

**SEES-Project:
Sustainable Electrical & Electronic System for the Automotive Sector**

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This paper provides results and background information of a European research project “SEES - Sustainable Electrical & Electronic System for the Automotive Sector”. SEES aims at the development of guidelines, prototypes and processes striving for sustainable, clean, cost- and eco-efficient automotive electrical and electronic systems (EES).

The SEES project follows a life cycle approach covering the whole life cycle of EES, including design, assembly, disassembly, recycling and recovery. Major project activities have been studies on optimisation of the disassembly and shredding processes, development of mechanical and chemical recycling processes for EES and plastics, environmental & economic evaluation of the EES life cycle, implementation of evaluation methods in a software tool for designers and recyclers, provision of eco-design guidelines for automotive EES and development of a new EES concept which is partially prototyped. Several project results are presented in this paper. They are unique and nearly the final versions of the project. The project consortium brings together car manufacturers and suppliers, universities, recyclers/dismantlers, research centers and consultants and guarantees practical and scientific results.

Because of the increasing functionality of modern cars, e.g. in terms of safety, comfort, engine management, emission control, entertainment, the use of automotive electrical and electronic systems (EES) has been growing. EES contains valuable materials (e.g. copper, precious metals, plastics) which are only partly recovered in conventional car shredders. EES may also contain restricted substances, e.g. lead in solder or mercury in lights which require special end-of-life treatment.

The European Directive 2000/53/EC [1] on end-of-life vehicles (ELV) requires increased reuse, recycling and recovery rates of vehicles to be achieved by the years 2006 and 2015 with the latter being currently under revision. Additional materials (beyond currently recycled metals) have to be recovered/recycled to achieve these targets in the respective years. Theoretically, two strategies to achieve these targets in the recycling process could be followed:

1. Disassembly of components before the vehicle enters the shredder; and/or
 2. Post-shredder-treatment of the shredder residues to recycle/recover material fractions.
- For future automotive EES also improved designs towards sustainability could facilitate reaching these targets.

Optimum end-of-life scenarios for automotive EES (as well as for the whole car) have to take into account the whole life cycle of the product without shifting problems from end-of-life to other – in the case of automobiles more impacting – life cycle phases. Therefore, SEES employs the life cycle perspective to develop design guidelines, prototypes and processes towards sustainable automotive EES.

The SEES project approach is the following:

- Life-cycle perspective, covering all the product's life steps (manufacturing, assembly, disassembly and materials recycling)
- Reduce disassembly time/cost (i.e. dismantling manuals, use of intelligent materials)
- Favour the recycling processes (chemical & mechanical recycling), and the development and demonstration of new technologies
- Eco-design (development of generic & specific guidelines to improve future designs)
- New EES concept and specific parts and functions prototyping and testing

- Development of new methodologies & software tools to assess the end-of-life scenario (supporting recyclers decisions) and the recyclability potential of the EES (supporting designers)

The main deliverables resulting from the SEES project are:

- Integrated economic & environmental assessment of automotive EES life cycle
- Software tools for recyclability assessment and end of life scenarios simulation
- Eco-design guidelines to improve future designs of car E&E systems
- New recycling technologies for EES metals and plastics recycling
- Demonstration and application of new dismantling and recycling technologies by product prototyping for assembly and disassembly

For further details, newsletters, posters, preliminary results including downloads see on SEES project website: <http://www.sees-project.net>, where you can find also the following papers, among others:

Greif, A., Alber, S., "Recycling and Design for Environment of Automotive Electrical and Electronic Systems – The SEES Project", *Proceedings of Transport Research Arena Europe 2006*, Göteborg, 12-15 June, 2006, p. 226.

Greif, A., Dose, J., Castells, F., Rodrigo, J., Alber, S., Geraghty, K., *D7: Economical and Environmental Assessment*, Public report of the SEES project, www.sees-project.net, July 2005.

Greif, A., Dose, J., Fleischer, G., Alonso, J.C., Eikelenberg, N., Maas, H., Schmidt, W.P., "Eco-Design of Automotive Electrical and Electronic System – The SEES Project", *Proceedings of 13th CIRP International Conference on Life Cycle Engineering*, Leuven, 31 May – 2 June, 2006. Volume 1, pp. 293-298.