

Innovating mobility



Efficient industrial research

Innovating
mobility

Efficient
industrial
research

IFP Energies nouvelles (IFPEN) is a public research and training player. It has an international scope, covering the fields of energy, transport and the environment. From research to industry, technological innovation is central to all its activities.

The IFPEN Transports Energie Carnot Institute is part of the Carnot network dedicated to fostering innovation in companies, from SMEs to major groups.

Positioned at the heart of sustainable mobility and energy ecosystems, it addresses current mobility challenges: evolving transport modes supported by digitalization, improved energy efficiency, diversification of energy sources and pollutant and noise reduction.

It provides its industrial partners with innovative and competitive products and services relating to electrified mobility, connected mobility and low environmental impact mobility.

A research and innovation strategy hinged around products and industrial partnerships

Time-to-market

Know-how and expertise, experimental resources and design simulation tools reducing the development costs and time-to-market of innovative solutions.

Target markets

- Automotive, including trucks and off-road,
- Urban mobility,
- Aviation,
- Energy,
- Waterborne,
- Rail.

Innovative products and solutions to meet technological challenges and market needs

Summary

Electrified mobility	4
Connected mobility	6
Low environmental impact mobility	8
Our strengths	10



Electrified mobility

Efficient and cost-effective powertrain electrification solutions for optimum energy efficiency

OUR APPROACH

From hybrid to full electric vehicles, including electrification of internal combustion engines.

Electric & hybrid powertrains

New electric machine topologies

- Up to 97% efficiency,
- Significant weight and volume reduction,
- Very high efficiency over a wide range,
- Very high-speed motor technology, up to 200,000 rpm,
- Low (<48 V), medium (<400 V) and high (<800 V) voltage electric motor and electronics.

Fuel cell

Testing and simulation

- Balance of plant specification,
- Stack modeling,
- Global systems testing.

Electric & hybrid powertrains

New electric machine topologies

Thermal energy recovery systems

ORC thermal recovery systems

Fuel cell

Testing and simulation



Batteries

Modeling and simulation

Vehicle energy management

Global system approach

Batteries

Modeling and simulation

- Battery testing, from cells to packs,
- Aging, thermal management, etc.,
- Safety and thermal runaway,
- 2nd life and recyclability.

Vehicle energy management

Global system approach

- Hybrid vehicle specifications,
- Onboard software solutions.

Thermal energy recovery systems

ORC (Organic Rankine Cycle) thermal recovery systems

- Developed with the French SME Enogia,
- Development of ORC systems for the transport sector,
- Target: 2 and 3% reduction in CO₂ emissions for WLTC operation.



Connected mobility

Web services to reduce the environmental footprint associated with mobility and, ultimately, improve air quality



Market surveillance

Embedded PEMS REAL-e

- IoT measurement tool designed to easily characterize emissions in real usage conditions (RDE),
- Developed with the French SME Capelec,
- Based on:
 - a gas analysis system using samples,
 - numerical pollutant emissions models.

Air quality – The Geco air™ application

OUR APPROACH

On-road measurements coupled with crowdsensing data, physical powertrain modeling, cloud computing from real-time GPS data.

- Crowdsensing tool developed by IFPEN,
 - Participative approach,
 - Available free on iTunes and GooglePlay.
- For drivers: changing behavior at the wheel**
- Estimated emissions relating to journeys,
 - Advice relating to practices to adopt at the wheel.

For companies: optimize their mobility planning

For territories: incorporate air quality in city planning decisions

- Real-time emissions mapping across a region,
- Acquisition of knowledge relating to critical zones,
- Improved road infrastructure and traffic management.

Gentle mobility

Connected services for cyclists: Geovelo application & Galanck connected backpack

For cyclists

- Route comparison, weather forecast planning,
- Safe navigation guidance,
- Energy estimation, assessment of cyclist performance, cyclability / usages.

For territories

- Automatic user-based road roughness mapping,
- Mean effort mapping.



Low environmental impact mobility

Thermal engines and alternative fuels for electrified powertrains

OUR APPROACH

Improve the thermodynamic efficiency of IC engines

- 10% by 2025,
- 20% by 2030.

Achieve very low levels of pollutant emissions in real driving conditions

- Euro 7+ (incl. NH₃, N₂O, CH₄, aldehydes, PN10nm, etc.),
- Secondary and persistent organic pollutants.

Identify fuels with a dual impact to reduce CO₂ emissions

- Non-fossil origin,
- Targeted properties in terms of combustion efficiency.



Very low-carbon fuels

- Sustainable, low-CO₂ liquid fuels for current and future IC engines,
- Deposit formation and aging,
- Biogas and hydrogen engine combustion systems.

High-efficiency engines

Advanced combustion system design for hybrid vehicles

- Swumble™ technologies for very high-efficiency SI engines,
- 3D fully predictive reactive flow models implemented into Converge™ CFD software.

Air loop and engine control

- Hardware and associated component optimization, including virtual sensors,
- Control algorithms for optimum operation and calibration.

Reduced local pollutant emissions

- Innovative materials for SCR deNO_x systems,
- Experimental characterization, from laboratory to RDE (Real Driving Emissions) and ISC (In Service Conformity) conditions, and portable emission devices,
- Simulation of complex after-treatment systems.



Our strengths

Close ties with industry

- Industrial partners for innovation design, manufacturing and marketing,
- Software publisher partners for software marketing (Siemens Digital Industries Software, Convergent Science Inc., FEV),
- Joint industrial projects with major transport and energy sector players.

Long-standing partnerships

- GSM (Groupement scientifique moteurs), Economic Interest Group with Renault and PSA Group for engine pre-competitive research,
- AFRC (Aramco Fuel Research Center) for new engine/fuel pairing research.

Significant contribution to French and European joint projects.

Comprehensive analysis and testing facilities: from lab to demonstration vehicle.

A network of partnerships to support innovation

- A strong commitment to various French competitiveness clusters: Mov'eo, CARA and ASTech, and other public authorities such as the ITE (Energy Transition Institute) Vedecom, ANCRE (French National Alliance for Energy Research Coordination), etc.,
- Support for industrial sectors through pooled and targeted activities within the Carnot Institutes network, as a coordinator of CARNAUTO for the vehicle sector and as a partner in AIRCAR for the aviation sector,
- Synergy with networks of academic partners and R&I laboratories with a worldwide reputation,
- Strong ties with European public authorities and networks in the transport sector: EARPA, ERTRAC, EGVIA, POLIS.

www.ifpenergiesnouvelles.com



IFP Energies nouvelles

1-4 avenue de Bois-Préau
92852 Rueil-Malmaison Cedex - France

IFP Energies nouvelles-Lyon

Rond-point de l'échangeur de Solaize
69360 Solaize - France



Institutional Relations and Communications Division - 052007 - Photos: © IFPEN, Adobe Stock- X.
Document printed on 100% FSC-certified paper, partially recycled in a printing plant with the Imprim'Vert green printing label.