



**INNOVATION-ORIENTED
SCIENTIFIC ACTION
AND POLICIES**

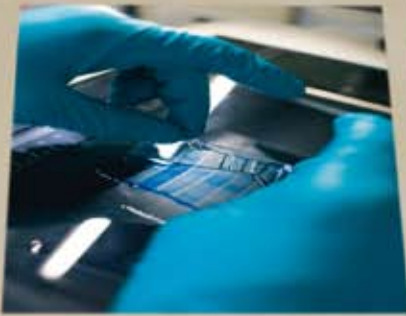


Innovation is a work in progress: from the organization of its research to its evaluation, from prospective to patent applications, from involvement in national research to European partnerships, IFP has set up the structuring policies and knowledge-sharing networks it requires to meet the challenges associated with the energy transition. To support its goals, IFP has a solid organizational base from which it is able to pursue active policies in fields as diverse as human resources management, quality and the environmental impact of its activities. The underlying aim is to establish IFP as a socially-responsible company.

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A NETWORK OF DIVERSE SCIENTIFIC EXPERTISE



In a nutshell, IFP's scientific policy can be defined as identifying scientific hurdles and overcoming them through research work conducted in partnership with the very best academic laboratories and creating new industrial applications for this research over the long term. IFP's fields of innovation reflect the priorities of public policies, particularly with respect to controlling greenhouse gas emissions, diversifying fuel sources and reducing vehicle fuel consumption. Naturally, this ambition to support innovation must go hand in hand with the rigorous implementation of scientific quality, ranging from research teams to the choice of research themes. IFP's Scientific Board plays a key role in this respect.

90%

A VARIETY OF SKILLS

IFP's R&D activities are supported by specialists from a broad range of different fields, ranging from earth sciences to engine combustion. The research teams include more than 350 PhD holders, of whom 52 are accredited to direct research according to french university standards. In addition, in 2008 it welcomed 42 post-doctoral students, mostly foreign nationals.

The scientific and technical expertise is grouped together in 11 specific research divisions, responsible for the scientific quality of the work carried out, for university partnerships and for experimental resources. Two of these were created on 1 January 2008: the Economics and Information Watch and Management Division and the Process Experimentation Division. These changes show how IFP has adapted to introduce economic and environmental assessments more systematically into its research and facilitate the implementation of efficient, small-scale experiments.

The experimental resources available to researchers at IFP include a range of heavy-duty material analysis equipment: EXAFS, electron microscopes (scanning, transmission, tomography, microprobe), X-ray diffraction, X-ray scanners, etc. IFP's computing capacities were boosted considerably in 2008 with the implementation of a cluster of 1,830 computation cores, with a power of 17 Teraflops (17,000 billion operations per second). This new configuration places IFP amongst the Top 5 French public research bodies in terms of computing power and represents a significant factor of competitiveness and innovation for its research.

Finally, to further enhance the technical and scientific excellence of its researchers and effectively promote this image of excellence among its industrial, institutional and academic partners, in 2008 IFP set up a network of experts comprising two levels (Expert/Expert Director). There are currently six Expert Directors and 21 Experts.

A HIGHLY COMMITTED SCIENTIFIC BOARD

IFP's Scientific Board, chaired by Bruno Chaudret, a member of the French Academy of Sciences, is made up of 14 advisors whose expertise covers all of IFP's research fields. The Board is also assisted by experts, including three new faces who joined the group in 2008: Philippe Sautet (theoretical chemistry, ENS-Lyon), Paul Colonna (biotechnology, Inra) and Jean-Marie Tarascon (electrochemistry, University of Picardy).

Each year, the Scientific Board makes recommendations concerning IFP's R&D program and its members select PhD subjects from amongst those put forward by research divisions. The Board is also responsible for the scientific evaluation of research teams and takes part in events organized to discuss specific themes in promising areas. With active members in

foreign laboratories and a Nobel prize-winner – Yves Chauvin, formerly research director at IFP –, the Board has a global outlook and helps ensure that the research conducted at IFP reflects the highest international standards.

RESEARCH EVALUATION

The Scientific Board is responsible for the scientific evaluation of each research division. For this purpose, an evaluation committee is formed made up of Board members and renowned scientists in the relevant field. In particular, the committee examines the relevance of the projects under way, the industrial impact of research results, the list of publications and patents, the number of theses defended and the placement of doctoral students. In 2008, three divisions were evaluated and two divisions went before the Board to present the implementation of recommendations made in the course of previous evaluations. During the course of 2009, evaluations of the remaining divisions will take place and a new cycle of evaluations will begin, with each division evaluated every four years.

The employment rate of PhD students one year after defending their thesis, increasing to 95% after two years. After their theses, the majority of IFP doctors secure employment in industry in their own particular area of expertise.



Fine analysis using a scanning electron microscope, IFP-Lyon laboratory.

The 11 research divisions

Geology - Geochemistry - Geophysics

Structural geology, sedimentology, mineral and organic geochemistry, oil system and reservoir modeling, seismic reservoir characterization, seismic and geochemical monitoring.

Reservoir Engineering

Physics and physical chemistry of flows in porous media, petrophysics, modeling and simulation of dynamic reservoir behavior, uncertainties

Applied Mechanics*

Mechanical engineering, solid mechanics (materials and structures), fluid mechanics (fluid flow, interactions with structures and solids)

Physics and Analysis

Separative and analytical sciences, molecular identification, physical and chemical solid characterization of solids

Catalysis and Separation**

Chemistry, organic synthesis, mineral synthesis and forming of solids, homogeneous catalysis, heterogeneous catalysis, separation techniques

Applied Chemistry and Physical Chemistry*

Chemistry and physical chemistry of complex fluids and materials, electrochemistry, biotechnology, thermodynamics, molecular modeling

Process, Design and Modeling

Optimization and simulation of industrial processes, chemical and hydrodynamic reactor engineering, thermal engineering, catalytic engineering

Process Experimentation

Construction of pilots, experimentation intensification, on-line analysis

Energy Applications Techniques

Modeling and simulation of engines and vehicles, combustion, engine technologies, after-treatment of exhaust gases, compatibility of engines with current and alternative fuels

Technology, Computer Science and Applied Mathematics **

High performance computing, meshing and visualization, optimization, automation, signal processing, software architectures, real-time systems, electronic measurements, power electronics

Economics and Information Watch and Management

Macro-economics, micro-economics and econometrics, techno-economic evaluation of energy and transport technologies

* Divisions evaluated in 2008 by the Scientific Board

** Divisions that presented a report to the Scientific Board in 2008 of actions undertaken following their scientific evaluation in 2006

SCIENTIFIC COOPERATION

IFP has partnerships with more than 200 academic research teams, including dozens with foreign laboratories. PhD theses, led by a university manager and co-supervised by an IFP sponsor, represent an ideal channel for long-term research partnerships.

For example, IFP has signed a framework agreement with the *Pierre and Marie Curie University* – Paris 6, the terms of which allow for the latter to take part in the transfer of research results to which its researchers have contributed. It was also involved in the renewal project relating to two doctoral Schools run by *University of Paris 6*: Geosciences and natural resources, and Physical and Analytical Chemistry.

On 6 February 2009, IFP signed a partnership agreement relating to research and training with the higher education and research cluster (*Pôle de recherche et d'enseignement supérieur* – PRES) at the University of Lyon.



Jean-Charles Pomerol, Vice-Chancellor of the *Pierre and Marie Curie University*, and Olivier Appert, IFP's Chairman, at the signing of a framework agreement reinforcing cooperation between the two bodies in terms of research and training programs.


Finally, the framework agreement signed in 2007 with the CNRS has proved useful as a reference for numerous partnerships with its laboratories.

The organization of international scientific events also facilitates exchanges with academic communities. For example, IFP organized three scientific events in 2008, bringing together more than 600 participants: Escape (European Symposium on Computer-aided Process Engineering) in June at IFP-Lyon, Advances in Hybrid Powertrains (in November at Rueil-Malmaison), LES for internal combustion engine flows (in December at Rueil-Malmaison). Two of these events were organized in collaboration with foreign partners: Escape with the European Federation of Chemical Engineering and Advances in Hybrid Powertrains with TNO.

EXPLORATORY RESEARCH AND PROSPECTIVE

Crucial to the way research programs evolve over the course of time is the long-range thinking that takes place on a regular basis in order to define the markets and technologies on which IFP should focus its work. In 2008, this long-range thinking looked in particular at hybrid materials for catalysis and adsorption, energy storage, 3rd-generation biofuels and desalination techniques.

The aim of exploratory research projects, which have a budget of around €9 million, is to explore innovative research avenues in terms of the methods implemented or applications. 2008 saw the start of several projects relating especially to electricity storage, molecular modeling (colloidal systems, conversion of heavy products and biomass), interactions between the paleoclimate and sedimentation and modeling in economics. Results obtained in 2008 include gas oil cetane number prediction, the demonstration of original catalytic effects with hybrid organometallic materials and advances in the field of electrochemistry leading to patents being filed (batteries, CO₂ recovery).



“In 2008, IFP equipped itself with a supercalculator with a power of 17 Teraflops (17,000 billion operations per second). This new configuration places IFP among the Top 5 French public research bodies in terms of computing power and represents a significant factor of competitiveness and innovation for its research.”

STÉPHANE REQUENA
Data Processing Service and
Telecommunications Division

Prizes and awards won by IFP researchers in 2008

LIONEL ALGIVE

Best Doctoral Paper at the Computational Methods in Water Resources conference (partnership with Ensam)

CAROLINE CHAUX

The *Club des Enseignants et des Chercheurs en Électronique, Électrotechnique et Automatique* Thesis Prize (partnership with University of Paris East)

JACQUES DEBYSER

2008 Jean Rostand Prize for the publication *“Un nouveau regard sur la nature, temps, espace et matières au siècle des lumières”* (“A new view of nature, time, space and materials in the Age of Enlightenment”)

PIERRE DURET

SIA (*Société des ingénieurs de l'automobile* – French automotive engineers society) award – Technical category: “Powertrains”

MARC FLEURY

Darcy Prize 2008, SCA (Society of Core Analysis) award for his work in the field of petrophysics and the development of characterization and interpretation tools

DENIS GUILLAUME

French Chemistry Society Catalysis Division Prize

ÉTIENNE LEBAS

National prize to support innovative technology start-up company – Ministry for Higher Education and Research

ANA PINHEIRO

EER (*École Énergies et Recherches* – Fréjus March 2008) best poster prize for “The influence of oxygen compounds present in biomass pyrolysis oils on hydrotreatment reactions”

Diesopti project teams

“Energy - Environment” prize of the ANR's VTT-Predit program

PHD PROGRAMS

PhD theses represent a rich source of new ideas and concepts for IFP. Around 60 new theses are started each year and some 180 doctoral students are supported by IFP at any one time. Generally speaking, they are given a three-year contract by IFP, which means they have the same rights as other employees. The majority of PhD students (70%) are located in IFP's laboratories, the remainder being conducted in the laboratory of the university where the student is registered. IFP's doctoral students are given access to and taught a broad range of disciplines (seminars conducted by guest researchers, knowledge of the oil industry, industrial property, communication, etc.) to make them as employable as possible. Students are also expected to deliver a mid-term report concerning their thesis to experts on the Scientific Board. Following their thesis, IFP's successful PhD students find employment in industry and in their own specific field of expertise. The 2008 survey



The Escape 18 Conference – the 18th European Symposium on Computer-aided Process Engineering – organized by IFP was held from 2 to 4 June 2008 at the *Cité internationale* conference center in Lyon under the aegis of the European Federation of Chemical Engineering (EFCE).

looking at what happened to successful PhD students when they left showed that more than 90% of them had secured employment a year later and 95% had done so after two years. These figures demonstrate that IFP's PhD programs are fully meeting their objectives in providing industry with highly qualified scientific specialists.

INDUSTRIAL PROPERTY POLICY

The policy is part of an active industrial development approach, aimed at protecting IFP's research results and ensuring technology transfer. IFP's excellent position in national and international patent-applicant rankings, which it has enjoyed for many years now, stems from its capacity to innovate and transfer technology to industry. In 2008, IFP filed 183 patent applications (an increase of 15% compared with 2007 and a record for IFP) and in 2007 it was placed among the top 12

national patent applicants in France. In addition, 820 industrial property rights were created abroad. IFP is also the 6th largest French patent applicant in the United States (in terms of the number of patents issued), according to the latest statistics in the Patent Intelligence and Technology Report.

IFP's determination to protect its scientific and technological property represents a fundamental stage in its innovation-oriented research policy. Industrial property specialists are involved right from the start of a research project to examine, with researchers, the potential forms that transfer of results could take. This integration of research and industrial development means that IFP is able to bring its technological innovations to market effectively. IFP ensures that the processes and equipment it develops and offers are unrestricted in terms of the patent rights of third parties.

- 1,003 patent rights created throughout the world (including basic patents)
- 80 United States
 - 47 Germany
 - 43 Italy
 - 40 UK
 - 37 Netherlands
 - 34 Japan
 - 27 China
 - 22 Iran
 - 20 Venezuela
 - 18 Thailand
 - 18 Belgium
 - 17 GCC⁽¹⁾
 - 17 Brazil
 - 15 Spain
 - 183 First-filed patents (principally in France)
 - 385 Others

(1) Gulf Cooperation Council comprising Saudi Arabia, Bahrain, United Arab Emirates, Kuwait, Oman and Qatar



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LAURENT FORTI
Scientific Management

KNOWLEDGE MANAGEMENT AND SHARING

Optimizing the management of knowledge and promoting its widest possible dissemination – to the public authorities, scientific and economic circles, and industry – is one of IFP's public-interest missions.

With this objective in mind, IFP's scientific journal, *Oil & Gas Science and Technology* is freely available on the Internet. This two-monthly peer-reviewed journal, indexed in the major international databases, publishes themed reports and summary articles relating to the gas and oil chain and more generally all disciplines relating to the energy field within a context of sustainable development. Fifty-three new articles were published in 2008, and there are now more than 700 articles that can be freely accessed in their entirety at <http://ogst.ifp.fr>. The journal has maintained a growing readership and international profile, as illustrated by the continued improvement in its impact factor and a spectacular increase in the number of times it is quoted (+ 50% between 2007 and 2008 for articles published since 1993).

Additionally, in 2008, four new books were published (Éditions Technip) in the IFP Publications collection:

- the first two books are aimed at a broad public:
- *“Énergie et climat - Réussir la transition énergétique”* (“Energy and climate – How to achieve a successful energy transition”), written by Alexandre Rojey, explains why it is now crucial that we conduct a radical rethink of our energy model and shows how a smooth energy transition will enable us to preserve our planet.

- *“La nouvelle donne du charbon”* (“The new coal situation”) written by François Kalaydjian and Sylvie Cornot-Gandolphe, focuses on the essential role that coal will play to meet the energy needs of the 21st century. It sets out the new uses of coal, which combined with CO₂ capture and storage technologies, may make it possible to reconcile mass recourse to this energy source with respect for the environment.

The two remaining books are aimed at a more specialist public, engineers, researchers and students:

- *“Petroleum Microbiology - Concepts, Environmental Implications, Industrial Applications”* (2 vol.) by Jean-Paul Vandecasteele is a reference work that examines the conversion and degradation of hydrocarbons and their derivatives by microorganisms. It highlights the importance of the processes implemented and their environmental impact, as well as their industrial applications.

- *“Multiphase Production”* written by Jean Falcimaigne and Sandrine Decarre, presents the fundamental principles of multiphase production, and, in particular, the modeling of multiphase flows in pipelines, pumps and flow measurement systems.

IFP also has a dynamic policy on papers at the major international congresses with 464 papers delivered in 2008. In addition, 226 scientific articles were published in international scientific journals, including 196 indexed in the Thomson-Reuters ISI database. Of these, 147, i.e. 75%, were the fruit of academic or industrial collaborative work and 36, i.e. 18%, involved international teams.

In addition, IFP contributes to the promotion of scientific research and ensures that its knowledge is disseminated to the widest possible audience. To this end, its researchers took part in the 2008 Science Fair held in Paris at the *Grand Palais* and in Lyon on the Doua Campus. For the event, which was placed under the aegis of French Presidency of the European Union, IFP joined forces with Air Liquide, BRGM and Total to run a 100 m² stand on the theme “CO₂ storage and capture: towards a European roll-out” as part of the European City of Science initiative. An IFP-designed model was used to demonstrate how CO₂ disperses in porous media when injected.

Finally, IFP regularly produces analyses, summaries and educational documents and these are made available to the public *via* its website (www.ifp.com) to keep them informed of the major issues associated with the fields of energy, transport and the environment, as well as the R&D under way at IFP to meet the challenges in these fields. The website as a whole has proved to be a great success, testimony to the public's interest in the issues covered.

Educational model used to observe the distribution of CO₂ in a porous medium following injection.



Principal publications in 2008 by field ⁽¹⁾

Earth sciences

From pore scale to wellbore scale: impact of geometry on wormhole growth in carbonate acidization.

Cohen Charles Édouard, Ding Didier Yu, Quintard Michel, Bazin Brigitte

Chemical Engineering Science, Vol. 63, No 12, 2008, pp. 3088-3099

Integrating stratigraphic modeling and seismic interpretation: two practical examples.

Cacas Marie-Christine, Laigle Jean-Marie, Albouy Émilie, Sulzer Caroline

Petroleum Geoscience, Vol. 14, No 3, 2008, pp. 253-261

Role of NSO compounds during primary cracking of a Type II kerogen and a Type III lignite.

Behar Françoise, Lorant François, Lewann Michael

Organic Geochemistry, Vol. 39, No 1, 2008, pp. 1-22

Foreland and hinterland basins: what controls their evolution?

Roure François

Swiss Journal of Geosciences, Vol. 101, Supplement 1 / September, 2008, pp. 5-29

Mechanics

A two-phase model for the mechanical behaviour of semicrystalline polymers. Part I: Large strains multiaxial validation on HDPE. Part II: Modeling of the time-dependent mechanical behaviour of

an isotropic and a highly oriented HDPE grade.

Brusselle-Dupend Nadège, Cangemi Laurent

Mechanics of Materials, Vol. 40, No 9, 2008, pp. 743-760 (part I) and 761-770 (part II)

Catalysis and Analysis

Comprehensive two-dimensional gas chromatography for enhanced analysis of naphthas: new column combination involving permethylated cyclodextrin in the second dimension.

Adam Frederick, Vendevure Colombe, Bertoncini Fabrice, Espinat Didier, Thiebaut Didier, Hennion Marie-Claire

Journal of Chromatography A, Vol. 1178, No 1-2, 2008, pp. 171-177

A selective synthesis of hydroxyborate anions as novel anchors for zirconocene catalysts.

Bibal Christine, Santini Catherine, Chauvin Yves, Vallee Christophe, Olivier-Bourbigou Hélène

Dalton Transactions, No 21, 2008, pp. 2866-2870

Deactivation handling in a high-throughput kinetic study of o-xylene hydrogenation.

Morra Guilhem, Farrusseng David, Guillon Emmanuelle, Morin Stéphane, Bouchy Christophe, Duchene Pascal, Mirodatos Claude

Catalysis Today, Vol. 137, No 1, 2008, pp. 71-79

Tuning the shape of nanoparticles to control their catalytic properties: selective hydrogenation of 1,3-butadiene on Pd/Al₂O₃.

Piccolo Laurent, Valcarcel Ana, Bausach Marta, Thomazeau Cécile, Uzio Denis, Berhault Gilles

Physical Chemistry Chemical Physics, Vol. 10, No 36, 2008, pp. 5504-5506

Atomic scale insights on chlorinated γ -alumina surfaces.

Digne Mathieu, Raybaud Pascal, Sautet Philippe, Guillaume Denis, Toulhoat Hervé

Journal of the American Chemical Society, Vol. 130, No 33, 2008, pp. 11030-11039

Applied Chemistry and Physical Chemistry

Evidence for the Iron(III) oxidation state in bis(imino)pyridine catalysts. A density functional theory study.

Raucoules Roman, De Bruin Theodorus, Raybaud Pascal, Adamo Carlo

Organometallics, Vol. 27, No 14, 2008, pp. 3368-3377

Diffusion impedance in a thin-layer-cell: experimental and theoretical study on a large disk electrode.

Remita Elias, Boughrara Dalila, Tribollet Bernard, Sutter Eliane, Vivier Vincent, Ropital François, Kittel Jean

Journal of Physical Chemistry (The) – C, Vol. 112, No 12, 2008, pp. 4626-4634

Optimisation of the dynamical behaviour of the Anisotropic United Atom Model of branched alkanes. Application to the molecular simulation of fuel gasoline.

Nieto Draghi Carlos, Bocahut Anthony, Creton Benoit, Have Pascal, Ghoufi Aziz, Wender Aurélie, Boutin Anne, Rousseau Bernard, Normand Laurent

Molecular Simulation, Vol. 34, No 2, 2008, pp. 211-230

Engine combustion

Modeling ignition and chemical structure of partially premixed turbulent flames using tabulated chemistry.

Michel Jean-Baptiste, Colin Olivier, Veynante Denis
Combustion and Flame, Vol. 152, No 1-2, 2008, pp. 80-99

Development of a two-line OH-laser-induced fluorescence thermometry diagnostics strategy for gas-phase temperature measurements in engines.

Devillers Robin, Bruneaux Gilles, Schulz Christof

Applied Optics, Vol. 47, No 31, 2008, pp. 5871-5885

Applied mathematics – Computer Science

Numerical simulation of a stratigraphic model.

Gervais-Couplet Véronique, Masson Roland

Computational Geosciences, Vol. 12, No 2, 2008, pp. 163-179

Global Airpath Control for a Turbocharged Diesel HCCI Engine.

Chauvin Jonathan, Moulin Philippe, Youssef Bilal, Grondin Olivier

Oil & Gas Science and Technology Revue de l'IFP, Vol. 63, No 4, 2008, pp. 553-561

Processes

Single-event microkinetic model for Fischer-Tropsch synthesis on iron-based catalysts.

Lozano-Blanco Gisela, Thybaut Joris, Surla Karine, Galtier Pierre, Marin Guy.

Industrial & Engineering Chemistry Research, Vol. 47, No 16, 2008, pp. 5879-5891

Liquid distribution and liquid hold-up in modern high capacity packings.

Alix Pascal, Raynal Ludovic

Chemical Engineering Research & Design, Vol. 86, No 6, 2008, pp. 585-591

Economics

The impact of automobile diffusion on the income elasticity of motor fuel demand.

Lescaroux François, Rech Olivier

The Energy Journal, Vol. 29, No 1, 2008, pp. 41-60

(1) in bold, IFP authors

A NETWORK OF NATIONAL AND INTERNATIONAL PARTNERSHIPS



In order to find effective solutions to the global challenges associated with the energy transition and tackling climate change, IFP operates an increasingly dynamic partnership policy with other players in the worlds of research and industry. On a national level, IFP makes an active contribution to discussions on research and innovation policy and participates in the implementation of tools within the framework of the French Research and Innovation System. As an international energy player, it also offers innovative solutions throughout the world, through scientific collaborative research initiatives, industrial partnerships and training programs.

A STRONG COMMITMENT TO THE FRENCH RESEARCH AND INNOVATION SYSTEM (SFRI)

IFP plays a leading role in helping to define national research and innovation strategy. It also implements concrete initiatives in partnership with other research players.

Where competitiveness clusters are concerned, IFP is a founding member of the global System@tic cluster, in the Paris area, two clusters of global importance – Axelera, the Chemistry and Environment cluster based in the Rhône-Alpes region and the Mov'eo cluster dedicated to transport in the Île-de-France region – and the national Lyon Urban Truck & Bus cluster. In addition, IFP is an active member of other clusters, including Tennerdis, Industrie Agro Ressources, Astech Paris Région and Aerospace Valley. The policies implemented by these eight clusters were all fully endorsed by an audit conducted by the State in 2008. Among initiatives associated with these clusters, IFP's involvement in two proposals for structuring technological platforms is worthy of specific mention: Mov'eo-Dege in Satory, on carbon-free vehicles, and Axel'One in Lyon on innovative materials and clean processes. Both platforms were pre-selected by the *Direction générale Compétitivité, Industrie et Services* (DGCIS or General Directorate for Competitiveness, Industry and Services) in February 2009.

Within the context of the ANR (French National Research Agency) partnership, 2008 saw the acceptance of new projects involving IFP, particularly relating to the CO₂, VTT-Predit (land vehicles and transport) and Cosinus calls for tender. IFP is the Support Unit for various themed calls for tender, including Energy Storage (Stock-E), Chemistry and Processes for Sustainable Development (CP2D) and, since January 2009, VTT-Predit.

Ademe (the French Environment and Energy Management Agency) is also one of IFP's major partners. Within the context of the *Grenelle de l'Environnement* forum on the environment, IFP took part in discussions that identified the need for research demonstrators in the fields of CO₂ capture and storage, 2nd-generation biofuels and hybrid vehicles. IFP is also active in several projects submitted to Ademe relating to each of these three themes.

Finally IFP supported the *Groupeement d'Équipements Nationaux de Calcul Intensif* (GENCI, the French high-performance computing organization) in its mission to provide the French scientific community with high-performance computing tools.

EUROPEAN COLLABORATIVE RESEARCH

IFP has actively contributed to the emergence of a European vision in the field of energy, particularly through its active contribution to the 6th European Framework Program for Research and Technological Development (FP6) for 2002-2006. Twenty-eight projects were financed by the European Commission within the program. Since, IFP has been involved at the highest level in European technological platforms ZEP (Zero Emission Fossil Fuel Power Plant) and Biofuels. As an extension of these initiatives, IFP submitted numerous proposals as part of FP7 for the period 2007-2013, particularly in sectors such as CO₂ capture and storage, biofuels, transport and aeronautics. At the end of 2008, 12 projects had already been selected, to which four further Eurêka-labeled collaborative projects must be added, as well as a project in response to a specific call for tender issued by the European Commission.

The Modelisar project labeled by the Eurêka ITEA2 (Information Technology for European Advancement) cluster, is one of the important successes of the year 2008. Its objective is to provide solutions for the integration, design, testing and management of vehicle systems using innovative libraries of components of the Modelica system modeling language. Twenty-eight partners are involved in this project alongside IFP, including AVL, Daimler, Dassault Systèmes (project coordinator), DLR, Fraunhofer, LMS International and Volkswagen.

The number of IFP European projects already selected at the end of 2008 as part of FP7, to which four Eurêka-labeled collaborative projects and a project in response to a specific call for bids must be added.



As part of the process intensification project, an experimental reactive adsorption system, aimed at combining reaction and separation operations.

Within the context of the French Presidency of the European Union, in partnership with the European Commission and at the request of the Ministry of Higher Education and Research and the Ministry of Ecology, Energy, Sustainable Development and National and Regional Development, IFP co-organized the "Towards a low-carbon energy – the European Strategic Energy Technology Plan" conference with the CEA. More than 500 people attended, including the European Commissioners Janez Potočnik, responsible for Science and Research, and Andris Piebalgs, responsible for Energy.

Finally, IFP pursued its policy of bilateral partnerships with European research centers working in the field of new energy technologies. In 2007, IFP had already signed a protocol of cooperation with the Dutch institute TNO. In 2008, IFP signed

a new memorandum of understanding with the Norwegian research center Sintef, paving the way for cooperation between the two bodies, particularly in the fields of CO₂ capture and storage.

INTERNATIONAL PARTNERSHIPS

In line with its strategy, IFP focused its efforts on the international stage on a number of target areas and countries, where all its activity sectors are represented or the development potential is significant: Algeria, Brazil, China, India, Libya, Malaysia, Mexico, the Middle East – particularly Saudi Arabia, the United Arab Emirates and Kuwait –, Russia and Venezuela. In parallel, IFP maintains a global presence *via* networks of its researchers, who are daily acting at the international scale.

International activities in 2008 concentrated on four principal sectors:

- training, as the bearer of the diversity of IFP's professions. Through it, IFP is preparing the future with, among other

Competitiveness clusters: concrete results

Among the various programs it is involved in as a member of the Axelera competitiveness cluster, in 2008, IFP developed breakthrough technologies using compact units and modernized unit operating tools as part of the Process Intensification project conducted in partnership with three other founding members of the cluster (Rhodia, Arkema and the CNRS). The work involved the construction of pilot installations, including a narrow channel reactor, an example of a microstructure making it possible to reduce the size of installations by facilitating contact between the various fluids, and an experimental reactive adsorption system, aimed at combining reaction and separation operations. In December 2008, a program assessment was conducted for an event organized to coincide with the Pollutec exhibition, with a view to encouraging new companies to take part in the technological implementation of these results and initiate the desired economic development. The presentation of the Axel'One collaborative platform project at the event will pave the way for the preparation of new programs on the same theme.

IFP also continues to play an increasingly important role in Mov'eo, the globally recognized cluster active in the field of transport. Today, it is represented on the cluster's board of directors and takes part in steering committees in several strategic fields of activity, responsible for promoting the emergence of R&D projects. In 2008, for example, IFP played its part in setting up six projects labeled by Mov'eo; it is also participating in the Mov'eo-Dege innovation platform in Satory. This research platform, dedicated to carbon-free vehicles, will extend IFP's activities on Mov'eo's Rueil-Malmaison site.

Finally, IFP continues to run the Powertrain and drive train program being conducted by the Lyon Urban Truck & Bus (LUTB) cluster, the objective of which is to provide innovative solutions to the challenges facing industrial vehicles: cutting fuel consumption, combining electrical/thermal energy, the use of alternative fuels, reducing atmospheric pollution and noise pollution. In 2008, it was also active in setting up several projects in partnership with other players, dedicated in particular to the electrification of heavy-duty vehicles. In addition, this year LUTB drew up a proposal for an innovation platform for urban public transport for people and goods.



activities, a well-established policy of satellite degree programs, alongside technology transfer,

- refining which, because of the global economic climate, has become a major development avenue,

- knowledge of oil reservoirs and assisted recovery, areas in which IFP's expertise is globally recognized,

- the growing demand for efficient engine technologies, in a context where automobile manufacturers are seeking innovative solutions.

In addition, an increasing number of our partners – principally state-owned companies in oil-producing countries – have turned to us for advice and project management to enable them to acquire their own research resources and use them efficiently.

Finally, in addition to the increasingly international scope of IFP School, some very highly qualified engineers have been welcomed in our laboratories, reflecting the IFP's global appeal.

“As an extension of its European initiatives, IFP responded to a large number of first calls for proposals in the context of FP7 for the period 2007-2013, particularly in sectors such as CO₂ capture and storage, biofuels, transport and aeronautics. IFP draws on these multiple forms of cooperation to pursue its policy of bilateral partnerships with European research centers, such as TNO and Sintef.”

GAËLE VALET
Legal Division



Signing of a cooperation protocol between IFP and Sintef in the field of CO₂ capture/storage.



AN EFFICIENT OBJECTIVE-ORIENTED ORGANIZATION



To support its research and innovation strategy, IFP has established an organizational framework and chosen management tools designed to optimize the way it operates. This organizational framework is constructed around internal policies which, in the fields of human resources, quality certification and reducing our environmental footprint, reflect IFP's concrete commitment, as a socially-responsible company, to supporting the economic fabric, in line with the *Grenelle de l'Environnement* forum.

A MATRIX-BASED ORGANIZATION

All IFP initiatives are undertaken within the framework of projects with precise objectives, defined on the basis of IFP's public-interest missions and industry requirements. To deliver the results expected of a project, the project manager leads a multidisciplinary team which, within the framework of the matrix organization, is made up of personnel from research divisions and functional divisions combining homogeneous expertise. This structure means that skills can be used on the basis of a project's needs with maximum efficiency and a high level of flexibility. It also provides an opportunity to combine talents, multidisciplinary being a genuine source of innovation.

HUMAN RESOURCES MANAGEMENT

IFP's employees are highly skilled people with a proven capacity for creativity. It is they who hold the key to meeting the challenges of tomorrow. Skills are anticipated as a function of the strategic directions defined within the context of the Objectives Contract (2010) and it is against this background that recruitment and skills development programs are planned.

IFP operates an active policy to enhance employability, ensuring that employees are well-equipped to rise to the technological and organizational challenges they will encounter throughout the course of their careers. Being able to focus on a priority and stand back from another in line with our strategy is a considerable source of efficiency for the company and of skills development for employees.

A significant training budget combined with genuine prospects for professional mobility within the Group give IFP employees the opportunity to grow in their areas of expertise, enhance their adaptability and help shape their own future. Training is one of the keys to maintaining and developing employees' technical, scientific, behavioral and managerial skills, the aim being to anticipate and adjust to IFP's evolving requirements. In 2007, IFP devoted 4.2% of its payroll to staff training. As far as professional mobility is concerned, it plays a central role in finding the best fit, in both the short and medium terms, between strategic requirements and employees' skills. In this area, in 2008 IFP signed a group mobility charter with five of its subsidiaries. In particular, the charter sets out guarantees in terms of remuneration, contractual positioning and the conditions for a possible return. The charter sits alongside the interEPIC charter, signed in the previous year and designed to facilitate the transfer of skills between research organizations.

IFP believes that diversity is an asset as well as a source of social cohesion and for many years it has implemented a proactive policy of professionalization, hosting PhD students (52 new research students joined IFP in 2008). The quality of the training programs available to them means that more than 90% of them go on to secure employment. IFP's commitment in this area is also reflected in the number of openings for placement students (280 in 2008, i.e. almost 5% of the company's total staff), as well as work-study students (31 new contracts in 2008). IFP's international dimension is also a source of diversity, since more than forty nationalities are represented in its teams. Furthermore, for a number of years IFP has been welcoming, training and integrating young people from deprived backgrounds as well as disabled people and, through retraining courses, supporting staff who become handicapped.

Finally, in, 2008, IFP launched a psycho-social risk (PSR) prevention initiative. Today, well-being at work, through the prevention of stress and of PSR in general, is considered to be a public health issue and a vector for enhanced collective performance in companies. IFP wants to make improvements at every level in the area of prevention and a working group involving all the relevant players is in the process of drawing up an action plan, due for submission by the end of 2009.

placement students, i.e. almost 5% of the company's total staff, and 31 new sandwich training contracts in 2008, reflecting the proactive policy of professionalization for young people to which IFP has been committed for a number of years.

Integration of disabled workers

IFP signed a 5th company-wide agreement for the period 2007-2009, reasserting its commitment to employing disabled people. In 2008, the *Mission Insertion Handicap* (MIH – disability integration taskforce), which is piloting the project, had the following priority objectives:

- the training and integration of disabled workers: five placement students joined IFP and five people were recruited full-time,
- job adaptation and professional retraining concerning six employees suffering from a handicap,
- the development of partnerships with eight companies in the protected jobs sector (providing jobs specifically for people with disabilities) for sub-contracting or on-site services, such as reception duties for example.

These results were made possible thanks to management training initiatives and disability awareness-raising initiatives aimed at staff, particularly *via* business theater.

SUPPORTING THE LOCAL ECONOMIC FABRIC

At a time when the reorganization of research in France is increasingly hinged around the reinforcement of regional clusters, IFP is actively involved in supporting development in these regions, particularly in Rhône-Alpes, increasing their competitiveness and appeal. To facilitate the joint work of the three pillars of innovation represented by research, training and industry, IFP is playing the role of “research operator” and relaying, on the ground, the new tools provided by the State.

Its commitment to innovation and its support for the local economic fabric, particularly SMEs, is illustrated primarily by its involvement in the Lyon and Rhône-Alpes (Axelera) Chemistry and Environment and Lyon Urban Truck & Bus competitiveness clusters, of which it is a founding member. In 2008, IFP also supported the creation of two new research

platforms: the analytical chemistry research, expertise, service and training center (ISA) and the Lyon Chemistry Institute (ICL). These platforms have been designed to pool resources in order to support large-scale investments and develop “chemistry” expertise in the Lyon region. Supporting government agencies such as Ademe and Oseo, IFP is also acting as an innovation process facilitator assisting the entrepreneurial implementation of projects in the field. As part of this process, IFP has used its expertise in the field of applied research to assess projects and has sat on regional panels that award prizes to companies and innovative projects.

Keen to facilitate the transfer of technology from the academic setting to industry, in 2008, IFP became a scientific partner of the *University of Lyon* (PRES), and was involved in the construction of the new education and research organization, in the context of the *Plan Campus* operation and fitting squarely with its activities. In particular, it is

“IFP’s commitment to being a socially-responsible company also entails the implementation of an ethical and social approach to its dealings with suppliers. For a number of years, it has been defining and applying a responsible and transparent purchasing policy, hinged around an ethical code that it shares with its partners.”

ASTRID MONIOT
In-House Management,
Safety and Security Division



involved in a collaborative platform project based in the Rhône-Alpes region led by Axelera, known as Axel'One. IFP may use this to reinforce and increase its partnerships with players in the region.

Finally, with its close involvement in the economic development of companies working in the new sustainable development technologies sector in the region, in 2008 IFP played an active role in drawing up Greater Lyon's Cleantech plan, designed to promote the emergence of eco-industries and support the transformation of Chemical Valley.

CORPORATE SOCIAL RESPONSIBILITY

As a socially-responsible company, IFP has established an organizational structure for its activities that, in keeping with the undertakings of the *Grenelle de l'Environnement* forum on the environment, enables it to reduce its environmental footprint. IFP's efforts in this area, aimed at achieving the dual objective of improving its environmental balance and economic optimization, are piloted *via* an environmental management system (EMS), one of the first results of which was ISO 14 001 certification for its powertrain engineering activity at its Rueil-Malmaison site, obtained in July 2006. To broaden its impact, IFP has rolled out a set of good practices acquired within the framework of the certification "process" to all the company's activities and establishments.

Energy and resource management lies at the heart of the EMS. A centralized technical management system is now opera-



With its ideal facilities and infrastructure, IFP regularly hosts benchmark international scientific conferences and sometimes offers site tours to participants.

Increasing the international visibility of regions

To develop the economic appeal of regions, IFP is helping to increase their international visibility. To this end, in November 2008, it, along with several other Lyon-based players, signed a collaborative research contract in the field of molecular modeling for catalysis with King Abdullah University of Science and Technology (KAUST), an international university with a research center based in Saudi Arabia. This project places IFP at the heart of a new global catalysis cluster in the Rhône-Alpes region. In addition, IFP is able to use its facilities at its Lyon campus to host regular reference international scientific conferences. Participants are able to tour the site and meet researchers to learn about the range of scientific research carried out by IFP, particularly in the field of new energy technologies.



tional, giving IFP a detailed map of electricity, gas and water consumption. It is thus in a position to identify and rectify incidences of overconsumption, favoring solutions that offer the best returns on investment. Ambitious objectives have been set: IFP is seeking a 15% reduction in water consumption for the period 2006 to 2010, and a 5% reduction in overall energy consumption for the same period. To achieve these targets, in addition to the centralized technical management system in place, any new buildings are constructed to comply with thermal insulation standards and any refurbishment project is designed as a function of the data collected from the energy assessment of the building concerned. Low energy consumption lighting is now being seen throughout all buildings and outside lighting will be optimized once the best solutions have been identified. Wherever possible, solutions based on new energies are implemented; for example, solar panels have been installed to provide hot water for the canteen at the Lyon site. As far as water management is concerned, IFP is working, in particular, to limit its use of groundwater and eliminate processes in its research laboratories that lead to water wastage.

Waste recycling initiatives also play a key role in IFP's environmental policy. The aims of such initiatives are to recycle as much waste as possible and to limit waste at source. In order to meet these aims, in 2006, IFP set up a dedicated waste management system, in partnership with a single service provider. The system is based notably on sorting waste

by specific type, facilitated by the setting up of specialized mini-waste collection centers and a central waste collection center. In 2007, employees attended an internal forum on waste management and in 2008 a recycling rate of 95% was achieved at the Rueil-Malmaison site, while Lyon achieved a rate of more than 50%. The overall saving in economic terms is 20% compared to the situation prior to the initiatives.

IFP is also working to reduce noise pollution caused by its activities, particularly at the Rueil-Malmaison site, which is located in the urban environment. Some initiatives have already been planned, following a study conducted by the establishment in 2008 to model noise emissions. More generally, the environment policy and specific action plans are due to be implemented over the coming years following carbon assessments at the Lyon and Rueil-Malmaison sites. The measures already in place include those aimed at reducing CO₂ emissions associated with transport. Hence, the average emission rate of the company vehicle fleet is 130 g CO₂/km, and an inter-company travel plan in Lyon, established by the Association for the development of Chemical Valley, chaired by IFP, is designed to encourage carpooling. Finally, IFP is endeavoring to restrict the amount of travelling its employees have to do by providing teleconferencing systems, enabling staff at its various establishments to work together.

Closely tied in with the EMS, a health and safety management system (HSMS), launched in 2002, is now fully operational.

	FREQUENCY RATE	SERIOUSNESS RATE
2005	4.67	0.075
2006	3.52	0.085
2007	3.21	0.042
2008	2.92	0.044

In 2008, the accident frequency rate target set for 2010 was reached and the seriousness rate remained low. The target is now to achieve a frequency rate of under 3 for all on-site IFP and subcontractor personnel by 2012.





Projected view of the Claude Bonnier building (Rueil-Malmaison site). The refurbishment work under way is designed to meet the HEQ target of ensuring harmony between the building and its immediate environment.

HEQ property management

IFP's commitments and good practices in the field of sustainable development also apply to property management at its Rueil-Malmaison and Lyon sites. For any new construction and refurbishment project, IFP ensures compliance with regulatory standards (RT 2005 standard for new buildings), and promotes the implementation of a high environmental quality (HEQ) approach. For example, the refurbishment of the Claude Bonnier building in Rueil-Malmaison, launched in 2008 and due to be completed at the start of 2011, is subject to certain HEQ targets, designed to meet three objectives: eco-construction (environmentally-friendly building and recycling of building site waste), energy management, visual (office layout) and acoustic (limit activity-related noise) comfort. This HEQ approach is also adopted at the Lyon site and will be reinforced for new construction projects from 2009.

IFP is permanently seeking to improve all its systems and the HSMS gives IFP optimum control over the safety of its employees as well as subcontractors at all its sites, while maintaining the high level of production of R&D tools. The HSMS is structured around an *ad hoc* organization and network in each division, together with a regularly updated safety policy and the use of indicators (accident frequency rate for all employees working on the sites, seriousness, etc). The HSMS incorporates numerous factors, including risk analyses of installations, the wearing of safety equipment, working environment safety, staff awareness and consultation and communication with employee representative bodies.

Compatibility between the various management systems (EMS, HSMS and QMS for quality) is also a primary concern for IFP as it seeks to optimize and streamline procedures. Where possible or appropriate, the environment, safety and quality dimensions of research activities are interlinked, as is the case, for example, in the design procedure for R&D installations, which takes into account all these criteria in a single process from start to finish (from the engineering department to final operator). IFP is recognized for the effective organization of its management systems and is often called upon by foreign research and development centers seeking help in the construction and operational optimization of new laboratories.

The other aspect of IFP's commitment to being a socially-responsible company is the implementation of an ethical and social approach to its dealings with suppliers. For a number of years, it has been evolving and applying a responsible and transparent purchasing policy, hinged

around an ethical code that it shares with its partners, a code that will be formalized in a charter in 2009. It also embraces fair trade service providers.

QUALITY POLICY

All the research, consultancy and expertise activities carried out by IFP's three R&D business units in 2008 met the requirements of international standard ISO 9001:2000. At the end of 2008, these certifications related to the planning and conduct of all projects in the fields of exploration-production, refining-petrochemicals and powertrain engineering, as well as the activities of the principal associated support functions (skills management, purchasing and IT).

For the second year running, the use of a new IT project portfolio programming and management tool (Planisware OPX2 software) and the support provided to R&D project managers in the adoption of this software have made it possible to make significant improvements in one of the four principal areas of the Quality policy, namely "enhancing efficient project management". The changes have been perceptible, particularly in terms of project structuring and the characterization of results. There is now a better match between the program and available resources, guaranteeing that deadlines are met and costs controlled. These results confirm the application's potential and its operational roll-out will continue both for project portfolio management and for more detailed monitoring of a project's progress.