

# CALL ‘GREEN VEHICLES’

***H2020-GV-2014/2015***

This call of the Transport Challenge represents an essential component of road transport research and innovation. It includes research, technological developments, innovation and demonstration in support of improvements in energy efficiency of road transport vehicles and the use of new types of non-conventional energies into road transport such as electricity, CNG and LNG, renewable and tailored fuels.

The scope of the activities include both advanced power-train technologies and new vehicle architectures, weight reduction, improved aerodynamics and rolling resistance and component development for alternative fuel vehicles. Concerning new forms of energy, the interfaces between the vehicles and the recharging infrastructure will also need to be taken into account with particular attention to standardisation issues. Demonstration activities will play an essential role in ensuring a proper and timely deployment of the new technologies. In this respect, innovation activities linked with other EU funding mechanisms such as cohesion and regional funds should be considered.

This call has been defined taking into account the other calls and initiatives where the Transport Challenge is concerned, particularly the calls on ‘Mobility for Growth’ and ‘Smart Cities and Communities’, and the ‘Fuel Cells and Hydrogen 2’ joint undertakings. Multi-sectorial research involving other research and innovation areas such as Energy and Environment coupled with research on new materials, advanced production and Information and Communication Technologies will be encouraged, particularly in fields such as advanced energy storage systems and interfaces between vehicles and energy recharging infrastructures.

In addition to the topics of this call, a topic on post lithium ion batteries for electric automotive applications” (NMP 17 – 2014) is included in “Nanotechnologies, Advanced Materials and Advanced Manufacturing and Processing (NMP)” under “Leadership in Enabling and Industrial Technologies” (LEIT).

Proposals are invited against the following topics:

## **GV.1-2014. Next generation of competitive lithium ion batteries to meet customer expectations**

Specific challenge: It is important that next generations of electric and plug-in hybrid vehicles incorporate basic electric components, such as electric batteries and their constituent components, that are manufactured in Europe. This is not the case for the first generation of these vehicles that incorporate non-European battery technologies. The challenge to be addressed is the development of new materials, facilities and technologies for advanced Li-ion batteries to support the development of a strong European industrial base in this field. This challenge is complementary to

the above mentioned battery electrochemistry topic pursuing longer terms solutions in the Advanced Materials Work Programme of 2014.

Scope: Proposals should be based on a multidisciplinary approach to pursue the optimisation of the electrochemistry to hone parameters critical to customer acceptance: cost, safety aspects, resistance to high-power charging, durability, recyclability and the impact of hybridisation with other types of storage systems (e.g. ultracapacitors), as well as consideration of scale-up for manufacturing.

In addition, better knowledge on the ageing mechanism and its modelling are needed in order to support test procedures and the development of standards. In line with the Union's strategy for international cooperation in research and innovation<sup>1</sup> international cooperation to establish world-level standard is encouraged.

The Commission considers that proposals requesting a contribution from the EU of between EUR 5 to 8 million euro each would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact: Research and innovation activities will bring European industry to a stronger position on the world market making it possible to launch new production in Europe while at the same time addressing the shortcomings of electric cars as compared to conventional cars (e.g. cost and weight reduction, safety, reliability, longevity and fitness for charging under real world conditions). The proposed solutions should demonstrate industrial scale prototypes improving cell-level energy densities by at least 20%, and costs by 20%, with respect to the best cell chemistries currently on the market.

Type of action: Research and Innovation Actions

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

## **GV.2-2014. Optimised and systematic energy management in electric vehicles**

Specific challenge: Range limitation, due to the limited storage capacity of electric batteries, is one of the major drawbacks of electric vehicles. The main challenge will be to achieve a systematic energy management of the vehicle based on the integration of components and sub-systems. The problem is worsened by the need to use part of the storage capacity in order to feed auxiliary equipment such as climate control. In extreme conditions up to 50% of the batteries' capacity is absorbed by these systems. The systematic management of energy in electric vehicles is a means to gain extended range without sacrificing comfort. The challenge is therefore to extend the range of electric vehicles in all weather conditions.

Scope: Proposals should address the combination of the following developments: comprehensive thermal management system (including thermal insulation, innovative heating and cooling approaches), battery life duration enhancement as a side effect of thermal management, electronic

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<sup>1</sup> COM(2012)497

control of energy and power flows, energy efficiency of electrified accessories, energy harvesting functions and automated and eco-driving strategies.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 to 8 million euro each would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact: Research and innovation activities will contribute to a faster introduction of electric and plug-in hybrid cars. Cars autonomy will be increased thanks to a reduction of at least 50% of energy used for passenger comfort and at least 30% for component cooling in extreme conditions with reference to electric vehicles currently on the market.

Type of action: Research and Innovation Actions

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

### **GV.3-2014. Future natural gas powertrains and components for cars and vans**

Specific challenge: The challenge is to reach the fleet level of 95g CO<sub>2</sub>/km and 147g CO<sub>2</sub>/km emissions targets for passenger cars and light duty commercial vehicles respectively (according to the new Worldwide harmonised Light Vehicle Test Procedure), through the development of advanced engine and after-treatment concepts adapted and optimised to use natural gas. Significant reductions in terms of real driving emissions of NO<sub>x</sub> and PM are also expected.

The technology needs to be competitive with respect to current vehicles using conventional fuels. Therefore the challenge can only be reached if vehicles demonstrate a driving range of at least 600 km with no space penalty in comparison to gasoline vehicles.

Scope: Proposals should focus on any combination of combustion process optimisation, variable compression, control systems, dual fuel operation, optimised fuel injection, adaptive systems and sensors to cope with different qualities and blends, after-treatment systems, advanced fuel tanks, ancillaries and overall powertrain optimisation.

The Commission considers that proposals requesting a contribution from the EU of between EUR 10 to 20 million euro each would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact: One demonstrator vehicle per platform/technology will prove, by independent testing, real driving emissions at least below upcoming Euro 6 limits, and will confirm the achievement of a reduction of at least 20% in CO<sub>2</sub> emission levels (including CO<sub>2</sub> equivalent unburned methane and N<sub>2</sub>O) compared with the best vehicles on the market in 2013. The research will develop technologies needed to progress towards the establishment of a future 'Super Low Emission Vehicles' standard with emission targets which are ambitiously lower than Euro 6.

Type of action: Innovation Actions

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

## **GV.4-2014. Hybrid light and heavy duty vehicles**

Specific challenge: The competitiveness of European road vehicle manufacturers is based on technological leadership particularly on system optimisation and affordability, particularly with respect to powertrains. The challenge is to recover a leading position in hybrid technology. The technology will also have positive effect on the reduction of CO<sub>2</sub> emissions from road transport and air quality.

Scope: Proposals should develop new knowledge on hybrid components (storage system power electronics, etc.) and system engineering, simulation and technology integration with the aim of achieving hybrid powertrain weight and cost reduction, increased functionality, simplification of complex systems, efficiency and affordability while decreasing emissions and improving performance, comfort and functional safety. For light vehicles, preference would be given to concepts providing significant zero emission ranges. The research should be validated through at least one demonstrator for each platform subject of research.

The Commission considers that proposals requesting a contribution from the EU of between EUR 10 to 20 million euro each would allow this specific challenge to be addressed appropriately.

Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact: The research will achieve a 20% powertrain efficiency improvement and a 20% powertrain weight and volume reduction with respect to the best in-class full hybrid vehicles on the market in 2013, while having a maximum 10% cost premium on the conventional model on which the demonstrator is based. To meet air quality targets, the research will prove, by independent testing real driving emissions at least below upcoming Euro 6 or Euro VI limits respectively. The research for light vehicles will develop technologies needed to progress towards the establishment of a future 'Super Low Emission Vehicles' standard with emission targets which are ambitiously lower than Euro 6.

Type of action: Innovation Actions

*The conditions related to this topic are provided at the end of this call and in the General Annexes.*

## **GV.5-2014. Electric two-wheelers and new light vehicle concepts**

Specific challenge: Europe has to face tough challenges in the field of air quality, noise and environmental protection, traffic congestion, competitiveness and jobs preservation. This calls for new and more efficient mobility concepts. L category vehicles are well placed to answer the demands for less energy consumption and affordability. They represent an attractive solution in congested cities with scarce parking space. The challenge is to develop a new generation of electrified powertrains for L category vehicles that are quiet, clean, energy efficient and safe and to investigate radically new light vehicle concepts for personal mobility in urban areas.

Scope: Proposals should focus on energy efficiency improvements for a wide range of vehicle types (from mopeds to quads and light quadricycles). Research will address cost efficiency, integration and modularity of battery packs, electric and plug-in hybrid power trains, system integration and innovative vehicle architecture. The scope also includes the development and proof of concept of new ultra-light vehicles for passengers taking into account their integration with infrastructure and, where appropriate, considering any necessary changes to homologation requirements and regulations to allow their use. The project results will be validated through demonstrators.

The Commission considers that proposals requesting a contribution from the EU of between EUR 5 to 8 million euro each would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact: The research will contribute to a significantly reduction of emissions (real driving emissions below Euro 5 level should be demonstrated for hybrids) and noise, congestion, greenhouse gas emissions and energy consumption. The research will also enhance the competitive position of the European industry. Research in this area will also support the implementation of the Clean Power for Transport strategy by developing the next generation of alternatively powered light urban e-vehicles.

Type of action: Research and Innovation Actions

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

## **GV.6-2015. Powertrain control for heavy-duty vehicles with optimised emissions**

Specific challenge: Reducing real driving emissions and consumption of heavy duty road haulage is one of the main societal challenges for the sector. Fuel efficiency and emissions reduction are sometimes dependent on how they interact with each other and with the specific vehicle application and operating conditions. The challenge is therefore to develop new means of flexible and global engine and emissions control in an optimal way for each application in order to maximise the potential utilisation of the individual systems.

Scope: Proposals should focus on methods how to optimise the control of powertrains taking into account specific transportation tasks. This can be achieved by using the information provided by new generation navigation systems and emission sensors linked to the On Board Diagnosis/On Board Measuring system in combination with electronics and actuators. The strategy will use data such as transport assignment (total weight, vehicle configuration, etc.), traffic and weather conditions, topography and road network on the chosen route, driving patterns of the surrounding vehicles, the state of the combustion engine, after treatment and transmission, monitored emissions emitted, etc. The resulting technology should deliver a global optimum for consumption (for both fuel, electric energy and other consumables related to emission control such as urea or ammonia) and noxious emissions on each mission, to be validated through a demonstrator.

The Commission considers that proposals requesting a contribution from the EU of between EUR 5 to 7 million euro each would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact: A reduction of fuel consumption of at least 20% on the same vehicle with conventional control should be demonstrated comparatively, while not exceeding Real Driving Emissions limits set by the established Euro VI procedures.

Type of action: Innovation Actions

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

## **GV.7-2014. Future natural gas powertrains and components for heavy duty vehicles**

Specific challenge: The challenge is the development of advanced non-hybrid powertrain concepts for heavy duty vehicles (either dual-fuel or optimised for pure natural gas operation), complying with the Euro VI standards and meeting the CO<sub>2</sub>/km emissions targets currently under definition.

This will deliver significant air quality improvements, particularly in terms of particle numbers and NO<sub>x</sub> in real driving conditions.

In order to achieve a real impact on the societal challenges, vehicles using the developed technology need to be competitive with current vehicles using conventional fuels. Therefore an additional technological challenge is to develop specific components (for instance better fuel tanks for liquefied natural gas with improved thermal insulation, optimised pressure handling systems and methane catalysers) for these types of fuels with lower cost, volume and weight while keeping high safety standards.

Scope: Proposals should include adequate combinations of combustion process optimisation, variable compression ratios, engine control, dual fuel operation, optimised fuel injection systems, adaptive systems and sensors to take into account different fuel qualities, new generation after-treatment systems (in particular for NO<sub>x</sub> and methane slip especially during transients and at low temperatures) and overall powertrain optimisation, advanced fuel tanks (high pressure gaseous, liquid or solid state) and any other innovative concepts and components for the different vehicle categories.

Ranges before fuelling should be demonstrated of at least 800 km on natural gas while keeping weight, volume and cost penalties to a similar level to current best in class vehicles.

All developed technology should be integrated on vehicles that should be tested by independent bodies on the World Heavy Duty Cycle (WHDC) test procedures, including the relevant Portable Emission Measurement System (PEMS) approaches.

The Commission considers that proposals requesting a contribution from the EU of between EUR 10 to 20 million euro each would allow this specific challenge to be addressed appropriately.

Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact: Real driving emission levels respecting post-2020 emission limits and procedures shall be achieved in order to address the air quality challenge. The capability to maintain this performance during the engine life should be also demonstrated through accelerated ageing procedures.

As far as the climate change challenge is concerned, the research target is to achieve at least 10% lower CO<sub>2</sub>-equivalent emissions (i.e. including unburned methane and N<sub>2</sub>O) than the best vehicles on the market in 2013 using the same fuel (natural gas for pure methane engines, diesel in the case of dual fuel systems).

Type of action: Innovation Actions

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***

## **GV.8-2015. Electric vehicles' enhanced performance and integration into the transport system and the grid**

Specific challenge: The limited driving range of electric vehicles is one of the biggest deployment challenges for electromobility. A ground-up re-design is needed to fully take advantage of the design freedoms and the opportunities in defining and developing the electric and electronic architecture and components. This should result in increased efficiency and range and make a major contribution towards the transition to fully electric vehicles (FEV's).

A particularly important element that needs to be addressed is the battery management system (BMS), which is fundamental for many aspects of electrified vehicle performance, from energy efficiency (and therefore range) to safety, battery life and reliability.

Information and communication technologies (ICT) significantly contribute to enhancing the energy efficiency and thus the range of the vehicle by providing accurate prediction of the range and offering personalised options and services to the driver. Furthermore ICT supports recharging that is coordinated with the local electric grid capabilities. Such coordination must accommodate not only passenger EVs, but also meet the requirements of electric buses, vans or trucks, which are expected to require high-powered fast recharging.

Scope: Proposals should address one of the following complementing domains and could include interfaces between these domains:

- EV concepts featuring a complete revision of the electric and electronic architecture to reduce complexity and the number of components and interconnections, whilst improving energy efficiency, functionality and modularity. This may be supported by drive-by-wire or wireless communication, as well as advanced energy storage, transmission and conversion systems including miniaturisation. Challenges in safety, security, reliability and robustness, including electro-magnetic compatibility, are to be

addressed. Work shall pursue a high degree of standardisation and cover the entire electric vehicle value chain.

- Concerning BMS research work will focus on a combination of the following aspects:
  - Novel BMS designs with improved thermal management, power density and life time, safety and reliability.
  - Improved modelling and simulation tools for BMS improvement.
  - Contribution to standardisation of BMS components and interfaces.
  - Test methodologies and procedures to evaluate the functional safety, reliability and lifetime of battery systems.
- In-vehicle integration of the overall cycle of EV energy management into a comprehensive EV battery and ICT-based re-charging system management, providing ergonomic and seamless user support. Such integration should build upon existing technology standards.
- Digital support for EVs such as common information model, market place interaction and service provision based on wireless / power line communication interfaces, roaming management, energy consumption and supply as well as cost aspects are in the scope.
- Interoperability of EVs with the communication infrastructure and electricity grid regarding locally deployed smart-grid and smart-metering systems while investigating arising operational issues and taking current developments into account. Specific requirements of various EV types and customer requirements should be addressed.

The Commission considers that proposals requesting a contribution from the EU of between EUR 5 to 10 million euro each would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected impact:

- Improvements in the cost-performance ratio of EV contributing to quicker market take-up.
- Enhancements to vehicle range and/or weight, battery life and reliability without compromising on safety - delivering a more robust and well managed battery system.
- Standardised BMS components and interfaces
- Progress on ICT-based technologies for coordinated EV recharging.
- Improved attractiveness of EVs, achieved through a seamless and ergonomic energy management cycle (spanning the entire cycle from re-charging spot selection/reservation to plug-out after re-charging).
- Contributions to standardisation strengthening the competitiveness of the European industry.

Type of action: Research and Innovation Actions

***The conditions related to this topic are provided at the end of this call and in the General Annexes.***



## CONDITIONS FOR THE ‘GREEN VEHICLES’ CALL

Publication date: 11/12/2013

Deadlines<sup>23</sup>:

Topics	
GV.1, GV.2, GV.3, GV.4, GV.5, GV.7	Single stage 28/08/2014 at 17.00.00 Brussels time
GV.6, GV.8	Single stage [27/08/2015 at 17.00.00 Brussels time]

Overall indicative budget: EUR 159.00 million from the 2014<sup>4</sup> and 2015<sup>5</sup> budgets (for 2014 – EUR 129.00 million and for 2015 30.00 million).

The indicative distribution of the call budget is as follows:

Topics	2014 EUR million	2015 EUR million	
GV.1, GV.2, GV.3, GV.4, GV.5, GV.7	129.00	–	All single stage
GV.6	–	10.00	All single stage
GV.8	–	20.00	All single stage

<sup>2</sup> The Director-General responsible may delay this deadline by up to two months.

<sup>3</sup> The deadlines provided in brackets are indicative and subject to a separate financing decision for 2015.

<sup>4</sup> The budget amounts for 2014 are subject to the availability of the appropriations provided for in the draft budget for 2014 after the adoption of the budget for 2014 by the budgetary authority or if the budget is not adopted as provided for in the system of provisional twelfths.

<sup>5</sup> The budget amounts for 2015 are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2015.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme.

Evaluation procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide associated with this call.

- Indicative timetable for evaluation and grant agreement:

Topics	Information on the outcome of the evaluation (single stage)	Indicative date for the signing of grant agreements
GV.1, GV.2, GV.3, GV.4, GV.5, GV.6, GV.7, GV.8	Maximum 5 months from the final date for submission	Maximum 3 months from the date of information applicants

Consortia agreements: In line with the Rules for Participation and the Model Grant Agreement, participants in Research and Innovation Actions or in Innovation Actions are required to conclude a consortium agreement prior to grant agreement.