, Other non-ferrous materials: 80 %, Plastics and other materials: 0 %, rest to ASR (landfill).

Use of LCA

- Information is needed on the robustness of results, if LCA is to be used as a tool for decision-making!
- Analysing the influence of assumptions:
  - Process-data: e.g. separation rate after the shredding process
  - Inventory-data: data set for copper.

Conclusions

- LCA case studies are conducted for a WH and SJB
- Different design and EOL-scenarios are analysed for evaluation of recycling techniques and eco-design solutions
- Information is needed on robustness of results
- LCA case studies ensure life cycle perspective in SEES.

Thank You for Your Attention!