E-MOBI: A Consortium of Excellence for Sustainable and Sovereign Electric Mobility

The E-MOBI project is a major initiative designed to tackle the technological, ecological, and economic challenges of electromobility. Led by a multidisciplinary regional consortium, this project is being implemented in the Hauts-de-France region with an ambitious goal: to locally develop and produce an innovative motor-inverter system without using rare-earth permanent magnets, while promoting the use of recycled materials and creating a new European industrial sector.

A Regional, Sustainable, and Integrated Value Chain

The project stands out by covering the entire electric motor value chain—from design to end-of-life, including production and repair. The consortium includes leading industrial and academic partners:

- **MOV'NTEC (Ruitz, 62):** Responsible for the design of the motor and inverter, as well as the development of the pilot production line.
- **Thyssenkrupp Electrical Steel (Isbergues, 62):** Specialist in grain-oriented (GO) electrical steels, developing high-performance rare-earth-free magnetic materials.
- **FAVI (Hallencourt, 80):** In charge of developing cooling systems for the motor and power electronics, using recycled alloys.
- **Eiffage Energie Systèmes Electronique (Verquin, 62):** Innovating in the eco-design and manufacturing of electronic boards.
- **University of Artois – LSEE and Tech3E & Polytechnic University Hauts-de-France (UPHF) and LAMIH (62):** Responsible for laboratory validation and doctoral research on the electromagnetic properties of materials.
- **ARIA HDF and MEDEE cluster:** Strategic support and dissemination of results.

An Ambitious and Multidisciplinary Technical Approach

The project is structured into several work packages, each led by domain experts.

Work Package 1: Optimization of GO Steels

(Thyssenkrupp, University of Artois, LAMIH)
Objective: Develop grain-oriented magnetic sheets with thermosetting varnish to improve cutting performance while maintaining excellent electromagnetic properties.
Tasks include:

- Reducing or eliminating ceramic glass film that damages tools.
- Adding thermosetting varnish to stabilize magnetic segmentation.
- Multi-parameter characterization (nano-indentation, SEM, X-ray diffraction).
  Two PhD theses (Cut_GO and T-Tif) support this work.

Work Package 2: Motor Design

(MOV'NTEC)
Development of a 15 kW rare-earth-free motor, including:

- Multiphysics design (thermal, electrical, mechanical).
- Use of GO steels and eco-friendly windings.
- Solvent-free insulation system modeling.
- Prototyping and pilot production line.
  A CIFRE doctoral thesis is planned in collaboration with LSEE.

Work Package 3: Cooling System

(FAVI)
FAVI is developing innovative cooling circuits for both the motor and inverter.
Objectives:

- Optimized thermal circuit design using numerical simulation.
- Integration of secondary-melt aluminum alloys.
- Low-energy pressure die casting processes.

Work Package 4: Inverter Design

(MOV'NTEC, FAVI, Eiffage, Tech3E)

- Development of modular, eco-designed electronic boards.
- Use of multi-sourced European components.
- Thermal modeling to reduce assembly temperatures.
- New adaptive control software modules.

Work Package 5: Laboratory Validation

(University of Artois)
Verification of electromagnetic, thermal, and mechanical performance under real-world conditions.

Work Package 6: Eco-Design and Recyclability

(All Partners)

- Comprehensive environmental assessment.
- Process improvements to strengthen the circular economy.

Work Package 7: Project Management and Dissemination

(All Partners)
Project coordination, communication of progress, and sharing of results with industrial, academic, and public stakeholders.

An Industrial and Societal Ambition

The E-MOBI project addresses several major challenges:

- **Decarbonizing mobility:** Elimination of rare-earth elements, use of recycled materials.
- **Industrial sovereignty:** Building a European supply chain from motor to inverter.
- **Job creation and industrial reconversion** in the Hauts-de-France region.
- **Training and research:** 3 doctoral theses, skill transfers, and replicable innovations.

With E-MOBI, the Hauts-de-France region positions itself as a pioneering territory for sustainable electromobility in Europe, creating a replicable model for a virtuous, innovative, and resilient mobility industry.