EGVI
European Green
Vehicles Initiative

Impact Assessment of the European Green Cars Initiative

Table of contents

1. Introduction

The European Green Cars Initiative (EGCI) was launched by the European Commission in 2008 as part of the European Economic Recovery Plan. The automotive sector had been selected due to the severe impact of the economic crisis on its activities combined with the high potential for green growth.

The objective of the EGCI was to **support Research and Development on technologies and systems** able to bring breakthroughs to achieve a safe and reliable decarbonized road transport system using alternative energy sources for the vehicle propulsion.

The discussions between the European Commission representatives and industry representatives, through the Technology Platform for road transport (ERTRAC), led to the identification of 3 main pillars for the EGCI, detailed in its multi-annual roadmap[1]:

- **> Electrification of road transport**
- **> Long-distance transport**
- **> Logistics & co-modality**

Over 4 years, under the Framework of the 7th Programme for Research and Innovation, 113 projects have been funded as part of Green Cars initiative, with a total budget of more than € 660 million, EU contribution being € 418 million.

The study reported here aimed at presenting the main impacts and added-value of the projects funded under this Public Private Partnership (2009 – 2013), in terms of scientific and technological advancement, and including the environmental impact, business and financial added-value during this period, networking and strategic benefits as well as the impact on human resources.

[1] European Green Cars Initiative Public-Private Partnership, Multi-annual Roadmap & Long term Strategy,

2. Objectives and methodology of the impact assessment study

2.1. IMPACT ASSESSMENT OBJECTIVES

The objectives of the study are as following:

- > **To review** the key achievements of the European Green Cars Initiative (EGCI) collaborative pre-competitive research projects funded with the support of the European Research Programme (FP7)
- > **To measure** the benefits of the European Commission contribution
- > **To identify** the success stories arising from the projects in terms of technological, socio-economic & environmental achievements
- > **To identify** the benefits of EGCI PPP for the automotive sector and its value chain

2.2. IMPACT ASSESSMENT METHODOLOGY

The methodology used combined quantitative and qualitative features in a bottom-up approach complemented by a transverse approach through interviews at higher levels with representatives of the European automotive industry.

The questionnaire sent to 78 project coordinators enabled consolidated figures, chart and graphs to be built. Among the 78 project coordinators contacted, 44 has returned a completed questionnaire. All charts/graphs published into the report are the result of this data collection and are associated with the mention “questionnaire sample”, in order to clearly specify the sample considered.

The approach adopted for the Green Cars impact assessment could be described by the 3 following steps:

<< Step1: Identify the main issues >>

<< *Aim* >>

The aim of this step is to understand the key issues and to collect a qualitative and quantitative feedbacks from the project participants.

<< *Methodology* >>

> **A project level analysis** was performed through a review of documents & data (including EGVIA, ACEA, CLEPA, EUCAR & EARPA publications, European Commission statistics, Portfolio of the Green Cars Initiative projects and dedicated websites & deliverables of projects),

> **An online questionnaire** sent to 78 project coordinators & a series of 12 interviews in order to identify the main success stories. This is organised in 3 main parts:

1. General information about the project and the technology fields addressed
2. Scientific & technological results and impacts
3. Societal & economic impacts

<< *Results* >>

This first step enabled:

> **44 questionnaire answers** to be collected corresponding to more than a 56% answering ratio

> **A better insight of EGCI project technical results**

> **The selection of 10 success stories**

<< Step 2: Strategic analysis of EGCI collaborative research >>

<< *Methodology* >>

A strategic analysis of EGCI PPP was then performed through more than 15 interviews with several senior managers from companies, research & technology organizations and professional associations.

<< *Results* >>

This second step enabled:

> **A more strategic & macro view** of the European collaborative research projects for the industry & research / academic partners to be gained

> **The benefits of the PPP compared to standard funding schemes** for research activities (European, national and private funding) to be established

> **An assessment of the impact of the EGCI PPP on the R&D strategy of companies** and its main impacts for European automotive industry comparatively to the USA & Asian countries

<< Step 3: Transversal projects analysis >>

<< *Methodology* >>

This third step was performed through 3 workshops organised in Brussels in parallel to the:

> **EGVIA General Assembly Meeting**

> **ARPA Conference 2015**

> **EUCAR Annual Conference**

<< *Results* >>

These workshops enabled:

> **The perception of industry & research/academic partners** in terms of added-value of PPPs such as EGCI to be identified

> **The impressions of the public & private stakeholders** in terms of technological, scientific, socio-economic & environmental outcomes to be grasped

> **The main achievements to be pinpointed**

> **The projects to be clustered by families of technologies** & the key technological achievements to be identified

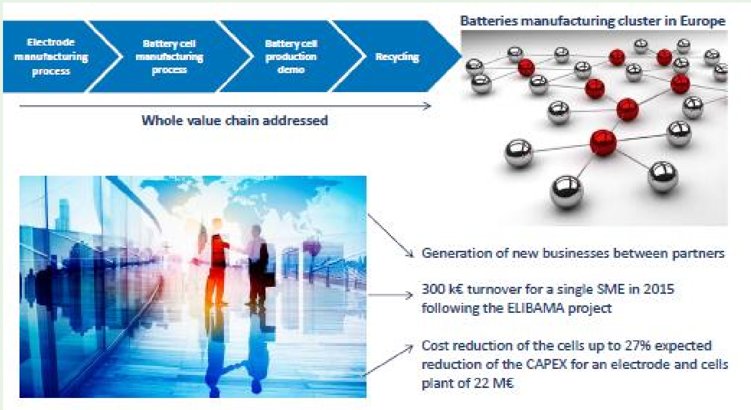
These three steps have been performed through a dynamic & simultaneous approach from the end of May to the end of December 2015.

3. EGCI Success Stories

Project	**E-VECTOORC –** *Electric Vehicle Control of Individual Wheel Torque for On- and Off- Road Conditions*
Overview	
Consortium	> 11 European organizations from 6 countries (4 large companies, 1 SME, 2 RTOs, 2 universities) > Budget: € 4,7 M – EU Funding: € 3,1 M > Duration: September 2011 – August 2014
Objectives	> Address the individual control of the electric motor torques of fully electric vehicles to enhance safety, comfort & fun to drive
Key Outcomes	> **Incremental innovations:** > Vehicle demonstration of torque-vectoring controllers > Demonstration of the significant stopping distance reduction achievable through ABS braking actuated through the continuous modulation of electric motor torques > Next generation electro-hydraulic braking system for modulating individual caliper pressures > **Business impacts:** > An SME planned a small-series production of their new switched reluctance electric motor drives > A supplier is focusing on the next generation of friction braking systems controllers for hybrid electric and fully electric vehicles. An OEM further invests internally in the area of advanced Human-Machine-Interfaces for electric vehicles > Another OEM has developed a strong research strategy towards the development of fully electric vehicles with multiple motors
Verbatim	**Further investments in in-house projects concerning the multiple electric drivetrain technology on vehicle safety and 'fun-to-drive'** *"Following E-VECTOORC new internal research programmes have been developed to bring some of the concepts and ideas developed during the project to a stage closer to their industrialization"*

Project — **ELIBAMA** – *European Li-ion Battery Advanced Manufacturing for electric Vehicles*

Overview



Consortium

> 17 European organizations from 5 countries (11 large companies, 3 SMEs, 2 RTOs, 1 university)
> Budget: € 15,4 M – EU Funding: € 9 M
> Duration: November 2011 – October 2014

Objectives

> Reduction of costs of batteries manufacturing / 30% of cost savings along the manufacturing steps
> Environmental challenges: CO_2 emission reduction by 25%
> Production and performance assessment of EV size cells manufactured with the innovative manufacturing processes

Key Outcomes

> **Incremental innovations:**
  > Clean manufacturing activities & cell filling
  > Effective transfer into mass production by industry partners

> **Breakthrough innovations:**
  > High efficiency recycling process (TRL 1 to TRL 3)

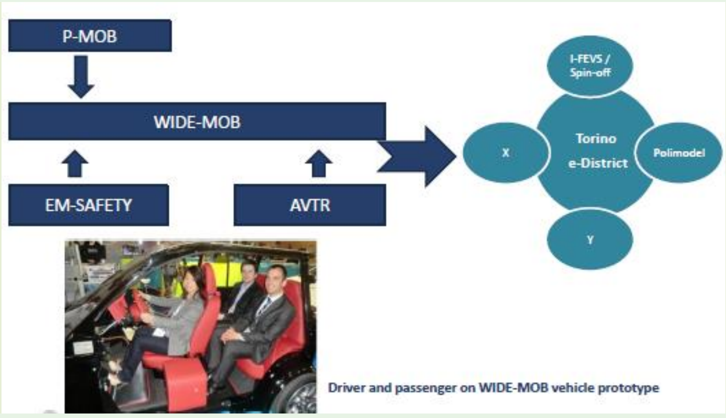
> **Business impacts:**
  > 300 k€ turnover for a single SME
  > Cost reduction of the cells up to 27%
  > Reduction of the CAPEX for an electrode and cells plant of 22 M€
  > 3 M€ dedicated to demonstration activities

> **Social impacts:**
  > 21 high-skilled jobs recruited by the different partners

Verbatim

ELIBAMA triggered further cooperation between partners

"The CEA, the university of Newcastle and Renault are involved in a running FP7 project MAT4BAT. It included some activities directly following the non-destructive test task of ELIBAMA" (OEM comment)"

Project	**WIDE-MOB** – *Building Blocks Concepts for Efficient and Safe Multiuse Urban Electrical Vehicles*
Overview	 Driver and passenger on WIDE-MOB vehicle prototype
Consortium	> 6 European organisations from 4 countries (2 large companies, 1 SME, 1 RTO, 2 universities) > Budget: € 3,7 M – EU Funding: € 2,6 M > Duration: December 2010 – May 2014
Objectives	> Design & development of basic building blocks including Aerodynamics, Lightweight, Propulsion, Electromagnetic field
Key Outcomes	> **Incremental innovations:** > First fail-safe two motor powertrain (four-wheel drive) > Efficiency with best in class aerodynamics > Introduction of new solution for crash safety in small electrical vehicles > High ergonomy for a supercompact vehicle > Smart photovoltaic capable of an average 20km/day by solar energy > Reduction of the emissions of electromagnetic field and specifically low frequency magnetic fields > **Business impacts:** > Creation of a cluster called “Torino e-district” gathering 18 industry suppliers which address the overall value chain of electromobility with a focus on Micro EVs > **Social impacts:** > Creation of a spin-off company with few number of employees > This spin-off is working with 17+ SMEs in the region of Torino which are actively involved in EU projects
Verbatim	**WIDE-MOB illustrates the need of further investments for the industrialization of EVs** *“The timeframe between R&D activity and production of electric vehicles is difficult to estimate for OEMs, usually it could take more than 10 years to appreciate the results of this kind of project”*

Project

LORRY - *Development of an innovative low rolling resistance truck tyre concept in combination with a full scale simulation tool box for tyre performance in function of material and road parameters*

Overview

Consortium

> 11 European organizations from 6 countries (4 large companies, 1 SME, 2 RTOs, 2 universities)
> Budget: € 3,6 M – EU Funding: € 2,4 M
> Duration: November 2012 - April 2016

Objectives

> Reduction of trucks carbon footprint by developing an innovative low rolling Resistance tyre concept reaching a gain of 5% in truck fuel consumption, of 20% in tyre rolling resistance and of 20% in tyre wear reduction
> Development of a comprehensive tool box for fleet fuel saving management
> Contribution to greener, safer and more efficient mobility in freight transport

Key Outcomes

> **Incremental innovations:**

> New validated tyres including new tread pattern and material features
> New methodology for tyre deflection measurement
> Smart systems for tracking and analysing trucks driving & environmental conditions
> Virtual analytical tool for optimization of trucks fuel consumption
> Possible drop down of 5% of fuel consumption per truck

> **Business impacts:**

> Time to market reduction by one year for the tyre developed

> **Social impacts:**

> Preservation of jobs 5 to 10 FTE/engineers and recruitment of 10 FTE/post-docs for the whole consortium

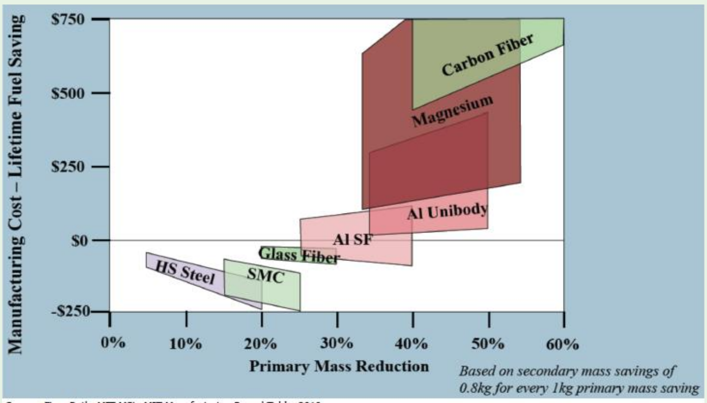
Verbatim

LORRY project enabled to reduce time to market

"The project contributed to reduce time to market and enables to save a year in the development of the tyre"

Project	**ENLIGHT** – *Enhanced Lightweight Design*

Overview



Source: Fine, Roth, MIT MSL, MIT Manufacturing Round Table, 2010

Consortium

- 22 European organisations from 10 countries (6 large companies, 9 SMEs, 4 RTOs, 3 universities)
- Budget: € 10,9 M – EU Funding: € 7,1 M
- Duration: October 2012 - September 2016

Objectives

- Development of highly innovative lightweight / low embedded CO_2 materials for their application in medium-volume automotive production

Key Outcomes

- **Incremental innovations:**
  - Five demonstrator modules of a future EV architecture developed, validating the performance of the materials: front module, firewall, central floor section, sub-frame & suspension, doors & enclosure
  - Saving of 20% weight for each module considered
  - Qualification of renewables & low-cost fibres for the automotive sector
  - Elaboration of testing procedures for new materials
- **Business impacts:**
  - Advanced materials meeting specifications regarding weight savings, crashworthiness & applicability in medium-scale production
  - Target vehicle is a 2-4 passenger car for mass production

Verbatim

SEAM cluster addressed 3 family of technologies: Lightweight design, safety & simulation

"ENLIGHT is part of the SEAM cluster (47 partners, 19 M€ of funding) composed by 3 other projects: ALIVE, Safe EV, MATISSE"

Project	**CONVENIENT** – *Complete Vehicle Energy-saving Technologies for Heavy-Trucks*
Overview	
Consortium	> 22 organisations: 3 major EU truck manufacturers, 10 suppliers Tier 1s /Tier 2s and 9 research centres and universities > Budget: € 26,6 M – EU contribution: € 9,8 M > Duration: November 2012 – April 2016
Objectives	> The focus of the project is to develop and leverage on a holistic approach for the energy management of complete vehicle, considering the truck, the semi-trailer, the driver and the mission together > The overall target is to achieve 30% improvement of efficiency and fuel-saving through the adoption of a new technologies for trucks and semi-trailers

Key Outcomes	> **Development by OEMs of 3 energy-saving prototypes based on production trucks**
	  > Prototype 1
	    – Hybridization of the transmission; Electrification of the auxiliaries; Dual level cooling system; Active and passive aerodynamics solutions; Energy savings solutions
	  > Prototype 2
	    – Cohesive control of cooling systems; smart electrified auxiliaries; Hybrid Powertrain Technology for a downsized engine; Programmable smart Electrified Auxiliaries; Driveline friction reduction; Active vehicle aerodynamics
	  > Prototype 3
	    – Novel Hybrid Powertrain; Smart electric auxiliaries; Plug-in connection for energy supply from grid; Aerodynamic hardware for tractor & trailer
	> **Business impacts:**
	  > Significant time to market reduction by at least 2-3 years for the implementation of technologies improving the energy efficiency in trucks
	  > Significant contribution of the project to the technology selection and decision making of the OEMs in terms of sustainable propulsion solutions and safety systems in commercial vehicles for long-distance transportation

Verbatim	**Significant incremental & disruptive developments for heavy-duty trucks** *"During this project a series of disruptive technologies such as supercapacitors for the hybridization of heavy-duty vehicles and incremental solutions related to the active vehicle aerodynamics have been developed and validated"*

Project	**OPENER** – *Optimal Energy Consumption and Recovery based on system network*
Overview	
Consortium	> 6 partners from 5 countries, 1 OEM, 2 Tier 1s, 2 RTOs & 1 academic organisation > Budget: € 7,7 M - EU contribution: € 4,4 M > Duration: May 2011 – July 2014

Objectives	> OpEneR aims to unlock the Full Electric Vehicle market:
	  > By increasing the driving range, not by enhancing battery technologies
	  > And by the development of an intelligent energy management and recovery system

Key Outcomes	> **Development of new driving strategies and driver assistance systems & demonstration in real conditions thanks to two fully operational electric vehicles**
	> **Incremental innovations:**
	  > Eco version of Adaptive Cruise Control in order to save energy and increase energy recuperation while braking
	  > Development of HMI solutions explaining the energy management system to the driver
	  > Eco-routing opens energy saving potential of up to 30 percent
	  > Energy consumption prediction
	> **Business impacts:**
	  > Follow-up activities related to driver assistance systems between industry partners
	  > Improvements in terms of knowledge & skills regarding Energy Management systems
	  > Energy consumption savings of up to 30 percent in return for a longer travel time of just 14 percent

Verbatim	**Close cooperation & acquisition of knowledge skills in terms of Energy Management Systems** *"The cooperation between partners was frank during the project. At the end of the project, some bilateral collaborations continued as well as in-house development"*

Project

POWERUP – *Specification, Implementation, Field Trial, and Standardisation of the Vehicle-2-Grid Interface*

Overview

Consortium

- 11 partners from 7 countries, 2 OEMs, 1 Tier 1, 1 utility, 4 SMEs, 1 standardisation organisation, 1 engineering company & 1 RTO
- Budget: € 3,5 M – EU contribution: € 2,4 M
- Duration: July 2011 – June 2013

Objectives

- PowerUp project aims to develop & validate the Vehicle-to-Grid (V2G) Interface

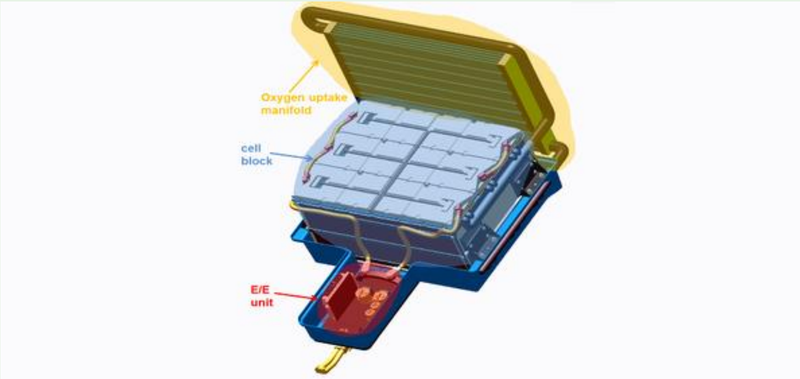
Key Outcomes

- **Technological outcomes (TRLs 6-7)**
  - Incremental improvements in terms of standardization process on the Vehicle to Grid (V2G) Interface
  - Prototyping of automotive side V2G interface adapters, including integration with battery management and HMI
  - Prototyping of infrastructure side V2G interface adapters, including integration with Smart Meters
  - Prototyping of PowerLine Communications media conversion and Pilot Control Function
  - Elaboration of V2G use cases, in line with expected customer needs
- **Learning curve improvements by OEMs involved in terms of the application & integration of V2G technology**
- **Acquisition of new skills by SMEs in terms of integration & testing**
- **Business impacts:**
  - Additional investments on further development & testing of V2G (~5 to 10% of turnover) for the SMEs involved
  - This project contributed to set-up a cluster in the Grid Integration field

Verbatim

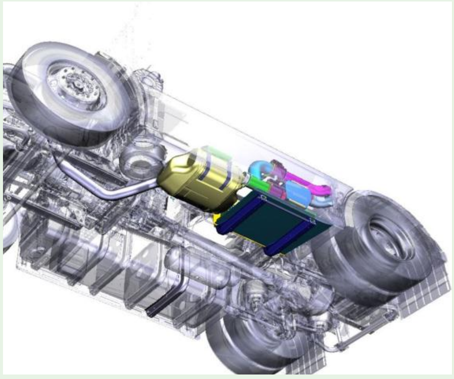
Acquisition of skills in V2G technology

"Follow-up activities between partners have been developed in terms of Standardisation and testing support. This project contributed to adjust our strategic & commercial roadmap and we hope to hire 2 or 3 sales representatives in the next future"

Project	**SUPERLIB** – *Smart Battery Control System based on a Charge-equalization Circuit for an advanced Dual-Cell Battery for Electric Vehicles*
Overview	
Consortium	> 10 partners involved from 8 countries (2 Tier 1s, 2 OEMs, 3 RTOs, 1 university, 1 large company, 1 SME) > Budget: € 6,5 M – EU contribution € 4,0 M > Duration: May 2011 – October 2014
Objectives	> The main goal of SuperLIB is to extend the lifetime of the battery and utilize an advanced battery management system to increase overall performance
Key Outcomes	> **Technological outcomes:** > Improvement of energy efficiency and extended driving range of FEVs through highly integrated HP and HE batteries > Reduction of costs of the electronic components and the overall FEV > Strengthening the global competitiveness of the European automobile, ICT and battery sectors > Improvements in terms of **reliability & safety** of the developed **dual-cell battery** > Increase of the usable SoC range of the battery from typically 70% in 2010 to more than 90% at the end of the project > **Increase of life time of the battery by up to 30%** in realistic driving situations > Longer battery replacement intervals, reduced warranty costs (lower cost and risk for car manufacturers) > **Reduction of total-cost-of-ownership** over the battery lifetime > Minimization of charge equalization losses and reduced overall weight and size > Lower amount of raw material requirement, especially expensive and partly hazardous metals like Co, Cu and Ni > **Business impacts:** > Results of the projects are exploited among partners in development & industrialization phases > The improvements in terms of battery technology will contributed to increase the number of EV/HEV/PHEV models over existing models
Verbatim	**Leading role of Europe in the battery development** *"This project contributed to strengthen the leadership position of EU in terms of battery packaging electronic control"*

Project	**NoWaste** – *Engine Waste Heat Recovery and Re-Use*

Overview



Consortium

> 6 partners involved from 5 countries (2 OEMs, 1 RTO, 1 university, 1 Tier 1 and 1 SME)
> Budget: € 4,5 M – EU contribution € 2,7 M
> Duration: October 2011 – September 2015

Objectives

> NoWaste project aims to develop the waste heat recovery system and demonstrate its feasibility with a test rig and a vehicle demonstrator
> The purpose of this project is to improve the vehicle fuel economy increasing the overall vehicle energy efficiency from 12% to 15% thanks to an innovative system capable of recovering and re-using the waste heat by transforming it, by means of a thermodynamic cycle into mechanical energy

Key Outcomes

> **Incremental innovations:**

- > The technologies being developed in the project focus directly on waste heat recovery producing electric energy having impact on energy management and reducing fuel consumption
- > Study & realization of 2 Rankine cycle system architectures
- > ORC systems validation at engine test bench level
- > Control strategy hardware & software development and tuning
- > Overall on-board system integration on the demonstrator vehicle
- > Energy Management analysis related to some new electrified auxiliaries to be installed on board of the prototype vehicle

> **Business impacts:**

- > Further in-house research & development activities on-going by OEMs in order to increase energy efficiency
- > Consolidation of R&D roadmaps of OEMs and Tier 1s involved
- > Improvements of Propulsion efficiency of OEMs
- > Synergies between NoWaste results & in-house and national projects related to Waste Heat Recovery (Turbo Steamer Project & Thermoelectric Generator project) as well as the CO_2RE FP7 project

Verbatim

Energy recovery is one of the main challenges addressed by European OEMs

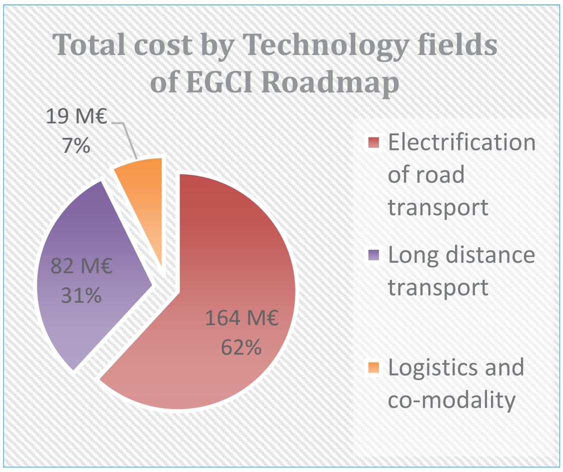
"The waste heat recovery technologies will be a priority to reduce the fuel consumption and the technologies developed during the project will be the base for new development"

4. EGCI impact assessment outcomes

CONTEXTUAL INFORMATION / PORTFOLIO OF GREEN CARS PROJECTS

The graphs below show the number of projects addressing each technology fields of the EGCI roadmap.

Total cost & EU contribution breakdown per roadmap area



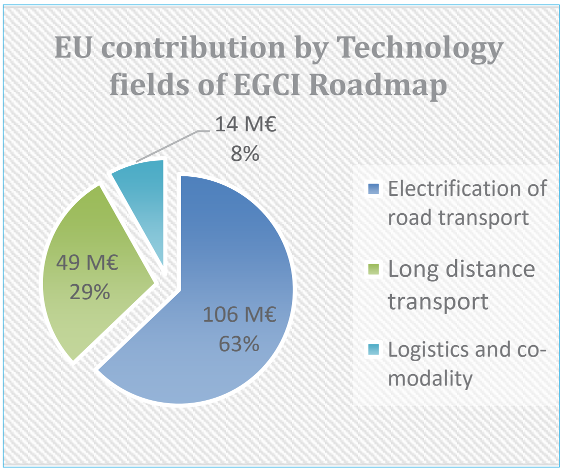


Figure 1: Total Costs & EU contribution by technology areas (questionnaire sample)

Around 62% of the projects address the area of “Electrification of road transport” (questionnaire sample).

Funding allocation per EGCI priorities

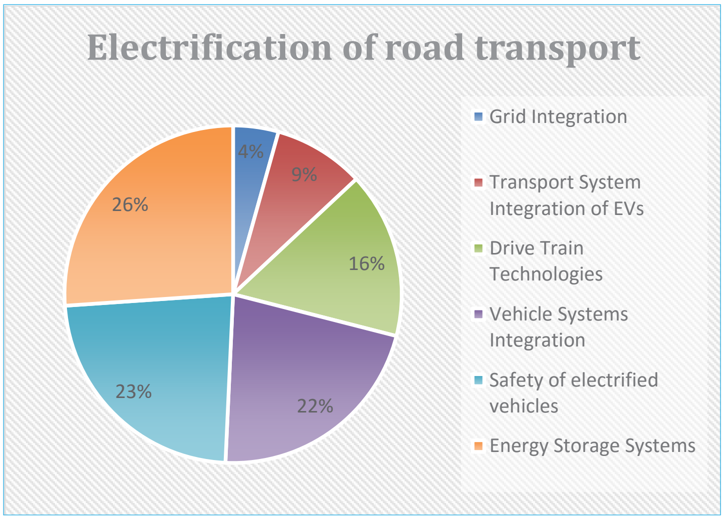


Figure 2: EU Contribution by detailed Technology Fields of “Electrification of road transport” (questionnaire sample)

“Energy storage system” is by large the most funded technology field in the “Electrification of road transport”.

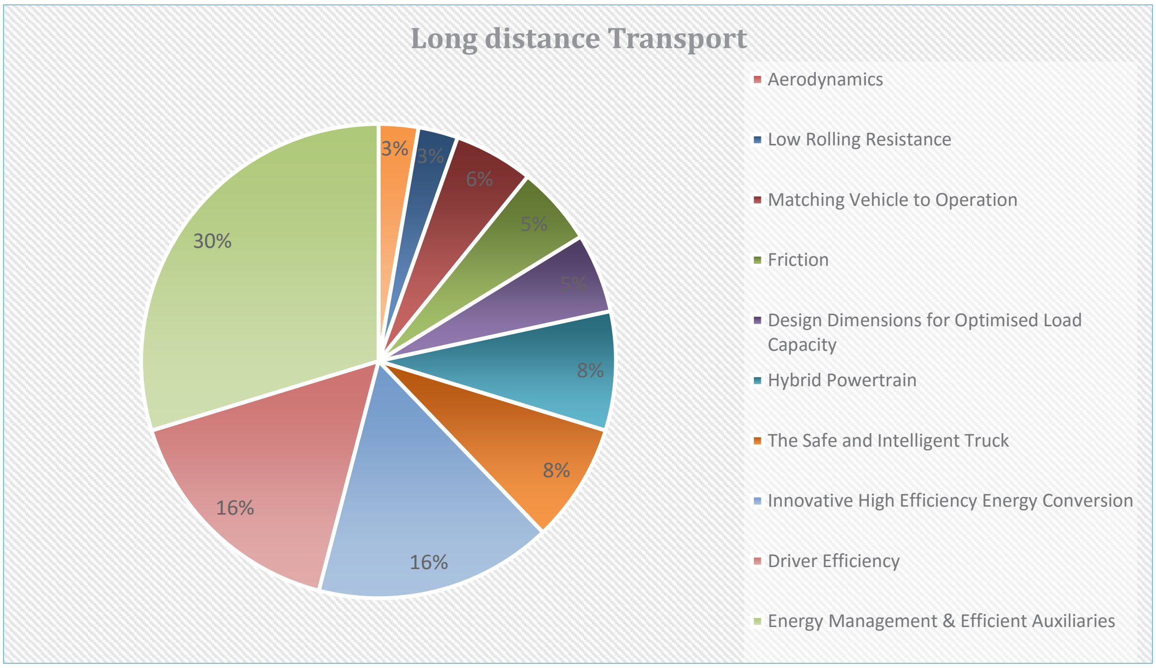


Figure 3: EU Contribution by detailed Technology Fields of "Long distance transport" (questionnaire sample)

3 items represent over 50% of the EU contribution in "Long distance transport" area:

> Energy Management & efficient auxiliaries
> Hybrid powertrain
> Innovative high Efficiency energy conversion.

5 items were not funded in the 44 projects used as basis for the analysis.

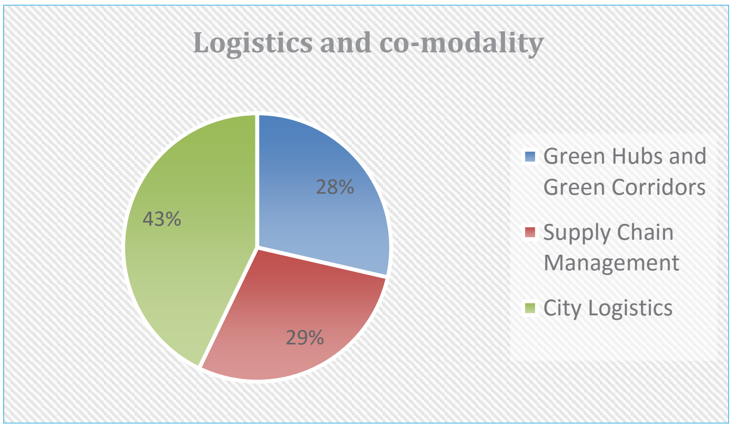


Figure 4: EC Contribution by detailed Technology Fields of "Logistics and co-modality" (questionnaire sample)

4.1. SCIENTIFIC AND TECHNOLOGICAL ACHIEVEMENTS TO SUPPORT EU's ENVIRONMENTAL AMBITION

4.1.1. Scientific and technological achievements

INCREMENTAL VS BREAKTHROUGH INNOVATION IN EGCI PPP

The European Green Cars Initiative (EGCI) covered 3 main areas: electrification of road transport, long-distance transport and logistics and co-modality.

During this 4 years PPP, 2/3 of the budget has been dedicated to the electrification area, leading to a quicker advancement in the state of the art in this area compared to the other topics covered by the initiative. Calls for proposals have been drafted based on the main priorities identified in the Green Cars Roadmap and funded projects selected by independent experts as the most promising ones to tackle key challenges for greening the automotive industry.

The graphs here below detail the project coordinators' assessment of scientific and technological impacts of funded projects:

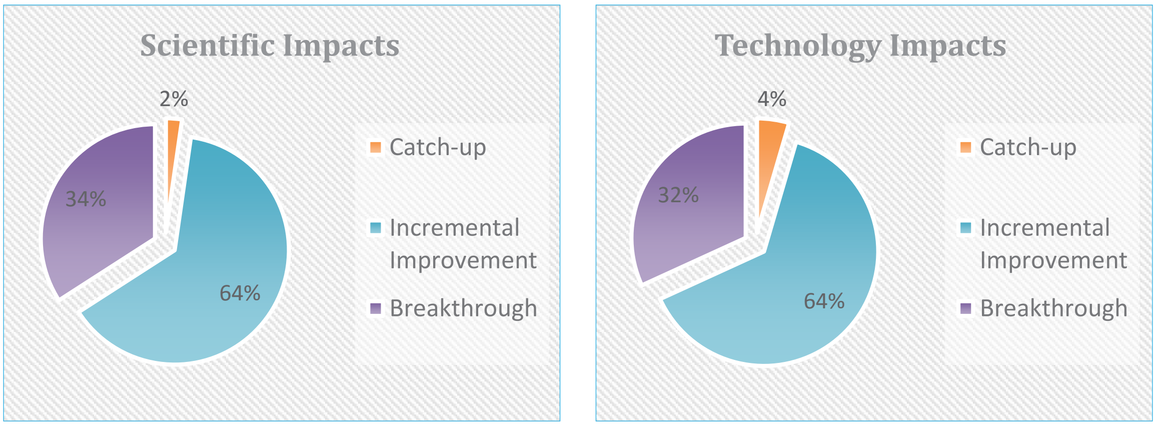


Figure 5: Scientific and Technological project impacts (questionnaire sample)

More than half of the project panel achieved incremental improvements either in terms of scientific or technological impacts, and more than a third of them have resulted in breakthroughs.

Industry & research partners stressed that there is a need to have a balance between incremental & breakthrough innovations.

While breakthrough innovations are needed, they mainly arise from in-house or bilateral research activities with academic institutions.

Incremental innovations on the other side are considered by participants as highly positive and as successful outcomes of the collaborative funded projects. Indeed, incremental innovations are usually easier to integrate into the existing vehicle architectures and still offer an important potential for knowledge improvements and skills reinforcement.

> **Pooling various incremental steps is an essential steps to develop the mobility of tomorrow.**
>
> *"We offer mobility services to society. If we are going to get those products to markets, we need to go through a large number of incremental steps to go from idea through innovation to market. It is quiet acceptable and clear that the collaborative funding should be supporting incremental steps otherwise we do not support the industry and we do not deliver the results to the society.*
>
> *By supporting these incremental steps, we help the ideas work through the process of innovation, work through the process of valley of death of innovation and get to market to deliver improvements to the society." – RTO Comment.*

Industry partners emphasized that incremental innovations are one of the main results of Green Cars funded projects in the different families of technologies considered in the PPP multi annual Roadmap (see figure 5).

- In the field of energy storage system, incremental innovations resulting from a **mosaic of Green Cars projects namely** **clean manufacturing and cell filling activities** have been driven up to a high level of TRL and even already transferred in mass production by partners.
- The **reduction of fuel consumption** has been done through a series of very small steps and incremental innovations that could be more easily integrated to the architecture of the vehicles and in the whole fleet on the market.

Even though EGCI mainly led to incremental innovation, several breakthrough innovations have been achieved in various technological fields thanks to a pool of various successful R&D projects, which include Green Cars funded project, i.e.:

- The **development of integrated solar panels with improved efficiency thanks to their electronics** and the **integration of regenerative braking systems** are two concretes examples derived from Green Cars projects contributing to significant technology advancement in the field of **vehicle systems integration.**

> In the **drive train technologies**, the **development of e-motor configuration** based on fail safe two motors is a meaningful example.

> The **development of specific solution to lower Electromagnetic field** (EMF) generated by e-vehicle as well as the **introduction of new solution for crash safety** in small electrical vehicles was an important contribution to the improvement of safety in electric vehicles.

One of the key factor of success of innovation is a right balance between incremental & breakthrough innovation.

"Of course, when it comes to applied research close to market we should be aware that incremental research is needed. If you would like to accelerate the transfer of the know-how into products in certain stages, you need research addressing incremental steps. However, in the longer term it is also important to come up with breakthrough where universities and RTOs are more involved addressing lower TRLs level." – RTO comment.

The PPP constitutes a unique opportunity for the SMEs, Tier 1s & 2s, OEMs, RTOs and universities involved in the automotive industry at European level to be part of a community of practice and develop incremental & breakthrough solutions in an open innovation ecosystem.

TECHNOLOGY AND SCIENTIFIC ACHIEVEMENTS TO SUPPORT EU ENVIRONMENTAL OBJECTIVES

The combination of incremental and breakthrough innovation will contribute to the improvement of the environmental footprint of road transport by acting on various levers, such as reducing pollutants emissions, improving the introduction of alternative energies sources in powertrains, increasing the energy saving or acting on the raw materials consumption.

The figures hereafter highlight the contribution of EGCI projects to the environmental objectives.

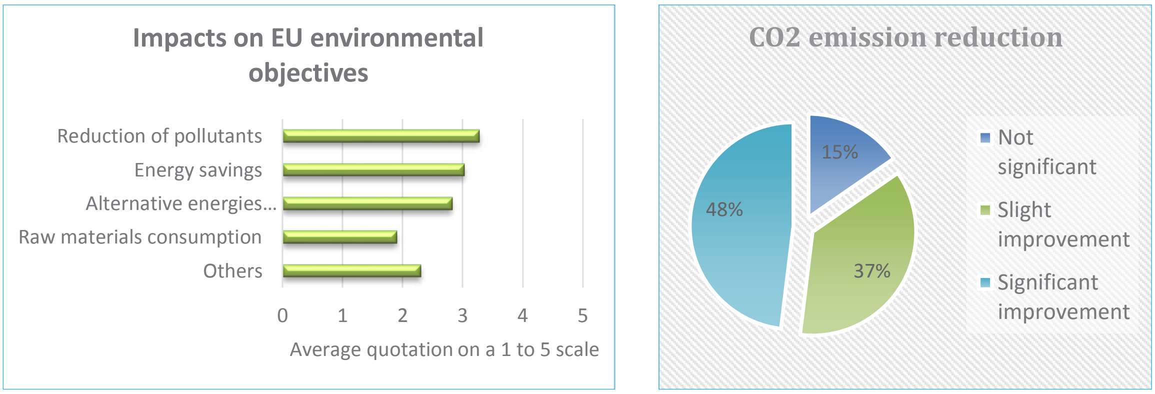


Figure 6: Environmental impacts of EGCI project (questionnaire sample)

On a 1 to 5 scale (1 being minor and 5 being major), project coordinators have performed a self-assessment of their project contribution to various environmental items (energy savings, reduction of pollutants ...).

The majority of the project coordinators agreed on the significant impact of their project regarding CO_2 emission reduction, even though the estimation of precise figures is extremely challenging; several factors will contribute to reduce the CO_2 emissions and their combination will lead to significant reduction once all innovations are implemented in a vehicle.

> ***"The target of the project was 30% improvement in fuel consumption (and hence CO_2 emissions per km); it is likely that this target will be reached following the conclusion of the project." – CONVENIENT Project Coordinator.***

> ***"The aim of LORRY project is to reduce trucks carbon footprint by developing an innovative low-rolling resistance tyre concept". – LORRY project Coordinator.***

EGCI PROJECTS IMPACTS ON THE LI-ION BATTERY VALUE CHAIN

In line with the objective to support electrification of road transport in Europe, and in order to overcome various gaps identified by the European automotive industry, EGCI has addressed through various calls the challenge of high energy storage.

As lithium-ion (Li-ion) battery was considered as the most likely technology to tackle the fundamental challenge of energy storage systems in automotive, EGCI projects have addressed the key technology issues along the Li-ion batteries value chain (see following chart), as well as the materials and manufacturing cost topics (e.g. in the battery pack).

The following chart points out the positive results in the processed materials and cells fields, in which EGCI projects have enabled various breakthroughs, e.g. new cathodes / anodes structures, use of graphene etc. These achievements are the key for future competitive R&D and battery manufacturing activities in Europe.

EGCI Projects Impact on Li-Ion Battery Value Chain

	Processed materials	Electrodes	Cells	Battery Pack
Currently shipped	**Globally**	**Regionally**	**Globally**	**Locally**
Success factors	• Critical to quality • Demand assurance • Cost of capital • Reduction cost input (e.g. regulatory, energy…)	• Critical to quality • Processing know-how (e.g. coating thickness uniformity, solvent & moisture content)	• Critical to quality • Processing know-how (e.g. stack uniformity, drying, formation, electrolyte additive)	• End-product knowledge and integration know-how • Proximity to customers: shipping costs, exchange of technical specifications
EGCI projects	**ELIBAMA ELECTROGRAPH SOMABAT**	**ELIBAMA LABOHR**	**MARS-EV ELIBAMA EUROLIS**	**SMARTLIC SuperLIB ESTRELIA**
Key breakthroughs	• LiTFSI (as salt or co-salt) in Li-ion Batteries and nanometric lithium titanate • Optimise production of graphene for electrode material • Li polymer battery via recyclable solid materials	• 3D structured collector foils for cathodes, various innovative electrode coating processes • O2 cathode operating in the liquid phase and novel system for harvesting O2 from air	•New Si/C based, spinel ferrites and Li metal anodes developed to achieve stable capacity •Robust and reliable electrode foils stacking and welding •Construction of Li-S cell with energy density 500 Wh/kg and power density 1000 W/kg	•Innovative battery monitoring system at cell level, implementing Impedance Spectroscopy for battery state •Dual-cell Battery Concept comprising high-power and high-energy cells • Ultracapacitor power cell pack with 50% higher energy density

4.1.2. Graphics and summary of technological achievements & environmental impact

EGCI projects portfolio clearly demonstrated significant scientific, technological & socio-economic outcomes.

It is important to stress that the technological innovations derived from EGCI are not the result of single projects but more the outcome of clustered projects addressing the same family of technology as emphasized in the EGCI Roadmap.

We highlight below some relevant examples of transverse success stories that address the following families of technologies:

- > Energy storage system
- > CO_2 reduction for road transport heavy duty vehicles
- > Lightweight design
- > Safety systems
- > Drive train technologies

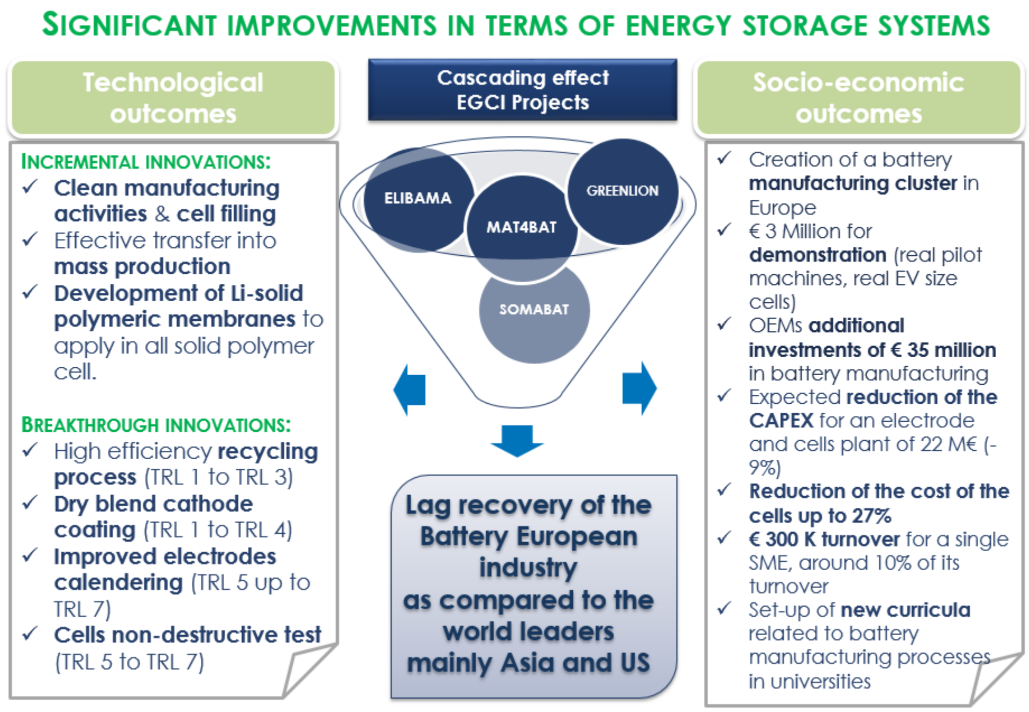
For the seek of highlighting global achievements of the EGCI, the families of technologies listed herebelow are not as detailed as the ones from the Green Cars roadmap but reflects the key areas in which scientific and technological advancements were expected in order to accelerate the greening of road transport, without compromising the safety level achieved in conventional vehicles.

Projects classified under these families of technologies will contribute to address major bottlenecks to the deployment of electrified road transport across Europe:

- > Scientific and technological ones (battery lifetime, energy density, inclusion of new (lighter) materials, engine downsizing, hybridisation, optimisation of electric drivetrain, improvement of energy efficiency of auxiliaries, heat recovery potential…)
- > Socio economic ones (reduction of range anxiety, reduction of the total cost of ownership…)

2013, the last year of Green Cars Initiative, represented a key time for the capacity production of OEMs in terms of electrified vehicles: **the number of EV model launched** (including hybrid vehicles) **almost doubled** between 2012 (23 models) and 2013 (43 models). The projections for 2016 are a total of 57 new EV models[2], testifying the dynamism of the value chain in this area.

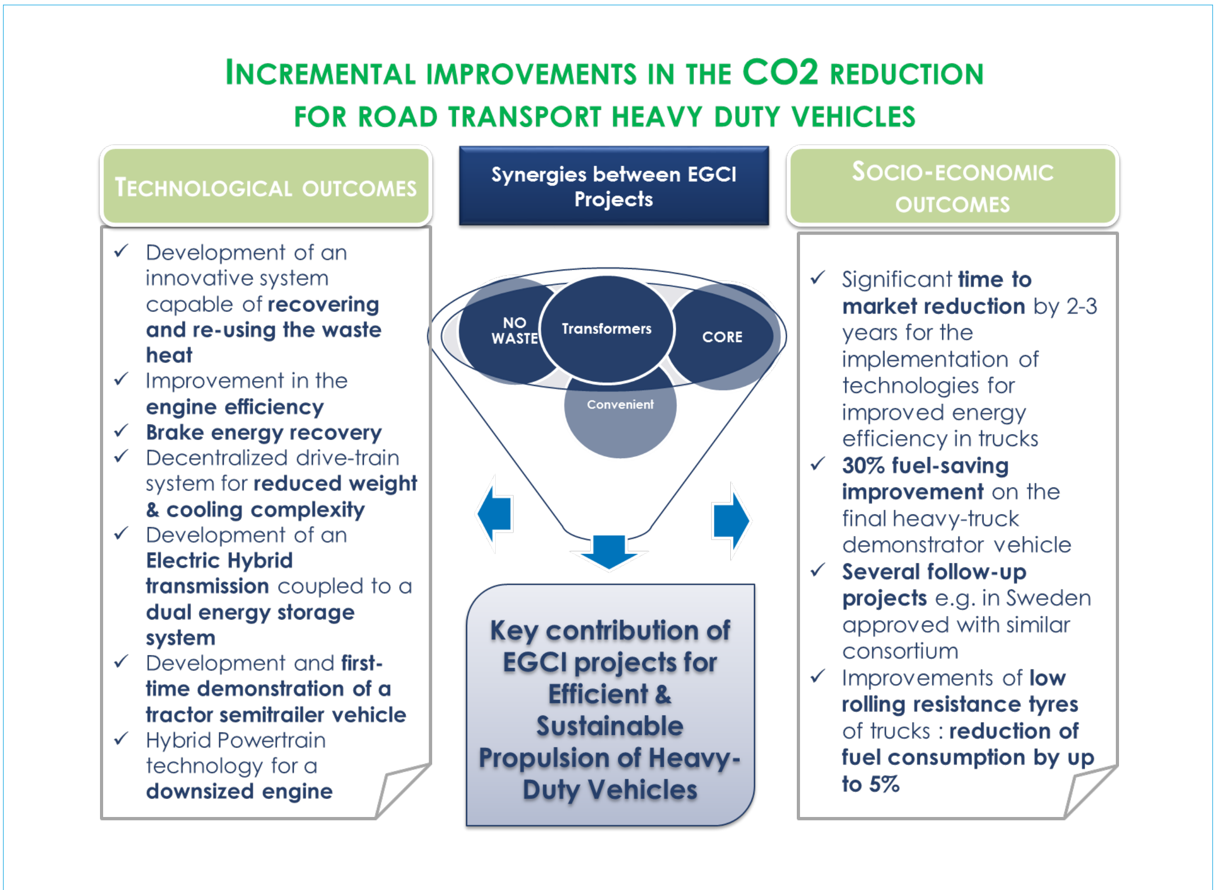
Even though the expected cumulated registered vehicles in the EU (153 000 EVs registered between 2010 and 2014) are still lagging behind the 2016 milestones of EGCI roadmap, the funded projects clearly opened the path for the market uptake in the coming years.



[2] The Amsterdam Roundtables Foundation & McKinsey, Electric Vehicles in Europe: gearing up for a new phase?, 2014

A more detailed review of the milestones achievement, as well as the identification of future areas of investigations needed for further technological advancements in electrification and electric vehicles deployment on the market is currently performed in the framework of the joint Task Force (gathering members from ERTRAC, EPoSS, Smart Grids and EGVIA) reviewing the "Electrification of road transport" roadmap. The outcome of this work will complement the impact assessment of EGCI.

Details on project achievements per technological categories are available in Appendix 2. A mapping of all EGCI projects contribution to those technological areas is available in Appendix 3.

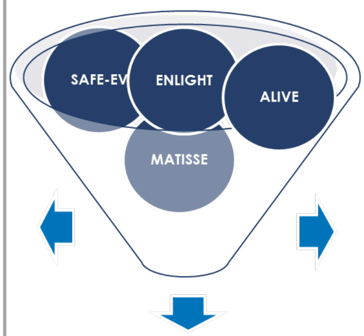


Significant achievements in lightweight design

Technological outcomes

- ✓ Implementation of **advanced lightweight materials such as hybrids, CFRPs or thermoplastics**
- ✓ Qualification of **renewables and low-cost fibers** for the automotive sector
- ✓ Demonstration of the proposed solutions through the realization of **5 full scale demonstrator modules:**
  - ❖ Front module
  - ❖ Firewall
  - ❖ Central floor section
  - ❖ Sub-frame & suspension
  - ❖ Doors/Enclosures

European Cluster on lightweight design



Lightweight materials highly desirable to :

- **Reach EU CO2 regulation**
- **Reduce system cost**
- **Improve the driving performance**

Overall lightweight market in automotive : from **€ 70 bn in 2010** up to **€ 300 bn in 2030**

Socio-economic outcomes

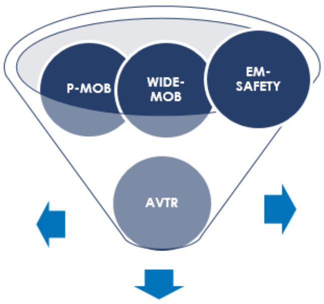
- ✓ **€ 20 million of investments** by the partners
- ✓ **Cost-effective manufacturing technologies** for medium-scale production advanced lightweight materials
- ✓ **LCA and economic analysis** to ensure the highest probability of application by 2020
- ✓ **Highly innovative lightweight / low embedded CO_2 materials** for their application in medium-volume automotive production **(50.000 units/year)**
- ✓ **Each considered module saves 20% weight**
- ✓ **Weight & Cost impact of lightweight materials: 250-490 kg at 4 -10 €/kg saved**

Technological achievements in the drivetrain technologies in small urban electric vehicles

Technological outcomes

- First **Fail-safe two motor powertrain**
- Efficiency with **best in class aerodynamic**
- Development of a **novel chassis & manufacturing methods**
- New solution for **crash safety** in small electric vehicles
- **High-level ergonomics** for a supercompact vehicle
- Smart photovoltaic capable of an average 20km/day by solar energy
- Specific solution to **lower Electro-Magnetic Field**
- New power cables and connectors for **magnetic field minimization**

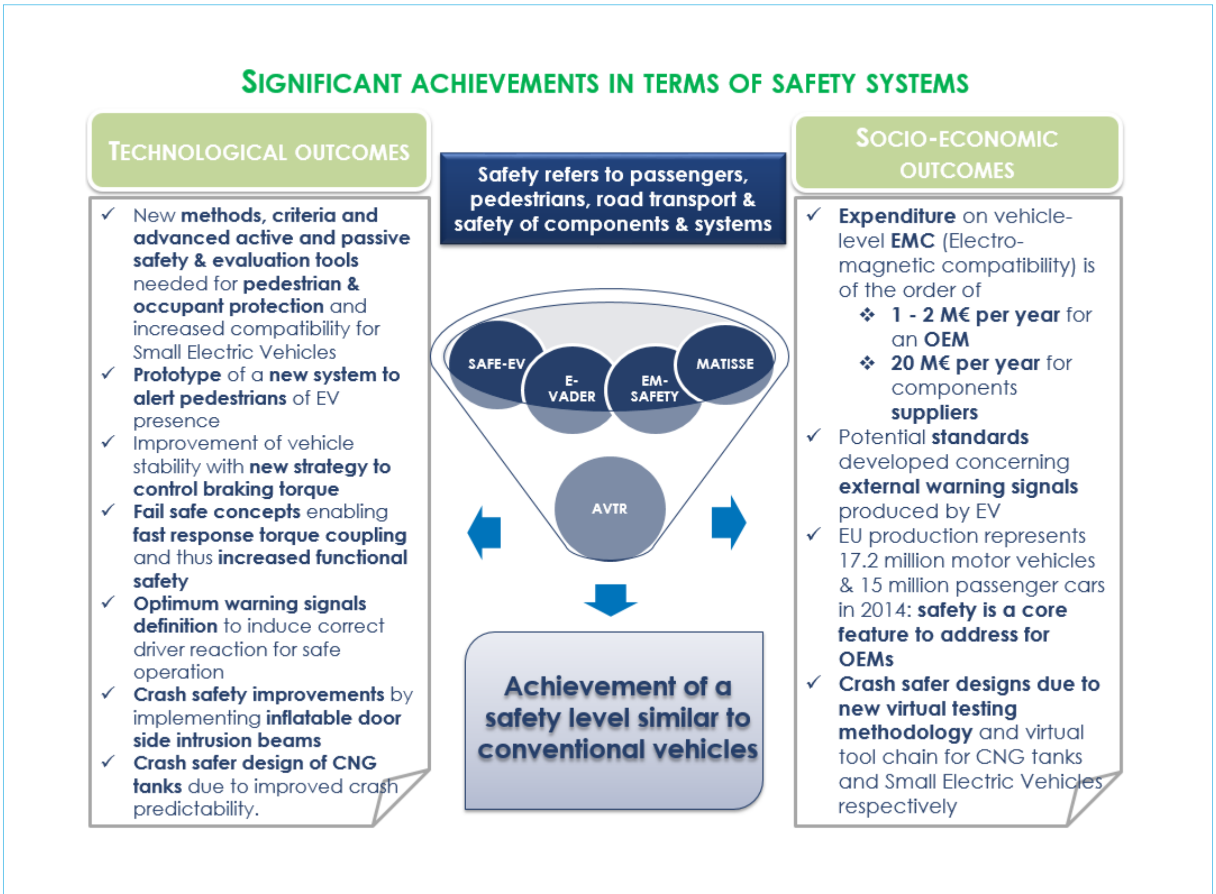
Integrated approach



Important milestone in the development of Small Urban Electric Vehicles

Socio-economic outcomes

- Generation of a **spin-off** (IFEVS)
- **30+ new R&D skills** created
- Creation of a **cluster of SMEs in Torino region** (Torino e-district) focused on Electromobility field
- Set-up of a **new low-cost production facility** in Torino
- Several **patents on chassis design & manufacturing** approach
- **Exploitation of patent portfolio** of partners at **worldwide level**
- **Commercialization** of new **gear boxes, BMS systems & smart photovoltaic systems & new bumpers**


SIGNIFICANT ACHIEVEMENTS IN TERMS OF SAFETY SYSTEMS
TECHNOLOGICAL OUTCOMES
✓ New methods, criteria and advanced active and passive safety & evaluation tools needed for pedestrian & occupant protection and increased compatibility for Small Electric Vehicles
✓ Prototype of a new system to alert pedestrians of EV presence
✓ Improvement of vehicle stability with new strategy to control braking torque
✓ Fail safe concepts enabling fast response torque coupling and thus increased functional safety
✓ Optimum warning signals definition to induce correct driver reaction for safe operation
✓ Crash safety improvements by implementing inflatable door side intrusion beams
✓ Crash safer design of CNG tanks due to improved crash predictability.
Safety refers to passengers, pedestrians, road transport & safety of components & systems
SAFE-EV
E-VADER
EM-SAFETY
MATISSE
AVTR
Achievement of a safety level similar to conventional vehicles
SOCIO-ECONOMIC OUTCOMES
✓ Expenditure on vehicle-level EMC (Electro-magnetic compatibility) is of the order of
❖ 1 - 2 M€ per year for an OEM
❖ 20 M€ per year for components suppliers
✓ Potential standards developed concerning external warning signals produced by EV
✓ EU production represents 17.2 million motor vehicles & 15 million passenger cars in 2014: safety is a core feature to address for OEMs
✓ Crash safer designs due to new virtual testing methodology and virtual tool chain for CNG tanks and Small Electric Vehicles respectively

4.2. EGCI PPP IMPACTS ON STRATEGIC R&D AND BUSINESS DEVELOPMENT OF PROJECT STAKEHOLDERS

Beyond the scientific and global environmental impact on the European automotive industry, EGCI PPP projects have encouraged partners to adjust their own R&D and business development strategies, according to project outcomes and to align them with those taken by the other stakeholders, creating a community of practices.

4.2.1. Impact on R&D strategies of stakeholders

One of the added value of the EGCI PPP – compared to regular collaborative funding scheme – is that collaboration between project partners goes beyond a single project.

The EGCI funded projects had a significant influence on the R&D strategy of the participating entities although it had less effect on the R&D budgets of the partners.

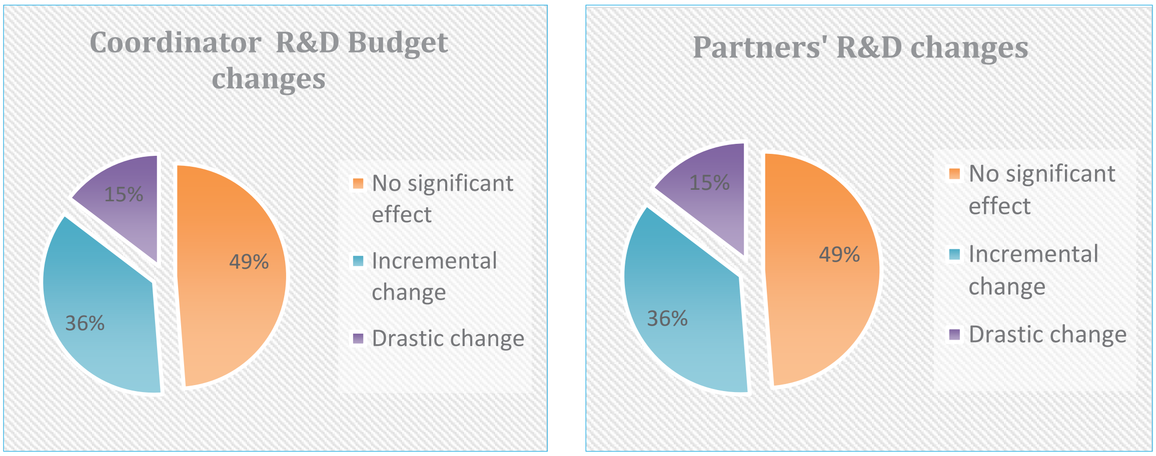


Figure 7: EGCI projects impacts on budget & strategy of stakeholders (questionnaire sample)

FOSTERING VALUE CHAIN INTEGRATION: FROM COMMON PROJECTS TO SHARED TECHNOLOGICAL PRIORITIES

The participation in Green Cars funded projects gave the opportunity for project partners to clarify and consolidate their R&D roadmaps according to the results of the projects. Depending on the outcomes of the projects, those roadmaps have been either consolidated or adjusted in order to align their R&D strategy to the market's needs.

Green cars project could have a direct impact on the participants R&D roadmaps.

"By giving a better understanding of the environmental and economic impact of the electrodes and cells production and by exploring innovative manufacturing paths, the ELIBAMA project contributed to modify the electrification roadmap of Renault." – ELIBAMA project coordinator.

"Our R&D strategy has a long term focus on electric powertrain components; the results of SuperLib confirmed this strategy." – SUPERLIB Project Coordinator.

Industry & RTOs / academic partners shared technological priorities and common interest fields.

From an industrial point of view, a continuous roadmapping exercise as well as the monitoring of research activities performed by the companies are necessary to identify the technology fields in which further investigations are still needed. The PPP was the opportunity to **identify the scientific and technological areas in which the impact of acting in collaboration at pre-competitive stage and European level will be greater than the performance of the same activities on a competitive basis.**

From RTOs perspective, some of the technologies developed at European level are then transferred and industrialized at national level in a more bilateral way with industry partners, generating new opportunities for collaboration.

TOWARDS BROADER COOPERATION

The participation in Green Cars projects enables partners to get inputs from the other consortium members, sometimes at a different layer of the value chain, and contribute to the success of the project thanks to the R&D capabilities of each partner. It is a unique opportunity for industry and research partners to initiate a **multilateral cooperation** and to **launch partnership beyond their national / regional supply chain.**

As an example, a Tier 1 stressed the specific contribution of EGCI projects in the development of its Open Innovation Network: from 2009 to 2015, its partnerships with RTOs, universities and other industry partners increased from 3 to more than 50, some of them being direct consequences of the participation in Green Cars projects.

Broader cooperation possibilities are also offered to project members by progressive integration in clusters, sometimes directly linked to EGCI projects and its main members, as it is the case for the Torino e-District cluster.

The **constitution of clusters** is one of the positive outcome from the Green Cars projects. It generally encompasses various partners, who represent the whole value chain at local level.

These clusters shape core groups in some specific technology fields and facilitate the structuring of an eco-system.

Contribution to the structuration of local eco-systems

"Torino e-District is a cluster of companies based in Turin area which has been launched by IFEVS (Interactive Full Electric Vehicles), a spin-off resulted from P-MOB & WIDE-MOB Green Cars projects.

It is organized as an integrated supply chain (Conception/Specification, Engineering & Running Vehicles). The cluster puts together car industry suppliers which work in the follow-up of WIDE-MOB project." – WIDE-MOB Project Coordinator.

4.2.2. Impact on business opportunities

STRENGTHENING BUSINESS COMMON OPPORTUNITIES

For many project members, beyond the research and/or development activities, being involved in a PPP project is also a way to further strengthen their business opportunities and collaborations.

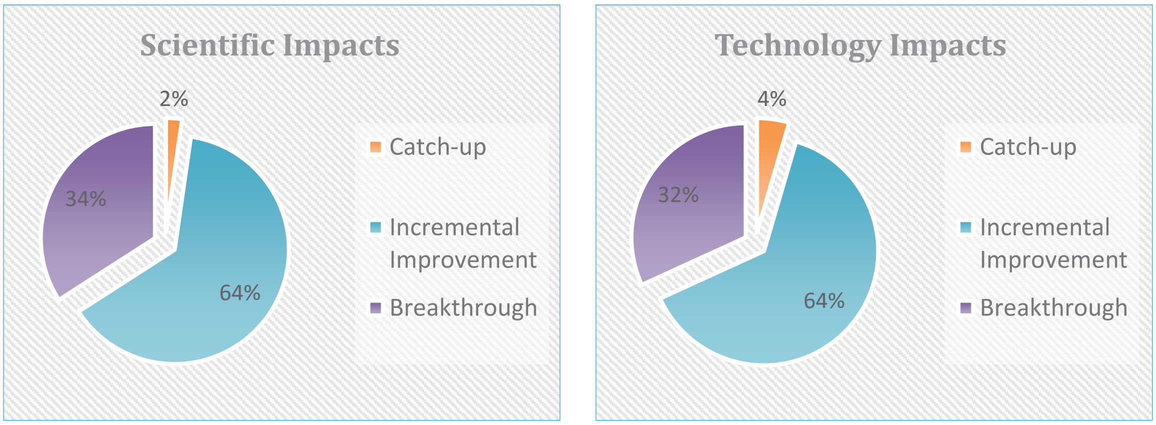


Figure 8: Business impacts (questionnaire sample)

These stakeholders outlined that the results of the projects were exploited internally through **new and earlier bilateral collaborations** (mainly between industry and RTOs). European collaborative research projects provide an opportunity for RTOs and academic partners to **measure the level of interest of their research activities by the industrial partners** and to adjust their roadmap accordingly. Furthermore, they allow partners to transfer the results of the projects to the industrial environment.

The majority of project coordinators emphasize that the Green Cars projects contributed to **build or tighten relationships between partners** on specific technology fields.

Academic and industry partners learnt from each other during the collaborative research projects and, for some of them, maintained their relationships through follow-up projects addressing more advanced Technology Readiness Level (TRLs) in the European Green Vehicles Initiative PPP under the H2020 Programme.
Follow-up could also take the form of bilateral business collaborations or research projects between industry partners & universities.

"The University of Surrey is involved in the follow-up FP7 projects iCOMPOSE, SilverStream, PLUS-MOBY and FREE-MOBY {partly involving the same partners, and partly involving complementary partners}." – E-VECTOORC Project Coordinator.

"The RTOs, the University and the OEMs are involved in a running FP7 project MAT4BAT. Even if this project mainly deals with batteries material developments, it included some activities directly following the non-destructive test task of ELIBAMA.

A German granted project has also been launched to continue the work started in ELIBAMA on solvent free electrodes coating." – ELIBAMA Project Coordinator.

FOSTER BUSINESS INTIMACY

This assessment also underlines the opportunity to work directly with customers, to take into account their needs and specifications earlier in the development phase and, therefore, to go faster to the market with targeted and efficient innovations developed.

The Research & Development cycle in automotive industry takes time (generally 5 to 10 years for the Development-Innovation stage and the Industrialization stage combined); any saving in the research and innovation phase is of great added-value to **speed-up market uptake** and could be a game changer in the competitive worldwide landscape.

The issue of trust is fundamental because most successful projects are those in which the atmosphere of work was based on mutual trust, a frank involvement and knowledge sharing. Generally, the success of a project leads to follow-up projects bilaterally or through a new consortium in H2020 programme or at national level.

This **cascading effect** is a key opportunity for stakeholders to ensure the consistency of their research activities and ease technological advancement by pulling results from funded projects to a higher TRL.

Pre-competitive collaborative project allows to take into consideration customers experience at an early stage

"Our strategy is very much customer driven. With SMART-LIC we could confirm the view on the market coming from the experience with the customers. It has allowed our company to take important selection decisions." – SMART-LIC Project Coordinator.

EGCI projects enabled industry, RTOs, universities and SMEs to reinforce and extend their collaborations and reinforced the consistency between stakeholder's strategies.
By reinforcing collaboration between stakeholders, EGCI projects also contributed to save time in development of innovative technologies.

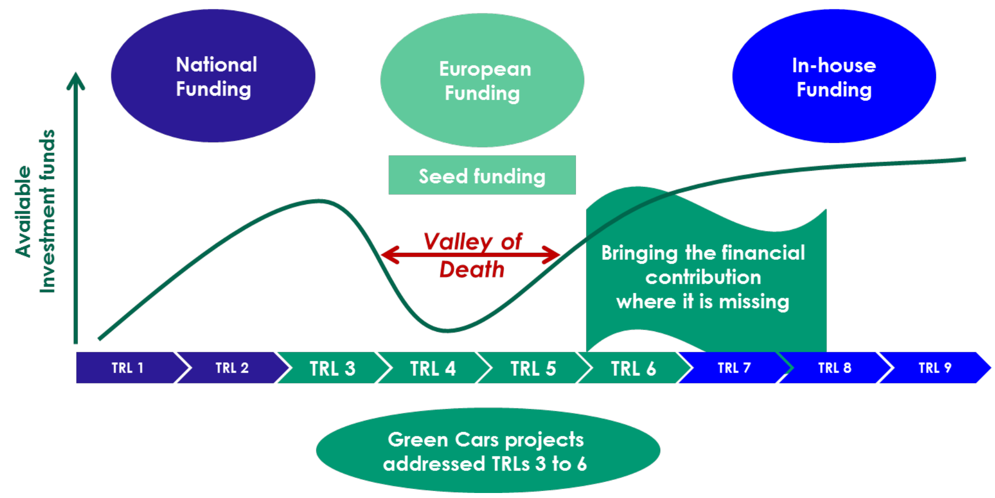
4.3. SHARING RISKS TO OVERCOME THE VALLEY OF DEATH OF INNOVATION – FINANCIAL IMPACT OF THE PPP

4.3.1. European funding to support pre-competitive research

The **sharing of R&D risks and costs** was stressed by the industry partners as a key driver for going for this kind of EU collaborative research projects. As matter of fact, sharing the R&D financial risks of long-term pre-competitive research is a way for global players to maintain and sustain their competitiveness at worldwide level. Besides, interviews emphasized the positive impact of Green Cars projects in terms of time and money saving in the pre-competitive stage of research: companies launched the research activity earlier than if self-financed, providing them an advantage in the global competition.

The collaboration between industry partners in PPP such as Green Cars enable significant economies of scale for the development of innovations in the different families of technologies targeted in the PPP. For instance, the cross fertilization between actors and projects allow to decrease the costs of technologies and components such as the battery cell costs by 27%.

RTOs and academic partners with less financial capacity stressed the importance of European collaborative research in order to overcome the valley of death period of innovation (TRL 3 to 5).



European funding is considered by the industry partners as a seed-funding and an accelerator for their pre-competitive research.

Over the four years of EGCI, the European Union provided a financial contribution to project partners for a total amount of **€ 418 million**, which has been complemented by **private stakeholders' co-investment in EGCI pre-competitive research projects**, for a **total budget of € 662 million.**

In parallel to the participation to EU collaborative research project, the automotive and parts sector is investing a lot in R&D activities; for the single year 2014, it spent **€41.5 billion on Research & Development** activities, putting it as first R&D investor sector in the EU.

Research activities of the **OEMs & Tier 1s** represent **about 5 to 10% of their total R&D budget.** The rest is dedicated to the Development activities (TRL 6 and above). Moreover, less **than a third of the research budget is dedicated to new powertrain technologies.**

Therefore, the European funding received through EGCI (over €400 million) is important for the pre-competitive research activities of the industry partners.

OEMs and research partners invest about 3 to 5 times the funding coming-in from European programmes.

Even though the total amount dedicated to the initiative remains relatively low compared to the total amount dedicated by the automotive industry to R&D, various levers still attract industry partners:

- **Collaboration with the whole value chain** at European level and the access to a broad range of research capabilities
- **Sharing of knowledge and best practices** in each family of technologies described in the Green Cars Roadmap
- Industry partners spent money and have an interest by participating in PPP programmes. The contractualisation through the European Commission is a **guarantee of fairness and sustainability of the relationships between partners**
- European funding enables OEMs & suppliers to **save time** by starting projects earlier than they would have planned if self-financed, generally 1 to 2 years before
- European funded projects also enable partners to **take the risk to fail** which is inherent to the innovation process.

> ***"The funding received by the European Commission is lower than our R&D expenditures inside the company but it is essential for our pre-competitive research projects. Indeed, these European projects like Green Cars enable us to save time by starting projects earlier than we planned, generally 1 or 2 years before. Money received by the Commission is an accelerator which provides us a competitive advantage in a specific technology field."***

4.3.2. National funding inspired by this PPP model: to boost value chain in R&D

Since 2009, the success of EGCI PPP can also be measured thought a wide replication process in different European countries. This “mirror effect” emphasizes the importance of the electrification at national level and the positive impact of EGCI on institutional local bodies. Several institutional bodies were created as interface between industry partners at national level and European institutions such as the Automotive Council UK established in 2009.

France: with the **“Pacte Automobile”**, started to actively support the domestic market back in 2009, **€250 million** is dedicated to **Green projects** and the creation of a modernization Fund of about **€600** million to sustain the automotive suppliers.

UK: which invested **£500 million** to support the development of **low emission vehicles** through the Low Carbon Vehicle Partnerships (LCV), organized in 5 Working Groups:

- Bus,
- Passenger car,
- Fuel,
- Innovation,
- Commercial Vehicle Interest Group.

Sweden: The Strategic Vehicle Research & Innovation PPP supervised by Vinnova, which devoted **€100 million** per year on **automotive research** (covering Production, Automation, Logistic, Software and Energy). About 20% of this amount, i.e. €20 million per year, being dedicated to Electrification since 2009. It addresses the following **families of technologies:**

> Energy and Environment,
> Traffic Safety and Automated Vehicles,
> Electronics,
> Software and Communication,
> Sustainable Production,
> Efficient and Connected Transport Systems.

Austria: focus on **propulsion** family of technology through Austrian Association for Advanced Propulsion Systems (A3PS); **€60 million** devoted on electrification related topics all along the programme duration.

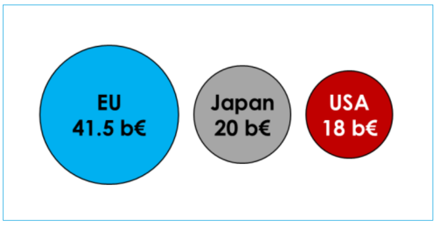
Germany: The German National Platform for Electric Mobility (NPE) was founded on the initiative of the Federal Government in 2007 with a €360 million per annum public funding on several topics:

> Vehicle Technology
> **Battery Technology** (in the past three years alone, over **€600 million** has been invested in developing battery systems)
> Charging Infrastructure & Power Grid Integration
> Regulation, Standardization & Certification
> Education & Training
> One of the major achievements of this initiative is the development of **17 electric models already on the market,** a further **12 following in 2015** and **some 34,000 electric cars** (as of March 2015) are already on Germany's roads.

EGCI PPP has provided a key financial support to the partners with less financial capacities. This scheme has proved to be a successful one: several Member States initiated similar programmes replicating the models and targeted similar and complementary topics.

4.4. HUMAN RESOURCES / SAVING JOBS AND DEVELOPING NEW SKILLS

The automotive industry provides jobs for more than 12 million people and accounts for 4% of the EU's GDP. The EU is among the world's biggest producers of motor vehicles and the sector represents the largest private investor in research and development (R&D): in 2014, the automotive and parts sector invested €41,5 billion in Research & Development activities.



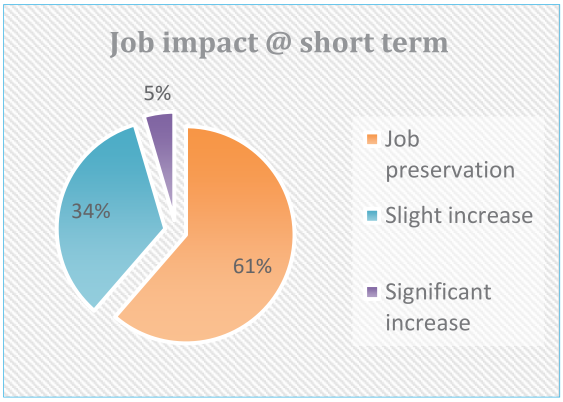
The different interviews with project coordinators, senior R&D managers or research directors underlined the importance not only to preserve jobs in the difficult context of 2008 but also to ensure the acquisition of **new competences and skills for the workforce and maintain the quality of R&D jobs** in order to be able to answer the upcoming challenges. For instance, new competences were acquired by the industry partners in the battery manufacturing field thanks to Green Cars projects. EGCI allowed the preservation and even the creation of R&D jobs in Europe with a **"catapult" effect on the job preservation in the whole automotive industry. One R&D job has a multiplier effect of about 5 on employment within the region**[3] where it is created, EU-wide employment could therefore increase by 850,000 to 1.1 million in 2030 in scenarii in which Europe moves rapidly to a fleet of advanced hybrid and battery-electric vehicles.[4]

The European automotive industry has a **catapult effect on other sectors;** the development of low-carbon technologies will contribute to promote high-skills jobs and **boost the creation of new jobs outside the automotive industry** such as services, chemicals, electrical & electronical equipment and manufacturing.

[3] The Multiplier Effect of Innovation Jobs, Leslie Brokaw, MIT Sloan Management Review, 2012

[4] Fuelling Europe's Future - How auto innovation leads to EU jobs, Cambridge Econometrics (CE), in collaboration with Ricardo-AEA & Element Energy, 2013, Brussels

"From a longer term point of view, a significant impact in term of job creation could be expected as ELIBAMA enables to drastically improve the competitiveness of the partners in the battery manufacturing field. This competitiveness will be a clear benefit when the battery industry will settle in Europe (when the EV market will be at a sufficient level)." – ELIBAMA Project Coordinator.



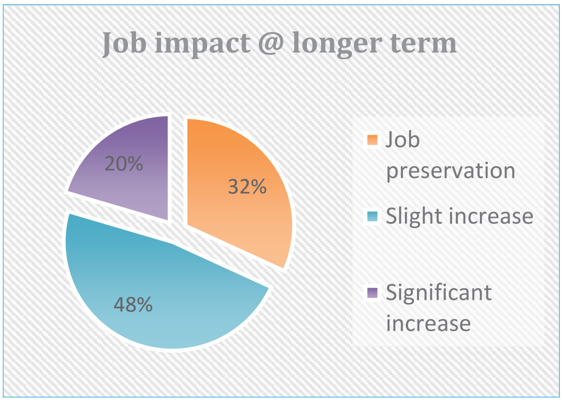


Figure 9: Job impact (questionnaire sample)

At short term job preservation is the main impact, although a slight increase in jobs is almost equally mentioned. At longer term two thirds of the project will result in job increase.

Even though the jobs creation is difficult to estimate precisely, Green Cars projects led to the **creation of several cluster and spin-offs,** among which IFEVS (Interactive Full Electric Vehicles) in Italy which is already a tangible results of the P-MOB project. This spin-off does not represent an important number of jobs creation compared to the total sector but it will contribute to **structure the ecosystem** in this geographic area and more jobs creation are expected in the near future.

It is important to outline the critical importance of Green Cars projects for universities as it was a positive incentive for them to offer **relevant and targeted PhDs topics** to their students. Universities also used Green Cars projects to propose R&D jobs to their engineers and PhDs within their industry partners. Ensuring the **development of appropriate curricula** thanks to a close collaboration between industry partners and universities is one of the key to ensure the competencies that will be needed to produce the next generation of vehicles could be found in the European Union.

Green Cars Initiative projects allowed industry and academic partners to learn and enrich from each other.

> *"Concretely, all partners drastically increased their knowledge in the batteries manufacturing field during the project. The work done commonly also reinforced the battery cluster in Europe." – ELIBAMA project coordinator.*

EGCI PPP has contributed to preserve jobs in the automotive sector in a difficult context of financial crisis. Beyond preserving jobs, EGCI also had a catapult effect and contribute to the creation of new curricula in universities.

4.5. PARTNER CONTRIBUTIONS – ADDED VALUE FOR SMES & ACADEMICS PARTNERS

In a very structured sector such as automotive, SMEs and academia might face difficulties to stand out. However, the contribution from those stakeholders to Green Cars project have been highlighted as essential for the success of the projects.

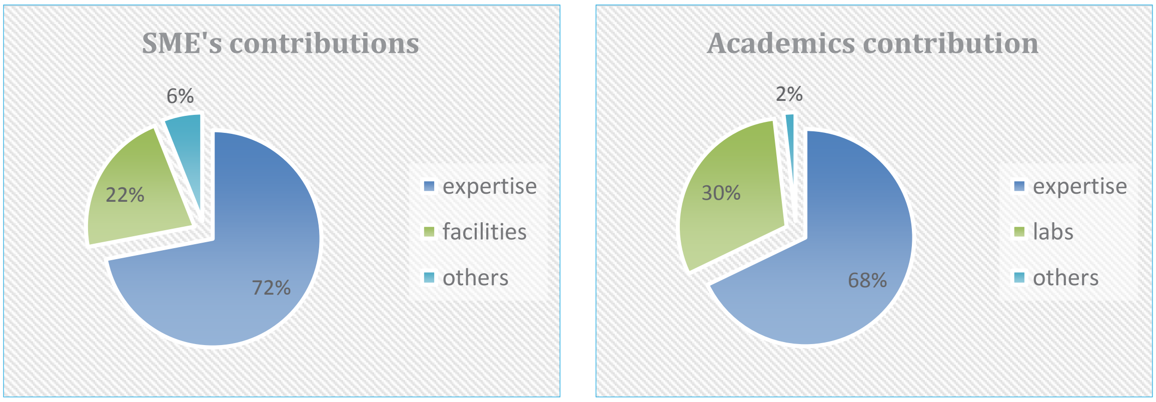


Figure 10: Partners' contributions (questionnaire sample)

In about 2/3 of the projects SMEs and academics mainly brought key expertise.

PROMOTION OF THE TARGETED EXPERTISE OF SMEs

Contributions from SMEs are mentioned as positive: project coordinators highlighted their added-value, their expertise and the benefits derived from their involvement in these collaborative research projects.

SMEs provided technical expertise in a niche technology field and benefited also from the networking effect through collaboration with potential customers. Green Cars projects provided to these SMEs the opportunity to develop their solutions, validate methodologies and grasp OEMs or supplier's needs.

> ***"The SMEs involved in the ELIBAMA project mainly bring their core expertise to the project's tasks and activities:***
>
> ***– Ingecal and Kroenert in the field of coating a calendering equipments and processes.***
>
> ***– Entegris as filtering expert involved in the clean manufacturing task.***
>
> ***– In-Core brought its expertise in vision and control technics to adapt it to the batteries manufacturing processes.***
>
> ***– In a less technical domain, PE International came with its LCA experience to help the partners understand the environmental key points in the electrodes and cells manufacturing but also in the recycling." – ELIBAMA Project Coordinator.***

STRATEGIC POSITIONNING OF SMES IN THE R&D LANDSCAPE

SMEs learned about the strategies of OEMs, the demand and the threats of the EV market. This learning stage will nurture their own technology roadmaps and **influence the national ecosystem,** namely research institutes and universities, to participate in the PPP and the national government to **replicate PPP at national level.** It is for instance the case of medium size company HIDRIA group in Slovenia.

SMEs acknowledged the critical importance of PPP in the development of their research & development and business activities. More concretely, SMEs involved are satisfied by their participation in the European projects in terms of **networking with industry partners,** the co-conception of technological solutions with potential customers (OEMs, Tier 1s...) and **spread of their business activities** at European level.

> ***"In this project, the SME called Polimodel had a crucial role and was in charge to conceive a prototype vehicle based on the P-MOB project as platform to demonstrate the applicability of the developed technology advances. Polimodel***

has now the opportunities to collaborate with some large companies like FCA & ST Microlectronics, especially in the H2020 Programme." – WIDE-MOB Project Coordinator.

INTERNATIONALIZATION OF R&D FOR SMES

Interviews with R&D managers and professional associations in Europe stressed that one of the main effect of European research projects is the **internationalization of R&D.** In other words, these collaborative pre-competitive projects offer to large companies, SMEs, research organisations and universities the opportunity to internationalize their pre-competitive research activities by **pooling resources** and **mobilize skills** across Europe.

ACADEMIC AND RESEARCH PARTNERS

Regarding scientific impacts, academic and research organisations were generally well represented in the Green Cars PPP.

Project coordinators outlined the **key expertise and the key experiment laboratories** brought by the academic & research organizations in the Green Cars Initiative projects.

"We worked with high-standard academic partners who hold some know-how in terms or methodologies and our team of engineers learnt from them. They are key partners specifically for setting up new innovative materials.

The involvement of 6 academic & research organizations permits to save time (nearly one third) and one year in terms of development of the new tires with low rolling resistance." – LORRY Project Coordinator.

Academic & Research partners deployed their methodologies, innovative concepts and competences which were transferable to the industry partners during the project.

The participation of academic partners in Green Cars projects allowed them to develop more applied oriented research in parallel or in addition to the basic research that was already performed thanks to their close collaboration with industry representatives. The opportunity to collaborate with other research partners – beyond their regular collaborations – was a great opportunity for **knowledge transfer** between academic & research organizations across borders which contribute to a catch-up effect between laboratories. Last but not least, **new curricula and jobs creation** (PhD, scientists, engineers, post-docs…) have resulted from their participation in Green Cars.

EGCI projects have been a great opportunity for SMEs and universities to be included in an innovative eco-system and benefit from closest business relations with major stakeholders. Their specific expertise and capacities have been a key factor of success for several funded projects.

4.6. EU COMPETITIVENESS

EGCI PPP had brought to the European automotive industry the opportunity to remain competitive and enabled it to conceive and develop the upcoming solutions for the electrification of road transport.

4.6.1. Preserve the environment of pre-competitive European R&D

The interviews conducted with senior managers & high-level representatives of research & academic organisations highlighted the uniqueness of the PPP scheme in Europe, with respect to US and Japan:

> Being pre-competitive research activities, EGCI projects pushed industry partners to develop research projects that they would not do on their own.

> European collaborative research projects enable to put together all the competent partners of the value chain (OEMs, suppliers, research institutes…)

> The PPP projects are seen as a guarantee of **fairness and sustainability of the research activities** during 3 or 4 years

> In terms of funding level, it is the specificity of the PPP that has to be preserved and highlighted. Asia and America fund in more direct and "opaque" systems their own automotive research. It is never a multi country approach as is the requirement of the EU scheme.

> The amount of funding particularly in powertrain research in Japan, China and US may be more important versus Europe. But it is the uniqueness of the transversality of the PPP projects that makes it special in our continent.

COMPETITIVE ADVANTAGE OF PPP AS PER ITS TRL SCOPE:

Contrary to the USA and Asia, which programmes mainly address fundamental research with low TRLs, European projects were more focused on **pre-competitive research TRLs 3 to 5.**

The cyclical approach (funding of low TRLs projects followed by high TRLs projects and so forth) is also a key feature of European PPP. By focusing in the middle level of TRLs the EGCI PPP was able to become a useful brick between lower and higher TRLs projects: it helped to cover the cyclical approach.

This feature was also acknowledged by the project coordinators', as circa half of them consider this funding mechanism and the specific focus on pre-competitive research as a possibility to **maintain automotive R&D at world standard in a crisis context.**

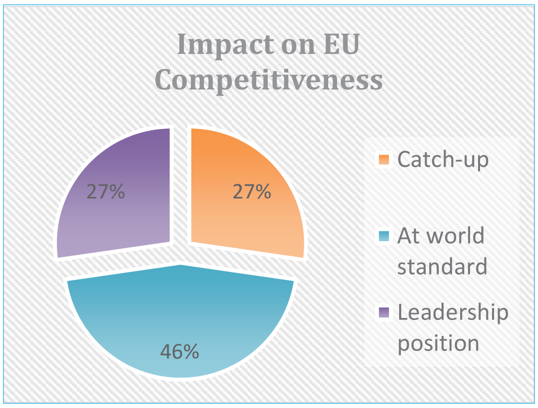


Figure 11: Impact on EU Competitiveness (questionnaire sample)

4.6.2. Collaborative approach to foster European competitive value chain and consolidate electrification R&D arena.

The EGCI specific funding mechanism based on **strong collaboration between various stakeholders** of European automotive R&D has created a clear knock-on effect on all actors and thus a positive impact on the European automotive competitiveness.

According to the project coordinators, about three quarters of the projects put the EU at world standard or at a leadership position in their fields. Benefits derived from networking between public & private partners during the whole lifecycle of the project seem to be relevant for all the projects assessed.

To this point, project coordinators stressed the different impacts of the networking as follows:

> The opportunity to address R&D issues with stakeholders positioned in the whole **value chain**

> **Knowledge transfer** like scientific and technological transfer between SMEs, large companies and academic partners

> The compliant collaboration between competitors which enable them to **develop technological standards and share common R&D priorities**

> The creation of a **cluster** in a specific technology fields included in the EGCI Multi-annual Roadmap

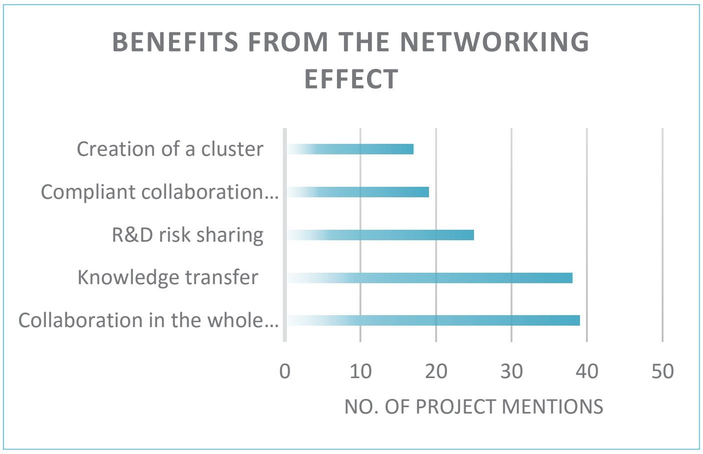


Figure 12: Impact from the networking effect (questionnaire sample)

"GeM project could be considered as a success story by bringing together the common experience of the 42 partners - industrial companies and automobile manufacturers, utilities, municipalities, universities, and technology & research institutions - the excellent results of Green eMotion could be achieved to define and implement an interoperable electromobility system, the cooperation of all electromobility stakeholder groups was necessary".
Green eMotion (GeM) Project Coordinator.

Contrary to other countries, **European projects are much more collaborative and foster global competitiveness.** Indeed, in Europe, public & private stakeholders try to find complementarity activities rather than competing activities, contrary to the US, in which competitive programmes are more common, but less collaborative.

"In Austria, we are a supply industry. Then you need to research some other partners. EU research projects enabled us to build more easily the supply chain. If you are only national active, you are missing some partners of the supply chain in the industry. We have to consider a unique market in our strategic policy. We can build now supply chain activities and we are finding research institutes who are not in Austria but somewhere in Europe but leading in a specific field and which you can integrate in a project that is really an advantage."

At macro level, European collaborative research projects provide an extremely important support through funding & access to high-level skills to the competitiveness of the automotive industry in the European regions like Sweden, UK, Spain or Austria.

Finally, the participation of industry partners in European projects from outside EU countries could also be considered as valuable for the European automotive industry in terms of sharing technological issues, learning from different approaches and cultures in order to access to non-European markets.

4.6.3. Standardization activities

Collaborative research projects like Green Cars projects also permit to industry partners (large companies, SMEs), and, more precisely, compliant competitors to work together and **launch pre-normative activities** which are particularly useful for the industry in order to anticipate the needs of the market and the technological and legal shifts.

> *"If you are thinking about standardization and regulation activities, you can only do it in a European approach and develop European solutions."*

This was particularly accurate in projects in which standardisation organisations like ASAM (Association for Standardization of Automation and Measuring Systems) or CEN (European Committee for Standardization) were involved in order to coordinate the development of technical standards by a group of experts which represent the interests of car manufacturers and suppliers of the automotive industry.

> *"The impact on standardization is one major key indicator for the success of the GeM project In July 2012 major partners led by Daimler and Renault initiated a two-day workshop in Berlin inviting many relevant EU EV players. There, they decided to form a new industry eMobility organization called eMI3 (eMobility ICT Interoperability Interest group) to bring together all the relevant partners from the different industry sectors" "GeM project resulted to the set-up of Standardization roadmap for electromobilty, ICT architecture & interfaces for a marketplace." Green eMotion (GeM) Project Coordinator.*

"The PowerUp specification results which contain improvements and extensions over the V2G and Smart Metering base standards are being contributed to the IEC TC69 and IEC TC13; thereby these specifications can become the basis of upcoming V2G product development. The V2G interface adapter prototypes developed in PowerUp can be used for V2G field trials and the related know-how gained by project participant will be utilized in the course of follow-up V2G product development phase". PowerUp Project coordinator.

PPPs in Europe are perceived as unique and enable compliant competitors to share knowledge and co-create some key technological standards to address European markets and beyond. The uniqueness of PPPs attracts OEMs and suppliers from outside Europe who are interested to grasp European markets expectations and co-develop standardization activities with their European counterparts.

5. Conclusion

Amongst the other European research funding schemes, requested by CARS 2020, the European Green Cars Initiative has truly proven to be useful tool in the very difficult context of the financial and automotive crisis of the years 2007-2009. EGCI contributed to **preserve key jobs and create new R&D jobs** with a multiplier effect of about 5 on induced employment. It **maintained in Europe a high-level of expertise & expenditure** in the field of electrification.

EGCI, as a PPP, has reinforced the **multi-stakeholders practice** of collaborative research. This collaborative research is pushing towards more and more **open research,** which is a very challenging scheme of approach in one of the **most competitive transport industry sectors:** competition occurs amongst all actors **horizontally & vertically at a country, European and at worldwide scales.** This PPP has contributed to accelerate co-developed R&D deliverables. Each project has been a valuable opportunity to explore the complementary approaches of the different research partners, with the aim to deliver **efficient & decarbonized surface mobility solutions.** All the partners together could take advantage of the latest knowledge of the academic partners: **this virtuous approach has indeed created added value.**

> In order to accelerate the electrification, it has optimised the advanced research in the field of integration of the electrified components in the powertrains.

> It has contributed to **speed-up the full electrification research** and deployment of the different industrial and research actors.

> It has reinforced the coherence between European initiative and national schemes. Hence, it has reinforced the dissemination and deployment aspects of electrification.

This PPP has very well satisfied the different partners due to its implementation and its agility. It is a very important lesson learnt should the Euopean Commission like to examine a new PPP for other thematic of new mobility topics.

Last but not least, the whole scheme of PPP has contributed to **preserve overall the automotive European automotive R&D** (activities, jobs, skills, and R&D value-chain) and brought **important opportunities for collaboration** with other continents.
The EGCI PPP has also contributed to secure the leading edge of Europe in **new powertrain technologies.**

Appendices

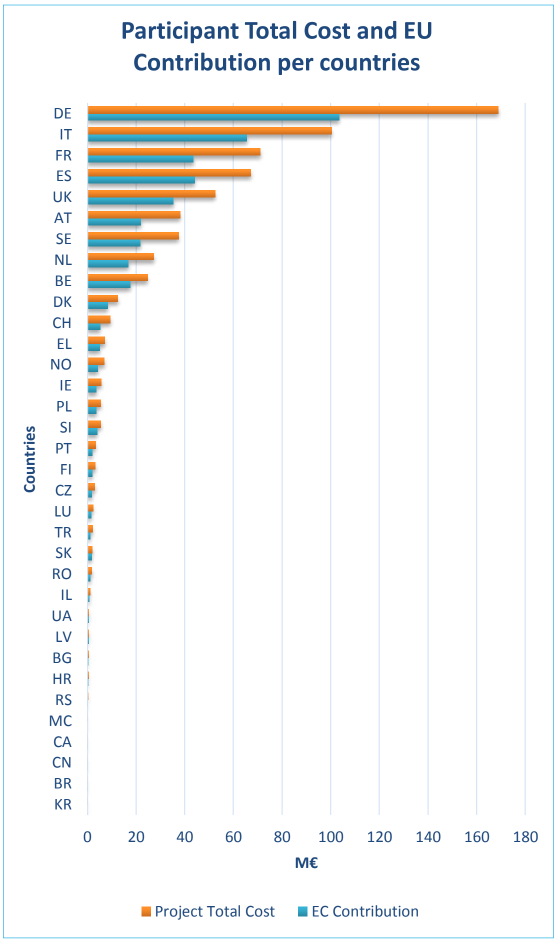
APPENDIX 1: EGCI PORTFOLIO ANALYSIS

Preselection of projects

European Green Cars Initiative encompasses 113 projects with 1 379 participants.
It amounted for:

- a total budget of € 662 million
- among which, an EU contribution of € 418 million
- The EC funding constitutes a seed-money addressed to the research activities from TRL 3 to 5/6

The graph below shows the breakdown by countries in terms of participant total costs and EC contribution:



EGCI Projects – Participant Total Cost and EU contribution by countries

> 7 countries represent 81% of the EGCI participant total cost: Germany, Italy, France, Spain, the United Kingdom, Austria and Sweden.
> These countries are the most active in the European automotive industry and have strong private investments from their industrialists in the areas covered by the EGCI.

Among the 113 EGCI projects a set of 78 projects was selected for questionnaire circulation. Selection process was based on the following approach:

> Completed projects or projects ending at the end of 2015 were selected.
> Coordination and Support Actions (CSA) Projects were excluded.

As a result of this the set of 78 projects represents:

> 892 Participants, i.e. 64% of the participants in the 113 projects of EGCI.
> Participant Total Cost of € 399 million (61% of 113 EGCI projects).
> EC Contribution of € 257 million (62% of 113 EGCI projects).

Panel project portfolio

The return rate is of 44 questionnaires completed out of 78 circulated, representing 56% in terms of number of projects and 66% in terms of EC contribution.

Participant Total Cost & EC contribution distributions

The table below shows the Participant Total Cost & EU contribution distribution for the 78 selected projects and the 44 filled-out questionnaires.

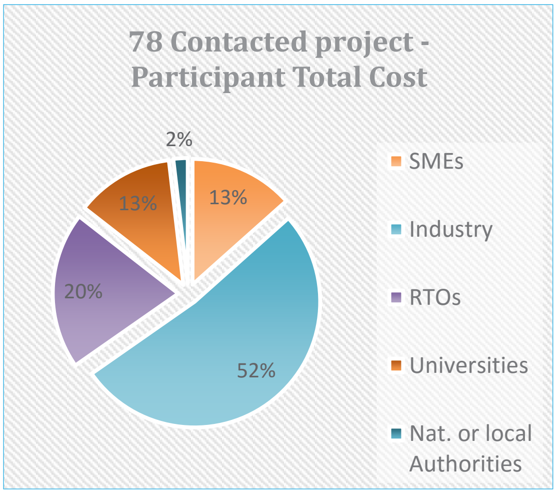
	Participant Total cost €M		EU contribution €M	
	78 projects	44 answers	78 projects	44 answers
Total	398.9	265.1	257.3	168.6
Average	5.1	6.0	3.3	3.8
Median	4.1	4.3	2.8	2.8

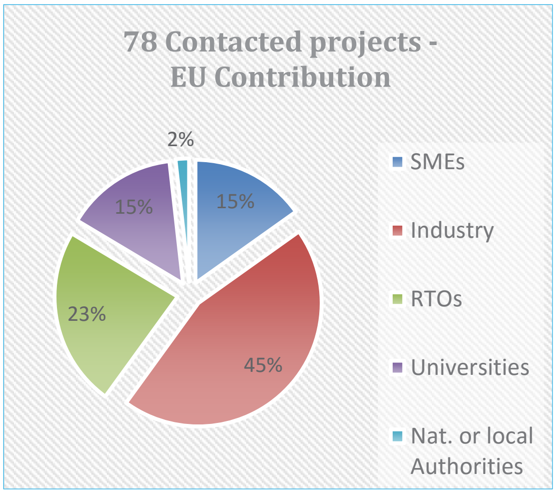
With the exception of 4 large projects "Participant total costs" are in the range of € 4 million and EC contribution in the range of € 2.8 million (median values).

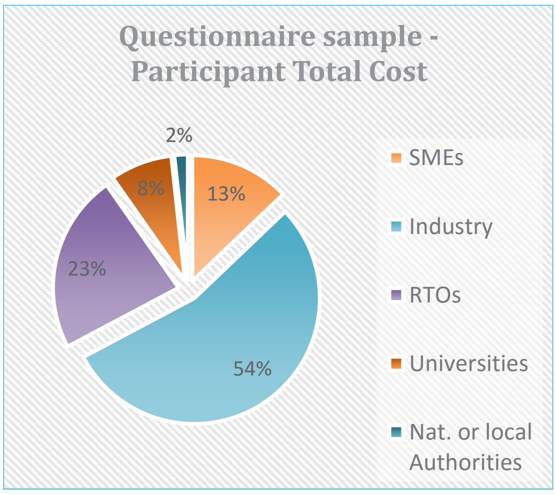
Breakdowns by types of participants

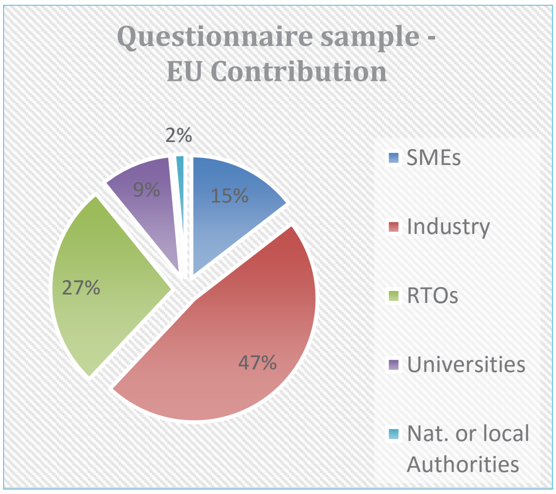
The breakdowns by types of participants in the selected projects are the following:

> In terms of budgets

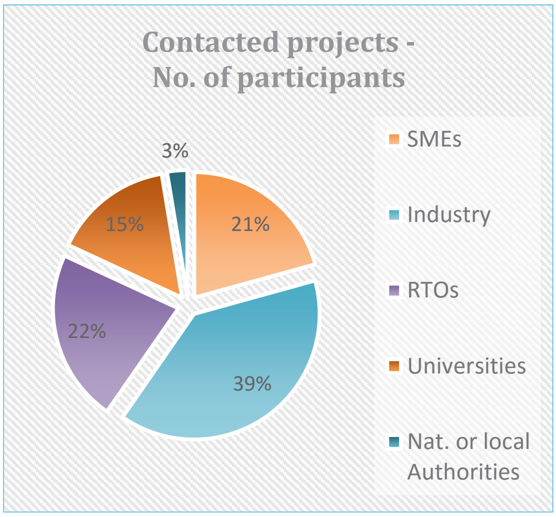


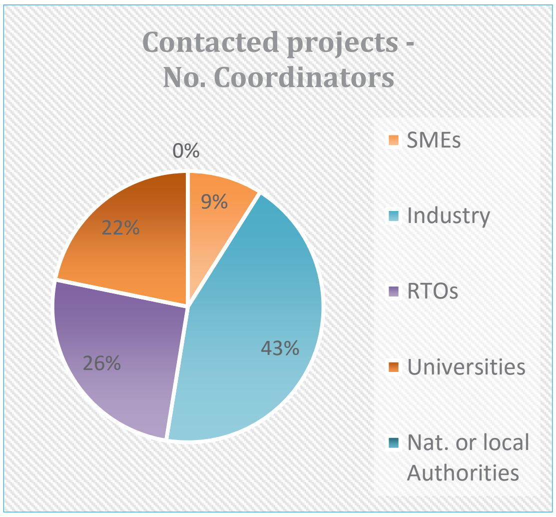


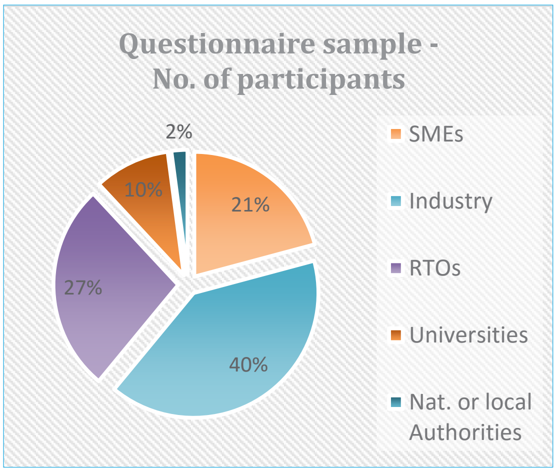


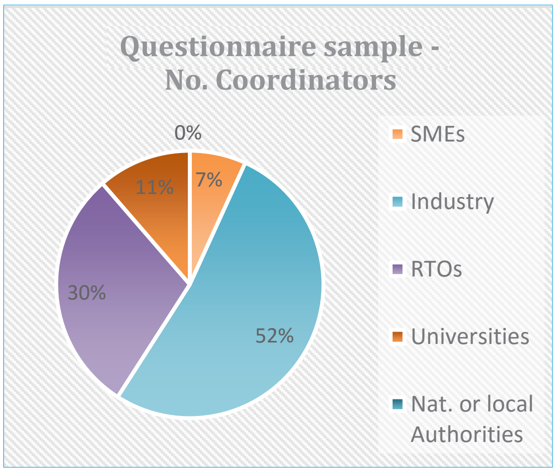


> In terms of number and types of participants









Hence the questionnaire sample is representative of the 78 projects contacted both in terms of budget breakdown and number of participants.

APPENDIX 2: MAIN TECHNOLOGICAL ACHIEVEMENTS

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
SAFETY		MATISSE *(Modelling And Testing for Improved Safety of key composite StructurEs in alternatively powered vehicles)*		Developement of new modelling techniques for FRP structures as well as improvements for CNG tanks and adaptive crash structures leading to lighter and safer cars. New safety criteria for APV will be proposed. Below are some of the project achievements: – Deeper analysis of vehicle accident types – Improvement of modelling and simulations techniques for fibre reinforced materials – Application of simulation tools for different fibre reinforced materials – Integration of the simulation progress in full vehicle simulations – Development of components made of fibre reinforced materials for automotive applications (virtual and real) – Development of testing procedures – Assessment of results and guidelines for Application	No data available – Indirect effect	11 publications

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
SAFETY		**Safe-EV** *(Safe Small Electric Vehicles through Advanced Simulation Methodologies)*		– Development of test proposal for electric vehicles in the vehicle class L7e for assessment of pedestrian and occupant safety, for which no safety regulations exists before – Further development in terms of human body models – Proposal for a seamless virtual tool chain for pedestrian and occupant safety – SafeEV will enable small electric vehicles to be a desirable alternative to ICE vehicles and enable the industry to design and bring to market a generation of urban small electric vehicles that are safe, energy efficient, clean and affordable by using the developed best practice guideline.	No data available – Indirect effect	11 publications
SAFETY		**SuperLIB** *(Smart Battery Control System Based on a Charge-equalization Circuit for an Advanced Dual-Cell Battery for Electric Vehicles)*		– Lower amount of raw material requirement, especially expensive and partly hazardous metals like Co, Cu and Ni.	Direct effect	3 patents 20 publications
SAFETY		**HELIOS** *(High Energy Lithium-Ion Solutions)*		– Propose safety and life test procedures for HE battery cells	No data available – Indirect effect	information not available
SAFETY		**OPTIBODY** *(Optimized Structural components and add-ons to improve passive safety in new Electric-Light Trucks and Vans (ELTVs))*		– Improved safety for V.R.U though the design and development of an add-on – Structural modularity development: cabin + chassis + add-ons + absorbers – First crash test of the integrated system	No data available – Indirect effect	information not available
SAFETY		**HEMIS** *(Electrical Powertrain Health Monitoring for Increased Safety of FEVs)*		– Prognostic health monitoring system – Assess electromagnetic compatibility issues	No data available – Indirect effect	information not available

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
SAFETY		**OPTIMORE** *(Optimised Modular Range Extender for every day customer usage)*		– Functional Safety concept for EVs with safety requirements including High Voltage safety according to ISO 26262	No data available – Indirect effect	12 patents 11 publications
SAFETY		**e-vader** *(Electric Alert for Detection and Emergency Response)*	Development of directional acoustic sources for warning signals (TRL 1 to 7)	– Improvement of the detectability of electric cars by pedestrians	No data available – Indirect effect	2 publications
SAFETY		**EM-Safety** *(EM safety and Hazards Mitigation by proper EV design)*		– Prudent avoidance practices based on design guidelines for field mitigation – Flexible monitoring platform to measure magnetic field levels in critical locations of the electric vehicle.	No data available – Indirect effect	1 patent 10 publication
BATTERY	Life time & degra-dation (including BMS)	**MARS-EV** *(Materials for Ageing Resistant Li-ion High Energy Storage for the Electric Vehicle)*		– Li-ion cells from the lab-scale (<1000 cm^2) to the preindustrial scale (up to 20000 cm^2, B5 format) will be realized as proof of concept and tested on electrochemical performance, lifetime and safety. – Besides the use of graphite as anodic material, new Si/C based, spinel ferrites and Li metal anodes will be considered to achieve 1000 mAh/g stable capacity over 1000 cycles. Best performing materials will be scaled-up in two generations.	Newly developed electrode nanomaterials and synthesis routes are REACH and CLP compliant but the CO_2 impact has not been evaluated yet.	3 publications

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
			ELECTRICAL VEHICLES			
BATTERY	Life time & degra-dation (including BMS)	**SMARTLIC** *(Smart and Compact Battery Management System Module for Integration into Lithium-Ion Cell for Fully Electric Vehicles)*		– New system architecture to improve performance (charging efficiency and lifetime) and reduce cost – Implementation of Electrochemical Impedance Spectroscopy (EIS) – Addressing and evaluating of wireless and wire-based communication solutions – Consideration of shielding and EMC issues caused by Signal and Power Integrity – Reliable, Secure and Cost-effective packaging of ECU for Harsh enviroment F14 – Incorporated safety devices, isolating of individual cells – Testing of packages BMS module	Direct effect	3 patents 12 publications
BATTERY	Life time & degra-dation (including BMS)	**SuperLIB** *(Smart Battery Control System Based on a Charge-equalization Circuit for an Advanced Dual-Cell Battery for Electric Vehicles)*	– Increase of life time of the battery by up to 30% in realistic driving situations (since the different cells are used just at its best points).		Direct effect (through weight reduction & use of alternative less scarce materials)	3 patents 20 publications
BATTERY	Life time & degra-dation (including BMS)	**ESTRELIA** *(Energy Storage with Lowered Cost and Improved Safety and Reliability for Electrical Vehicles)*		– New battery management system Ics: Cell monitoring and autonomous active and passive balancing: Supports up to 7 cells, cell voltages from 1.8V to 4.5V; Chainable up to 32 IC's – EMC robust serial communication; Simultaneous cell monitoring; Autonomous active or passive balancing on trigger – New gas sensors and spark detection sensors: Lowered costs and improved safety monitoring	Direct effect	4 patents 7 publications

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
BATTERY	Life time & degradation (including BMS)	**HELIOS** *(High Energy Lithium-Ion Solutions)*		– Comparative assessment of performance and life characteristics	Direct (through the use of alternative materials)	information not available
BATTERY	Life time & degradation (including BMS)	**ELIBAMA** *(European Lithium-Ion Battery Advanced Manufacturing for EV)*	– Demonstrate benefits use of LiTFSI (as salt or co-salt) in terms of life-time of the batteries, high capacity gains and improvement of cell capacity after storage. – New recycling process of Li-ion batteries (electrolyte recovery, dry sorting techniques, rometallurgical treat-ment) – New technique for testing Li-ion batteries (non-destructive test)		Direct effect	2 patents issued (TFAK Sulfination, LiTFSI recycling)
BATTERY	Life time & degradation (including BMS)	**EUROLIS** *(Advanced European lithium sulphur cells for automotive application)*		Development of a tool to predict li-SS battery degradation mechanism	Direct effect	information not available

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
BATTERY	Recycling / recyclability	**SOMABAT** *(Development of novel SOlid MAterials for high power Li polymer BATteries)*		– High cyclability anodes: Specific capacity vs cycle number for anodes based on: graphite SL30; binary mixture SL30 +3% Carbon xerogels	Direct effect	1 patent 7 publications
BATTERY	Recycling / recyclability	**NECOBAUT** *(New Concept of Metal-Air Battery for Automotive Application based on Advanced Nanomaterials)*		– Iron / air cell low degradation after a few charge / discharge cycles	Direct effect	5 publications
BATTERY	Energy density & weight	**SmartBatt** *(Smart and Safe Integration of Batteries in Electric Vehicles)*		– Improved energy density of 148 Wh/kg at system level leading to range improvement	Direct effect	8 publications
BATTERY	Energy density & weight	**SuperLIB** *(Smart Battery Control System Based on a Charge-equalization Circuit for an Advanced Dual-Cell Battery for Electric Vehicles)*	– Increase of the usable SoC range of the battery from typically 70% (during the time of project submission, 2010) to more than 90%	– Improved energy efficiency and extended driving range of FEVs through highly integrated HP+HE batteries – Minimized charge equalization losses and reduced overall weight and size – Lower amount of raw material requirement, especially expensive and partly hazardous metals like Co, Cu and Ni.	Direct effect	20 publications 3 patents
BATTERY	Energy density & weight	**ESTRELIA** *(Energy Storage with Lowered Cost and Improved Safety and Reliability for Electrical Vehicles)*		New Ultra Cap cells: Delivering energy densities in the range of 7-9 Wh/l – new battery management system ICs – new gas sensors and spark detection sensors at lowered costs – ultra capacitor cell with 40% higher energy density	Direct effect	4 patents 7 publications
BATTERY	Energy density & weight	**ELECTROGRAPH** *(Graphene-based Electrodes for Application in Supercapacitors)*	Optimize the overall performance of super-capacitors (graphene in electrode materials, ionic electrolyte solutions)		Direct effect	information not available

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
BATTERY	Charging time	**Fast In Charge** *(Innovative fast inductive charging solution for electric vehicles)*		– Inductive transformer composed of two cores with magnetic properties, one for the primary circuit and the other for the secondary circuit, – On-route charging infrastructure. – The CAD of the mechanical system is almost ready (90%) – Stationary charging station composed of power and communication electronics	No data available – Indirect effect	information not available
BATTERY	Charging time	**Unplugged** *(Wireless charging for Electric Vehicles)*		– Integration into the vehicles architecture – Inductive charging station design – Focus on interoperability for inductive charging solutions	No data available – Indirect effect	information not available
BATTERY	Recycling / recyclability	**MARS-EV** *(Materials for Ageing Resistant Li-ion High Energy Storage for the Electric Vehicle)*		The choice of materials, synthesis methods and the cell assembly processes will be driven by the Life Cycle Assessment that will be realized taking into account the recyclability of the complete cells (>50% recycling rate).	The Life Cycle Assessment of the baseline chemistries revealed a significant decrease on cell CO_2 impact for the electrode manufacturing using aqueous slurries instead of commonly used organic solvents (mainly NMP), especially on the cathode side which accounts for more than 50% of the cell impact. The LCA showed 20% CO_2e/cell reduction with aqueous vs NMP processing.	3 publications
BATTERY	Recycling / recyclability	**ELECTROGRAPH** *(Graphene-based Electrodes for Application in Supercapacitors)*		– Bar coating: Controllable film thickness; Fast and reproducible – Pressure Assisted Filtration: Formation of electrode films; Controllable film thickness; Fast and reproducible – Cyclic Voltammetry results of significant samples (scan area 2x2 cm^2) – Improved adhesion in "Batch 2013_3" through use of carbon-nanotubes as binders Employment of carbon nanotubes also: Allows use of less metallic collector (i.e. lighter supercapacitor); Reduces recycling challenges (i.e. reduce halogens present in conventional binders)		information not available

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
BATTERY	New chemistry solutions (post-lithium)	**NECOBAUT** *(New Concept of Metal-Air Battery for Automotive Ap-plication based on Advanced Nanomaterials)*		– Assessment of a new metal-air battery concept for energy storage in electric vehicles – Development of new materials and components for this metal-air battery – Increased discharge capacity		5 publications
BATTERY	New chemistry solutions (post-lithium)	**APPLES** *(Advanced, High Performance, Polymer Lithi-um Batteries for Electrochemical Storage)*		– New chemistry involves the use of lithium-metal alloy (Sn-C) as anode (with a practical specific capacity, i.e. 500 mAh/g, higher than that of the common graphite), a lithium nickel manganese oxide spinel, LiNi0.5Mn1.5O4 as cathode (with an operational voltage, i.e. 4.5V vs. Li higher than that of the common lithium cobalt oxide) and a composite, gel-type membrane as polymer electrolyte (with expected reliability and processability higher than those of the common organic carbonate solutions).	Unsignificant CO_2 reduction in project per se but interesting CO_2 reduction potential if deployed at large scale	12 publications
BATTERY	New chemistry solutions (post-lithium)	**LABOHR** *(Lithium-Air Batteries with split Oxygen Harvesting and Redox processes)*	Ultra High-Energy battery systems breakthrough on use of alloy anodes, innovative O2 cathode, and a novel system for harvesting O2 from air	maintain the leadership in the field of ILs	Unsignificant CO_2 reduction in project per se but interesting CO_2 reduction potential if deployed at large scale	2 patents 30 publications

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
BATTERY	New chemistry solutions (post-lithium)	SOMABAT *(Development of novel SOlid MAterials for high power Li polymer BATteries)*		– Development of Li-solid polymeric membranes to apply in all solid polymer cell. – Cost effective cathode: Hydrothermal synthesis of LiFePO4 microspheres – High cyclability anodes: Specific capacity vs cycle number for anodes based on: graphite SL30; binary mixture SL30 +3% Carbon xerogels – High voltage polymer electrolyte: PVdF-HFP based polymer membrane (blue line) – High electrochemical window of the membrane. High stability. – Recycling of materials and components was also performed.	Unsignificant CO_2 reduction in project per se but interesting CO_2 reduction potential if deployed at large scale	1 patent 7 publications
BATTERY	New chemistry solutions (post-lithium)	EUROLIS *(Advanced European Lithium sulphur cells for automotive application)*		– Stable cycling with high efficiency in the lab – setup of several analytical tools for Li-S batteries: Tools for the effective control of polysulphides formation and migration. – Can be used for prediction of Li-S battery degradation mechanism(s).	Unsignificant CO_2 reduction in project per se but interesting CO_2 reduction potential if deployed at large scale	information not available
BATTERY	New chemistry solutions (post-lithium)	STABLE *(STable high-capacity lithium-Air Batteries with Long cycle life for Electric cars)*	High capacity of 1200 mAh/g obtanied with fuel cell type batteries, Such design permits to multiply the capacity adding more cells together. The cycle life was here improved to 151 cycle in air with 17% of relative humidity. This is one of the best results actually present in the literature.	– Influence of the lithium air batteries and their processing technologies developed in the STABLE project on European academic research. – Increase in highly skilled workforce (engineers and scientists) – Reduction of waste production and improvement of resource efficiency through a more efficient recycling of critical materials. – Standardization of the measurement cell: anode, cathode, electrolyte, measurement cells –New materials and their optimisation: Different cathodic carbon based materials with or without catalyst – Different strategies to protect Li anode – Membrane to prevent moisture inlet – Liquid electrolytes with or without additives, ionic liquids	As the studied system is not commercial the reduction is not actually important. Nevertheless we are expecting a great change for the future reducing the produced CO_2 of 50%	13 publications

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
BATTERY	Cost	**MARS-EV** *(Materials for Ageing Resistant Li-ion High Energy Storage for the Electric Vehicle)*		The initial inversion and running costs of the solvent recovery system would be avoided and distilled water is also cheaper than 50% of pure NMP (0.20 €/L vs. 0.90 €/L)	No data available – Indirect effect	3 publications
BATTERY	Cost	**SuperLIB** *(Smart Battery Control System Based on a Charge-equalization Circuit for an Advanced Dual-Cell Battery for Electric Vehicles)*		– Reduced costs of the electronic components and the overall FEV – Strengthened global competitiveness of the European automobile, ICT and battery sectors – Longer battery replacement intervals, reduced warranty costs (lower cost and risk for car manufacturers) – Reduced total-cost-of-ownership over the battery lifetime	No data available – Indirect effect	3 patents 20 publications
BATTERY	Cost	**GREENLION** *(Advanced manufacturing processes for Low Cost Greener Li-ion batteries)*	High capacity anodes improving the cyclability	– Water based electrode formulation and industrial manufacturing, without organic solvents have been achieved. – Module design followed eco-design rules and easy (dis)assembly concept. – Developed LCA analysis proofs the minimal environmental impact of the used technologies.	Impact on waste reduction	7 patents 15 publications
BATTERY	Cost	**ELIBAMA** *(European Lithium-Ion Battery Advanced Manufacturing for EV)*	9% reduction of cell cost production thanks to porostiy reduction and thickness mastering leading		CO_2 emission savings both during manufacturing and recycling phases	3 patents 8 publications
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	HDV	**CO_2RE** *(CO_2 Reduction for long distance transport)*		– Hybridization of the powertrain – Friction of the combustion engineAdditional and energy efficient exhaust gas aftertreatment systems and operation	a 15% improved fuel efficiency (compared to a EURO V engine and at the same time fulfilling EURO VI emission legislation)	1 patent 11 publications

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	HDV	**LORRY** *(Development of an innovative low rolling resistance truck tyre concept in combination with a full scale engineering tool box for tyre and material design in function of road param-eters)*	– Rolling resitance improvement of at least 18% – Complete simulation tool of tyre performance		Possible drop down of 5% of fuel consumption per truck	5 publications
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Multiuse vehicles	**WIDE-MOB** *(Building Blocks Concepts for Efficient and Safe Multiuse Urban Electrical Vehicles)*		– Vehicle Systems Integration: integrated solar panels with improved efficiency thanks to their electronics. Integration of regenerative braking system. – Drive Train Technologies: e-motor configuration based on fail safe two motors – Safety of Electrified vehicles: specific solution to lower EM field generated by e-vehicle. Introduction of new solution for crash safety in small electrical vehicles.	The use of solar energy could lead to a Zero emission	11 patents 6 publications
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Passenger cars	**SMARTOP** *(Self powered vehicle roof for on-board com-fort and energy saving)*		Development of innovative low cost energy harvesting solar cells based on hybrid organic/inorganic solutions (DSSC). Integration of several functionalities in autonomous systems: – Refrigeration by TE modules – Courtesy lighting	– Energy harvesting from solar cells expected impact around 2% – Reduction in power consumption to cool down the cabin	20 publications
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Passenger cars	**ODIN** *(Optimized elec-tric Drivetrain by Integration)*		– Optimised integrated e-powertrain concept – Simulation to optimise acoustic behaviour – Prototyping & initial testing high speed e-motor	Direct effect	information not available

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Passenger cars	ASTERICS *(Ageing and efficiency Simulation & Testing under Real world conditions for Innovative electric vehicle Components and Systems)*	– Advanced testing ethodologies and models for E-driveline components – Development of accurate high fidelity model for battery, inverters and electric motors – Development of procedures for accelerated ageing of battery, inverter and electric motor to shorten the testing time – Complete vehicle simulation model, including virtual driver setup and driving cycle description		– Reduction of overall development time and testing efforts for FEV and components by 50% – Enable improvement and optimization of overall efficiency and performance of FEV by at least 20%	2 patents 2 publications
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Passenger cars	AVTR *(Optimal Electri-cal Powertrain via Adaptable Voltage and Transmission Ratio)*		– Power electronic and control performing energy conversion – Extend drive range – Market penetration of key components for FEVs	Direct effect	3 publications

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Passenger cars	COSIVU *(Compact, smart and reliable drive unit for fully electric vehicles)*	– Development of a drive train system (electric motor, compact transmission, full SiC power electronics, control and health monitoring module with wireless munication, and an advanced ultra-compact cooling solution.		20% higher energy efficiency and thus extended driving range due to dramatic reductions in the vehicle weight (30%) and in the losses in the power module (50%-70%)	1 patent 13 publications
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Passenger cars	DELIVER *(Design of Electric LIght Vans for Environment-impact Reduction)*		An advanced all electric drivetrain, with in wheel motors including a 2 speed transmission and an advanced Lithium battery giving excellent vehicle performance in all traffic conditions and high efficiency	A vehicle at least 40% more efficient than existing delivery vehicles.	9 publications
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Passenger cars	e-VECTOORC *(Electric-Vehcile Control of Individual Wheel Torque for On- and Off-Road Conditions)*	– Vehicle demonstration of torque-vectoring controllers and experimental analysis of their actual benefits; – Demonstration of the significant stopping distance reduction achievable through ABS braking actuated through the continuous modulation of electric motor torques; – Industrially implementable anti-jerk controllers for on-board electric drivetrains; – Next generation electro-hydraulic braking system for modulating individual caliper pressures.		The design of the understeer characteristic for energy efficiency and the optimal control allocation algorithm of the wheel torques can bring energy consumption savings of about 5% (calculation made in kWh/km, as calculation made on a EV)	3 patents 18 publications

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Passenger cars	MAENAD *(Model-based Analysis & Engineering of Novel Architectures for Dependable Electric Vehicles)*		– Refined modelling and documentation approach – Refined analysis and optimization methods – Refined support for safety annotation according to ISO26262	Indirectly: The project's methods and tools increase effciency in engineering and thus increase the potential for optimising product technology towads low CO_2.	23 publications
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Passenger cars	P-MOB *(Integrated Enabling Technologies for Efficient Electrical Personal Mobility)*		Introduction of first concept of low weight, small footprint, safe fully electric vehicles. New concepts of manufacturing large volumes with very low investments. Novel chassis, novel manufacturing methods, partitioned battery systems, multimotor powertrain, smart photovoltaics.	Direct CO_2 reduction	14 patents (including AVTR) 3 publications
OPTIMISED POWERTRAIN AND VEHICLES SOLUTIONS	Passenger cars	LIBRALATO *(Libralato Engine Prototype)*	First "one stroke" rotary Atkinson cycle engine, completing all of the engine phases in parallel in each rotation		Capable of reducing average vehicle CO_2 to 50g/km in a way that is cost-competitive with conventional vehicles	1 patent 2 publications
ENERGY MANAGEMENT AND RECOVERY	In passenger cars	OPTIMORE *(Optimised Modular Range Extender for every day customer usage)*		Main project results: – Typical driving cycles for robust optimisation of EVs RE-EVs. – Three integrated and optimised range extenders with improved performance. – Range Extender unit with a gasoline 2 cylinder Natural Aspired engine where the integration of internal combustion engine and electric components allows a strong weight, cost and volume reduction and efficiency and packaging optimisation. – Modular vehicle concept covering BEV, RE-EV and PHEV. – Bench test demonstrating emissions, efficiency and performance for total RE. – Vehicle test demonstrating integration/NVH and vehicle performance. – Functional Safety concept for EVs with safety requirements including High Voltage safety according ISO 26262. – Study on volume production optimisation (low cost solutions). – A method to optimize range extenders for different vehicle niches and different usage profiles.	A mid sized car with a range extender (= PHEV) on a mid-/long range trip (> 300km) allows a reduction of CO_2-emissions in the range of 50-75% – e.g. from 100 to 25-50 g/kWh.	12 patents (the project was based on several patents filed before the start of the project but elaborated in detail in OPTIMORE) 11 publications

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
ENERGY MANAGE-MENT AND RECOVERY	In passen-ger cars	**OpEneR** *(Optimal Energy consumption and Recovery based on sys-tem network)*	– Energy efficient ACC 5% to 25% (simulation results) – Coasting assistant up to 40%	– OpEneR prototypes: Allow real testing very early in the project – Human Machine Interface: A suitable HMI was defined taking into account OpEneR systems requirements, including SW and HW implementation – Newly developped functions: – Energy efficient route calculation: Development of vehicle individual energy consumption model that considers specifics of electric drives including recuperation – 2-channel cooperative regenerative braking: Two separate channels for requesting electric motor brake torque improve vehicle stability and thereby the recuperation efficiency – Torque distribution: Energy optimal distribution of torque request to both electric motors – Coasting assistant: Use pure coasting to reach speed limit signs – Energy efficient ACC: OpEneR vehicle approaches slower vehicle on own lane – Acceleration assistant: Help driver follow the optimal efficiency profile of the electric machines – Energy efficient auxiliaries	Direct CO_2 reduction effect	9 patents 15 publications
ENERGY MANAGE-MENT AND RECOVERY	In passen-ger cars	**EMERALD** *(Energy Man-agEment and RechArging for efficient eLectric car Driving)*		Energy use optimisation of a FEV based on consumption prediction, efficient routing, and V2I/V2G data exchange	Direct CO_2 reduction effect	information not available
ENERGY MANAGE-MENT AND RECOVERY	In passen-ger cars	**EUNICE** *(Eco-design and Validation of In-Wheel Concept for EV)*		Better In-wheel eco-design, by reducing the thermal stress (by air cooled motor and innovative active wheel concept)	Direct CO_2 reduction effect	information not available

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
ENERGY MANAGE-MENT AND RECOVERY	In HDV	**NoWaste** *(Engine Waste Heat Recovery and Re-Use)*		– Possible configuration of the **Rankine cycle evaporator** between the turbocharger outlet and the EATS inlet and determine the gain in energy recuperation by simulations – Identificaion of **steady state waste heat recovery potential,** also including investigations on efficient heat storage systems. The fuel economy potential shall be analysed performing road cycle simulations with a Ranking cycle model including indirect heat exchange. – Determination of optimal cycle architecture for the given boundary conditions and the estimation of necessary heat exchanger dimensions. – Use of the existing **heat rejection** capacity when available – Increase of the heat rejection capacity using part of the body panels as heat exchangers (flat heat exchangers) functionalising the aerodynamic under-body and of part of the side body panels	Reduction of the fuel consumption of about 10 to 15%	8 publications
BATTERY	In HDV	**ICE** *(MagnetoCa-loric Refrigera-tion for Efficient Electric Air Conditionning)*		Better undestanding of the magneto caloric technology readiness and to update our systems and components road-map	Direct CO_2 reduction effect	14 publications
BATTERY	In HDV	**CONVENIENT** *(COmplete Vehicle ENergy-saving Technologies)*		– Innovative energy efficient systems and energy harvesting devices – Advanced active and passive aerodynamics devices – Energy management at vehicle level – Driver support to maximise the benefits of the energy-saving systems and strategies	30% improvement in fuel consumption	information not available

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
LIGHTWEIGHT		**SmartBatt** *(Smart and Safe Integration of Batteries in Electric Vehicles)*	- 23 kWh with a total mass of 155 kg (reduction in housing mass to just 8.5 kg). The ratio between cell and total mass increased to over 80% by use of new materials such as Aluminium hybrid foam sandwich for the battery housing and smart integration.E77	– Complete assembled and fully functional battery SmartBatt prototype available. – Total weight of 155 kg achieved (goal was 169 kg). –The smart integration in the chassis improves the torsional rigidity, the bending strength and therefore the crash safety of the whole vehicle frame – The concept is very suitable for mass production, with potential cost savings. Cost outlook indicates potential in price reduction for cells	Complete assembled and fully functional battery SmartBatt prototype: – Total weight of 155 kg achieved (goal was 169 kg). – 23 kWh with a total mass of 155 kg (reduction in housing mass to just 8.5 kg). – Improved energy density of 148 Wh/kg (system level)	8 publications
LIGHTWEIGHT		**EVOLUTION** *(The Electric Vehicle revOLU-TION enable by advanced materials highly hybridized into lightweight components)*		– Novel Body-in-white architecture based on a Multifunctional-Rolling Chassis (MRC): Fully structural MRC underbody and customized non-structural upperbody – Polymer Composites and Foams: Enhanced mechanical properties – Investigation of Aluminium Foam Filled structures	Direct CO_2 reduction effect	information not available
LIGHTWEIGHT		**ENLIGHT** *(Enhanced Lightweight Design)*	Saving of 20% weight for each module considered		Direct CO_2 reduction effect	information not available
VEHICLE INTEGRATION INTO THE TRANSPORT SYSTEM		**MOBINCITY** *(Smart Mobility in Smart City)*		– System integration (FEVs) and field tests from the three pilot cities Rome, Ljubljana and Valencia – Integration of the EV in the City Transport Systems. – Energy efficiency applied to the route planification – New ICT Applications for mobility	CO_2 reduction expected via ICT	4 publications
VEHICLE INTEGRATION INTO THE TRANSPORT SYSTEM		**Unplugged** *(Wireless charg-ing for Electric Vehicles)*		Test and demonstration with a focus on interoperability	No data available – Indirect effect	information not available
VEHICLE INTEGRATION INTO THE TRANSPORT SYSTEM		**eCo-FEV** *(Efficient Cooperative Infrastructure for Fully Evs)*		Open and flexible architecture for the integration of FEVs into cooperative infrastructure systems (including contactless charging solutions)	No data available – Indirect effect	14 publications

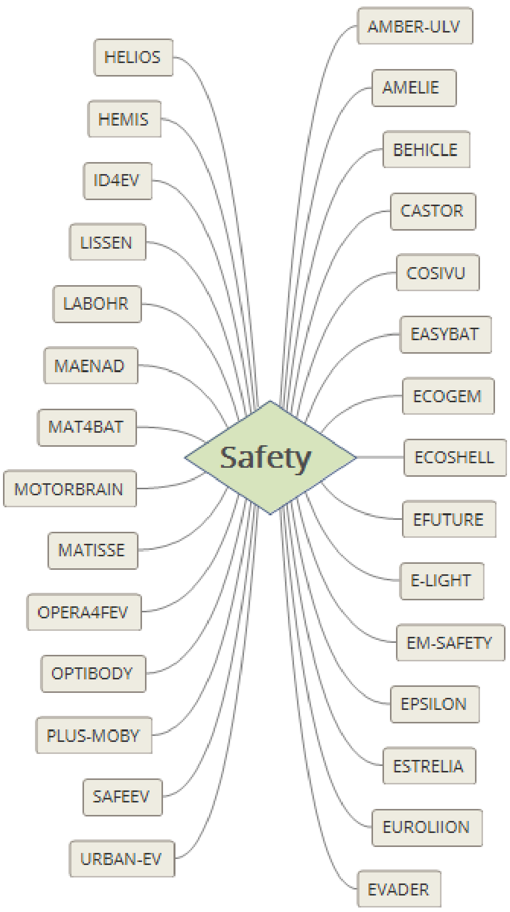
Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
GRID INTEGRATION		**PowerUp** *(Specification, Implementation, Field Trial, and Standardisation of the Vehicle-2-Grid Interface)*		The most important project outcomes include the following: – Prototyping of automotive side V2G interface adapters, including integration with battery management and HMI. – Prototyping of infrastructure side V2G interface adapters, including integration with Smart Meters. – Prototyping of PowerLine Communications media conversion and Pilot Control Function, specifically demonstrating deployment scenarios co-existing with UPA, Home-Plug, or G3 infrastructures. – Completion of the TTCN-3 based V2G conformance testing suite.	Expected but not reported	2 publications
GRID INTEGRATION		**EMERALD** *(Energy ManagEment and RechArging for efficient eLectric car Driving)*		– ICT services for energy-efficient FEV operation – Consumption prediction, efficient routing, V2I/V2G data exchange		17 publications
GRID INTEGRATION		**Green e-motion**	Development, testing and demonstrations of Standards for Electromobility: (i) in 12 European regions (connected to the marketplace), (ii) demonstration of the feasibility of roaming solution between all the demo regions enabling the interoperability of the European charging network from a user's perspective			23 publications

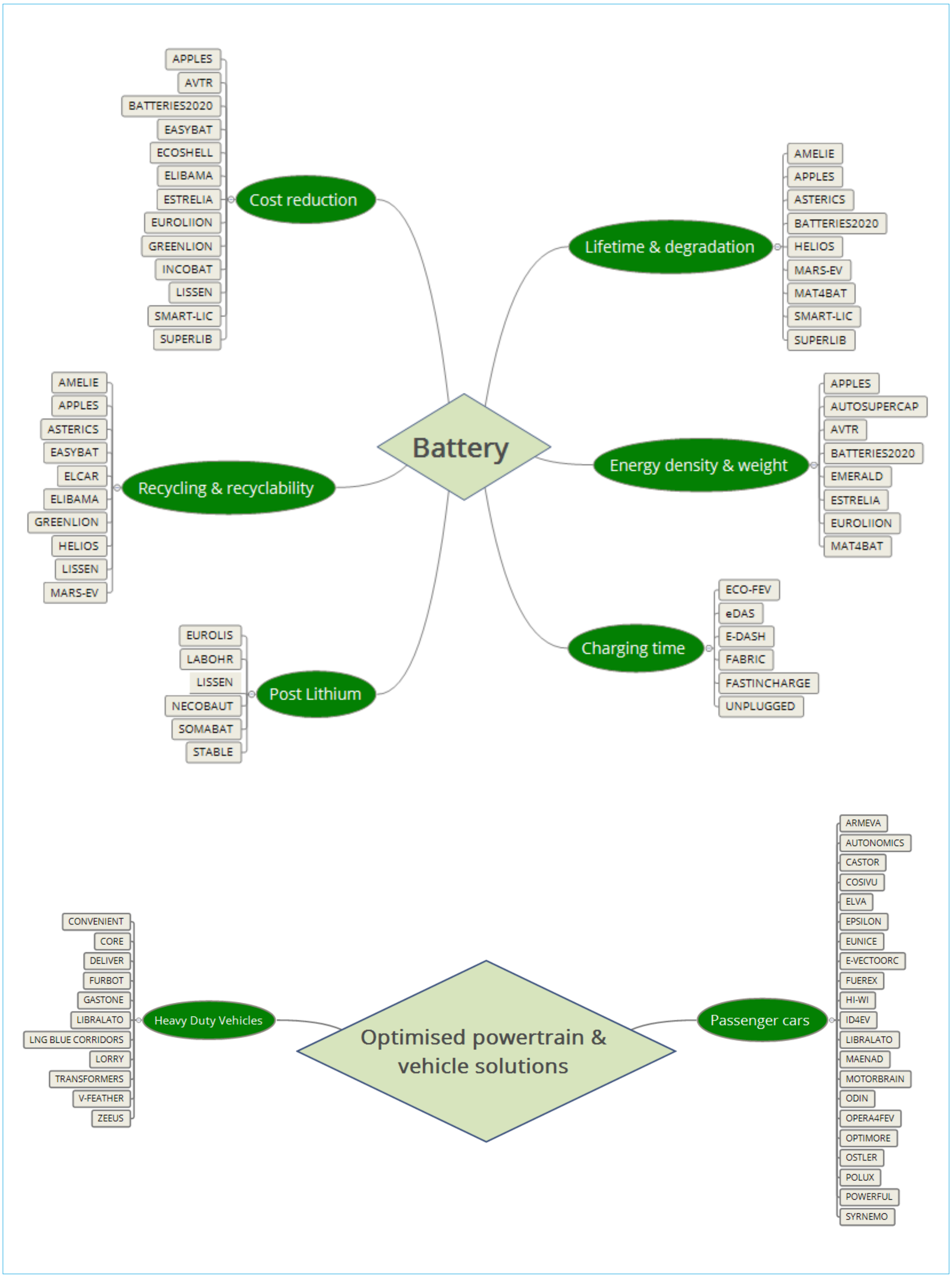
Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
LOGISTICS		SMARTFUSION *(Smart Urban Freight Solu-tIONs)*		– Adaption and proof of use of logical framework analysis for city logistics intervention problem analysis, cause and effect as well as a solution path. – Development of car CAMBUS integration with human machine interface (HMI) on a tablet, inegrated with strategic and tactical route navigation systems. – Development of geofencing tools to switch between electric and diesel propulsion in a truck integrated into CAMBUS integration with human machine interface (HMI) on a tablet, inegrated with strategic and tactical route navigation systems. – Deployment of institutionally led city logistics using 7,5t electric truck with a viable ongoing business model.	The Newcastle pilot can lead to a saving of 402 tonnes of carbon a year. It is not possible to detail this as a rate per km, since changing the km driven is part of the solution.	4 publications
LOGISTICS		STRAIGHTSOL *(STRAtegies and measures for smarter urban freIGHT SOLu-tions)*		– A new evaluation framework for city logistics measures. Business model development and incorporation of multiple stakeholder perspectives in evaluation of urban freight transport projects. – Development of a new mobile depot for last-mile deliveries and pick-ups by TNT, a totally new vehicle concept. – Use of different new remote monitoring technologies. These technologies are not new, but their use is an important step as part of the techonology develoment and improvement. – Better supply chain visibility and 'smarter' operations	No data available – Indirect effect	10 publications

Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
LOGISTICS		**TELLISYS** *(Intelligent Transport System for Innovative Intermodal Freight Transport)*		– Development a new intermodal family of volume optimized loading units, a super low deck tractor and the suitable trailer – New design allows the stacking of three box pallets commonly used in the automotive industry thus allowing up to 50% more cargo volume compared to the current transport used. – Cost savings of up to 15% over other current transport systems, most notably mega-trailers and 45 ft high cube containers – Product-family of MegaSwapBoxes with individual members specialised for different use cases – Next generation super low deck tractor unit with 85 cm fifth wheel height and single driven axle – Low profile tyres enabling the significant lower truck chassis height – Lightweight, super low-deck trailer chassis to carry the MegaSwapBoxes on road – Up to 100 m^3 cargo volume while keeping the total system at 4m height on the road	Significant reduction of CO_2 equivalent and an increase of 25% environmental efficiency (kg CO 2 -Eq).	1 patent 3 publications
LOGISTICS		**WINN** *(European Platform Driving KnoWledge to INNovations in Freight Logistics)*		– Creation of a collaboration framework (ALICE) between already stablished networks in freight logistics operating in different areas and in different geographical levels and led by industry. (support action).	Not applicable	information not available

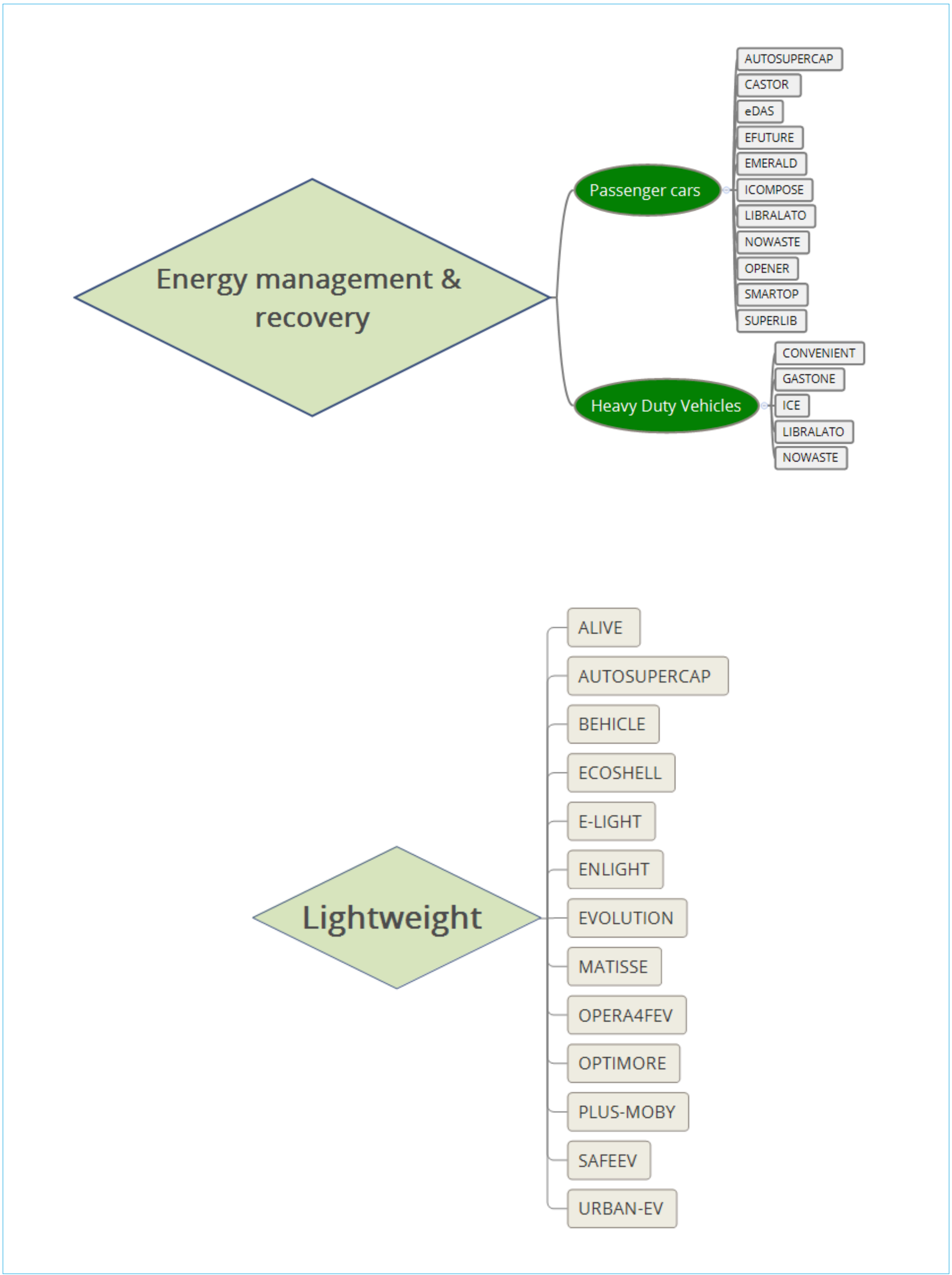
Technological area	Sub areas	Projects	Breakthrough innovation	Incremental innovation	CO_2 reduction & sustainability impacts	Performance indicators (patents applications / publications)
ELECTRICAL VEHICLES						
LOGISTICS		**MODULUSHCA** *(Modular Logistics Units in Shared Co-modal Networks)*		– First prototype of modular box: manufacturing of a first prototype focusing on interlocking mechanism	Not applicable	information not available
LOGISTICS		CO3 *(Collaborative Concepts for Comodality)*	System breakthrough based on horizontal collaboration in supply chain (based on CO3 methodology)		Gains on efficiency in supply chain and CO_2 emissions (réduction by 20-25%)	4 publications

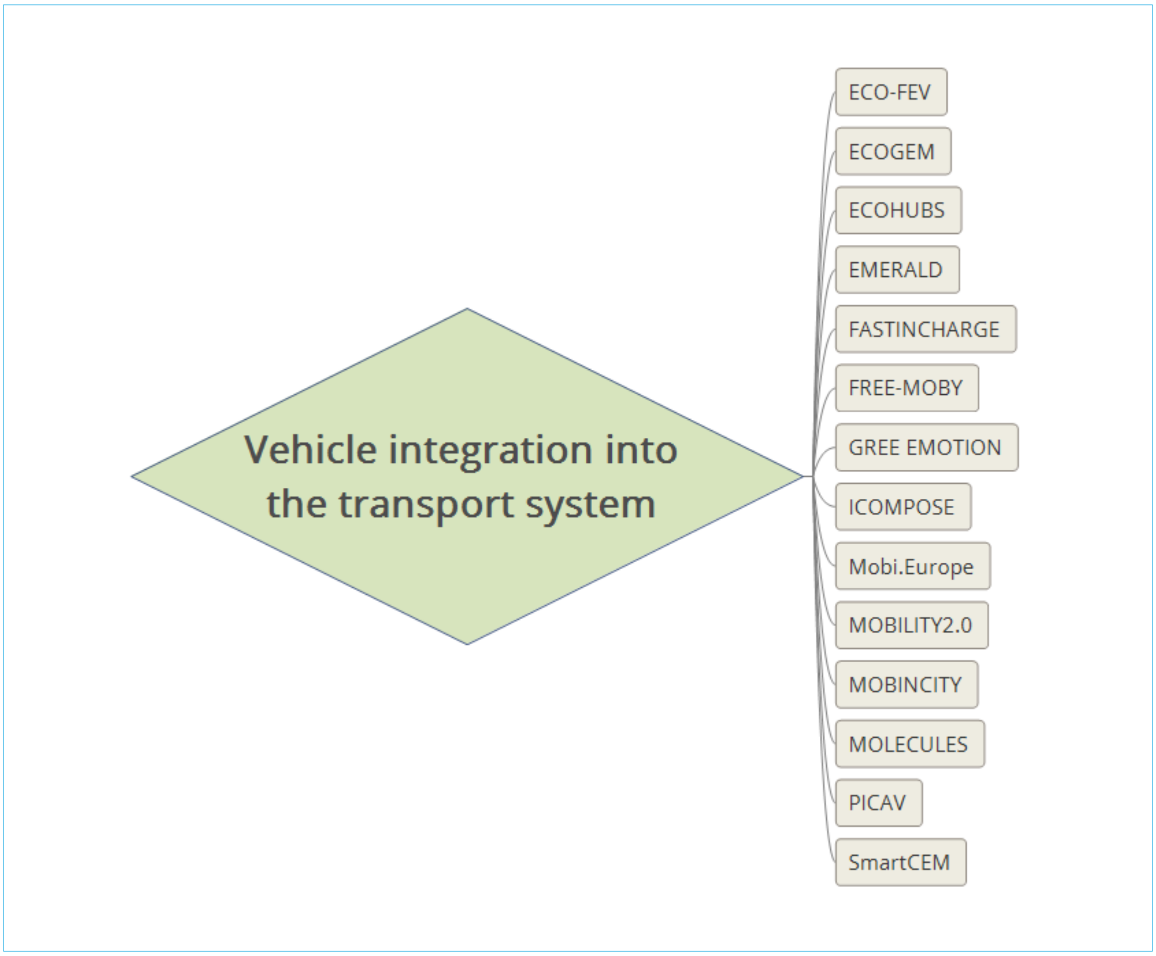
APPENDIX 3: MAPPING OF EGCI PROJECTS



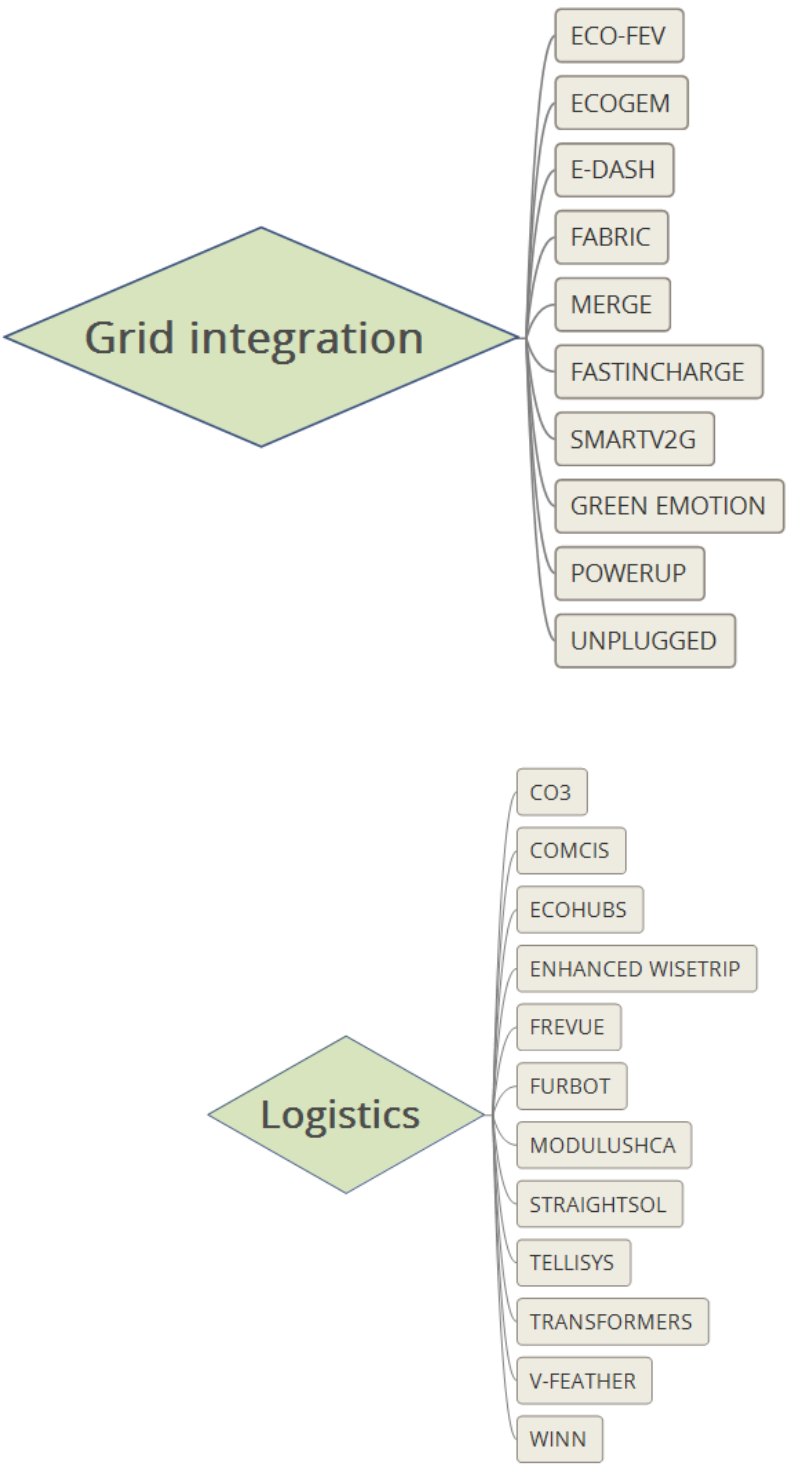


Battery
Cost reduction
APPLES
AVTR
BATTERIES2020
EASYBAT
ECOSHELL
ELIBAMA
ESTRELIA
EUROLIION
GREENLION
INCOBAT
LISSEN
SMART-LIC
SUPERLIB
Lifetime & degradation
AMELIE
APPLES
ASTERICS
BATTERIES2020
HELIOS
MARS-EV
MAT4BAT
SMART-LIC
SUPERLIB
Recycling & recyclability
AMELIE
APPLES
ASTERICS
EASYBAT
ELCAR
ELIBAMA
GREENLION
HELIOS
LISSEN
MARS-EV
Energy density & weight
APPLES
AUTOSUPERCAP
AVTR
BATTERIES2020
EMERALD
ESTRELIA
EUROLIION
MAT4BAT
Post Lithium
EUROLIS
LABOHR
LISSEN
NECOBAUT
SOMABAT
STABLE
Charging time
ECO-FEV
eDAS
E-DASH
FABRIC
FASTINCHARGE
UNPLUGGED
Optimised powertrain & vehicle solutions
Heavy Duty Vehicles
CONVENIENT
CORE
DELIVER
FURBOT
GASTONE
LIBRALATO
LNG BLUE CORRIDORS
LORRY
TRANSFORMERS
V-FEATHER
ZEEUS
Passenger cars
ARMEVA
AUTONOMICS
CASTOR
COSIVU
ELVA
EPSILON
EUNICE
E-VECTOORC
FUREX
HI-WI
ID4EV
LIBRALATO
MAENAD
MOTORBRAIN
ODIN
OPERA4FEV
OPTIMORE
OSTLER
POLUX
POWERFUL
SYRNEMO


Energy management & recovery
Passenger cars
AUTOSUPERCAP
CASTOR
eDAS
EFUTURE
EMERALD
ICOMPOSE
LIBRALATO
NOWASTE
OPENER
SMARTOP
SUPERLIB
Heavy Duty Vehicles
CONVENIENT
GASTONE
ICE
LIBRALATO
NOWASTE
Lightweight
ALIVE
AUTOSUPERCAP
BEHICLE
ECOSHELL
E-LIGHT
ENLIGHT
EVOLUTION
MATISSE
OPERA4FEV
OPTIMORE
PLUS-MOBY
SAFEEV
URBAN-EV



Vehicle integration into the transport system
ECO-FEV
ECOGEM
ECOHUBS
EMERALD
FASTINCHARGE
FREE-MOBY
GREE EMOTION
ICOMPOSE
Mobi.Europe
MOBILITY2.0
MOBINCITY
MOLECULES
PICAV
SmartCEM


Grid integration
ECO-FEV
ECOGEM
E-DASH
FABRIC
MERGE
FASTINCHARGE
SMARTV2G
GREEN EMOTION
POWERUP
UNPLUGGED
Logistics
CO3
COMCIS
ECOHUBS
ENHANCED WISETRIP
FREVUE
FURBOT
MODULUSHCA
STRAIGHTSOL
TELLISYS
TRANSFORMERS
V-FEATHER
WINN

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