EUROPEAN AUTOMOTIVE
RESEARCH PARTNERS ASSOCIATION

earpa

Life Cycle Assessment for the **determination of the environmental impacts** of road vehicle transport system including air pollution and climate change

Introduction

EARPA members share commercial product development with academic research to provide a valuable contribution in research delivery, innovation and strategic vision and actively support **decision making on pollution and GHG (green house gas) mitigating actions in the transport sector** for the entire lifecycle of light and heavy-duty vehicles, for different powertrain types and for different fuels or energy carriers in the next years and up to 2050.

Our road transport system is rapidly transforming in response to climate change and resulting demand for a high sustainability over the full value chain and considering the full life cycle. New propulsion systems are having steadily increasing market shares, connected and automated vehicles as well as the vision of smart and climate neutral cities demand for new infrastructures and mobility concepts. In order to define realistic sustainability goals –for all stakeholders in the mobility sector – and to select the most sustainable solution, the **environmental impact of technologies and mobility concepts** must be assessed and continuously **monitored in a holistic way**.

Clean and sustainable mobility, at the vehicle and at the system level must be coherent with the **ecological footprint and the impact of each technology onto the society**, at an early stage of development and planning. For this reason, strong research and innovation based on a lifecycle sustainability assessment (LCSA) approach is needed, to complement and push beyond environmental life cycle assessment (LCA) in order to include considerations regarding the economic and societal impact of the potential solutions in a comprehensive way: from component to system integration and from cradle to cradle, reflecting the needs of a **circular economy**. Another relevant point is the **integration of sustainability analysis within the early design phase**. Until now LCA is mostly used to validate and compare alternative design solutions, which are already conceived and defined by the designers. However, the assessment of the ecological footprint by means of a LCSA will be key to select the right technology.

The **development of holistic eco-design tools** able to deal with technical and life-cycle sustainability aspects on the same level represents a key-element in the transition towards more efficient and sustainable design. With the digitalization of the full value chain and its components, LCSA is enabled by providing the ingredients for full traceability of materials, components and systems as well as their lifetimes. The aim is to decouple the economic growth from resource usage and environmental impacts by taking into account the circular economy system, preserving and enhancing natural capital by controlling finite stocks and balancing renewable resource flows between renewable and the finite stock management through **recycling, refurbishing, remanufacturing, reusing and correct operations and maintenance**, while promoting the use of bio-friendly materials with regeneration capabilities in order to minimize systematic leakage of resources and negative externalities.

It is necessary to decide on the future from a well-informed, long-term and sustainability focussed perspective. To definitively contribute to the goal of minimising the negative effects transportation implies in the present and in the following decades, it is no longer an option to focus on one single step in the complete life cycle of our transportation operation and properly inform on the global effect that must be compiled and shared. As such, EARPA fully agrees to the challenges identified in the 2ZERO SRIA and the research areas defined. In particular, research on following aspects should be strengthened:

- Availability of **standardised and comparable real-life data**;
- **Standardised procedures** for inventory data collection and monitoring and continuous update;
- **Harmonised methods and tools** for affordable cost and time content and easy-to-handle assessment of the ecological footprint and social implications;
- Coherent and systematically **harmonised assessment of the ecological footprint** of technologies and product life cycle processes;
- Implementation and anchoring of **circular economy strategies**, as a measure to lower the ecological footprint, including value and supply chain;
- Definition of a **set of impact categories** able to properly evaluate the impacts of transportation

Specific research needs are given in the following table:

EARPA's perspective on LCA research needs:

	automotive context	Research needs
	1. Energy and fuel generation and provision a. Primarily liquid and gaseous renewable fuels b. H2 generation c. Electricity	- Harmonised concepts, approaches, methods to obtain reliable, real-world data and monitor/update them - Which system boundaries need to be considered: What are the environmental, economic and social impacts - Consideration of geographical situation of energy and fuel production (composition of electricity grid mix)
	2. Impact of natural resources (links to point 5) a. Critical raw materials b. Natural resources	- Concepts, approaches, methods to obtain reliable, real-world data and monitor/update them - How to integrate environmental, economic and social aspects in the S-LCA assessment
	3. Infrastructure needed to reach net zero a. Electrification/ Charging b. For CCAM including data processing/storage and software c. For Hydrogen	- Harmonised assessment of impact / relevance of infrastructure on/for LCA - Harmonised description of infrastructure - How to define the system boundaries - How to allocate the impact of infrastructure to transportation impact - Sustainability of energy production
	4. Vehicles and components a. production b. operation with following points that should be addressed • Sourcing of fuel cells • FC passenger cars	Optimisation of entire value chain: Raw materials-battery pack- restore following circular economy principles - Harmonisation of tools and methods - Harmonised concepts, approaches, methods to obtain reliable, real-world data and monitor/update them towards a harmonised LCI data base - How to integrate LCA into product design and development along the full value and supply chain - Single-score indicator for holistic assessment of sustainability - Consideration of ICE for comparisons.

	• Vehicles with increased electronics content • On-board energy vector storage components (batteries, cylinders, cryo-gas tanks etc) • Design aspect (simulation)	- Harmonisation of boundary conditions for the assessment of use phase scenarios (driving cycles, driving styles, vehicle models, energy generation) for ICEV and EV - Balance between advantages and disadvantages of new propulsion technologies with respect to conventional ones (i.e., EV vs ICEV)
	5. Retrofitting, repair and end-of life concepts a. re-cycling b. second life c. retrofitting d. avoid environmental impact of recycling e. Improved recycling of existing vehicles	Recycling with highest efficiency in material recovery towards a circular economy - Harmonised circularity approach, methods… - Harmonised concepts, approaches, methods to obtain reliable, real-world data towards a harmonised recycling LCI data base, considering a global economy - Impact of end-of-life and recycling processes - Definition of substitution factors to quantify the environmental credits achievable through recycling of specific materials and by specific recycling processes - Availability of separation and recycling technologies as a key point to increase product recyclability
Overarching aspects		Research needs
1. Social and economic aspects a. Acceptance for engineers and deciders b. Business models for different mobility concepts (operational models) c. Public awareness enhancement		- Demonstration of the benefit of a LCA driven product development and economy (down to individuals) - New business models for LCI data and circular economy solutions - Socio-economic impact of switching to more eco-sustainable energy generation
		- Tool that can be configured to evaluate a technology concerning its life cycle - Certification process of the data

2. Standardization of Data and Methodology a. Consequential LCA b. Data collection and validation c. Tools and concepts d. System boundaries e. Regulated/ non-regulated emissions		- Definition of a circular economy framework (business models, financial incentives, legal aspects, responsibilities) - Standardisation of LCI and data collection procedures - Standardisation of Impact allocation of use phase (impact from battery pack by weight, economic value, or other…)
3. Synergies with other transport modes		- Quantification of benefits achievable through interoperability of transport modes

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