FUEREX Newsletter

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FUEREX

Introduction

The EC Co-funded FUEREX project proposes highly efficient, compact, clean and low cost engines applied **as range extenders for battery electric vehicles**, capable of using renewable bio fuels as well as regular fossil fuels..

Worldwide, there is a strong trend towards **highly efficient, low emission vehicles.** Factors that add to this trend are worldwide concern on: global warming and climate change, air quality and decreasing availability and dependency of fossil fuels.

In order to facilitate the **transition from conventional fuel-driven vehicles** towards electrically driven vehicles, there is a short(er) term need for advanced plug-in hybrids and electrical vehicles with range extenders for regular customer duty.

Objectives

- Development of **3 compact spark-ignition engines** for low cost Range Extender.
- Development of **multifuel capability** and flexibility.
- **Vehicle integration** of the range extenders in vehicles with state of the art battery packs.
- **Demonstration** and validation of the integrated technology at a realistic scale (3 test vehicles).

Main results

Three range extenders demonstrating state of the art performance and integration.

- Bench test demonstrating **emissions, efficiency and performance** for total Range Extender.
- Vehicle test demonstrating **integration, Noise Vibration & Harshness (NVH)** and vehicle performance.
- A study on **volume production optimization** (low cost solutions).
- Design guidelines of how a **RE shall be optimized** for a given vehicle and how the RE itself is optimized.

SEVENTH FRAMEWORK PROGRAMME

The FUEREX project has been made possible by a financial contribution by the European Commission under Framework Programme 7.

UNIRESEARCH · AVL · AVL SCHRICK · IVECO ALTRA · CRF CENTRO RICERCHE FIAT · CHALMERS · VOLVO · BOSCH

Technical progress

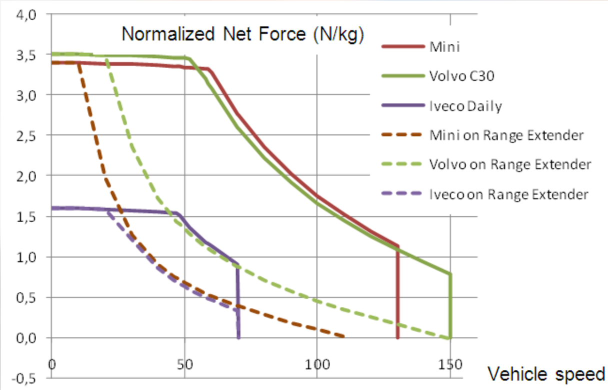
WP 2 - System definition - D2.1

The basic vehicle data and the performance requirements of the three target vehicles for the FUEREX range extenders have been defined in Deliverable D2.1. The drive line of all the three vehicles are of the same type; an electric motor with a fixed gear ratio as the only propulsion power source. For this type of driveline the number of performance requirements can be reduced to four main parameters, if they are selected in a way which reflects the way the driveline is designed. In this D2.2 report the below four parameters have been used to define the performance requirements for the three vehicles:

- Take-off acceleration on a flat road
- Maximum power of the drive system in field weakening mode
- Maximum speed
- Maximum power when only supplied by the range extender

Based on these four performance requirements the drive lines capability to produce longitudinal force on the vehicle can be calculated.

By calculating the *Normalized Net Force* produced by the drive line, the capability of the different drive lines can easily be illustrated and compared in a single plot. The *Normalized Net Force* is calculated as the longitudinal force from the drive line minus the drag force from rolling resistance aerodynamic drag, divided by the vehicle mass. Since it is the difference between the force from the driveline and the drag force which can be used to accelerate the vehicle or climb a gradient the *Normalized Net Force* will show how much acceleration the vehicle is capable of on a flat road, and it can at the same time be used to determine how high gradient the vehicle can climb at constant speed. The maximum Normalized Net Force is proportional to the acceleration on a flat road or the maximum gradient which the vehicle can drive uphill without losing speed. 1 N/kg will correspond to an acceleration of 1 m/s^2 or to climb a 10% slope.



WP 2 - System definition - D2.2

The requirements on a range extender are mainly based on the customer requirements on the vehicle and are derived from them. It is discussed how vehicle level requirements for range extender vehicles can be defined and why they may in some respect differ from the requirements on today's vehicles.

In the below table the requirements on the range extenders are summarized, together with requirement levels. These requirements have been agreed by the FUEREX partners as defining attractive range extender concepts for the three investigated vehicle types. They have been defined taking the business perspective into account, to make sure that cost effective solutions are developed.

The evaluation methods include not only analyzing the below requirements on the range extenders, but to also to estimate the fuel consumption and emissions in typical driving situations. Methods to evaluate this through simulations are also described in the end of this D2.2 report.

The results of this study are given in Deliverable D2.2.

Requirement	**Rotary piston engine**	**3 cylinder engine**	**2 cylinder natural gas engine**
Maximum electrical power output	15 kW	35 kW	30 kW
Running hours (service life, B10)	800 h*	1200 h*	800 h*
Fuel efficiency	260 g/kWh	240 g/kWh	220 g/kWh
CO2 emissions	810 g/kWh	748 g/kWh	605 g/kWh
Nitrogen oxides (NOx)	0.030	0.030	0.040
Total hydrocarbon (THC)	0.050	0.050	0.100
Non-methane hydrocarbons(NMHC)	0.040	0.040	0.035
Carbon monoxide (CO)	0.500	0.500	1.100
Particulate matter (PM)	0.003	0.003	n.a.
Noise at 2 meters distance with the range extender running at full power.	< 65 dBA	< 65 dBA	< 65 dBA
Vibrations (mounted in vehicle)	Not recognized by the driver	Not recognized by the driver	Not recognized by the driver
Cost (in high volume production)	< 1,500 €	< 2,800 €	< 2,500 €