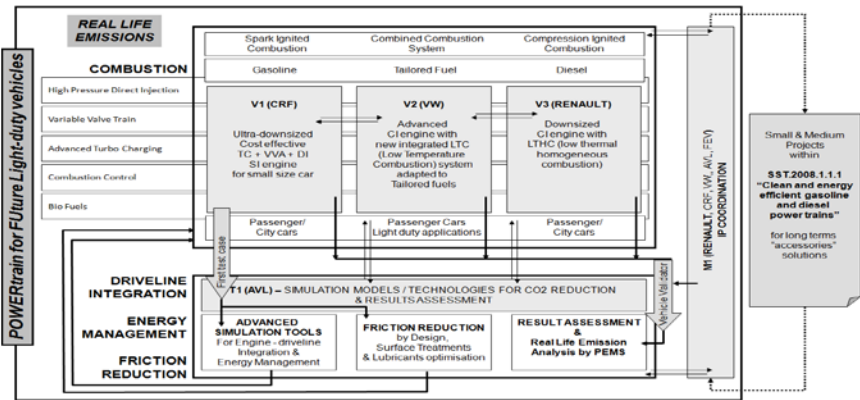


### Motivation and Objectives

- To meet 40% lower CO<sub>2</sub> emissions with respect to the 2005 figures for spark ignition (SI) engines powered vehicles and 20% lower CO<sub>2</sub> than the 2005 level for compression ignition (CI) engine powered vehicles with comparable fun-to-drive figures of the 2005 vehicles.
- To meet CO, HC, NO<sub>x</sub> and PM figures, as engineering targets, at least 10% less than Euro 6 emissions limits.
- To maintain the CO<sub>2</sub> and pollutant emissions levels during the useful engine life and keeping into account real world emissions, i.e. in accordance with both, the standard New European Driving Cycle (NEDC) and with the Artemis cycle. Furthermore the PEMS procedure will be applied to vehicles independent of any cycle.
- By fulfilling the above targets, POWERFUL realizes the Light-duty Environmentally Enhanced Vehicle (LEEV) concept, defined as a vehicle that both meets the next stage of pollutant emission limit values and stays below the above mentioned level of CO<sub>2</sub> emissions.

### Project Plan, Milestones and Deliverables



### Technical Approach

POWERFUL will address research, development, validation and demonstration of future light-duty vehicle engines for road transport. The project consists of three vertical sub-projects:

- V1:** An advanced four-stroke SI engine concept characterized by low-cost / low emissions;
- V2:** An advanced four-stroke CI engine concept able to run also on new tailored fuels and integrating the LTC (low temperature combustion) mode in the CI combustion system;
- V3:** An advanced two-stroke CI engine concept running on diesel fuel and integrating the Low Thermal Homogeneous Combustion (LTHC) mode in the CI system.

These advanced engine concepts will be accompanied by a transversal sub-project T1 taking care of the development of new simulation tools describing the strong interactions between combustion systems and engine architecture, means for reducing engine frictions and performing an intelligent energy management.

### Achievements

- V1:** The prototype vehicle with an advanced engine integrating Gasoline Direct Injection (GDI), Variable Valve Actuation (VVA) and Turbo Charger (TC) technologies has been realized.
- V2:** The production intent 1.2l TDI engine has been delivered to partners; potential of improvement for enhanced after treatment system (EATS) has been identified; alternative fuels are being tested in a single cylinder engine with focus on emissions and potential for low temperature combustion (LTC).
- V3:** The innovative elements of the Diesel 2-stroke engine are verified (reliability, scavenge, combustion).
- T1:** The methodology and software tools for a virtual engine integration were demonstrated by an example. Assessment criteria for evaluation of individual engine and vehicle concepts were defined. With respect to the reduction of friction design guidelines were summarized, innovative materials and surface coatings were selected and test procedures were defined. The material lab tests were started.

Budget 24.35 M€  
 Duration 48 months  
 DG Research  
 Coordinator Pascal Tribotté, Renault  
 Partners 18 partners, among them Renault, CRF, VW, AVL, FEV, Delphi, Ifp  
 Website www.powerful-eu.org

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