

# IFP ENERGIES NOUVELLES

2 0 1 0   A C T I V I T Y   R E P O R T

## STRATEGY

Addressing the challenges of the energy transition

## INNOVATION

Developing technologies that can be used by industry

## INTERVIEW

**OLIVIER APPERT**  
Expertise that has been expanded to include new energy technologies

# INNOVATING FOR ENERGY





## THE MISSION OF IFP ENERGIES NOUVELLES

IS TO PROVIDE PUBLIC PLAYERS AND INDUSTRY WITH EFFICIENT, ECONOMICAL, CLEAN AND SUSTAINABLE TECHNOLOGIES TO TAKE UP THE THREE MAJOR CHALLENGES FACING SOCIETY IN THE 21<sup>ST</sup> CENTURY: CLIMATE CHANGE AND ENVIRONMENTAL IMPACTS, ENERGY DIVERSIFICATION AND WATER RESOURCE MANAGEMENT. IT BOASTS WORLD-CLASS EXPERTISE.

### PUBLIC/PRIVATE FUNDING

IFP Energies nouvelles has proven expertise across the entire value chain, from fundamental research to industrial research and innovation. It is funded both by a state budget and by resources provided by French and foreign international partners.

### CROSS-DISCIPLINARY R&D TEAMS

Representing over 50 professions, from geological engineers to powertrain engineers, IFP Energies nouvelles' employees form a unique body of globally recognized scientific specialists and an unparalleled network of expertise. In order to carry out their research work at the cutting-edge of innovation, they have access to an extremely high-quality technical environment, in terms of both facilities and testing resources.

### INNOVATION-DRIVEN RESEARCH

The aim of IFP Energies nouvelles' R&D programs is to overcome existing scientific and technological barriers in order to develop innovations that can be used by industry.



### INNOVATION A DRIVING FORCE FOR GROWTH

Through its research and resulting innovations, IFP Energies nouvelles fosters the economic development of fields related to the energy, transport and eco-industry sectors. In so doing, it also contributes to creating wealth and jobs. IFP Energies nouvelles' innovations are developed industrially through close partnerships with industrial players and IFP Energies nouvelles Group subsidiaries. In both emerging and mature markets, IFP Energies nouvelles creates companies or acquires stakeholdings in companies of significant potential, either directly or via capital funds. In addition, IFP Energies nouvelles supports the development of SMEs and SMIs as part of collaboration agreements, contributing its technical and legal expertise.

### TRAINING A VECTOR FOR COMPETITIVENESS

Against the backdrop of a rapidly-changing energy sector, IFP School and IFP Training provide industry with the highly-qualified personnel it requires to take up current and future technological, economic and environmental challenges. IFP School operates within an international environment and provides young graduate engineers with advanced postgraduate programs in the fields of energy, motor vehicles and the environment. Over 600 students from throughout the world graduate from IFP School each year. IFP Training, an IFP Energies nouvelles subsidiary, offers training programs to almost 15,000 employees from industry every year, securing their competitiveness.

### INFORMATION A CATALYST FOR PROGRESS

IFP Energies nouvelles has built up a unique fund of knowledge as a result of several decades of research and scientific and industrial expertise. This extensive library of knowledge is made available to the widest possible audience with a view to informing and enriching collective and individual decisions regarding current and future energy and environmental issues.



**2010  
ACTIVITY REPORT**

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**IFP ENERGIES NOUVELLES  
IS A PUBLIC-SECTOR RESEARCH,  
INNOVATION AND TRAINING  
CENTER ACTIVE IN THE FIELDS  
OF ENERGY, TRANSPORT  
AND THE ENVIRONMENT.**



# FIVE STRATEGIC PRIORITIES

## 1 RENEWABLE ENERGIES

In order to tackle the greenhouse effect causing climate change and alleviate the transport sector's reliance on oil, IFP Energies nouvelles works on the production of biofuels, chemical intermediates and energy via the transformation of biomass. It also designs the technological solutions required to harness marine resources.

## 2 ECO-FRIENDLY PRODUCTION

Since industrial activities generate CO<sub>2</sub> emissions and use water resources, IFP Energies nouvelles develops CO<sub>2</sub> capture, transport and geological storage processes to combat global warming. It also works on technologies aimed at optimizing industry's use of water.

## 3 INNOVATIVE TRANSPORT

Drawing on its experience in the field of powertrains, acquired in partnership with the world's major automobile manufacturers, IFP Energies nouvelles designs and perfects technological solutions aimed at further reducing fuel consumption and minimizing the environmental impact of vehicles. It also works on the development of low CO<sub>2</sub>-emitting engines for the aviation industry.

## 4 ECO-EFFICIENT PROCESSES

In order to meet ever-increasing demand while mitigating the environmental footprint, IFP Energies nouvelles develops eco-efficient processes and products with a view to transforming a variety of fossil resources (technological oils, coal, gas) into fuels and chemical intermediates.

## 5 SUSTAINABLE RESOURCES

In order to secure long-term energy supplies, the exploitation of oil and gas resources remains crucial. While working to develop oil substitutes, IFP Energies nouvelles perfects advanced simulation tools geared towards gaining an insight into the underground environment as well as environmentally-friendly technologies with a view to pushing back the current boundaries of oil and gas exploration and production.



# 1,719

**Total full-time** equivalent workforce for 2010, including 1,166 researchers (engineers and technicians). 46% of the managers hold doctoral degrees and some sixty researchers hold a national accreditation to direct research (HDR). In addition, IFP Energies nouvelles hosts an average of 156 doctoral students and 26 postdoctoral researchers per year.

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# €311.3 million

**Operating expenses** including €252.7 million for R&D.

Product:

- budget allocation: €169 million,
- other products: €115.5 million,
- dividends: €33.6 million.

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# 179

**Basic patent applications** (mainly French) in 2010 including 98 in the field of new energy technologies and 1,134 rights created abroad, i.e. a portfolio of over 12,900 active patents. IFP Energies nouvelles therefore is ranked amongst the top 10 national patent applicants in France according to the number of patents published by INPI (French National Industrial Property Institute) in 2010. IFP Energies nouvelles is the 10<sup>th</sup> largest patent applicant in the United States (with 76 patents granted in 2009).

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# 252

**Articles published** in international scientific journals, including 221 listed in the Thomson-Reuters ISI database. In addition, three new books written by IFP Energies nouvelles researchers were published in 2010.

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# 28

**European projects** in which IFP Energies nouvelles is involved for FP6 and 20 for FP7, including 3 as coordinator.

# INTERVIEW WITH OLIVIER APPERT

IFP ENERGIES NOUVELLES' CHAIRMAN AND CEO



AT A TIME WHEN IFP ENERGIES NOUVELLES IS PREPARING TO SIGN A NEW OBJECTIVES AND PERFORMANCE CONTRACT WITH THE STATE FOR THE PERIOD 2011-2015, ITS CHAIRMAN, **OLIVIER APPERT, OUTLINES THE CHANGES IMPLEMENTED BY THE COMPANY TO ESTABLISH ITS POSITION AS A MAJOR PLAYER IN THE ENERGY TRANSITION CURRENTLY UNDERWAY.**

## THE 2006-2010 OBJECTIVES CONTRACT BETWEEN THE STATE AND IFP ENERGIES NOUVELLES HAS JUST COME TO AN END. HOW WOULD YOU SUM IT UP?

**OLIVIER APPERT:** This contract defined the broad lines of our research over the last five years: capturing and storing CO<sub>2</sub> to combat the greenhouse effect, diversifying fuel sources, developing clean and fuel-efficient vehicles, converting as much raw material as possible into energy for transport and pushing back the boundaries in oil and gas exploration and production. This ambitious program was accompanied by performance indicators related to the industrial application of our research, as well as scientific excellence, training, dissemination of knowledge and expertise in support of public policies. We are proud to have achieved all the objectives that we had agreed with the State, well before the 2010 deadline.

## WHAT WERE THE REASONS BEHIND THE NAME CHANGE?

**O.A.:** It was IFP Energies nouvelles that wanted to change its name, but also the public authorities and the French President himself. It had become necessary to ensure our name reflected the true nature of our activities. Because we have come a long way since the company was founded in 1944! Our traditional oil and gas-related activities have expanded to include new energy technologies, hence the incorporation of “énergies nouvelles” into the new name. Almost half of our research programs today concern these new energies. Our new name reflects this, while at the same time demonstrating the State’s recognition of the relevance of our positioning. Everyone knows that we will not be able to stop using fossil fuels overnight. They will continue to be essential in every sector – and especially the transport and chemicals sectors – for many years to come. We believe that the solution is based on an “energy mix” combining oil and gas with new energies and ensuring a smooth transition between the energy systems of today and tomorrow. Hence it is necessary to maintain a balance between the two.

## IFP ENERGIES NOUVELLES HAS BEEN ASSESSED BY AERES. WHAT CONCLUSIONS DID THE ASSESSMENT COMMITTEE COME TO?

**O.A.:** The committee members highlighted the clarity of our strategy and our capacity to meet the objectives set for us by the public authorities. This is due to both the advanced skills of our researchers and the quality of our research facilities. Aeres (French Agency for

“OUR TRADITIONAL OIL AND GAS-RELATED ACTIVITIES HAVE EXPANDED TO INCLUDE NEW ENERGY TECHNOLOGIES, WHICH TODAY ACCOUNT FOR ALMOST HALF OF OUR RESEARCH PROGRAMS.”



the Evaluation of Research and Higher Education) also underlined the strength of our economic model, based on the transfer of our technologies to industry, a creator of jobs and wealth. Furthermore, it encouraged us to continue our policy of forming European and international partnerships in the field of new energy technologies.

#### LET'S SPEAK ABOUT THE FUTURE: WHAT ARE THE NEW STRATEGIC ORIENTATIONS OF THE 2011-2015 OBJECTIVES AND PERFORMANCE CONTRACT?

**O.A.:** Like the previous contract, it reflects our fundamental mission, which is to provide both the public authorities and industry with efficient, economical, clean and sustainable technologies in the fields of energy, transport and the environment. It sets out our new road map, incorporating the achievements of the last five years and taking these even further, expanding our scope to include new fields, such as marine energies – in the form of floating wind power in the immediate future – and the management of production water. It also focuses on innovation, the aim being to develop new green industrial processes that will help France emerge from the economic crisis. It nonetheless stresses the essential nature of oil and gas, resources we will be unable to do without any time soon. It will be necessary to conduct research aimed at extending oil and gas reserves until the new energy technologies are technically and economically ready, and at reducing the environmental impact of the oil industry.

#### WHAT TRUMP CARDS DOES IFP ENERGIES NOUVELLES HOLD TO HELP IT TAKE UP THESE CHALLENGES?

**O.A.:** Our scientific excellence, the expertise of our research teams, our experience and our numerous past and current successes... It is important to remember that a significant proportion of skills acquired in our traditional fields can be adapted to new energy technologies! Our capacity to instigate and lead partnerships is another great strength, since, given the magnitude of the challenges facing us, research bodies and industry need to join forces and work together to take them up. It is against this backdrop that the Ancre (French National Alliance for Energy Research Coordination), currently chaired by IFP Energies nouvelles, was created. In 2010, Ancre finished mapping the strengths and weaknesses of French R&D in the fields within its scope. From 2011 onwards, it will be in a position to propose particularly ambitious and innovative joint research projects. In addition, we have launched projects in the context of the Investment for the Future government-backed spending program, in partnership with other research and industry players. Here, I am thinking particularly about the projects Indeed on low-carbon industrial processes and VeDeCoM on smart low-carbon and communicating vehicles. Finally, through IFP School, we are helping to prepare the future by training the engineers who will take up the energy, transport and environment challenges in coming decades.

# CORPORATE GOVERNANCE



From left to right: Pascal Barthélemy, Olivier Appert and Georges Picard.

## THE EXECUTIVE COMMITTEE

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### GENERAL MANAGEMENT

**Olivier APPERT**  
*Chairman and CEO*

**Pascal BARTHÉLEMY**  
*Executive Vice-President*

**Georges PICARD**  
*Executive Vice-President*

### DIRECTORS OF THE BUSINESS UNITS

**Maurice BOUTÉCA**  
*Resources*

**Jean-Pierre BURZYNSKI**  
*Processes*

**Philippe PINCHON**  
*Transport*

**Jean-Luc KARNIK**  
*Education and Training*

**Éric LAFARGUE**  
*Industrial Development*

### OTHER MEMBERS OF THE EXECUTIVE COMMITTEE

**Yves BOSCHER**  
*Human Resources Director*

**Sophie JULLIAN**  
*Scientific Director*

**Pierre-Henri BIGEARD**  
*Director of IFP Energies nouvelles-Lyon*

**Jean-Jacques LACOUR**  
*Strategic Implementation Director*

## THE BOARD OF DIRECTORS<sup>(1)</sup>

### STATE REPRESENTATIVES

#### Michèle ROUSSEAU

Director, Deputy General Commissioner for Sustainable Development, representing the Minister for Energy

#### Michel FERRANDERY

Head of the "Automobile, railway, aviation and naval construction industries" bureau at the General Directorate for Industry and Service Competitiveness, representing the Minister for Industry

#### Maria FAURY

Director of the "Energy, sustainable development, chemistry and processes" sector at the research and innovation strategy service at the General Directorate for Research and Innovation, representing the Minister for Research

#### Marine CAMIADE

Head of the "Energy, stakeholdings, industry and innovation" bureau at the Budget Directorate, representing the Minister for Budget

### QUALIFIED MEMBERS

#### Olivier APPERT Chairman

#### Michel BÉNÉZIT

President Refining and Marketing, Total

#### Bruno JARRY

Member of the French Academy of Technologies and member of the Board of Directors

#### Jean-Claude DEPAIL

Executive Vice-President of GDF Suez, in charge of infrastructures business line

#### Sophie PATURLE-GUESNEROT

Founding Partner of Demeter Partners, member of the Board of Directors and of the Investment committee

#### Philippe KLEIN

Executive Vice-President, Plan, Product Planning, Programs, Renault

#### Guillaume FAURY

Managing Board Member, Research and Development Executive VP, PSA Peugeot Citroën Group

#### Yves BAMBERGER

Scientific Advisor to the Chairman and CEO of EDF, Member of the French Academy of Technologies

#### Hélène JACQUOT-GUIMBAL

Managing Director of Ifsttar (French Institute of Sciences and Technology for Transport, Development and Networks)

#### Hervé LE TREUT

Director of Research at the CNRS, Director of the Institut Pierre Simon Laplace

### STAFF REPRESENTATIVES

#### Karine GAILLARD

#### Guillaume GOUGEUL

(1) as of 27 June 2011

(2) as of 1<sup>st</sup> April 2011

### WITH THE ATTENDANCE OF

#### Philippe GUILLARD

Government-Commissioner to IFP Energies nouvelles, Assistant Director for Energy, General Directorate for Energy and Climate, Ministry for Ecology, Sustainable Development, Transport and Housing

#### Mériadec RIVIÈRE

Head of the Petroleum, Chemicals and Mineral Resources Control Mission, General Economic and Financial Control, Ministry for the Economy, Industry and Employment

#### GRANT THORNTON and DELOITTE & ASSOCIÉS

Auditors

## THE SCIENTIFIC BOARD<sup>(2)</sup>

#### Bruno CHAUDRET

Chairman, Member of the French Academy of Sciences, Director of the CNRS' coordination chemistry laboratory (Toulouse)

#### Alain BONNEVILLE

Professor at the Pacific Northwest National Laboratory in Houston (United States)

#### Valérie CABUIL

Professor at Pierre and Marie Curie University-Paris 6

#### Sébastien CANDEL

Professor at the École Centrale, Paris, Member of the Board at the Aeres (French Agency for the Evaluation of Research and Higher Education)

#### Yves CHAUVIN

Honorary Board Member, Nobel Prize for Chemistry in 2005, Member of the French Academy of Sciences

#### Sierd CLOETINGH

Professor at the University of Amsterdam (Netherlands)

#### Roland GLOWINSKI

Professor at the University of Houston (United States), Member of the French Academy of Sciences

#### Lino GUZZELLA

Professor at ETH Zurich (Switzerland)

#### Bernard LEDUC

Professor at the University of Brussels, Director of the Applied Mechanics Department (Belgium)

#### Johannes LERCHER

Professor at Munich University of Technology (Germany)

#### François MARÉCHAL

Professor at the École Polytechnique fédérale de Lausanne (Switzerland)

#### Guy MARIN

Professor at the University of Ghent (Belgium)

#### Philippe SAUTET

Director of the Chemistry Laboratory at ENS-Lyon (École normale supérieure de Lyon)

#### Marie-Christine SAWLEY

Director of Research at ETH Zurich (Switzerland)

#### Henri VAN DAMME

Professor at the École supérieure de physique et chimie industrielles, Structural and macromolecular physics and chemistry laboratory (Paris)

# THE MAJOR EVENT OF 2010

## IFP CHANGED ITS NAME TO IFP ENERGIES NOUVELLES

### STRATEGY

ANYONE HAVING FOLLOWED IFP ENERGIES NOUVELLES' ACTIVITIES IN RECENT YEARS WILL KNOW THAT FOSSIL ENERGIES NOW ACCOUNT FOR ONLY HALF OF ITS RESEARCH. WITH 50% OF ITS WORK FOCUSING ON NEW ENERGY TECHNOLOGIES TODAY, IT WAS ENTIRELY NATURAL THAT IT SHOULD CHANGE ITS NAME. AN ANALYSIS OF ITS 2006-2010 OBJECTIVES CONTRACT RESULTS SERVES TO CONFIRM THIS SHIFT.

**F**rom an activity dedicated almost exclusively to oil and gas in 2000 to almost 50% of R&D work devoted to new energy technologies in 2010: the company has come a long way! In a seamless change, IFP has become IFP Energies nouvelles. The change was long overdue given the discrepancy between the company's name and the diversified nature of its research programs.

Back in 2009, in a speech made in Chambéry, the French President indicated that IFP's name did not "do justice to its contribution to new energies". The amendment submitted to change the company's name from IFP to IFP Energies nouvelles, integrated into the "Grenelle 2" law, was approved in mid-June and the law came into force on 14 July 2010.



## THE PAST, PRESENT AND FUTURE COMBINED IN IFP ENERGIES NOUVELLES.

Following the name change IFP Energies nouvelles' image more closely reflects its activities. The new name portrays the company's past, what it has now become and what it will be in the coming decades: a major player in the field of energies, be they low-carbon or produced from oil and gas.

The new name embodies the company's significant efforts over the last ten years to adapt its research programs in line with the evolving global economic, energy and environmental context. In addition, it reinforces the solidity of its strategic positioning, which aims to contribute to the energy transition through innovating to promote a clean, sustainable and balanced "energy mix", combining works in the fields of fossil and new energies. Rather than being in conflict with one another, these sectors are actually part of the same drive.

### REVIEW OF THE 2006-2010 OBJECTIVES CONTRACT: A SUCCESSFUL CHANGE IN FOCUS TO INCLUDE NEW ENERGY TECHNOLOGIES

**A**nalysis of the performance indicators in the 2006-2010 objectives contract reveals that IFP Energies nouvelles has been able to rapidly update its R&D policy. As a result, new energy technologies (NET) now account for almost 50% of its research: this shift is a key factor for

the successful implementation of its strategy in the coming years. Other results are also worth highlighting, such as the number of patents filed by IFP Energies nouvelles, up 30% in 5 years. This reflects a proactive innovation and technology transfer policy in all its business areas and, in particular, in the field of NETs, where

the number of corresponding patents has increased six-fold in 5 years, in line with society's expectations. Furthermore, the close matching of its R&D programs with its industrial partners' objectives has led to almost 50% growth in its resources, now accounting for over 45% of its budget.

It is also important to stress the successful integration of IFP Energies nouvelles into the French research and innovation system and its European and international actions which find expression in every dimension of the company: R&D, industrial development and training.

Internally, the refocusing of some of the company's expertise towards the field of NETs, as well as ISO 9001 certification of all its R&D activities are important points.



**Working in a concerted manner with public authorities to prepare a well-controlled energy transition; consolidating existing sectors and contributing to the emergence of new industrial sectors in the fields of energy, transport and the environment: these were the dual ambitions of our previous objectives contract. The outcome is a positive one, with almost all our objectives having been met or even exceeded."**

**Jean-Jacques Lacour**  
Strategic Implementation  
Director

# PANORAMA OF THE YEAR



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## FEBRUARY

### CREATION OF A "2<sup>ND</sup>-GENERATION BIOFUELS" TEACHING CHAIR

IFP School created a new "Thermodynamics for biomass fuels" teaching chair with a view to anticipating the growing need for expertise relating to biofuels and strengthening its positioning on environmental issues.

## APRIL

### EVOLUTION OF THE SCIENTIFIC POLICY

Sophie Jullian was appointed Scientific Director of IFP Energies nouvelles on 1<sup>st</sup> April 2010. At the same time, the scientific board was re-elected and the company's scientific policy was modified to promote a spirit of openness and networking. A system for



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the detection and incubation of innovations on breakthrough markets was also introduced (see p. 50).



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## APRIL

### NEW SPIN-OFF PROJECT IN THE FIELD OF FIRE ENGINEERING

The start-up company 6-Incendie was created in April 2010 as part of IFP Energies nouvelles' spin-off policy. It is founded partly on IFP Energies nouvelles' key expertise in process engineering, transposed to a rather unexpected field: firefighting (see p. 75).

## SEPTEMBER

### EVALUATION BY AERES

The Aeres (French Agency for the Evaluation of Research and Higher Education) evaluated IFP Energies nouvelles and published its conclusions in a public report available on its website ([www.aeres-evaluation.fr](http://www.aeres-evaluation.fr)).

In particular, it highlights the clarity of IFP Energies nouvelles' strategy and its capacity to meet the objectives set for it by the public authorities.

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## MARCH

### NEW GEOSCIENCE SOFTWARE SUITE

The software tools developed by IFP Energies nouvelles covering geoscience activities, from exploration to reservoir engineering, have been integrated into a suite dubbed OpenFlowSuite™, the first version of which was brought to market in March 2010 by Beicip-Franlab (see p. 40).



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## SEPTEMBER

### ASSESSMENT OF SOCIAL ACCEPTANCE OF CO<sub>2</sub> STORAGE

The European SiteChar project, coordinated by IFP Energies nouvelles, aims to study five potential CO<sub>2</sub> storage sites in Europe. One component of the project will be dedicated to raising awareness among the populations concerned (see p. 22).

# A YEAR MARKED BY NUMEROUS INNOVATIVE PROJECTS IN LINE WITH SOCIETY'S EXPECTATIONS.

## OCTOBER



### 7 SMART ELECTRIC VEHICLES

As part of the VME (Town, Mobility, Energy) project, a fleet of around ten self-service electric vehicles has been deployed in Rueil-Malmaison and Nice, the partner cities in the project. The work will focus mainly on ways of maximizing the energy efficiency of the vehicles and hence their range (see p. 28).

## NOVEMBER

### 8 FIRST ENERGY-WATER-CLIMATE FORUM

Around forty decision-makers from the worlds of politics, industry and research



came together at IFP Energies nouvelles for a conference on the theme of "Waste, materials and products: challenges and opportunities". This is the first forum in a new series of conferences launched by IFP Energies nouvelles, dedicated to energy and environmental issues (see p. 55).

## DECEMBER

### IMPROVEMENT OF THE PRIME-G+™ DESULFURIZATION PROCESS

The Prime-G+™ gasoline desulfurization process has been improved with the addition of a new range of even more efficient catalysts. It is marketed by Axens, a subsidiary of IFP Energies nouvelles, and over 190 units are equipped with the technology around the world.



## DECEMBER

### NEW BIOFUEL PRODUCTION PROCESS

IFP Energies nouvelles finalized the development of the Vegan™ process for the production of biokerosene and biodiesel from hydrogenated vegetable oil with Axens. It will be marketed by the latter company in 2011 (see p. 16).



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1 / The School has over 600 graduates per year.

2 / An integrated software solution enabling sequential management of the six component software programs.

3 / One of the Scientific Management's missions is to anticipate requirements in terms of research and innovation.

4 / 6-Incendie specializes in the field of firefighting in confined environments.

5 / The report also highlights the high level of expertise of IFP Energies nouvelles' researchers.

6 / Model explaining geological CO<sub>2</sub> storage to the general public.

7 / Moebius: an innovative mobility service that is practical, environmentally-friendly and economical.

8 / A new series of conferences dedicated to sustainable development technologies.

9 / Hydrotreatment of vegetable oils at IFP Energies nouvelles-Lyon.

10 / Prime-G+™ industrial unit at the Fortum Naantali refinery (Finland).