Solutions for ultra-low CO_2 gasoline vehicles

IFP Energies nouvelles offers industry players a comprehensive range of engineering tools and services for the design of ultra-low CO_2 gasoline powertrain systems.

Present throughout the powertrain development chain, IFP Energies nouvelles draws on its dual expertise in both engines and fuels and an innovative system development approach.

By optimizing the solutions put forward, the costs and timeframes involved in the development phases can be reduced, in line with industry's requirements, for both conventional and hybrid applications.

Vehicle architecture and integration

Comprehensive solutions developed using advanced test and simulation methods:

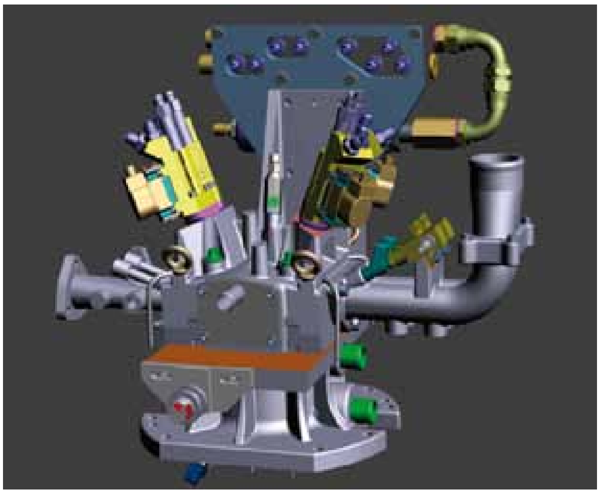
- new combustion processes (single cylinder test bench, RANS IFP-C3D code, LES AVBP code, etc.);
- air loop dimensioning;
- after-treatment systems (climatic test bench, synthetic test bench, etc.);
- model-based control strategies (IFP Energies nouvelles libraries within the LMS Imagine.Lab AMESim platform, etc.);
- advanced calibration methodologies (automated multi-cylinder, high-dynamic test benches, etc.).

Combustion system and air loop

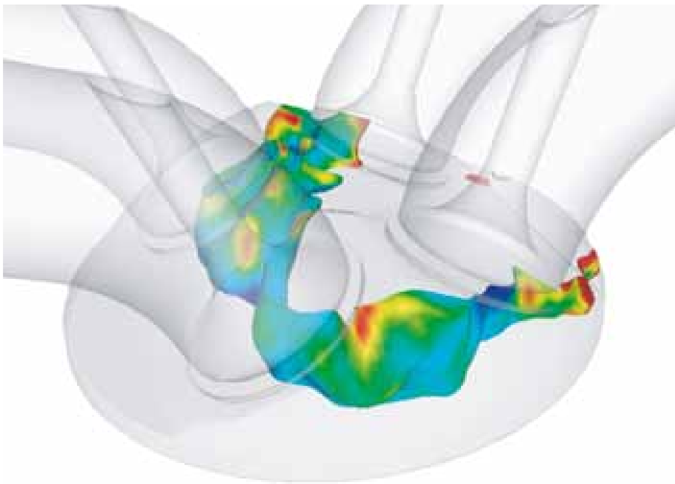
From new combustion modes to air loop dimensioning, a range of technologies aimed at improving the efficiency of gasoline engines:

- small , highly downsized engines (2 cylinders/3 cylinders, etc.);
- gasoline direct injection and variable distribution (VVT, VVL, VVA, etc.);
- cylinder deactivation, incorporating the issue of NVH;
- variable compression ratio and displacement;
- intake port design for high tumble motion and flow capacity;
- stratified combustion, CAI;
- lean burns with high EGR levels;
- 0D/1D air loop predimensioning tool (turbocharging, EGR, etc.);
- catalyst warm up (design, strategies, etc.);
- combustion in extreme conditions (Formula 1 applications).

IFP Energies nouvelles is a public-sector research, innovation and training center. Its mission is to develop efficient, economical, clean and sustainable technologies in the fields of energy, transport and the environment.



Variable Valve Actuation (VVA) system (Lotus AVT).



Large Eddy Simulation (LES) applied to combustion modeling.

Control and calibration

Control strategies based primarily on physical models leading to a reduction in calibration times, from initial design with co-simulation through to final vehicle integration:

- 0D vehicle and engine simulation libraries (IFP-Drive, IFP-Engine, IFP-Exhaust);
- model-based development process for engine control strategies (co-simulation, HIL);
- in-cylinder fresh air, EGR, IGR observer (virtual sensor) and control optimization;
- full-pass proprietary control prototyping system for engine test bed (ACEBox) and vehicle (embedded controller);
- advanced calibration methodologies based on automated tests.

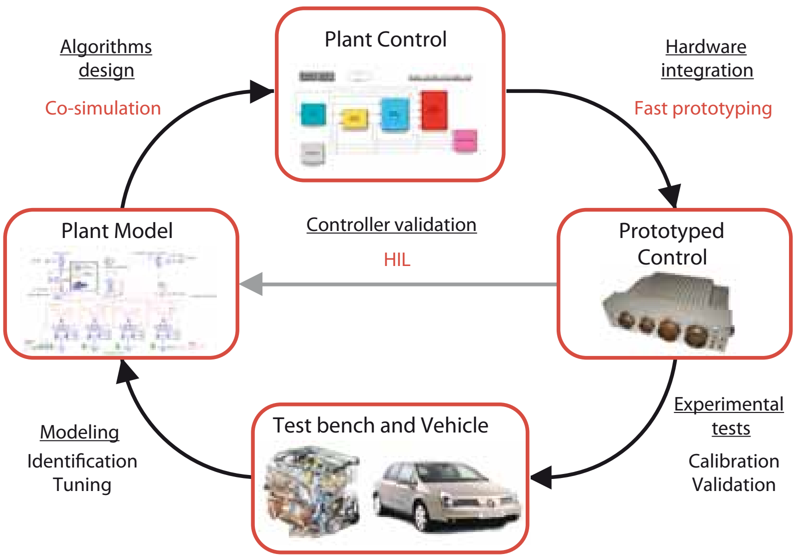
Hybridization and alternative fuels

Innovative solutions to adapt spark ignition combustion systems to low-CO_2 alternative fuels:

- flex fuel dedicated engines;
- NGV dedicated turbocharged engines;
- adaptation of combustion modes to take into account specific fuels.

Development of dedicated high-efficiency powertrain solutions for hybrid applications or electric applications with range extender.

Simulation-based design cycle



Simulation-based design cycle.

The information contained in this document is not contractual

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