OPerating RAck For Full-Electric Vehicle

Periodic report 2 – Publishable summary

- **Brief description of project context and objectives**

The OPERA4FEV project aims to develop thermoplastic battery racks on two functional demonstrators: one for a large scale vehicle from FIAT and one for a “niche” car, the F-City from FAM. In order to improve deployment of electrical vehicles in Europe, large scale production processes for rack and electrical components need to be developed.

The innovative solutions proposed by OPERA4FEV will integrate electrical, hydraulic connections and component housing in a thermoplastic approach to reduce cost, weight and assembly time.

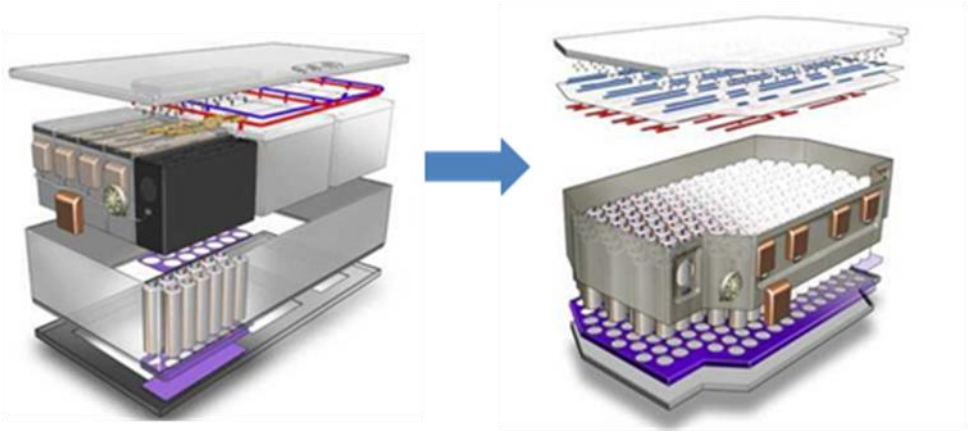

Figure 1 : Integrated rack

In order to show the relevance of the solution and meet strong industrial benefits, the two thermoplastics racks will be manufactured and assembled with industrial means.

The whole value chain will be addressed, including the eco-design (dismantling and recycling of critical materials), assembly and integration of cells and electrical components.

As safety of the on-board battery in electric, hybrid, and plug-in vehicles is of paramount importance to international automakers, OPERA4FEV will pay particular attention to evaluate the effects of the rack characteristics regarding vehicle crash safety, and will focus on the potential risks for the vehicle and its occupants in case of failure of one or more batteries.

To sum up, the main issues related to OPERA4FEV project are:

- the integration of cells into the thermoplastic rack
- an easier mounting and fast connexions of cells
- the reduction of assembly time
- 25% cost reduction on components (cells excluded) compared to existing rack
- the improvement of dismantling for better maintenance
- 50% reduction of number of components
- the eco-design of the racks and easier end of life (materials, dismantling) based on life cycle assessment

- the plastics parts design to improve thermal regulation, guaranty safety/crash behavior and deal with large dimensions
- the use of recycled polymers (70% in weight)
- 30% weight reduction on components (cells excluded)
- a concept proposal adjustable to automotive industry and evaluated with representative tools and assembly line (able to reach 20 vehicles/day).

- **Description of the work performed since the beginning of the project and the main results achieved so far**

The work performed so far can be summarised as follows:

- Initiation of the project
  - Functional analysis
  - DFMEA

- Thermal characterisation of the cells
  - Air cooling design with heatsink : ready for calculation in INSA
  - Cell test bench launched

- Design of the IVECO rack
  - Overall design
  - Overall bill of material
  - 3D design of the rack for IVECO vehicle
  - Drawings
  - Components drawings

- First prototype of IVECO rack (Figure 2)
  - Prototype achievement for verification on IVECO Vehicle
  - Verification of the rack prototype assembly and fitting in IVECO vehicle
  - Design modification accordingly
  - Design ready for 3D crash simulation in UPM

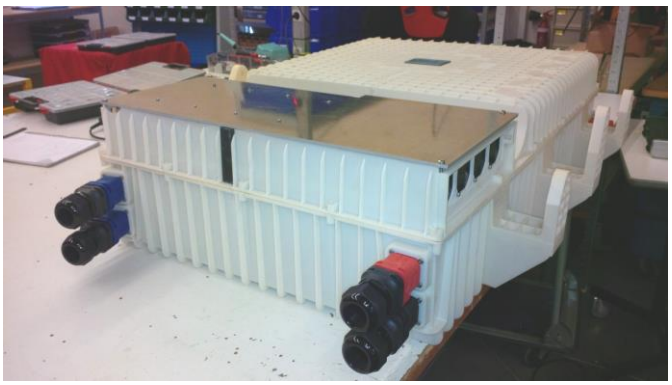

Figure 2 : First prototype of IVECO rack

- First work on cells
  - Cells delivery to EVE System
  - Rack and internal modules and parts to EVE for verification

- Modification of the consortium : MIA addition
  - FAM was excluded from the consortium
  - MIA integration in the consortium
  - Design brainstorming for MIA Rack definition
  - MIA Rack concept and first design trials

- **Expected final results and their potential impact and use (including the socio-economic impact and the wider societal implications of the project so far)**

So far, the project has not much impact in terms of socio-economic aspects. But we listed here-below the expected impacts.

The major impacts of OPERA4FEV will be:

- 25% production costs reduction and weight reduction of 30% for battery rack with plastic use and cells integration directly into a rack without intermediate module
- Reduction of components and dismantling time by including cells directly into rack
- Developing the whole value chain, assembly/integration and production of cells and electrical components
- Development of electrical components with better performances and at competitive cost specially designed for FEV
- Greener production processes
- Extended knowledge on material recycling
- Study and development of new industrial materials applied to the automotive industry,
- Increased security in the car with new materials and association of materials

- Reduction of other vehicle emissions (NOx, N2, hydrocarbons etc) on EU air – associated with cleaner environment, better health and living for EU residents
- Development of advanced eco-design and manufacturing processes for large scale production of lithium-based cells
- Help structuring the very promising market of electric cars and establishing the basis for a world level European automotive battery and electrical components manufacturing industry
- Introduction of Quality control of industrial process ISO 9001
- Contributions to EU low carbon vehicle policies according to CE/443/2009
- Position of Europe as a leader in key areas of underpinning science and engineering for future low-CO2 vehicles
- Increase competitiveness of EU OEM whilst underpinning EU automotive industry in readiness to tap future income in low carbon vehicles. The upcoming markets are mainly India, China, Brazil - 600 (India) and 500 (China) million cars on road, respectively, are expected by 2050 - while cementing low carbon vehicle philosophy
- Develop an approach of thermal management of the cells for Electric Vehicles with industrial solutions
- Develop an approach with calculation and measurements of gas venting management with industrial solutions
- The energy storage remains the main sticking point for electric vehicles, the project is expected to remain among the leading manufacturers of clean technologies using the most successful battery
- The project will respond to requests from manufacturers, the aim is to conquer 10% of market share by 2020 (estimated to 800.000 FEV/year) in Europe.

In particular, in terms of environmental impact, the project aims at taking 10% of the battery rack market. This will correspond to:

- the use of 600 tons of recycled materials which can contribute to the request defined in the directive 2000/53/EC.
- the weight reduction of 30% for the rack is about 2,5 kg. 2,5 kg reduction is equivalent to 95 kW.h reduction in the life time of one vehicle. Thus for 10% of the European market (80.000 vehicles), the energy reduction is of about 7,5 GW.h which corresponds to a reduction of 800.000 tons of C02 emission in western Europe (considering that 1kW.h is equivalent to 110 g/eq. C -average European energy mix-).

Besides, in terms of economic impacts, if we consider the market of FEV in Europe as 6% of the production in 2020, it will correspond approximately to 800.000 vehicles.

Each vehicle will corresponds to 150 to 300 cells with 5 to 10 kilos of plastic housing and a business 6 to 12 k€ per vehicles.

The corresponding figures for 10% of the market are:

- 600 tons of plastic/year
- 18 Millions of Cells
- 720 M€ (with about 108 M€ for thermoplastic rack)

- **Link to the project public website**

The public website is www.opera4fev.eu.