

# 03.

## A RESEARCH STRATEGY SERVING INNOVATION





## IFP ENERGIES NOUVELLES' INNOVATION-FOCUSED R&D ACTIVITIES AIM TO PROVIDE INDUSTRY WITH THE TECHNOLOGIES IT WILL NEED TO MEET THE CHALLENGES OF THE ENERGY TRANSITION.

This research strategy is supported by two pillars: scientific excellence and anticipation. It is implemented within a framework of strategic partnerships that reflect IFP Energies nouvelles' position as a major player in French, European and international research.

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## SCIENTIFIC EXCELLENCE, A CONFIRMED COMMITMENT

**An IFP Energies nouvelles researcher received the Wegener Award 2010**



François Roure, an Expert within IFP Energies nouvelles' Geology-Geochemistry-Geophysics Division received the 2010 Wegener Award. Every year, the award is given by the EAGE (European Association of Geoscientists and Engineers) to one of its members who has made a contribution to major technical and scientific advances in the field of geosciences or petroleum engineering. The award was given to François Roure in recognition of his contribution to exploration of frontier zones and the search for new reserves, particularly in mountain chains.

# 10

projects involving IFP Energies nouvelles were funded by the ANR in 2010.

IFP Energies nouvelles possesses high-quality resources, such as the X-ray scanner.

Over 300 articles published every year in peer-reviewed scientific journals, regular prizes and awards won by its researchers, numerous projects selected by the ANR<sup>1</sup> and the FUP<sup>2</sup>, etc. All these results are testimony to IFP Energies nouvelles' scientific excellence, excellence that is an ongoing requirement.

### CUTTING-EDGE SKILLS AND RESOURCES

To conduct cutting-edge, innovative research in its fields of interest, IFP Energies nouvelles draws on over 50 internal fields of expertise. Specialists in their fields, the most advanced researchers are working together through a project organization, adopting a cross-disciplinary approach to provide an overall response to the needs of industry. This matrix structure means

that skills can be used on the basis of a project's needs with maximum efficiency and a high level of flexibility.

Researchers have access to laboratories and experimental resources of the highest quality, such as material analysis equipment (EXAFS spectroscopy, electron microscopes, X-ray diffraction, X-ray scanners, FT-ICP/MS, etc.), high-speed testing loops and very powerful computing tools (supercomputer with a power of 17 Teraflops).

### EVALUATION, A GUARANTEE OF PERFORMANCE

To increase its level of scientific excellence, IFP Energies nouvelles continuously evaluates its performance. To achieve this, an evaluation process supported by a Scientific Board was implemented. This



## IFP ENERGIES NOUVELLES' SCIENTIFIC EXCELLENCE IS, FIRST AND FOREMOST, A CONSTANT REQUIREMENT.

international and independent structure, made up of 15 external members, issues opinions on R&D programs. It also selects these subjects from the proposals made by IFP Energies nouvelles, and monitors their progress. The Scientific Board is also responsible for regularly assessing research departments, with each one undergoing an individual evaluation every four years. An ad hoc committee examines the relevance of the scientific work, the industrial impact of research results, the number of partnerships, the list of publications and patents, the number of these defended, etc. Finally, Scientific Board members are consulted as experts during the course of themed meetings, to come up with or develop new research avenues. For some of these missions, it calls upon the services of renowned international experts.

In 2010, IFP Energies nouvelles was also evaluated by Aeres<sup>3</sup> for its R&D activities as a whole. The

clarity of its strategy, the expertise of its researchers and the efficiency of its resources were highlighted by the assessors.

### EXCHANGE WITH THE SCIENTIFIC COMMUNITY

To maintain the highest level of excellence, IFP Energies nouvelles is on a permanent quest for information from external sources. The scientific events it organizes are an opportunity to compare the points of view of IFP Energies nouvelles' researchers with those of the scientific community as a whole.

For examples its *Rencontres scientifiques* events, organized under the patronage of the French Academy of Sciences, enable IFP Energies nouvelles – and all participants more generally, experts from the worlds of academic research, applied research or industry – to present their work and discuss the progress made, possible applications and the challenges to be addressed. The IFP Sessions focus more specifically on industrial applications for technologies.

For their part, IFP Energies nouvelles researchers participate in major international conferences on a very regular basis.

### RENOWNED EXPERTISE

IFP Energies nouvelles' scientific excellence leads it to offer its scientific expertise to public authorities and industrial players, local authorities and judicial bodies. By making a critical review of the knowledge available on a given topic, this expertise provides decision-makers with the information they require to make the best possible choices.

To ensure position to effectively respond to requests of this type, IFP Energies nouvelles has set up an Expert network. Expert Directors – of which there are four – are particularly involved in forward thinking processes at IFP Energies nouvelles. The 16 experts provide scientific management and support for young researchers, help prepare new programs and respond to institutional requests for expertise.

### DISSEMINATION OF KNOWLEDGE

While the dissemination of knowledge is one of IFP Energies nouvelles' public interest missions, it also contributes to its scientific influence, and, more broadly, that of French and European research on the international stage. IFP Energies nouvelles has built up a

### WHAT OUR PARTNERS HAVE TO SAY...

### SUSTAINING AND REINFORCING EXPERTISE THROUGHOUT THE INNOVATION CHAIN

**In addition to its statutory role, the IFP Energies nouvelles Scientific Board's mission is to work more closely with research departments and offer them the benefit of its advice and expertise. It can thereby intervene to direct research work within strategic priorities. It also organizes themed reflection days. I see this interaction as being essential and we need to continue down this path. What's more IFP Energies nouvelles has a unique position since it covers the entire innovation chain, from fundamental research to technology transfer. I think it is important to maintain this strategy, which has been shown to be effective in the creation of value for French industry. It even needs to further reinforce its expertise in very upstream fields, such as modeling, giving it the technological edge it needs to fulfill its missions."**

#### Bruno Chaudret

Chairman of IFP Energies nouvelles' Scientific Board



1. Agence nationale de la recherche (French National Research Agency)

2. Fonds unique interministériel (French Interministerial Fund)

3. Agence d'évaluation de la recherche et de l'enseignement supérieur (French Agency for the Evaluation of Research and Higher Education)

## 2010 HIGHLIGHTS

**Two Rencontres scientifiques events**

IFP Energies nouvelles organized two *Rencontres scientifiques* events in 2010. The first concerned chemical looping combustion, a solution for CO<sub>2</sub> capture in industrial facility flue gases. This is a field in which IFP Energies nouvelles has particularly cutting-edge expertise. The second was dedicated to Large-Eddy Simulation applied to flow, injection and combustion in piston engines. IFP Energies nouvelles research in this field is among the most advanced.

**OGST dossiers in 2010**

Three themed special reports were published in the IFP Energies nouvelles Oil & Gas Science and Technology journal: Fractured reservoir simulation, CO<sub>2</sub> storage to tackle climate change and Process eco-design.

**Progress in batteries**

As part of its research in the field of batteries, IFP Energies nouvelles has discovered a class of new gellified electrolytes that could improve the safety of Li-ion batteries and reduce their onboard weight, with a view to applications in hybrid and electric vehicles. The project conducted on this theme led to some very encouraging results with formulas combining gelling polymers and ionic liquids. However, ionic conductivity at low temperature is still inadequate. It is for this reason that nuclear magnetic resonance (NMR) studies on



lithium and molecular simulation studies have been undertaken. Their results have already led to progress being made in terms of identifying the main obstacles limiting this conductivity.

**Materials with a promising future**

MOF (Metal-Organic Frameworks) are organic-inorganic hybrid crystallized porous materials. Their high adsorption and molecular sieving capacities mean that they are promising solids for catalysis and separation. Research conducted by IFP Energies nouvelles led to two major advances in 2010: the development of novel, highly active MOF in catalysis, using Click Chemistry (which consists in creating made-to-measure structures by assembly of small molecular models), and the discovery of the selectivity properties of certain MOFs. The latter characteristic could be used for the separation of multibranched paraffins, which have a better octane number than linear paraffins.

This work has been the subject of several patents and, in 2010, five scientific publications in high-impact journals.

**More enzymes for more biofuels**

Enzymatic hydrolysis is one of the options for the production of 2<sup>nd</sup>-generation biofuels from lignocellulosic biomass. IFP Energies nouvelles is using genomic methods to improve the natural capacity of the fungus *Trichoderma reesei* to secrete large quantities of enzymes (cellulases). In 2010, as part of a partnership involving the *École normale supérieure de Paris* and Vienna University of Technology (Austria) in particular, the use of DNA chips led to identification of the fungus genes directly involved in enzyme production. These results will enable researchers to optimize the genome of the microorganism and hence improve its productivity. The challenge is to improve the profitability of 2<sup>nd</sup>-generation ethanol production technology.



## 3

new books were published by IFP Energies nouvelles in 2010.

►►► unique fund of knowledge as a result of several decades of scientific research and industrial successes. IFP Energies nouvelles has created its own peer-reviewed journal, Oil & Gas Science and Technology (OGST). Indexed in the major international databases, it covers

all the disciplines and fields of activity within the scope of IFP Energies nouvelles (exploration-production, refining and petrochemicals, powertrains, new energies). It is freely available on IFP Energies nouvelles website (<http://ogst.ifpenergiesnouvelles.fr>).

IFP Energies nouvelles also publishes reference works in its recognized fields of scientific expertise. Éditions Technip, which publishes numerous IFP Energies nouvelles works, currently has a catalog of almost 1,000 titles.

Finally, IFP Energies nouvelles contributes to the promotion of scientific research and ensures its knowledge is disseminated to the widest possible audience. In particular, every year its researchers participate in the *Fête de la Science* (French Science Festival) and its website includes a Discovery space aimed at the general public. It provides analyses, summaries and educational documents keeping readers 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 Energies nouvelles to meet the challenges in these fields.



IFP Energies nouvelles' books are published by Éditions Technip.

## FOCUS ON...

# MULTI-SCALE SIMULATION

**RESEARCH** Multi-scale simulation is a relatively recent R&D approach. It allows a system to be considered on various scales of space – from the macroscopic to the microscopic (molecule, atom, electron) – and time (from the femtosecond to the year). By superimposing these scales, it is possible to obtain an overall view of the system and to zoom in on specific zones. It can also be used to predict the behavior of the system over different periods of time.

**In the next months, IFP Energies nouvelles will organize two Rencontres scientifiques dedicated to multi-scale simulation applied to porous media (16 and 17 November) and to innovative processes (25-27 January 2012).**

Already used for the development of certain processes in the oil sector, multi-scale simulation is proving to be crucially important in terms of responding to urgent climatic and energy challenges. For example, it makes it possible to speed up research into the conversion of biomass into syngas, a preliminary step in the production of biofuels as alternatives to fossil energies. For each type of biomass, IFP Energies nouvelles is developing tools that make it possible to understand, simulate and test the most appropriate catalysts and processes, right through to the industrial validation stage. More broadly, multi-scale simulation applies to all the work carried out at IFP Energies nouvelles.

## QUESTIONS TO...

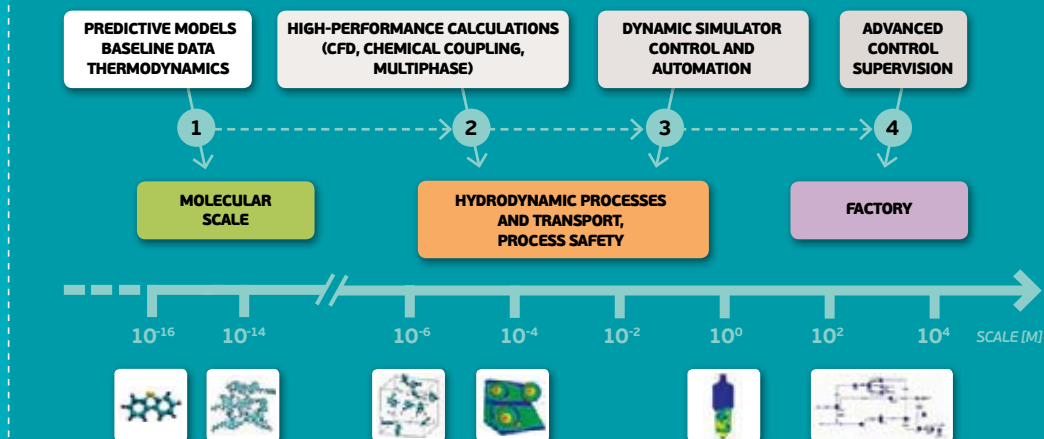
### Sophie Jullian

IFP Energies nouvelles  
Scientific Director

#### What is the role of multi-scale simulation in IFP Energies nouvelles' work?

**S.J.:** It is used in all our research activities, whether these concern hydrocarbons (from rock pore to sedimentary basin), processes (from catalysts to lifecycle analyses) or engines (from combustion simulation to energy management systems in transport). To a certain extent, it represents

IFP Energies nouvelles' scientific banner. We are one of the few structures in the world



Multi-scale simulation studies a system from the microscopic to the macroscopic level.

to have mastered this integrative approach and to apply it in all our work.

#### Do you work in partnership with other organizations that use multi-scale simulation?

**S.J.:** Yes, it is one of the guiding principles of our partnership strategy, especially within the context of the Investment for the Future government-backed spending program. Multi-scale simulation will thus be one of the main focuses of



the themed excellence institute project, indeed, that we are leading (see p.57). It also guides our involvement in excellence laboratories with the Lyon Higher Education and Research Cluster PRES (iMUST project – Institute for multi-scale sciences and technologies: from fundamental physics and chemistry to engineering of materials, processes and eco-technologies) and the Pierre et Marie Curie University (Matisse project – Materials, interfaces, surfaces, environment).

## GIVING INNOVATION A HEAD START

### A new cycle of Energy-Water-Climate conferences



In 2010, IFP Energies nouvelles launched a new cycle of conferences dedicated to energy and environment issues. The first Energy-Water-Climate forum was dedicated to the problem of recycling and waste conversion "Waste, materials and products: challenges and opportunities". These conferences bring together major players in the fields of energy, water and climate, who discuss and compare their viewpoints with IFP Energies nouvelles experts, adopting a strategic and forward-looking approach. There are two objectives: to examine major topical themes in the world of energy and anticipate future social and technico-economic trends.

# 156

doctoral students completed their theses in IFP Energies nouvelles laboratories in 2010.

IFP Energies nouvelles' exploratory research projects are conducted by the Scientific Management. These concern fields that help boost expertise used in the context of industrial research: molecular modeling, high-speed testing, energy storage, 3<sup>rd</sup>-generation biofuels, etc.

In addition, one of IFP Energies nouvelles' strengths is its capacity to anticipate requirements in terms of research and innovation. To do this, it employs long-range thinking on a continuous basis in order to identify the techniques that IFP Energies nouvelles should target as a priority. This thinking is supported by the Scientific Board, which takes part in themed days during which it gives its opinion on specific research themes. It also benefits from scientific partnerships involving IFP Energies nouvelles, which help generate new ideas.

To give structure to this approach, a strategic analysis method is currently being developed. The idea is to conduct a thorough analysis of the value chain of the technology studied, its requirements and the scientific and technological obstacles to be overcome. Detection of opportunities and the choice of research priorities are then explicitly determined, along with quantification of the risks and the related challenges. All this then leads to the construction of a programmatic itinerary, organizing the resources to be implemented over time (skills, technological bases, partnerships, funding, industrial development, etc.). This approach has also been applied to three research themes, two of which are included in the new objectives and performance contract drawn up with the State: offshore wind power and oil production water. Projects have already been launched on these different themes.

All the studies conducted by IFP Energies nouvelles are structured in project form and draw on multidisciplinary synergies.



“PATENT FILING IS TAKEN INTO ACCOUNT FROM THE VERY START OF PROJECTS, WITH THE INVOLVEMENT OF INDUSTRIAL PROPERTY SPECIALISTS ALONGSIDE PROJECT MANAGERS.”



**Chantal Le Naour**  
Legal Division

IFP Energies nouvelles' research programs take into account the needs of industry.



# 179

new patents were filed in 2010 by IFP Energies nouvelles, including 98 in the field of NETs. 1,134 patent rights were also created internationally.

In addition a new R&D project management method is being gradually implemented from 2010. This approach, which introduces an examination of the link between technologies and decision-making points at key stages in the project, is also aimed at enhancing IFP Energies nouvelles' innovation capacity.

IFP Energies nouvelles also hopes to increase its commitment to breakthrough innovations. An internal incubation system is currently in the process of being developed, the aim being to promote the emergence and maturation of ideas before they give rise to research programs. This reflection process will take into consideration the needs of industrial partners, but will also anticipate the emergence of new technologies.

### A pragmatic vision of innovation

The strategic analysis methodology used by IFP Energies nouvelles helps focus R&D work for the production of innovations. A sound knowledge of target markets makes it easier to provide solutions in line with the needs of society. The ability to work smartly with the market is nothing new at IFP Energies nouvelles, but the methodology developed enables it to improve its efficiency and reinforce its strategy, from the science to the market. This means it can create value by developing new concepts to address new markets—a modern and original approach for a research center!

Doctoral theses are another way of contributing to the emergence of new ideas and the birth of new concepts. Around sixty IFP Energies nouvelles researchers holding a national accreditation to direct research (HDR), supervise around 50 doctoral theses per year, mainly within IFP Energies nouvelles laboratories. At the end of their theses, doctoral students find jobs in industry, with a placement rate of over 90% one year later and 95% two years later.

Finally, industrial property issues are an integral component of IFP Energies nouvelles' research strategy and are taken into account from the project launch stage. The aim is not only to protect the results of R&D work, but also to ensure technology transfer, be it in the form of subsidiary creation or licensing out (see p. 76, *From research to industry* chapter). With over 12,900 live patents, IFP Energies nouvelles is one of the top patent filers in France and abroad.



Doctoral theses are a way of contributing to the emergence of new ideas and the birth of new concepts.

## STRATEGIC PARTNERSHIPS



IFP Energies nouvelles provides innovative solutions, developed either alone or through scientific collaborations.

In addition to structurally strong relationships with industry, linked to its economic model (see p. 68, *From research to industry chapter*), IFP Energies nouvelles is part of a very dense partnership network with French, European and international research players. In recent years, these partnerships – of which there are many in its traditional fields of activity (oil & gas and powertrains) – have been developing rapidly in the new energy technologies sector. They are a mirror of IFP Energies nouvelles' scientific excellence.

### ACTIVE PARTICIPATION WITHIN THE FRENCH RESEARCH AND INNOVATION SYSTEM

IFP Energies nouvelles is also a leading player in the French research and innovation system, taking part in discussions and implementing concrete initiatives in partnership with other research players.

It has partnerships with over 200 academic research teams in France (Andra<sup>1</sup>, BRGM<sup>2</sup>, CEA<sup>3</sup>, CNRS<sup>4</sup>, Inra<sup>5</sup>, Ineris<sup>6</sup>, Inrets<sup>7</sup>, PRES<sup>8</sup> in Lyon, Pierre et Marie Curie University, etc.) and internationally (such as the Federal Polytechnic School in Zurich, in the field of molecular

# Over 60%

of the investment for the Future program will be dedicated to supporting research and higher education.

#### Alliances join forces

The Ancre (energy), Aviesan (health), Allistene (digital) and AllEnvi (environment) research alliances joined forces to present their contribution to the coordination and program of the SFRI (French Research and Innovation System) at the 3<sup>rd</sup> Rencontres Universités-Entreprises (University-Industry Event) in June 2010.

modeling). These networks are a source of exchange and comparison regarding advances in the research sector.

IFP Energies nouvelles plays a coordinating role through the Ancre (French National Alliance for Energy Research Coordination), which it has chaired since it was founded in 2009. The objective of this alliance, created with the CEA, the CNRS and the CPU<sup>9</sup> at the request of the public authorities, is to step up the efficiency of energy research carried out in France by proposing a joint R&D policy and fostering synergies between public research bodies, universities and companies. The associate members are universities, *grandes écoles*, industrial players via competitiveness clusters and all the public R&D bodies involved in the energy sector. The first concrete proposals for joint research programs were formulated in June 2010: technical, economic and environmental assessment of algae processes for the production of biofuels, innovative materials for nuclear power, energy storage linked to the intelligence of networks or construction/energy/transport convergence. These will give rise to research projects in 2011. To reinforce its efficiency, Ancre is working in

## IFP ENERGIES NOUVELLES' INTERNATIONAL COOPERATIVE PARTNERSHIPS TAKE THE FORM OF R&D, TECHNOLOGY TRANSFER, PROJECT MANAGEMENT SUPPORT AND TRAINING."



**Hery Rakotoarisoa**  
International  
Relations Division

close cooperation with the EERA (European Alliance for Energy Research), which was created as part of SET Plan, to develop joint programs between research centers on a European level.

Close relationships are also nurtured with funding, guiding and assessment structures in the French research landscape (Ademe, ANR, Oseo, Aeres, ANRT, etc.). These relationships take a number of forms: secondment of personnel, participation in think tanks, steering or evaluation committees, etc.

IFP Energies nouvelles actively contributes to the vitality of the *Instituts Carnot* network, one of the objectives of which is to promote the development of public/private joint research. In 2006 it obtained the Carnot label for its perimeter and for its expertise in powertrain systems and fuels. The label also recognizes its capacity to conduct joint research activities.

With regions playing an increasingly important role in research and innovation, IFP Energies nouvelles is involved in several competitiveness clusters in the field of NETs. This involvement helps boost the development of the local economic fabric (see p. 66, *Corporate social responsibility chapter*).

For example, it is a founding member of the System@tic Paris Region global competitiveness cluster, as well as of globally-oriented clusters (Axelera<sup>10</sup>, specializing in

### Renewal of the Carnot label

On 28 April 2011, the French Ministry for Higher Education and Research renewed the Carnot label of IFP Energies nouvelles' IFP-Moteurs Institute for a period of five years from 2011.

1. Agence nationale pour la gestion des déchets radioactifs (French National Agency for the Management of Radioactive Waste)
2. Bureau de recherches géologiques et minières (Bureau for Geological and Mining Research)
3. Commissariat à l'énergie atomique et aux énergies alternatives (French Commission for Atomic Energy and Alternative Energies)
4. Centre national de la recherche scientifique (French National Center for Scientific Research)
5. Institut national de la recherche agronomique (French National Institute for Agronomic Research)
6. Institut national de l'environnement industriel et des risques (French National Institute for Industrial Environment and Risks)
7. Institut national de recherche sur les transports et leur sécurité (French National Institute for Transport Research and Safety)
8. Pôle de recherche et d'enseignement supérieur (Higher Education and Research Cluster)
9. Conférence des présidents d'université (French Conference of University Vice-Chancellors)

IFP Energies nouvelles is one of the first 20 French research structures to be awarded the Carnot label.



## TWO EXCELLENCE INSTITUTE PROJECTS

### VEDECOM

The VeDeCoM project (Institute for low-carbon intelligent transportation systems) aims to accelerate the bringing to market of rechargeable electric and hybrid vehicles with onboard intelligence and efficient methods for communicating with infrastructures. Supported by the Mov'eo competitiveness cluster, for which IFP Energies nouvelles is a founding member, the institute will be located at the Versailles-Satory site. It will use existing or planned facilities in this region (Satory test tracks, Mov'eo-Dege platform, etc.) and will include significant new facilities, including a study and simulation centre.

### INDEED

The Indeed project (French National Institute for the Development of eco-technologies and low-carbon energies) concerns the creation of a technological innovation campus on low-carbon industrial processes in "Chemistry Valley". The project is being led by seven founding members, consisting of industry players (Arkema, GDF Suez, PEP and Rhodia) and public research and higher education bodies (CNRS, IFP Energies nouvelles and University of Lyon). It is supported by the Axelera competitiveness cluster, for which IFP Energies nouvelles is a founding member, as well as by all the Ecotech clusters in Rhône-Alpes (LUTB, Tenerrdis, etc.). It schedules the use of pooled resources (particularly in terms of laboratories, platforms and demonstrators) and joint research teams. It will also bring together projects already underway in the region, such as the Axel'One collaborative innovation platform led by Axelera.

# 20

projects involving IFP Energies nouvelles have been funded within FP7.

►►► chemistry and the environment in Rhône-Alpes, and Mov'eo, dedicated to transport in the Île-de-France region) and of one cluster of national importance (Lyon Urban Truck & Bus). Within these clusters, several technological platform projects coordinated by IFP Energies nouvelles are under way, including Mov'eo-Dege in Satory (low-carbon vehicles) and Axel'One in Lyon (innovative materials and clean processes). In addition, IFP Energies nouvelles is an active member of other clusters, including Tennerdis<sup>11</sup>, Industrie et Agro-Ressources, Astech Paris Région and Aerospace Valley. It also chairs Avenia<sup>12</sup>, a regional competitiveness cluster in Aquitaine labeled in 2010 and specializing in the development of technologies linked to the exploration and production of underground environments. This is the only cluster in France dedicated to the sustainable management of the underground environment.

Finally, IFP Energies nouvelles is involved in the Investment for the Future government-backed spending program launched by the State in 2010. In this context, it is leading four projects within the scope of Excellence Facilities and Themed Excellence Institutes initiatives in the field of low-carbon energies (IEED). These will bring together training institutions, research bodies and industry, the aim being to promote public/private partnership. The objective of these initiatives is

to equip France with competitive economic networks in promising future sectors related to low-carbon energies. IFP Energies nouvelles is also involved in projects led by other research bodies.

Furthermore, the ANR launched the first calls for projects in 2010 to select excellence laboratories. These laboratories will be awarded funding to recruit internationally renowned researchers and invest in equipment, enabling them to boost their scientific excellence and their position on the international stage. IFP Energies nouvelles is involved in two excellence laboratory projects, with Pierre et Marie Curie University and the Lyon Higher Education and Research Cluster (PRES). This partnership further reinforces longstanding collaboration with these two entities.

#### **BUILDING THE EUROPEAN RESEARCH AREA**

IFP Energies nouvelles has played a major role in the emergence of a European research vision in the field of energy, actively participating in the European Union's research and development framework programs (FP).

For example, it participated in 28 projects funded within FP6 in the field of NETs and powertrain technologies. It has also invested in the ZEP (Zero Emission Platform), of which it is vice-chair, and Biofuels European technology platforms. Its involvement in

**Already involved in 20 projects, IFP Energies nouvelles is one of France's biggest contributors to FP7.**



FP7 perpetuates this strategy. IFP Energies nouvelles is already participating in 20 projects, and coordinating three of these: SiteChar<sup>13</sup>, LESSCCV<sup>14</sup> and Cocate<sup>15</sup>.

In parallel, IFP Energies nouvelles has got involved in new European research structures that have emerged since the launch of FP7. It is participating in JTI<sup>16</sup> Fuel cells and hydrogen, the “green cars” initiative set up by the European Commission, and the Eccsel<sup>17</sup> large infrastructure project aimed at creating a network between several European laboratories in the field of CO<sub>2</sub> capture and storage. IFP Energies nouvelles is also involved in the European Energy Research Alliance (EERA), for which it is coordinating the CO<sub>2</sub> capture and storage program for a period of two years.

Finally, IFP Energies nouvelles is building strong partnerships with other European R&D players, the aim being to accelerate the innovation process and pool resources in order to address the challenges related to climate change. An example of this is the agreement signed in 2009 with the Dutch research center TNO and the Norwegian institute Sintef in the field of CO<sub>2</sub> capture and storage.

### INTERNATIONAL CHALLENGES

The challenges of sustainable development concern all countries, and particularly those undergoing strong economic growth. IFP Energies nouvelles' collaborative research projects therefore go beyond the boundaries of Europe and have a global reach.

In terms of collaborative research, IFP Energies nouvelles has forged partnerships with US DOE (Department of Energy) laboratories. For example, it is involved in a network aimed at validating and establishing global standards for experimental combustion characterization methodologies, working with Sandia laboratories. Another example is the research contract signed in 2008 by the ICE consortium (IFP Energies nouvelles/CNRS/ENS-Lyon) with Kaust University in Saudi Arabia (King Abdullah University of Science and Technology) for a period of four years. This contract relates to molecular modeling applied to catalysis.

Partnerships of a more applied nature bring together IFP Energies nouvelles with industry players and foreign

All IFP Energies nouvelles' strategic priorities incorporate sustainable development issues.



Training activities are in high demand, particularly in oil-producing countries.

### A decisive step forward in the partnership with Sintef and TNO



In January 2011, IFP Energies nouvelles, Sintef and TNO agreed to set up a joint alliance (Tri4CCS) in the field of CO<sub>2</sub> capture and storage. It was officially launched at Trondheim (Norway) on June 15. The three bodies have joined forces to jointly address the R&D challenges in this field; the alliance will thus form a special portal of contact for industrial partners.

research bodies. In particular, this is the case of research consortiums, Joint Industry Projects and demonstrator projects (see p.70, From research to industry chapter).

Finally, state-owned companies in oil-producing countries have expressed significant needs in terms of technology transfer and project management support for the construction or modernization of their R&D and training centers. IFP Energies nouvelles offers its services in this field, brought together since 2009 within a consultancy structure called IFP Services.

Its training activities are also in strong demand. Handled by the IFP School and IFP Training, these activities prepare for and nurture commercial or partnership relationships between IFP Energies nouvelles and the countries involved.

10. Chimie-Environnement Lyon et Rhône-Alpes (Chemistry and Environment in Lyon and the Rhône-Alpes region)

11. Technologies énergies nouvelles énergies renouvelables Rhône-Alpes, Drôme, Isère, Savoie (Technology, new energies, renewable energies in the Rhône-Alpes, Drôme, Isère, Savoie regions)

12. Avenir énergie environnement en Aquitaine (Energy and Environment Future in Aquitaine)

13. Characterization of European CO<sub>2</sub> storage, launched in 2011

14. Large-Eddy & System Simulation to predict Cyclic Combustion Variability in gasoline engines, launched in 2010

15. Large CCS Transport Infrastructure in Europe, 2010-2012

16. Joint Technology Initiative

17. European Carbon dioxide Capture and Storage Laboratory