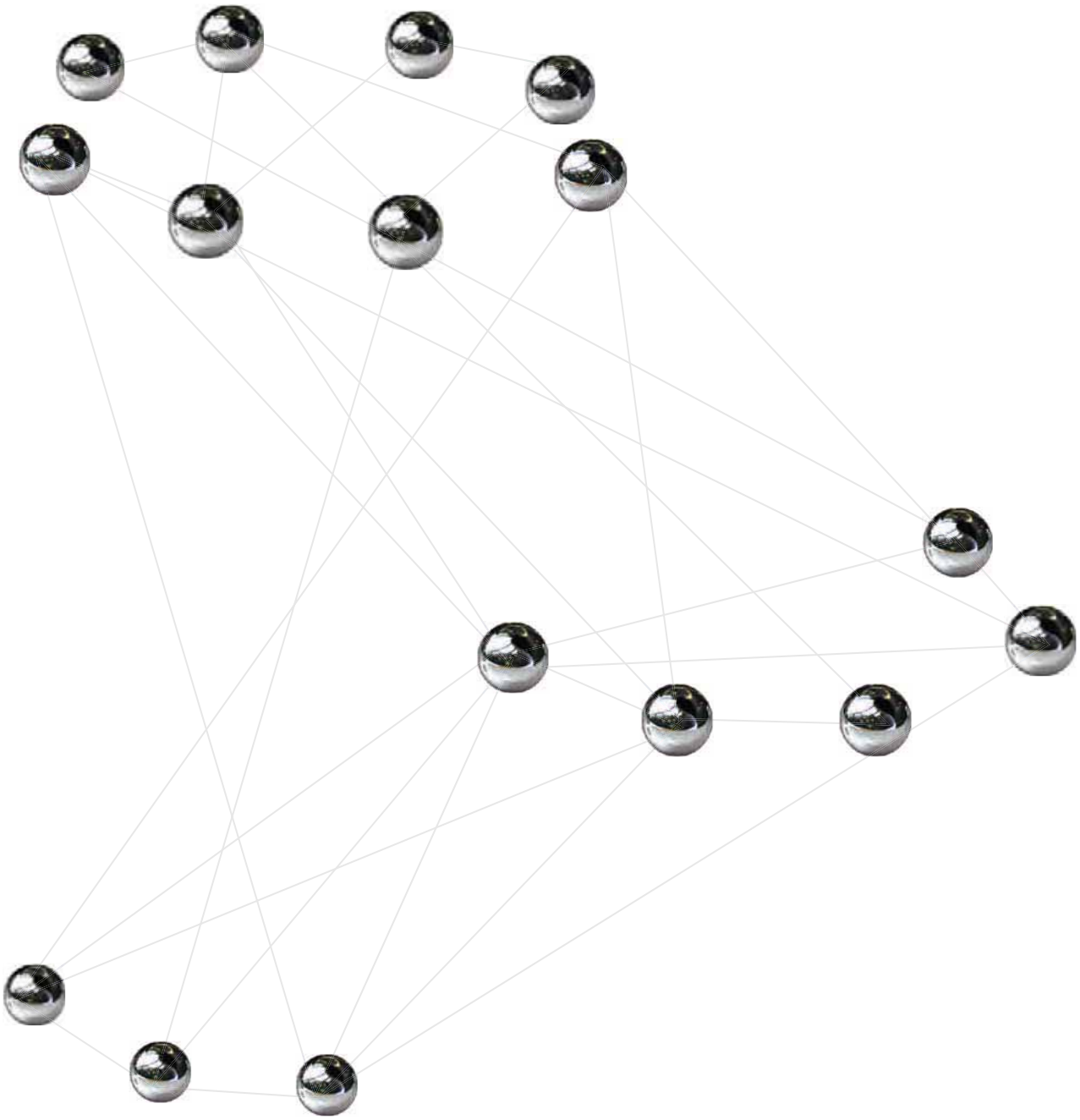
PETROBRAS



PETROBRAS TECHNOLOGY 2011

EXPANSION
OF LIMITS

VALUE ADDITION AND
PRODUCT DIVERSIFICATION

SUSTAINABILITY

PETROBRAS

PETROBRAS TECHNOLOGY 2011

CEO'S MESSAGE

Petrobras is internationally recognized for its history of achievements and currently ranks among the world's most innovative companies in the oil and energy sector. Our capacity goes beyond the creation of solutions for the challenges posed by the market. We attempt to anticipate scenarios, expand frontiers in the use of traditional energy sources, and diversify energy generation with new raw materials and products, always emphasizing sustainability in the production and consumption of energy. And, for that, technological innovation is critical.

For the greater part, our performance results from the significant investments in technology development and technical skills made throughout the company's history. These are investments that grow consistently. In 2011, Petrobras invested US$1.5 billion in R&D – a 47% increase over 2010.

In addition to boosting the results of Petrobras itself, investments and efforts dedicated to technology leveraged the entire oil, gas and biofuels industry chain. We invest in our internal research capacity and, in parallel, we maintain intense, productive exchanges with the external environment, acting in cooperation with Brazilian and foreign institutions, universities and suppliers, which also stand out for their innovation capacity. The performance in networks enables joint growth towards development of local content for our industry, which improves its ability to provide, with increasing excellence, goods and services demanded by the sector, with safety, speed, and efficacy.

This 2011 Petrobras Technology report gathers the main results obtained in the areas of basic engineering and research and development throughout 2011. By publishing these results to our investors and partners, we are showing some of the trends in which we are investing to ensure the sustainable growth that Petrobras has demonstrated throughout its history.

Maria das Graças Silva Foster
Petrobras CEO

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TECHNOLOGY STRATEGY

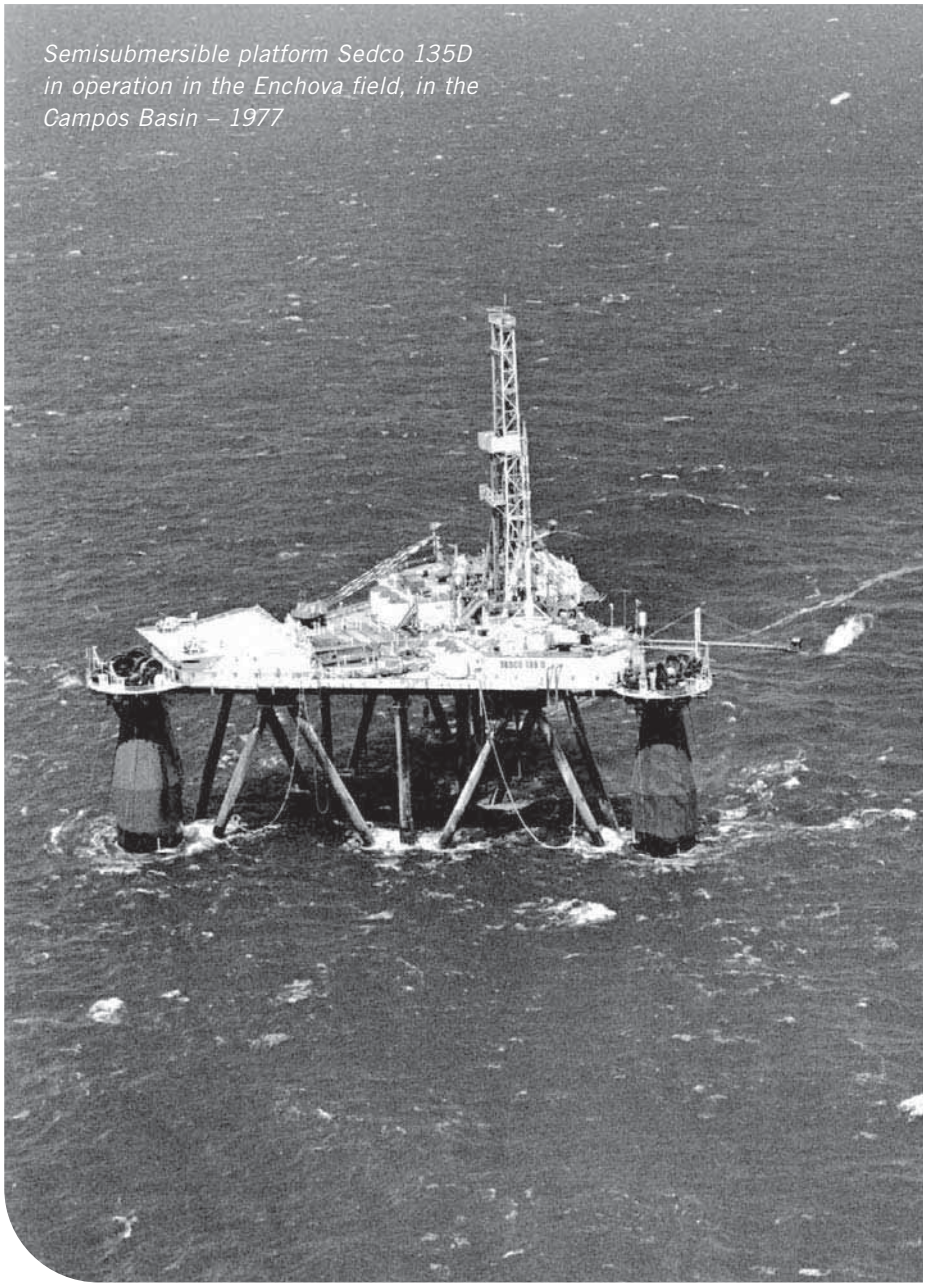
As the largest Brazilian company and one of the principal organizations in the world in the areas where it operates, Petrobras has a clear vision of the importance of innovation to its businesses. The results achieved throughout its history are largely due to continuous investments in technology and innovation. Since its early years, the company has maintained a technology strategy that is constantly renewed and adapted to the national historical context and the company's goals.

A brief history of this strategy is presented here, starting with the creation of Petrobras, in 1953. Petrobras resources for innovation, based on professional qualification, investments and cutting-edge experimental infrastructure, are also highlighted in this report, which includes technological partnerships with suppliers and Science & Technology Institutions.

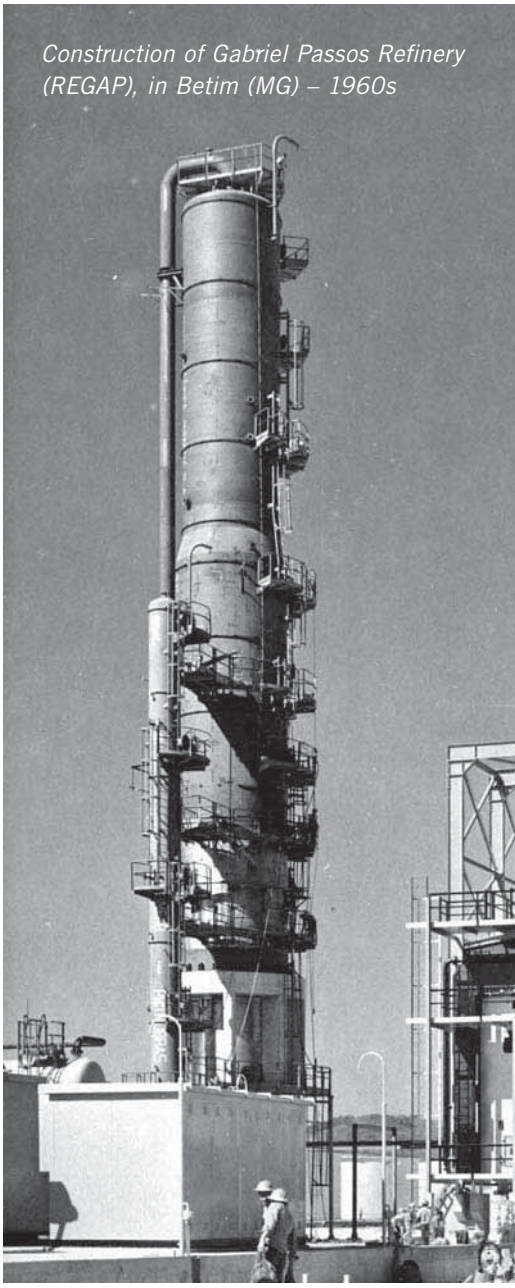
HISTORY

From the formation of the company, in 1953, to the mid -1970s, the implementation of refining industry was the main driver. In this period, Brazil imported oil, and the main objective was to promote the national capability of processing and production of fuel to supply the domestic market. Petrobras needed to learn the refining technologies available in the world to improve and adapt them to the national demands. That was a period of great emphasis on the qualification of human resources for this industry. Petrobras Research & Development Center (CENPES) was created in 1963, within this context.

In 1974, the Garoupa field opened up the recently discovered exploratory frontier of the Campos Basin, beginning the various discoveries of the first giant offshore fields of the company, such as Albacora, Marlim and Roncador. This oil province changed the scenario of the oil and gas industry in Brazil and made Petrobras significantly change its innovation strategy: it was no longer possible to learn only from foreign experiences. The challenges for the development of these fields were unprecedented and we would have to develop new technologies

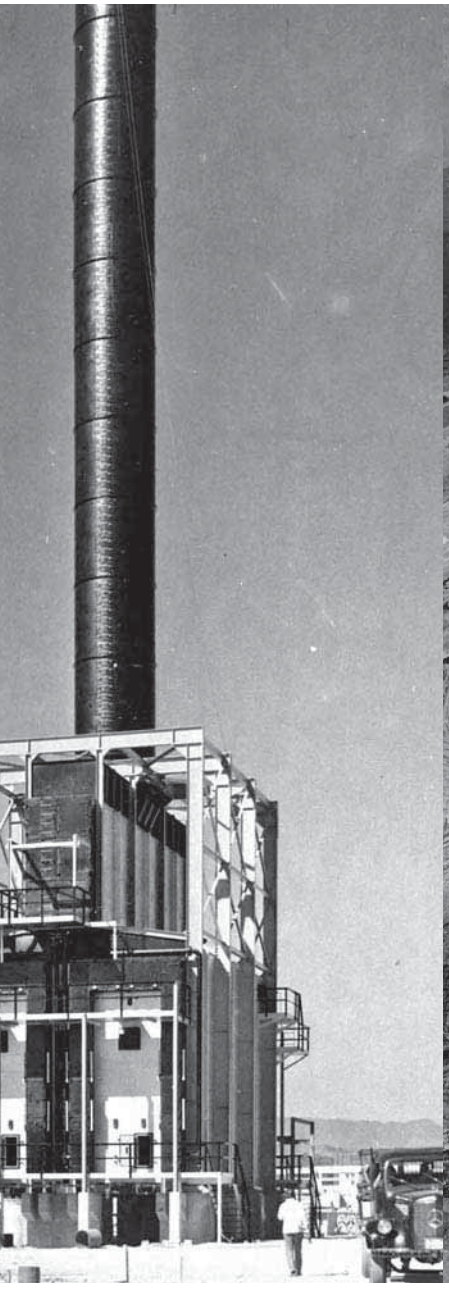


Semisubmersible platform Sedco 135D in operation in the Enchova field, in the Campos Basin – 1977



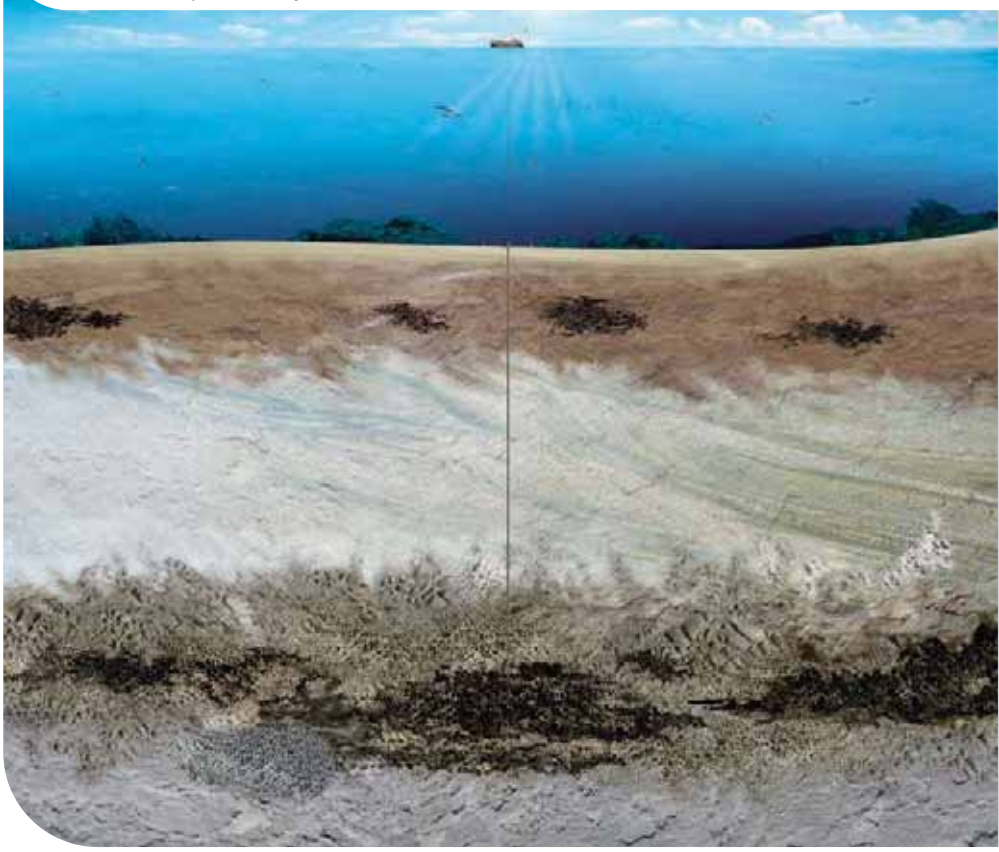
Construction of Gabriel Passos Refinery (REGAP), in Betim (MG) – 1960s

to achieve that much desired offshore production, from increasingly deep waters. We searched for partners with competence, both in Brazil and abroad. We were internationally recognized for our pioneering work in the production from deep waters. We have received two maximum recognitions at the Offshore Technology Conference (OTC), the main technology forum in the industry.



PRE-SALT AND PETROBRAS TECHNOLOGY STRATEGY

Illustration of pre-salt layers



With the discovery of the Lula field in 2006, and the consequent confirmation of the new exploration frontier of the pre-salt, we witnessed a new milestone in the oil and gas industry in Brazil. With extensive previous experience in deep waters, the company had familiarity with the technological solutions necessary for this scenario and vast knowledge to develop the production in this new province. However, given the scale of these reserves, even minor process and technology improvements may generate significant cost reduction and efficiency gains.

This is a great market opportunity for the development of a new generation of technologies for offshore oil and gas production, with a significant application scale. The Brazilian regulatory environment, associated with this opportunity, strongly encourages end-to-end conception, development and application in Brazil, and we have seen this in our actions and in the actions of our suppliers and partners. The country has become attractive to the leading players of this industry.

Conditions have been created for Brazil to increase not only its hydrocarbon production, but also the generation of technologies. Brazil offers a variety of opportunities for large suppliers and service providers. These are not simply installing their production units in the country. They are finding ways to generate technology locally, through captive research centers and in partnership with national science and technology institutions which are highly encouraged by investments in the sector. Innovation at Petrobras directs the company's efforts to the management of a large network of technology development in Brazilian territory which is articulated with the main technology centers of excellence in the energy industry worldwide.

The amount of business generated by the pre-salt to suppliers of equipment and services and to operators of the oil and gas industry is the driver for the consolidation, in Brazil, of one of the biggest technology centers of the sector in the 21st century. This movement is related to the Business Plan of Petrobras – a company that has historically operated in partnership with well known institutions around the globe, as well as Brazilian universities, national suppliers and others. Thus, a large network of cooperation has been consolidated and directed to local innovation capability, aiming at the scenario on which Petrobras technology strategy is currently grounded.

The results presented in this report are the consequence of this strategy and generated, to a large extent, by this broad network of innovation created by Petrobras and its partners.

Three pillars are essential to enable this technology strategy: people with excellent qualifications; proper financial resources in relation to the challenges; laboratories and cutting-edge infrastructure for experiments. These three pillars are materialized by Petrobras resources and the network of partnerships established with universities and suppliers. Leopoldo Américo Miguez de Mello Research & Development Center (CENPES) manages the technology function at Petrobras; it is responsible for the coordination of research, development and basic engineering activities at the company and also the articulation with partners for technological development.

HUMAN RESOURCES

CENPES has today 1,814 employees, 70% of which are exclusively dedicated to research and development. These professionals have a high qualification profile: 24% of the researchers have a doctorate degree and 43% have a master's degree. In addition, the Research and Development Center has 314 engineers dedicated to basic engineering activities at Petrobras; they are responsible for the first phases of large development projects. This arrangement places designers closer to researchers, facilitating the application of technological innovations to engineering projects of the company.

This group of professionals dedicated to the activities of Research, Development and Engineering is only one part of the broad network established by technological partnerships, significantly expanding the technological development capability of Petrobras and Brazil. A recent study conducted by the Institute for Applied Economic Research (IPEA) estimated that, for each researcher in CENPES, there are around 18 external researchers, at universities, suppliers and partners. When considering only Brazilian universities and research institutions, the estimate is of around 15 external researchers to each internal researcher, working on projects to address the company's technological challenges.

Some of CENPES' employees recognized for important associations, companies, institutes and congresses in Brazil and abroad in 2011

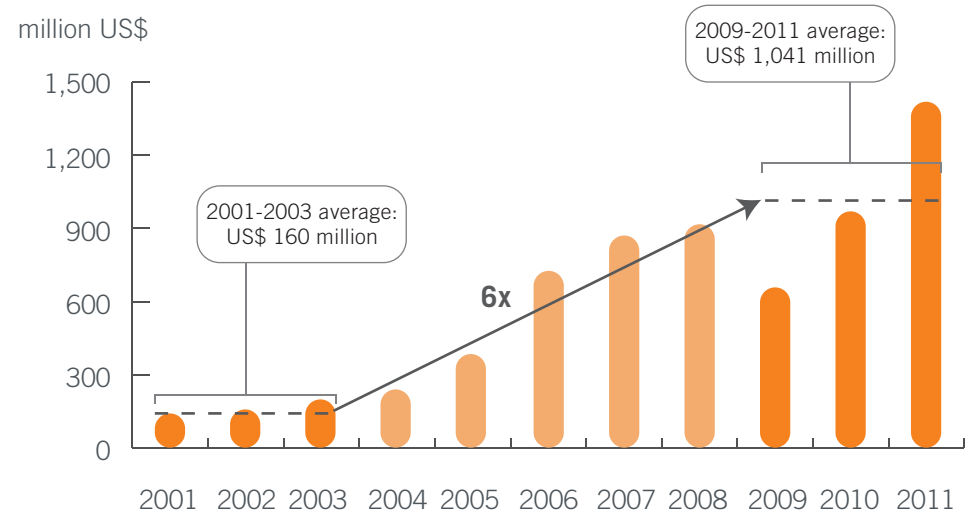
FINANCIAL RESOURCES

The financial resources dedicated to R&D at Petrobras have constantly grown, especially in the last five years. In 2011, Petrobras invested US$ 1.5 billion in R&D, a 47% increase in relation to 2010. Such consistent increase became more intense in 2006. When comparing the average investment in 2001-2003 to the average value of 2009-2011, the amount of resources increased more than six times.

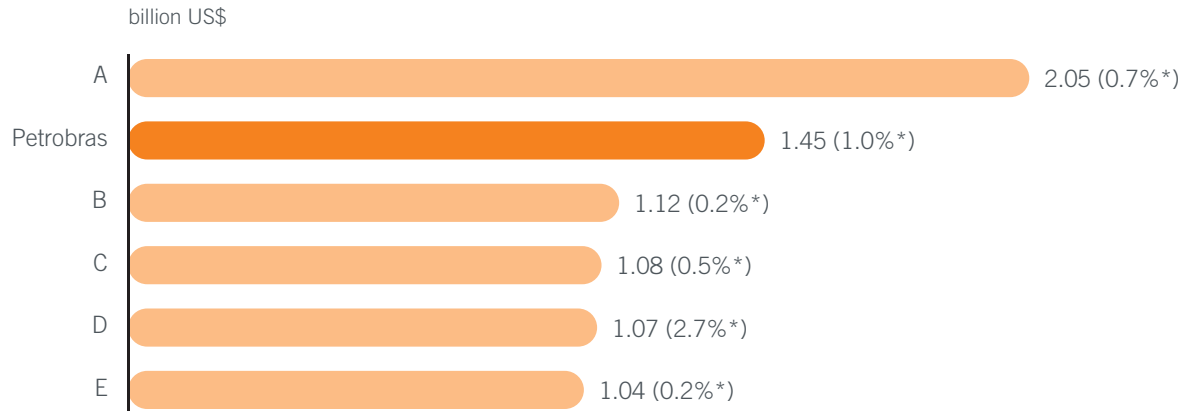
In recent years, this amount has systematically placed Petrobras among the top five corporate R&D investors in the energy area, worldwide.

The R&D resources have a similar profile to that of total Petrobras investment distribution, allocated by business area.

Petrobras R&D Investment



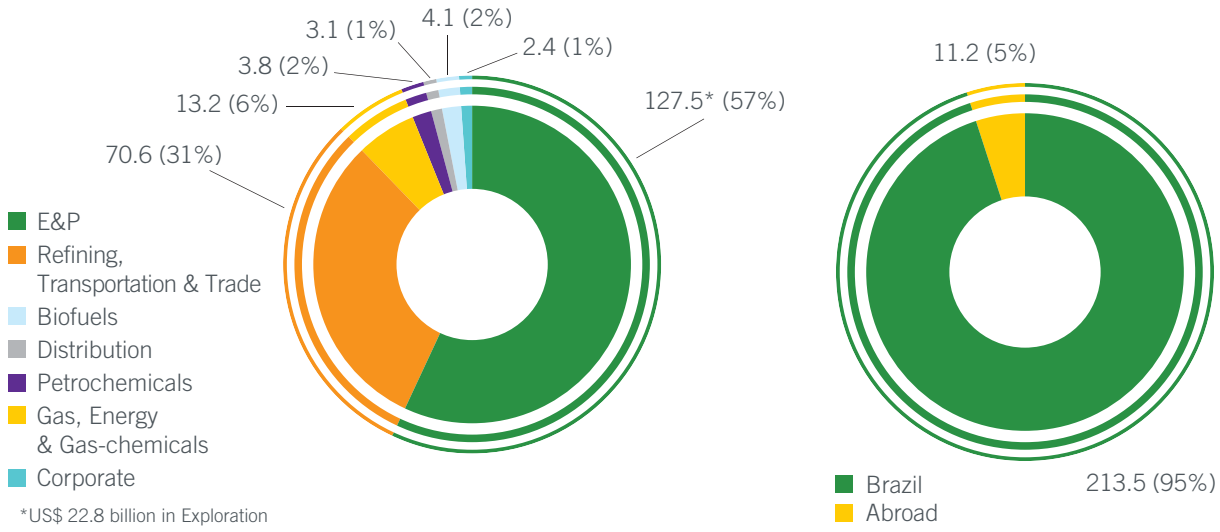
R&D investment by large energy companies in 2011



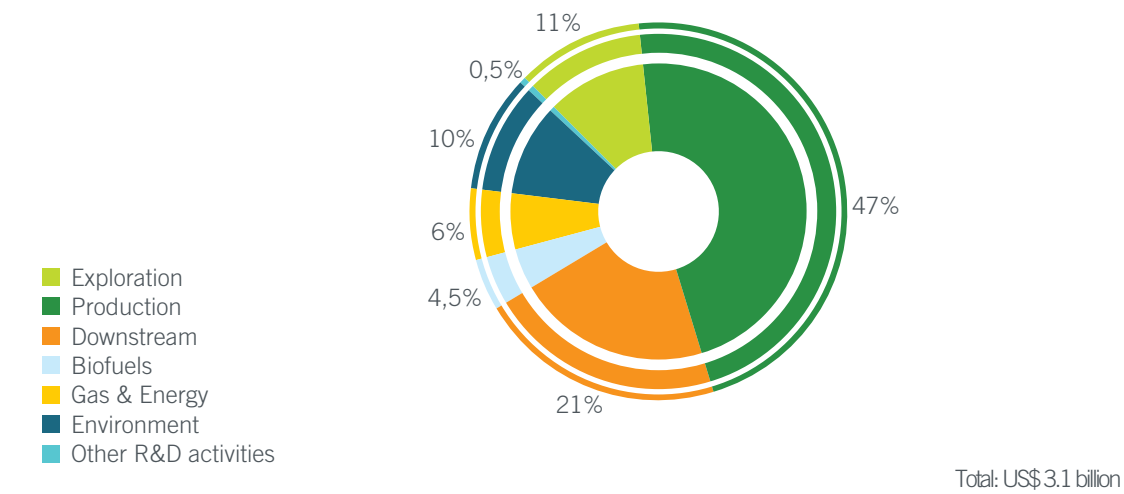
* % of Gross Revenue

Source: Evaluate Energy

Investments foreseen by Petrobras by business area for 2011-2015 (billion US$)



R&D investments by area in 2009-2011



EXPERIMENTION INFRASTRUCTURE

In recent years, the resources invested by Petrobras in its own R&D facilities and in the implementation of cutting-edge laboratories at national R&D institutions have contributed to the consolidation of a world-class experimentation park in Brazil for the industry of oil, gas and energy.

Petrobras R&D Center has one of the largest and most modern research facilities worldwide, occupying a total area of 300,000 m² in Cidade Universitária, Rio de Janeiro. This complex has experimentation plants, modern laboratories and a Visualization and Collaboration Center for simulations, interactivity and immersion of several processes related to the energy industry. Besides the facilities in Rio de Janeiro, CENPES also has six experimentation centers (see below) near their related business areas, which perform tests on a semi-industrial scale, an essential phase for technology escalation and its future availability to Petrobras.

R&D infrastructures of Petrobras and its partners

Technology Park in Rio de Janeiro, at UFRJ, where the technology centers of Baker Hughes, Schlumberger and FMC Technologies are installed. CENPES may be seen in the upper part

The research infrastructure is not limited to the company's facilities.

Since the creation, in 2006, of the Thematic Networks – a model that promoted partnerships between Petrobras and Brazilian universities and research institutions –, the amount invested in laboratory infrastructure has consistently increased. Twenty-four laboratories were inaugurated or expanded at universities and research institutions in Brazil in 2011, with resources of around R$ 77 million spent during the construction and/or equipment acquisition phases.

The national technology park was further enhanced with the arrival in Brazil of some of the main suppliers of equipment and services in the energy sector. Attracted by the scenario of great opportunities involving the pre-salt reserves, some of the largest companies operating in this industry decided to establish in Brazil not only their production plants, but also captive research centers and experimentation plants, to develop here – in partnership with Petrobras and Brazilian science and technology institutions – new technological solutions.

Some of them will have their research centers installed in the Technology Park, in Cidade Universitária, at the Federal University of Rio de Janeiro (UFRJ), near Petrobras Research Center. Schlumberger, one of the world's largest suppliers of exploration and production services inaugurated its research center there in 2010. In 2011, Baker Hughes, an important competitor of Schlumberger, also installed its facilities in the park. The company inaugurated its research center in Cidade Universitária at the UFRJ so as to develop solutions and technologies that will optimize the production in deep waters and in the pre-salt reserves. In 2011, FMC Technologies also started to build its research center and experimentation plants for the development and testing of subsea oil and gas production and processing systems.

In the coming years, other research centers of suppliers may be inaugurated in both Cidade Universitária, at the UFRJ, and on the campuses of other Petrobras partner universities.

2011 RESULTS

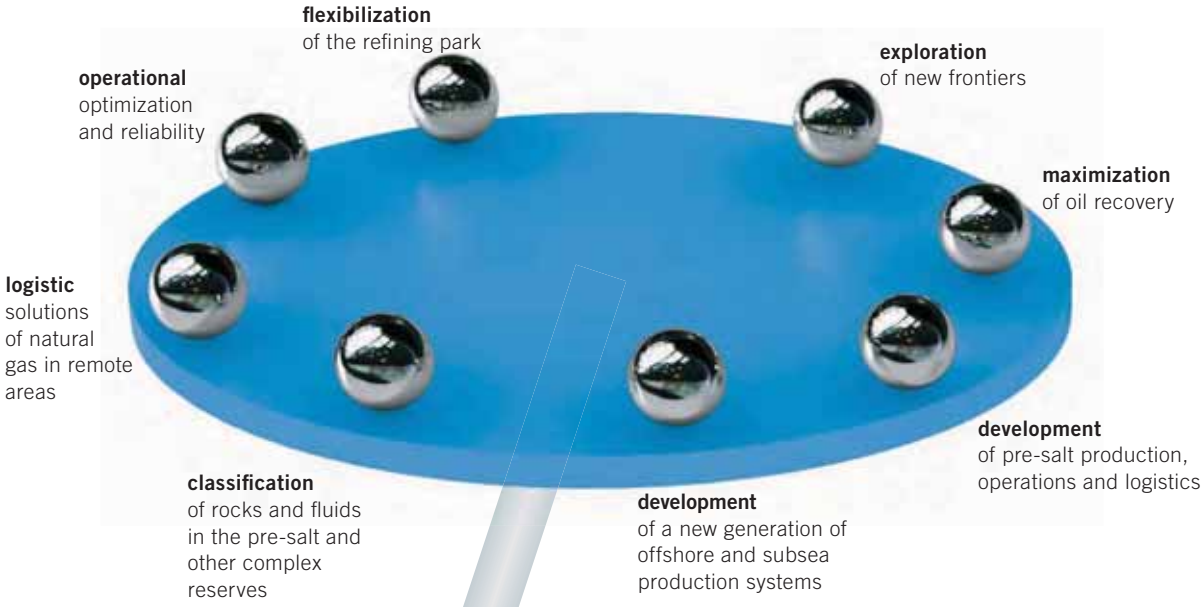
The research projects are undertaken according to the strategic business plan of the company. Each project aims at offering solutions to support one or more business goals. They are organized according to the three main pillars of the company's technological development: expansion of the current Petrobras business limits; value addition and product diversification and sustainability of the energy industry.

The key results of research and development achieved in 2011 are presented in this report for each of the company's principal technological development pillars.

EXPANSION

OF LIMITS

This pillar includes all lines of research and projects for the expansion of Petrobras conventional businesses: oil and natural gas exploration and production, processing, refining and the production of fuels and by-products, as well as transportation and logistic systems required to perform these activities. It includes all research projects that seek new techniques and methods, as well as constant improvements to our production processes, intended to maximize business results.



VALUE

ADDITION AND PRODUCT DIVERSIFICATION

This pillar includes projects to expand the diversity of energy sources and portfolio of products offered by Petrobras. It involves the constant search for quality and performance of fuels, lubricants and special products; the technologies for petrochemicals and gas-chemicals to transform hydrocarbons into high-value industrial products; the constant improvements of fuels and other biomass originated products, as well as the development of new sources of renewable energy.

SUSTAINABILITY

This pillar involves the R&D projects for sustainability in all Petrobras processes and products. The research activities included here are different from those of the other two pillars, as the permanent objective is to mitigate possible negative impacts that can be neutralized or even changed into positive environmental and economic results, with the conversion of waste and emissions into products that add value to the industry. The management of water, effluents and emissions, as well as energy efficiency improvement projects, are present here.

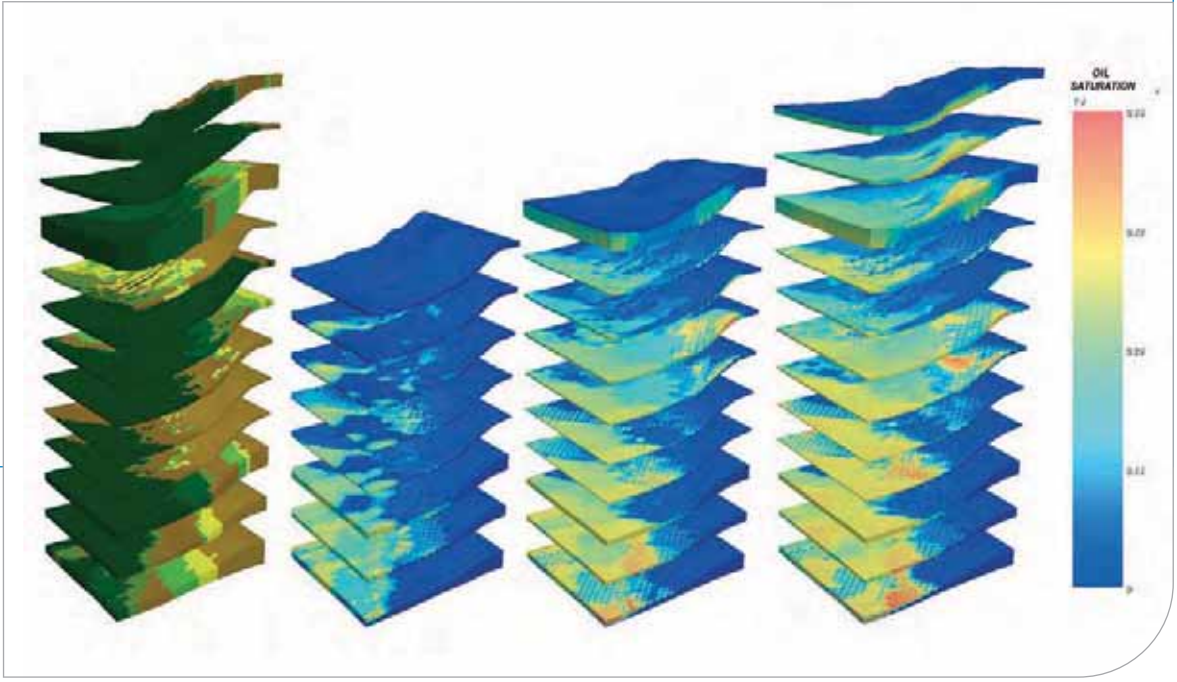
EXPANSION
OF LIMITS

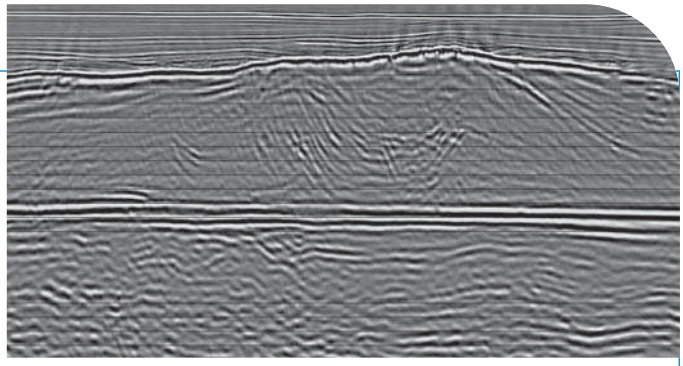
exploration
of new frontiers

the integration of geological simulators improves the study of oil system evolution

Petrobras has recently developed its own computer simulator, named SimBR, to model hydrocarbon generation and accumulation processes in sedimentary basins. This software simulates the evolution of sedimentary layers, reproducing physical and chemical processes of the interaction of rocks and fluids over geological time. In 2011, researchers incorporated into SimBR a stratigraphic modeling software called Steno, which can more precisely estimate the distribution of different types of sediments during the formation of layers. For instance, Steno simulates the process of sand deposition in distinct parts of a basin. Then, a more realistic representation of the occurrence in rocks in the geological layers is obtained, which is later incorporated into SimBR. The utilization of these two applications enables Petrobras to better understand the evolution of oil systems – which is essential for the reduction of exploratory risks.

Computer simulator SimBR applied to studies into the evolution of sedimentary layers over geological time





Seismic section of the pre-salt, in the Santos Basin, processed with RTM technology

Petrobras has implemented Reverse Time Migration (RTM), to improve seismic imaging

This is the most popular technology in the oil industry to obtain seismic imaging of good quality in geologically complex areas. This methodology implemented in Petrobras uses the full wave equation, while traditional seismic processing considers only the vertical propagation. The representation of more complex forms of the seismic wave enables better imaging quality and provides support to estimate physical properties of rocks, in search of reserves with the best characteristics of porosity and permeability. The implementation of RTM technology by Petrobras will enable the development, in 2012 and 2013, of unique improvements for exclusive use by the company, such as the inclusion of anisotropy effects (variation of seismic properties of rocks along the measurement direction), which are essential for obtaining better images of areas of complex geology, such as the carbonate reservoirs of the pre-salt.

The first sampling of gas hydrates has been performed off the Brazilian coast

Gas hydrates are compounds that occur in nature in the form of ice, where gas molecules are surrounded by water molecular structures under high pressure and low temperature conditions. They are found in sediments with high gas concentrations on the seafloor, starting at 500 meters of water depth and below, and under the permafrost in polar regions. These compounds may constitute a new non-conventional source of energy, whose commercial use has not been proven. In a partnership with Pontifical Catholic University of Rio Grande do Sul (PUC-RS), marine sediments were collected from the Pelotas Basin (RS, Brazil) tens of meters below the seafloor, to check for occurrence of hydrates. Depending on the results, high-resolution geochemical and geophysical data will be collected in the first half of 2012 using an autonomous underwater vehicle, for a more accurate mapping of the region. Petrobras is investing around R$ 23 million in these studies, whose objective is to characterize these occurrences and enable future exploration of this new energy resource.

Maximization
of oil recovery

Conclusion of basic designs and upgrade FEED for semisubmersible drilling rigs P-14 and P-17

The project for P-14 includes modernization with increase in drilling capacity, from 350 meters to a maximum of 1,100 meters of water depth. The project for P-17 includes increase in drilling capacity, from 700 meters to a maximum of 2,000 meters of water depth. In pioneer work, the upgrade in rig hulls will be performed with the rigs floating, providing savings of R$ 32 million to the company. This innovation may be applied to other upgrade projects of Petrobras semisubmersible rigs. Both projects have been certified by the Certification Society Bureau Veritas (BV).

Virtual model of platforms P-14 and P-17, after upgrade

The first well in the world drilled with the Liner Conveyed Gravel Pack (LCGP) technology, which reduces drilling time of horizontal wells in mature sandstone fields

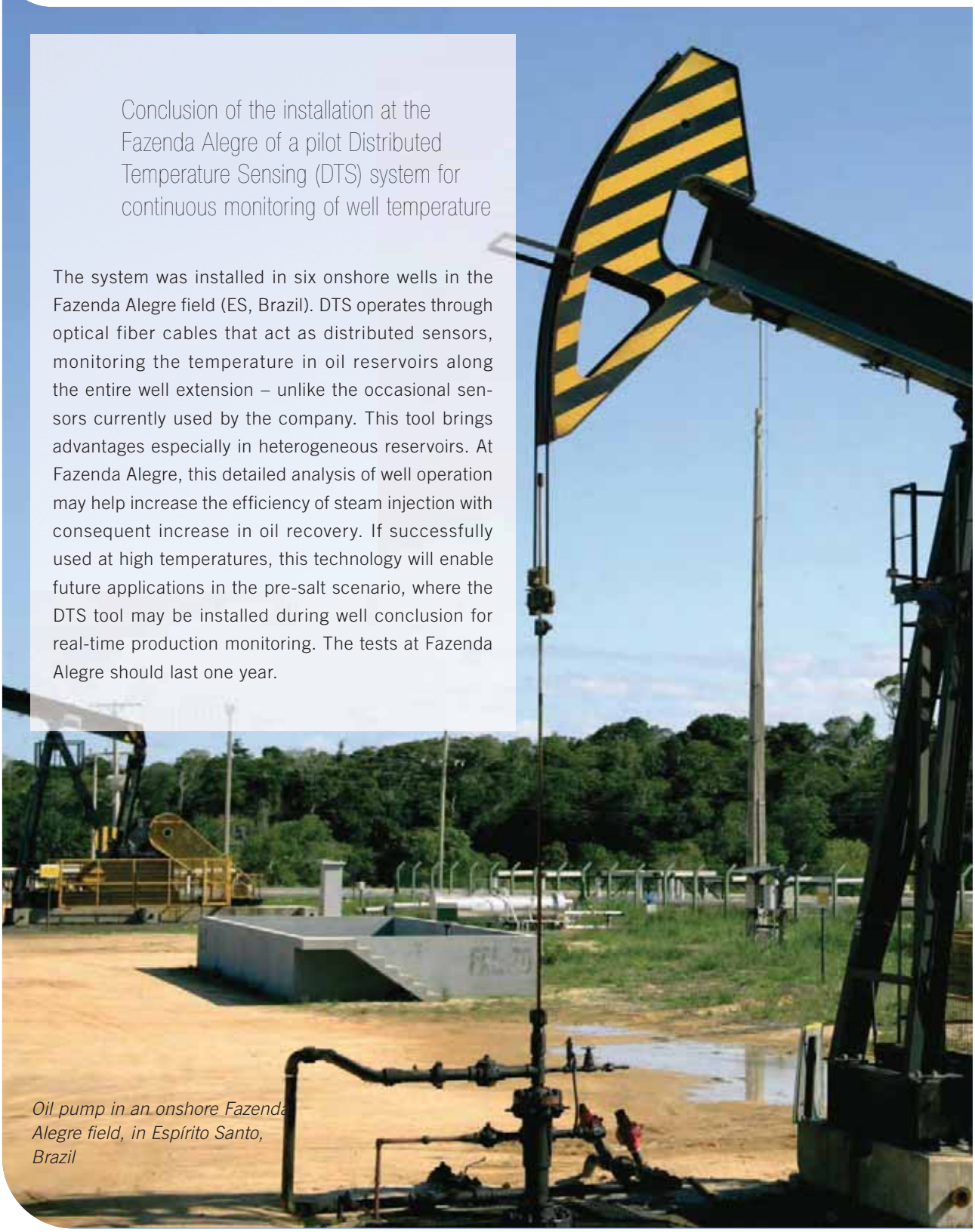
With investments of US$ 4 million made by Petrobras and in partnerships with Baker Drilling Fluids and Halliburton, a synthetic fluid was developed for wells in sandstone fields that enables the installation of a sand production control system – to prevent problems associated with erosion, especially in the horizontal portions –, followed by the 7" liner cementation in only one maneuver. This pioneer application was successfully performed in 7-MRL-212-RJS well (Marlim field), and it has enabled single-phase well drilling with gains in angle and horizontal portions, in existing wells from mature fields of the Campos Basin, reducing these operations by up to seven days.

Project evaluates glycerin injection for enhanced recovery of oil in Pojuca River field

The biodiesel production scale foreseen for the coming years may generate a large amount of glycerin by-product, well above the estimated consumption of the Brazilian and international markets. To prevent excess glycerin availability, Petrobras has developed a technology that injects this by-product, combined with a special surfactant, for enhanced oil recovery. As a consequence, a new economic application has been created for this compound, which may use its entire additional estimated production. Glycerin combined with a surfactant was injected in the field of Pojuca River in 2010 and 2011, where it helped recover 36,000 barrels of oil that would otherwise not have been recovered. This is an additional recovery of 2% of Original Oil in Place of the reservoir. In the next few years, this method will be used in the Fazenda Malaquias field (RN, Brazil), for additional testing and a more precise economic evaluation.

Conclusion of the installation at the Fazenda Alegre of a pilot Distributed Temperature Sensing (DTS) system for continuous monitoring of well temperature

The system was installed in six onshore wells in the Fazenda Alegre field (ES, Brazil). DTS operates through optical fiber cables that act as distributed sensors, monitoring the temperature in oil reservoirs along the entire well extension – unlike the occasional sensors currently used by the company. This tool brings advantages especially in heterogeneous reservoirs. At Fazenda Alegre, this detailed analysis of well operation may help increase the efficiency of steam injection with consequent increase in oil recovery. If successfully used at high temperatures, this technology will enable future applications in the pre-salt scenario, where the DTS tool may be installed during well conclusion for real-time production monitoring. The tests at Fazenda Alegre should last one year.

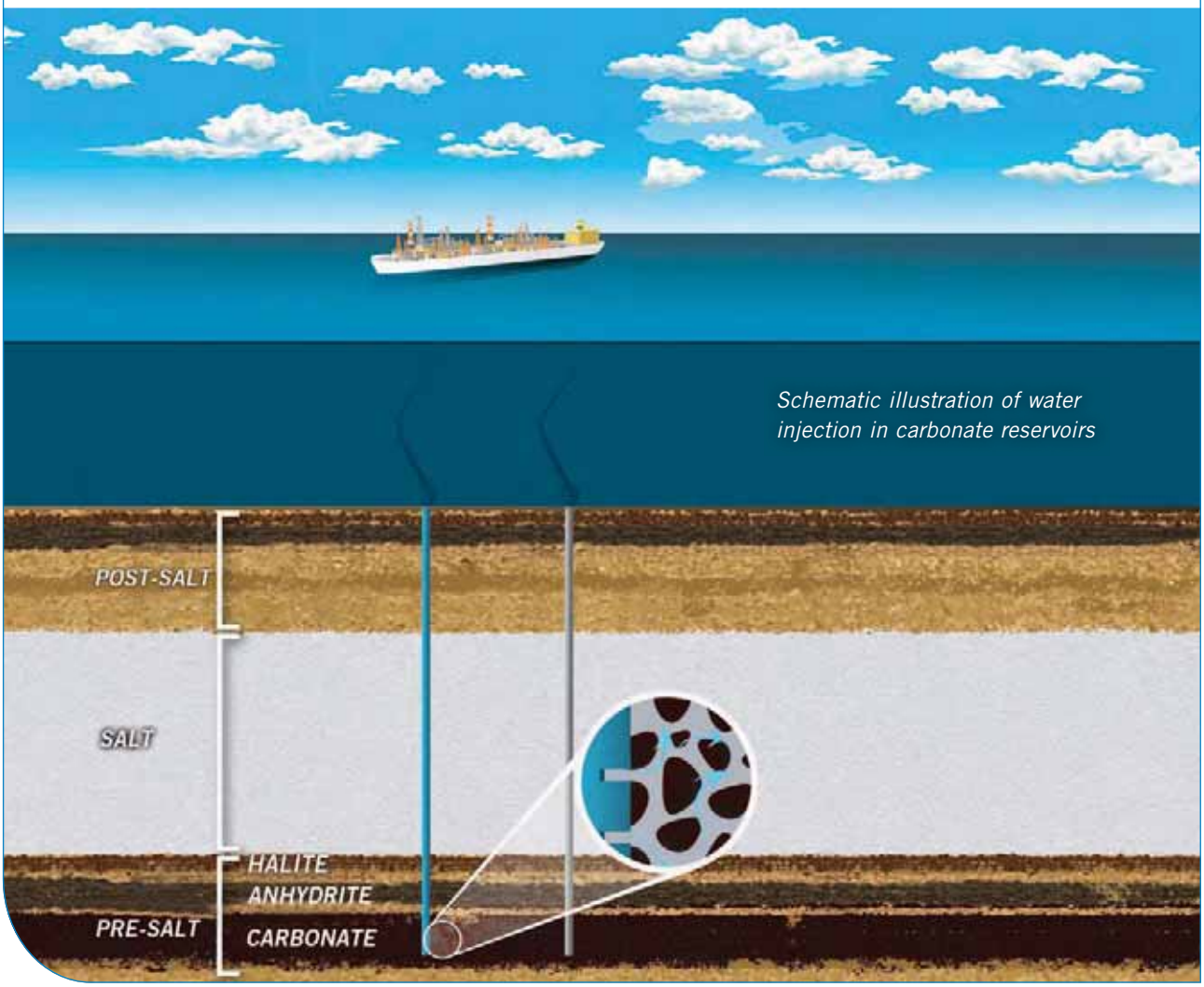


Oil pump in an onshore Fazenda Alegre field, in Espírito Santo, Brazil

Development
of pre-salt production,
operations and logistics

The safety parameters have been defined for water injection into a well in the Lula field

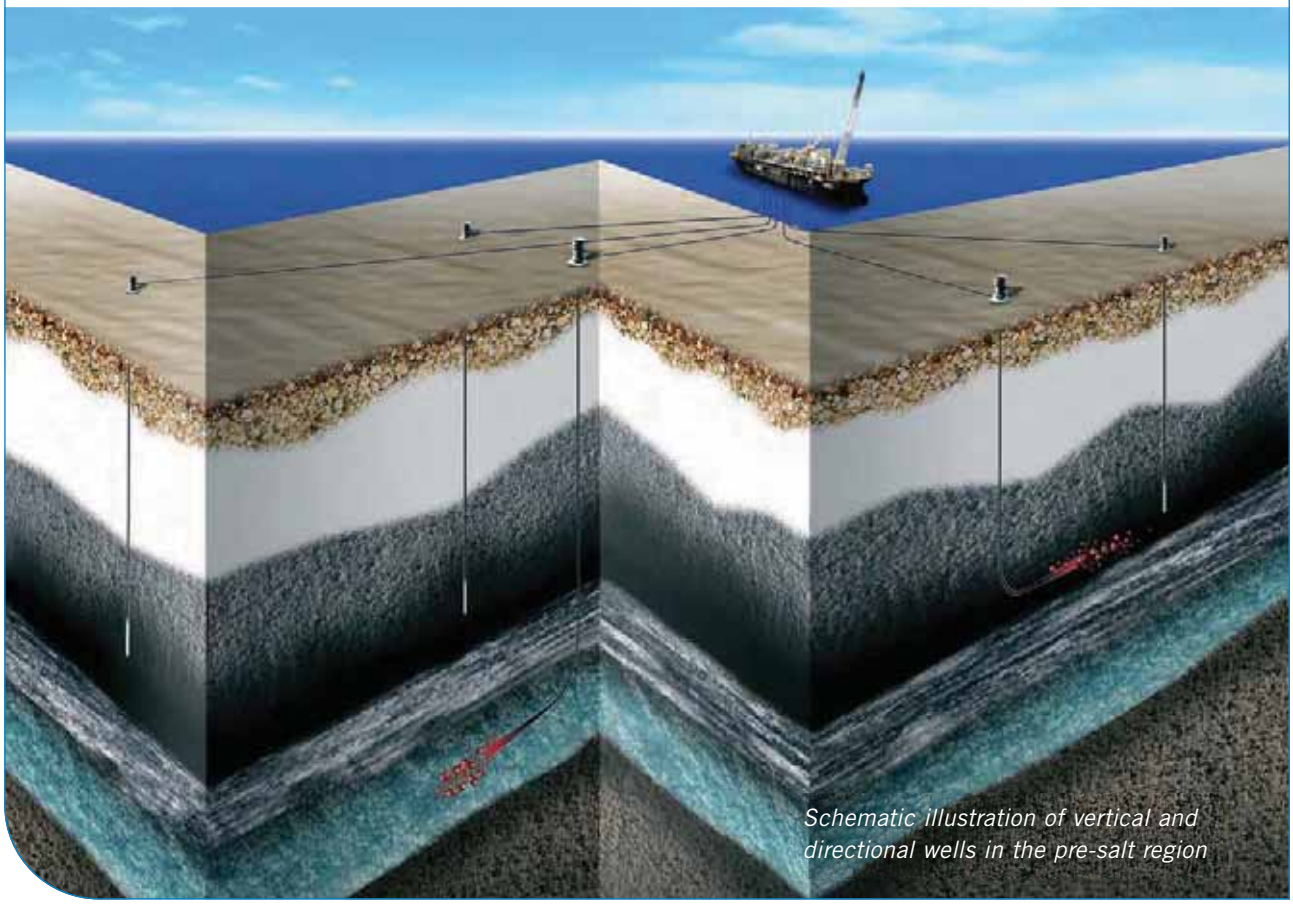
Pre-salt reservoirs have salts such as halite and anhydrite as cap rocks (non-permeable rock overlying the oil reservoir that traps oil, water or gas). Such salts dissolve when in contact with injection water, and one of the engineers' tasks is to define parameters to minimize such occurrence. Data from laboratory studies and analysis with Codebright software, developed by Politécnica de Cataluña (Spain), with contributions from the Federal University of Pernambuco (UFPE), were used to simulate these scenarios, involving fluids flows, chemical and mechanical interactions. Similar studies are planned to be developed in 2012 for other scenarios in pilot wells of the Lula field.



Schematic illustration of water injection in carbonate reservoirs

Successful conclusion of high-inclination directional well drilling

Petrobras has successfully concluded the saline portion drilling with angle gains of 53° at 7-LL2D-RJS well in the pre-salt region of the Santos Basin. Due to high mobility, this acts like a fluid in drilling operations, which makes it difficult to obtain angle gains in saline well intervals. This technology is the main challenge for horizontal well and extended reach well (ERW) drilling in the pre-salt area, to increase productivity of each well and consequently minimize the number of wells and associated costs. The first project phase was performed in the Aguilhada field, when numerical simulators were developed and calibrated to estimate saline deformation and salt dissolution, and special fluids (100% synthetic fluids) were created for drilling, as well as cement pastes. In the following phase, two directional wells were drilled, in Marlim (Brava) and Crealb (East Albacora), achieving final angles of 23° and 30°, respectively. In the last phase, already in progress, an almost horizontal well is being drilled, with angle gain of 84°. It is planned to be concluded in February 2012.



Schematic illustration of vertical and directional wells in the pre-salt region

Tank park at the Experimentation Center in Taquipe, Bahia

Software for simulation and visualization of fluid drainage in well cementation process is now available

Interfaces 1.0, developed in partnership with Pontifical Catholic University of Rio de Janeiro (PUC-Rio), optimizes operational parameters to minimize the mixture of fluids (drilling, spacer and cement paste), enabling the cementing operation in a faster and safer manner. This application can simulate, in one or two hours, compared with days of simulation using conventional software. In the first half of 2011, tests were performed in the well, at the Experimentation Center in Taquipe, Bahia, Brazil, for the software calibration and performance evaluation. The technology has already been used in the injection well of the Subsea Water and Oil Separator (SSAO) project, in the Marlim field, and in the 3-PPT-6-RJS well, in the Papa-Terra field. In the first half of 2012, the simulation of fluid drainage in turbulent situations will be incorporated into the software.

Utilization of acid fracturing technique developed in laboratory for well stimulation in carbonate rocks

The technique consists of injecting a solution of hydrochloric acid under pressures above fracture propagation pressure. This solution chemically reacts with the rock, causing fracture face stress and promoting hydraulic conductivity. Besides costing 40% less than the conventional technique (hydraulic fracturing) and reducing operational risks (as fluid does not contain solid materials), acid fracturing may achieve high conductivity levels, enabling a significant increase in well productivity. With investments of R$ 7 million, the project established a partnership with the State University of Campinas (UNICAMP) for physical test equipment, and with Texas A&M University for laboratory trial expertise. In the following phase, mathematical models will be developed that incorporate the parameters analyzed in laboratory trials to forecast the conductivity obtained in the acid fracturing process in carbonate rocks of the pre-salt.

Laboratory trials to test the acid fracturing technique

New technologies and operational improvements reduce well drilling time to one third in the Lula pre-salt field

The reduction obtained when comparing the drilling time of the vertical pilot well in the Lula field, in 2006, to the average drilling time of Lula wells drilled in 2011, which were all directional wells, is the result of a number of improvements, including the insertion of technological developments, best practice sharing between drilling teams, optimization in well projects, and selection of best drill bits, among others. The main cost of offshore well construction is the rent of drillships, whose contracts require payment according to the number of days the rig is allocated to the activity. Decreasing the drilling time directly reduces the costs of such contracts. And drilling directional wells will enable greater productivity per well, reducing the total number of wells required for the production systems being implemented.

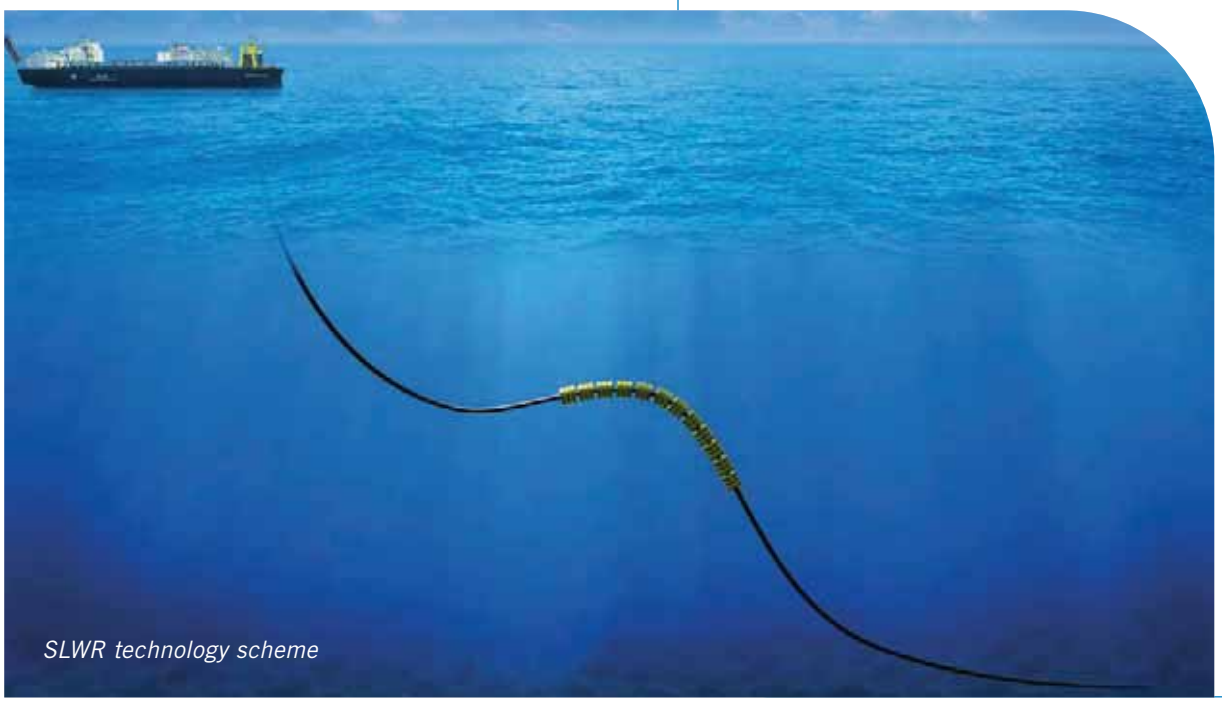
Internal view of a drilling rig

Tool enables selection of fluid with lowest damage to the salt layer, ensuring better cementing and greater integrity of pre-salt wells

Simulação de Solubilização Salina (4Sal) is software that calculates the increase in well diameter according to the dissolution of saline formation in the drilling fluid. The objective is to select the drilling fluid that minimizes salt solubility, preventing excessive widening of the well diameter and ensuring cementing quality and well integrity. Developed by Petrobras in a partnership with ESSS, the project had investments of R$ 800,000 and was used in the 9-RJS-681 (ADR-Iracema Alto) and P3 Lula pilot wells, both in the pre-salt region.

Rigid Riser Technology confirmed for pre-salt platforms

The Steel Lazy Wave Riser (SLWR) system has received new materials (mixing lined and cladded pipes), to make it resistant to fluids with high CO_2 content present in the pre-salt region. It employs rigid risers made of steel coupled to the floating unit, creating one more option to pre-salt riser systems, such as Riser Tower, Self-Supporting Hybrid Riser (RHAS) and the Self-supporting Buoy Riser (BSR), besides enabling the utilization of larger diameters (up to 24 inches). The intention is to increase competitiveness in the market of riser supply, reducing the company's riser acquisition costs. It is a technically feasible alternative for the application in the following fields: North Guará, South Cernambi, Lula Alto and Central Lula, all in the pre-salt area in the Santos Basin. The result of the bidding process, that is planned to be announced by June 2012, may have the new system of rigid risers as the winning alternative.



SLWR technology scheme

Laboratory analysis of Chromium 17

Chromium 17 approved for utilization in pre-salt fields

After Petrobras confirmed the potential of chromium 17 stainless steel for the coating of production wells and columns of the pre-salt region, for its resistance to corrosion in environments with a high content of contaminants, pipes of this material were produced with several diameters to attest the technical viability of the product making process on a commercial scale by JFE Steel Corporation, a Japanese company. In 2011, mechanical tests were performed on these pipes, which enabled the approval of the usage of Cr17 by Petrobras in its well projects. Besides its high resistance to corrosion, the new material costs up to 30% less than SuperDuplex, so far the most frequent solution in pre-salt wells. In 2012, corrosion tests will commence with alternative materials to SuperDuplex, under development by Brazilian companies.

Wettability inversion agent for pre-salt fields tested in laboratory

Successfully tested in laboratory, the chemical product can increase up to 10% of the oil recovery factor when added to the injection water at the concentration of 500 ppm. After analyzing more than 70 products from various suppliers, CENPES' researchers identified the potential applicability of the selected chemical product, compatible with the characteristics of pre-salt reservoirs. With wettability inversion ensured by the chemical product, making the rock release oil more easily, the process of natural resource exploitation has been optimized, as more oil is recovered when injecting less water. In the second project phase, the team performed an evaluation on a field scale, using the Carioca field, with the help of mathematical reservoir simulators. Parameters of the wettability inversion process determined in the first phase in laboratory were entered into this simulator (CMG-STARS). In the next phase, the interactions of this product during the primary processing of oil and water, refining processes and the environment will be analyzed.

Tests with Super Chromium 13 ensure reduced costs with processing in Cernambi wells, in the pre-salt region, in the Santos Basin

The results show that using Supermartensitic Stainless Steel (Super Chromium 13) in conditions of low contents of contaminants (CO_2 and H_2S), in production columns and coating materials, does not affect the well integrity in the Cernambi field. As a consequence, a reduction of R$40 million in the well costs of the first Cernambi module alone is expected, as well as reduced supply deadline. This material will replace the currently used SuperDuplex Stainless Steel, conventionally used in high corrosion conditions.

Tests qualify Multifunctional Bell Mouth technology for pre-salt FPSOs

The Multifunctional Bell Mouth makes the riser suspension system flexible in FPSOs through modularization and standardization of the principal components. The new bell mouth enables the connection of flexible or rigid pipes of a wide diameter range (2.5 to 16 inches, depending on the environmental conditions) to FPSOs and the replacement of pipes on the high seas, which allows the selection of risers after the FPSO design. This is an important characteristic to enhance the first family of replicated pre-salt FPSOs available, for the construction and rapid assembly of these units enabling a quick start to production in the fields that will receive them. It has already been incorporated in the engineering specifications of these units.

Prototype of Multifunctional Bell Mouth

Virtual model of an FPSO for the North Cernambi field

Conclusion of basic design for North Cernambi field platform

The basic design for the North Cernambi field was concluded in November. The platform retains the standardization and simplification principles and the lowest CAPEX of pre-salt replicated FPSOs (with standardized modules), using the same critical equipment. The design considers CO_2 contents below 10%, flow of 150,000 barrels of oil a day and 8 million m^3 of gas a day. The plant plans to use the unit of selective amines for H_2S removal, interconnection of Gas-Fluid Subsea Separation System (SSGL) and a portable pull-in system that will enable the installation and replacement of risers with improved safety and operational flexibility.

Improvements in computer tools ensure improved reliability and safety in pre-salt well construction

Computer tools, such as Sigma (PUC-Rio), for the production of geomechanical models, and Anvec (UFRJ), for the simulation of these models, used by the company since 1986, have received improvements for 3D simulation of geomechanical stability of directional wells, especially in saline intervals. These simulations are performed in two stages. The first one involves the drilling fluid density specification, to provide a safe operational margin for perforation, running in and coating cementation phases. The second stage allows us to design the coating to bear the stress from salt fluidity over the well life. As a result, it was possible to help design and build directional wells in the pre-salt region, minimizing operational risks and oil field development costs. The same software was used in 2011 in wells drilled in salt regions by Petrobras, both in Brazil and abroad.

Basic projects for the treatment and processing of pre-salt gas from the Santos Basin: Cabiúnas Pipeline project

The projects will enable the treatment and processing of up to 13 million m^3 of natural gas per day, which will flow through a gas pipeline connecting the pre-salt area in the Santos Basin to Cabiúnas Terminal, in Macaé (RJ). The units covered by the project are: Mercury Removal Unit; two Units of CO_2 Removal from natural gas through activation of amines – these units are the first of this type at Petrobras; Natural Gas Processing Unit II; Natural Gas Condensate Processing Unit IV; and one LPG (Liquefied Petroleum Gas) Caustic Treatment Unit.

Cabiúnas Terminal, which will have new units to receive gas from the pre-salt region of the Santos Basin

Conclusion of conceptual and basic designs for the new units of the Experimentation Center of Miranga (BA)

Pre-salt fields have high amounts of natural gas combined with oil (with initial contents of CO_2 ranging from 8% to 15%), which may be used to increase oil recovery factors. For this reason, the separation of the CO_2 from the associated gas will be carried out as to re-inject it into the fields to be developed. Separation processes can be developed or optimized, and, for this reason, the Experimentation Center of Miranga (BA, Brazil) will receive new units to test Brazilian and international technologies. These are complementary natural gas treatment and CO_2 compression technologies: (a) dehydration with molecular sieves (to remove H_2O from the produced gas, important to reduce the corrosion effects generated by coexistence of corrosion with CO_2, an acid component); (b) CO_2 separation through membranes (to test the utilization of hollow fiber membranes and spiral membranes); (c) removal of H_2S through fixed bed (to test the utilization of metal oxides and other absorbent agents); (d) removal of acid gases using amines, for complementary separation of CO_2, and (e) CO_2 compression to be injected into depleted gas reservoirs.

Conceptual designs started for the Stationary Unit of Future Production (UEP)

Petrobras is designing a new generation of production units in order to anticipate and systematize the application of new technologies in basic engineering designs for offshore production units. These conceptual designs will ensure the following benefits: project cost reduction and simplification, increased revenue, energy efficiency, reduced environmental impact and integrated operation management. In the first phase, technologies for surface processing were selected, which are ready to be used and that will be part of the first conceptual design.

Pipes with metallic liner qualified for use in risers and subsea pipelines of special metallurgical construction

The new solution, a result from extensive evaluation of material fatigue, enables a 60% reduction in manufacturing costs of risers when compared to the conventional solution of cladded pipes. Resonance tests achieved class E in fatigue resistance, according to the classification of Det Norske Veritas (DNV), which was considerably above the requirements for subsea pipeline applications (class F1). In 2012, new tests will be performed, reproducing the winding and unwinding process of pipes in reels, a method that will be used for the installation of risers. The solution will be applied to the pre-salt pilots in the Sapinhoá and Northeast Lula fields.

Conceptual designs for the treatment and processing of pre-salt gas in the Santos Basin, at COMPERJ Pipeline 3

The conceptual designs for the third gas pipeline of the pre-salt region in the Santos Basin have been concluded. The solution approved in October 2011 selected the Maricá alternative, to be served by COMPERJ. This alternative foresees an onshore and offshore gas pipeline of 14 million m^3 of gas per day, with subsequent treatment and processing.

The basic project of the Maricá alternative has already been started and is planned to be concluded in 2012, covering two Natural Gas Treatment Units, two Natural Gas Processing Units, two Natural Gas Condensate Processing Units and one LPG (Liquefied Petroleum Gas) Caustic Treatment Unit.

Petrochemical Complex Construction – COMPERJ, Itaboraí (RJ)

Development
of a new generation of offshore and subsea production systems

Installation of Subsea Water-Oil Separation Station (SSAO) in the Marlim field

On November 9th the prototype of the first Petrobras subsea water-oil separation system was installed. The equipment, which will be interconnected to platform P-37, was developed in a joint effort with FMC Technologies. It is the first in the world to separate, in deep waters, the produced water, re-injecting it into the reservoir as a secondary recovery mechanism. The technology employed in the subsea prototype was the tubular separation, which enables the re-injection of at least 70% of the water produced through the equipment. The prototype installed in the Marlim field will allow us to use the process plant capacity on P-37, previously occupied by the produced water, enabling increased oil production and recovery factor. Once the tests are concluded, Petrobras intends to provide this technology for usage by its operational units. The prototype is 29 meters long, 10.8 meters wide, 8.4 meters high and its total weight is 392 tons. The system is planned to start operating in May 2012.

Transportation from the Subsea Water-Oil Separation Station (SSAO) to the Marlim field

Startup of Skid-mounted Subsea Centrifugal Pump System (S-BCSS)

The system started operating in late December 2011, in the Espadarte field, in the Campos Basin. Installed on the seafloor, 1,200 meters deep, 200 meters from EPS-23 well and 11 km from the Cidade de Rio das Ostras platform, the system will produce during one of the Extended Well Tests of the Espadarte Field (EWT of Arauanã). The S-BCSS is the first skid-mounted subsea centrifugal pump system and it produces around 2,000 m^3 of oil a day, 100% more than the amount that would be obtained without the equipment installation. The S-BCSS was manufactured by FMC Technologies and the pumps were supplied by Baker Hughes. Integration tests were performed by Petrobras at the Experimentation Center of Atalaia, in Aracaju (SE). The validation of this technology in subsea environments provides one more alternative to existing pumping systems inside production wells.

Transportation of the Skid-mounted Subsea Centrifugal Pump System

Conclusion of Subsea Helical-Axial Multi-Phase Pump manufacture and testing for installation in the Barracuda field

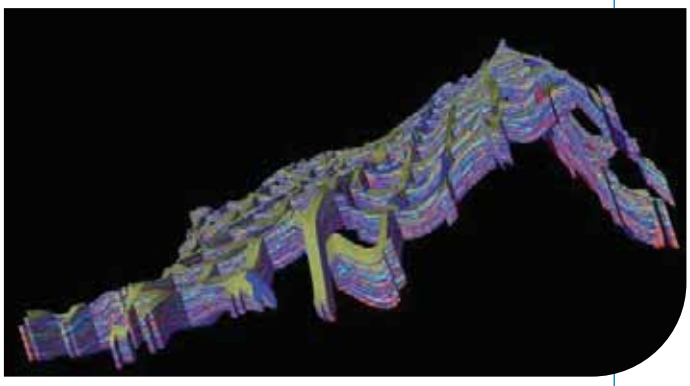
The pump, manufactured by Framo Engineering AS, will be connected to the P-48 platform and will start operating in the first half of 2012. This is the multi-phase pump with the highest differential pressure worldwide – 65 bar –, which enables increased production flow of 6,300 barrels per day in the Barracuda field.

Subsea Helical-Axial Multi-Phase Pump

Classification
of rocks and fluids in the pre-salt and other complex reserves

Facial (lithofacial and petrofacial) 3D modeling created for improved simulation of fluid flow in pre-salt reservoirs

The model makes a 3D representation of geological heterogeneities of microbial carbonate reservoirs in the pre-salt Lula field, allowing fluid flow simulations considering capillary effects. Initially, rocks were classified according to the geological description of samples (lithofacies) and later using pore geometry (petrofacies or rock types). With the new 3D model of lithofacies and petrofacies, it will be possible to simulate with higher precision the different schemes of well arrangement and geometry, optimizing pre-salt production estimates.



Example of 3D representation of facies

Geochemical classification explains the different types of oil in the pre-salt region

Petrobras has identified a specific biomarker (molecular fossil that preserves the characteristics of oil-generating rocks) that specifies two groups of oil in the areas of Tupi and Carioca. Data obtained now show that the accumulated oil in the Carioca area has the contribution of a source rock with particular characteristics in terms of depositional paleoenvironment and thermal history, resulting in a higher concentration of paraffin with high molecular weight and high WAT (Wax Appearance Temperature) value. Understanding the origin and phenomena related to the occurrence of paraffinic oils helps identify probable areas of oil incidence, which is an important element in planning the continuity of exploration and production processes in the pre-salt region.

Logistic solutions of natural gas in remote areas

Compact GTL technology qualified for usage in offshore Extended Well Tests

Pilot plant tests were concluded in November 2011 at the Atalaia Experimentation Center, in Aracaju (SE, Brazil), to qualify the technology for the chemical conversion of natural gas into synthetic oil, using milichannel reactors for application in offshore extended well tests. It is the first compact GTL plant worldwide. CompactGTL was Petrobras partner in this project. The tests verified the technology, which may be incorporated into Petrobras extended well tests, such as those planned for the Santos Basin pre-salt, so as to avoid gas burning. During 2012, further tests will be conducted to increase conversion efficiency and lifetime of the conversion unit, for the possible application in further scenarios. Other GTL technology with even smaller reactors (microchannels) is in test at the Fortaleza Experimentation Center, at the Northeast Lubrificant Refinery (LUBNOR). This second technology route, developed by Petrobras in partnership with the companies Velocys, Modec and Toyo, will be available for usage by Petrobras in the second half of 2012, if the tests are positive. A total of R$ 185 million was invested in the two pilot plants.

GTL Plant in the Experimentation Center for Flow Assurance and Processing in Atalaia, Aracaju (SE, Brazil)

Operational
optimization
and reliability

New refractory concrete with erosion resistance installed in REVAP FCC cyclone

Petrobras, in a partnership with the São Carlos Federal University, has developed a new nanobonded refractory concrete for application as internal coating of FCC risers. Besides presenting greater resistance to the erosive action of the catalyst, the material that has been developed can be applied using a simpler method and presents lower density and thermal conductivity than conventional solutions. During the research, still in progress, a new formulation to be used in the FCC separation cyclones was identified. In March 2011, this new material was used in the REVAP FCC regenerator cyclones, with final evaluation to be made in 2015, when the next planned interruption of the plant may take place. After its technical feasibility is confirmed and the material is implemented in all of the company´s FCCs, this solution may generate savings of over US$ 10 million a year.

REVAP FCC unit that received the regenerator cyclone and refractory cement

Ultrasonic pig prototype used in pipeline integrity inspection and control

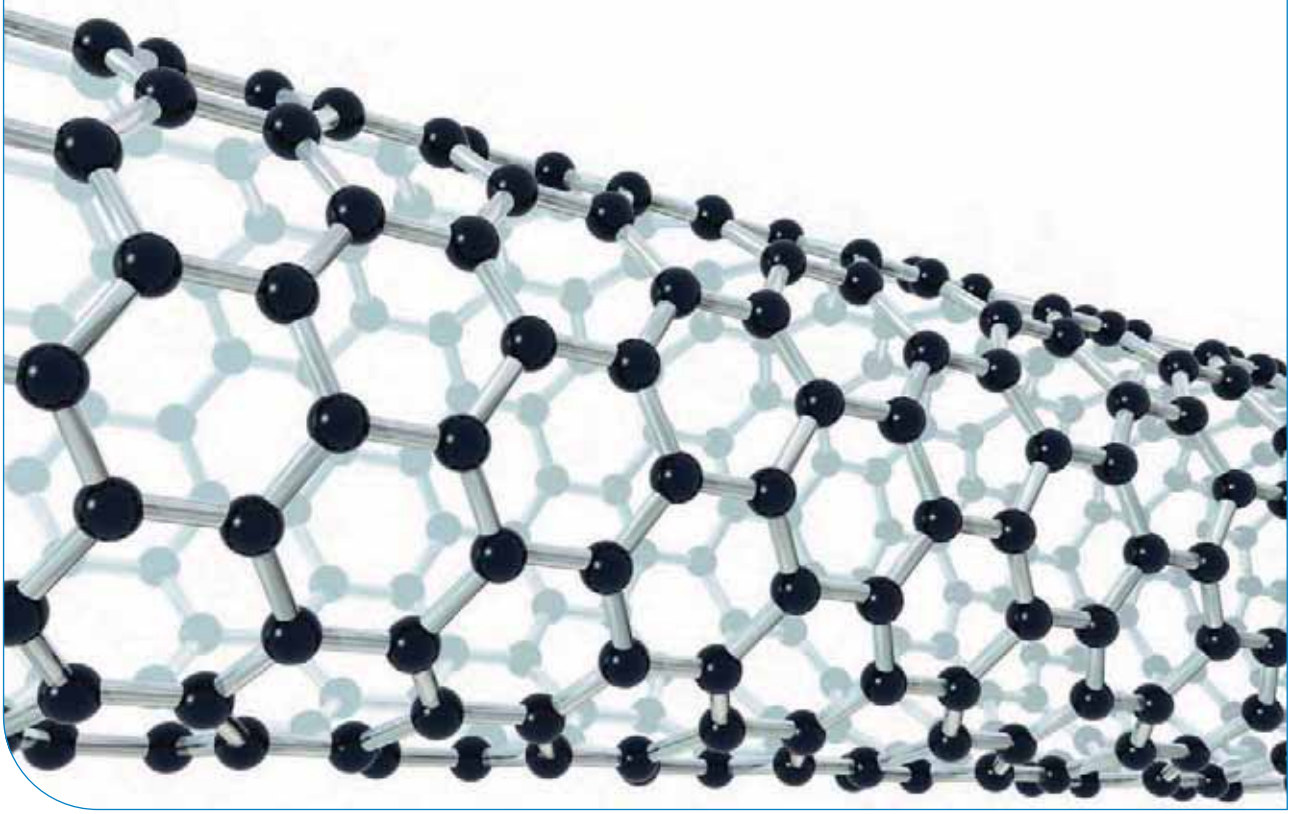
First inspection with ultrasonic pig concluded – 100% Brazilian technology

In November 2011, the first inspection was concluded in two of Transpetro´s pipelines in Cubatão (SP, Brazil), performed with the ultrasonic pig prototype for pipeline integrity inspection and control. This inspection, conducted after real-scale testing at the Pipeline Technology Center (CTDUT), attests the pig operation, developed in a partnership with the Pontifical Catholic University of Rio de Janeiro (PUC-Rio) and the University of São Paulo (USP). The pig can be operated autonomously (without constant human intervention) and without an umbilical, allowing the inspection of long pipeline extensions (up to 200 km). This way, Petrobras offers a national technological alternative, with cost reduction of around US$ 200,000/pipeline related to the imported service of pipeline inspection, with the possibility of flexible operation in the inspection of other subsea accessories, such as platform ties and manifolds. The technology has already been licensed by Pipeway, a Brazilian company, and may be offered to the market in 2012.

New nanocomposite materials for pipeline and riser coatings and junctions are submitted to laboratory testing

Produced from carbon nanotubes in a partnership with the Federal University of Minas Gerais (UFMG), nanocomposites, based on polyurethane, presented high potential for application to pipeline and riser coatings and junctions, with good mechanical performance. Petrobras and UFMG are negotiating with possible suppliers to increase the production scale of nanocomposites, for a field test in the first half of 2013.

Carbon nanotube
Credit: Thinkstock



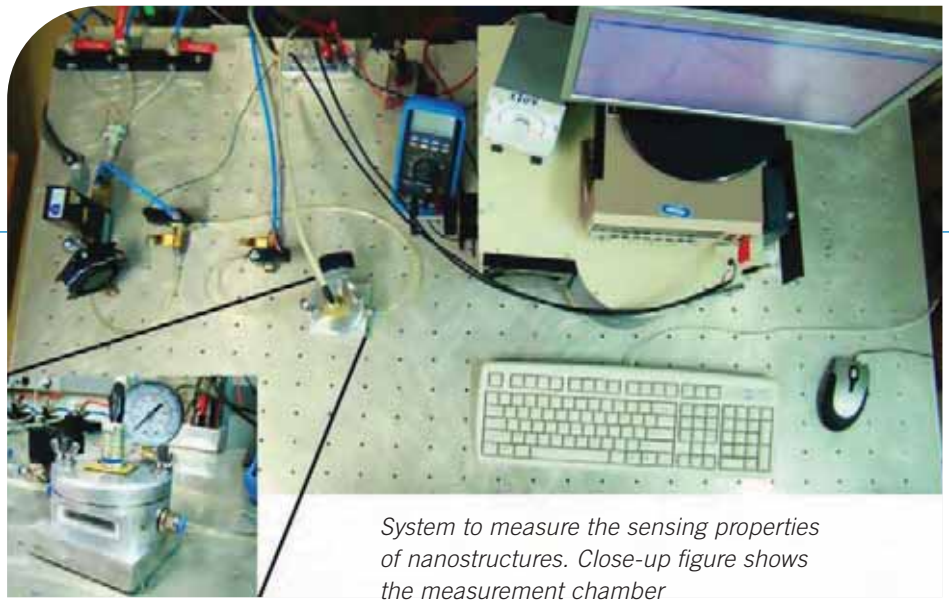
Integrated production management system implemented in Urucu

To maximize the oil and gas production in the three fields of Urucu (Urucu River (RUC), East Urucu (LUC) and Southeast Urucu (SUC)), Petrobras has developed, in a partnership with Norwegian Petroleum Engineering Reservoir Analysts (PERA), a system that helps to optimize oil and gas production. All production models are gathered in Pipe-It, a software that automatizes calculations and integrates data from reservoirs, wells and lines, offering aggregated data that go from the three fields and Arara process plant to individual visualization of wells and manifolds. The result enables engineers and geologists to make decisions with a view of all the disciplines involved.

Onshore base of the Urucu field (AM, Brazil) oil province

Bench tests validate nanosensors for hydrogen sulfide (H_2S) detection using high sensitivity and selectivity

Through a partnership established between the Federal University of São Carlos (UFSCAR) and Petrobras, a nanosensor was produced that can detect hydrogen sulfide (H_2S). The sensor principle is based on nanoribbons of metal oxides, and its detection range is 1 to 100 parts per million, at ambient temperature, compatible with the commercial systems offered in the market today. It offers the possibility of reducing the detection range down to 100 to 500 parts per billion. In the second project phase, forecast for 2012, the building of a prototype is planned.



System to measure the sensing properties of nanostructures. Close-up figure shows the measurement chamber

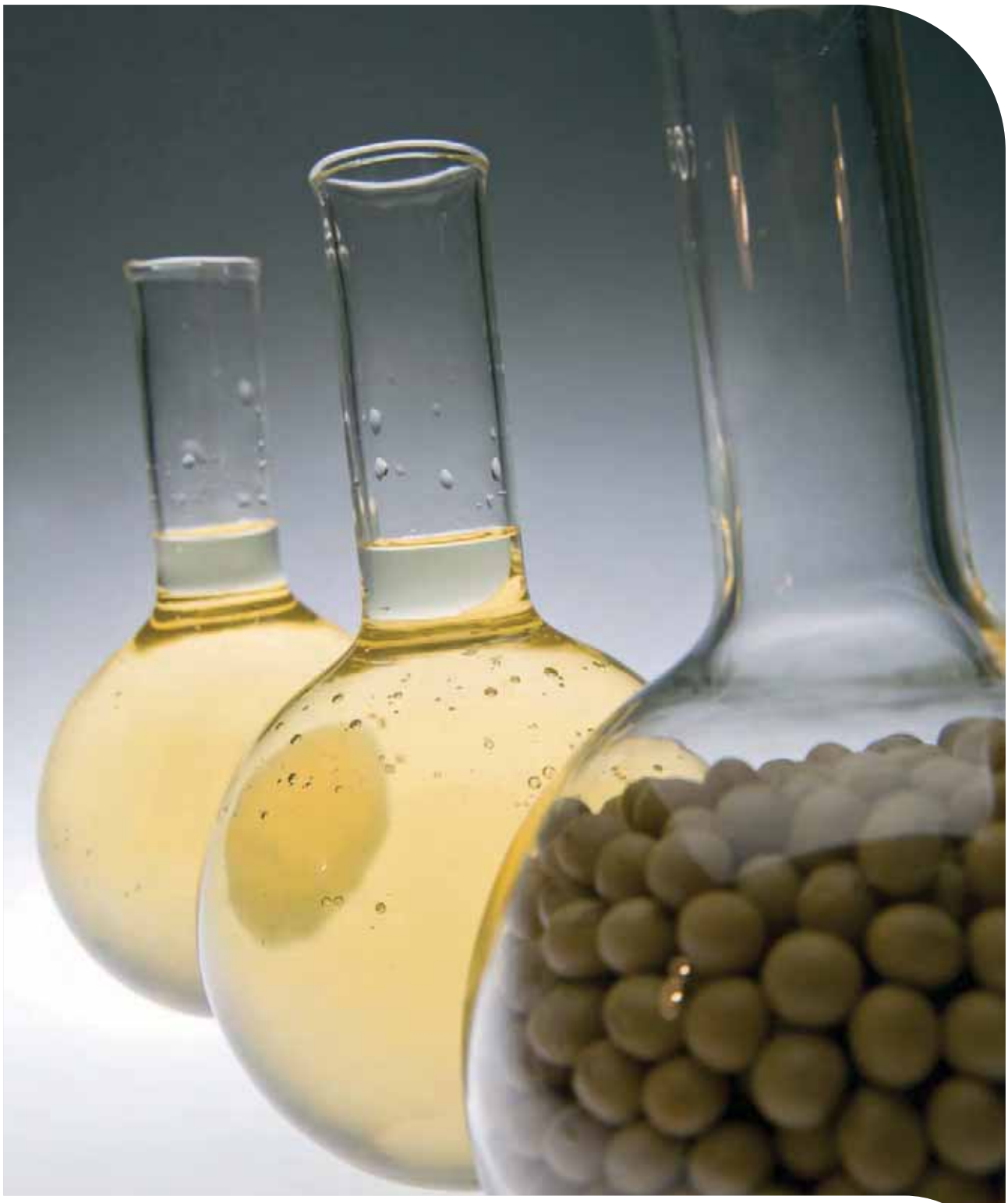
Incrustation Management Plan implemented in gas production fields associated with extremely saline waters

The fields of Uruguá, Tambaú and Mexilhão, in the Santos Basin, and Camarupim and Canapu, in the Espírito Santo Basin, present three determining factors for incrustation build-up: pressure variation, high temperature and presence of water with high salinity. Petrobras has developed the Incrustation Management Plan to prevent incrustation build-up from the early development phase of these fields. The applied complementary technologies use chemical products that inhibit incrustation and were especially developed for highly saline environments. The first solution uninterruptedly injects the chemical inhibitor via umbilical until the end of the vertical portion of the well, resulting in low concentration dosages, to protect the portion from the production well up to the production unit. If complementary inhibition is required, the second solution - an inhibitor squeeze treatment - directly applies the inhibitor to the reservoir, through a special formulation injected into the production well. The inhibitor is fixed to the rock and later slowly released by water production, preventing incrustation build-up from the reservoir to the production unit. The Incrustation Management Plan has already been implemented at the Mexilhão platform (PMXL-1) for the production of four wells, at Cidade de Santos FPSO for one well and at Cidade de São Mateus FPSO for four wells. The continuous application of this incrustation inhibitor has started in all of these wells and is in operation at Cidade de São Mateus FPSO.

Men working at the Mexilhão fixed platform in the Santos Basin

VALUE

ADDITION AND PRODUCT DIVERSIFICATION



Innovation
in fuels, lubricants
and special products

New Podium diesel with low sulfur and improved performance

The development of this new formulation required laboratory trials and performance tests in vehicles and engines, which attested the product benefits. Besides its lower sulfur content – reduction from 200 to a maximum of 50 mg/kg –, the new formulation presents low contents of polyaromatic compounds, reduced emissions of SOx and particulate matter, and high quality ignition. Podium S-50 diesel reinforces the intrinsic values of the Podium brand: high technology, superior quality and respect for the environment, bringing lower emission of pollutants, better vehicle performance and greater engine protection. Protection is ensured by its most modern complementary filtration system, which removes particles larger than 5 µm and ensures maximum water content of 200 mg/kg, as well as a pack of additives that minimize build-ups, reduce wear and foaming, with lower maintenance cost. The new formulation also offers the advantage of flexible production, without requiring segregated lines any more, thereby promoting an annual cost reduction of R$ 3 million. The study results enabled Petrobras to launch Podium S-50 diesel in July 2011.

Petrochemicals

Catalyst R&D Prototype Plant (PROCAT), Rio de Janeiro (RJ)

Start-up of Catalyst R&D Prototype Plant (PROCAT)

With 1,660 m² of constructed area and investments of R$ 27 million, PROCAT is a multipurpose plant for pilot scale studies, focused on the manufacture of catalysts and related products. Coordinated by the Federal University of Rio de Janeiro, the unit is part of the Technology Center of Santa Cruz, next to the Fábrica Carioca de Catalisadores S.A. With this new infrastructure which enables the scale increase in the R&D process, Petrobras supports partner universities in the development of new technologies in the area of catalysis. At PROCAT, the forecast activities include the development of catalysts and their components for the area of polymers, FCC and CO_2 emission reduction in industrial processes – research lines that obtained good results at laboratory level within the Thematic Network of Catalysis and the Petrochemical Network. PROCAT started to operate in the second half of 2011, with a study for the production of high-density polyethylene catalyst support. In total, R$ 6.7 million are planned to be invested in R&D projects at PROCAT.

Gas-chemicals

Pilot Plant of Mixed Fertilizers starts operating

Installed in the Nitrogen Fertilizer Plant in Sergipe (FAFEN-SE), the plant will produce urea-based fertilizers, which contain only the nitrogen nutrient. With the investment of R$ 17 million, the plant production capacity is 500 kg/h, with pastille technology, innovative in the area of fertilizers. This technology offers the advantage of generating particles with excellent uniformity and good physical properties, as well as lower costs of production and investment than the alternative solidification techniques (granulation or prilling). This plant will enable the development of new products from urea enriching with other nutrients (such as sulfur and potassium), resulting in a product with improved quality and added value. After the tests to adjust the operation, the plant will start the production of fertilizers with mixed urea, sulfur or ammonium sulfate, in the first half of 2012.

A technician operates the Pilot Plant of Mixed Fertilizers at the Nitrogen Fertilizer Plant in Sergipe (FAFEN-SE)

Biofuels

First phase of tests concluded for second-generation ethanol production in Upton (USA)

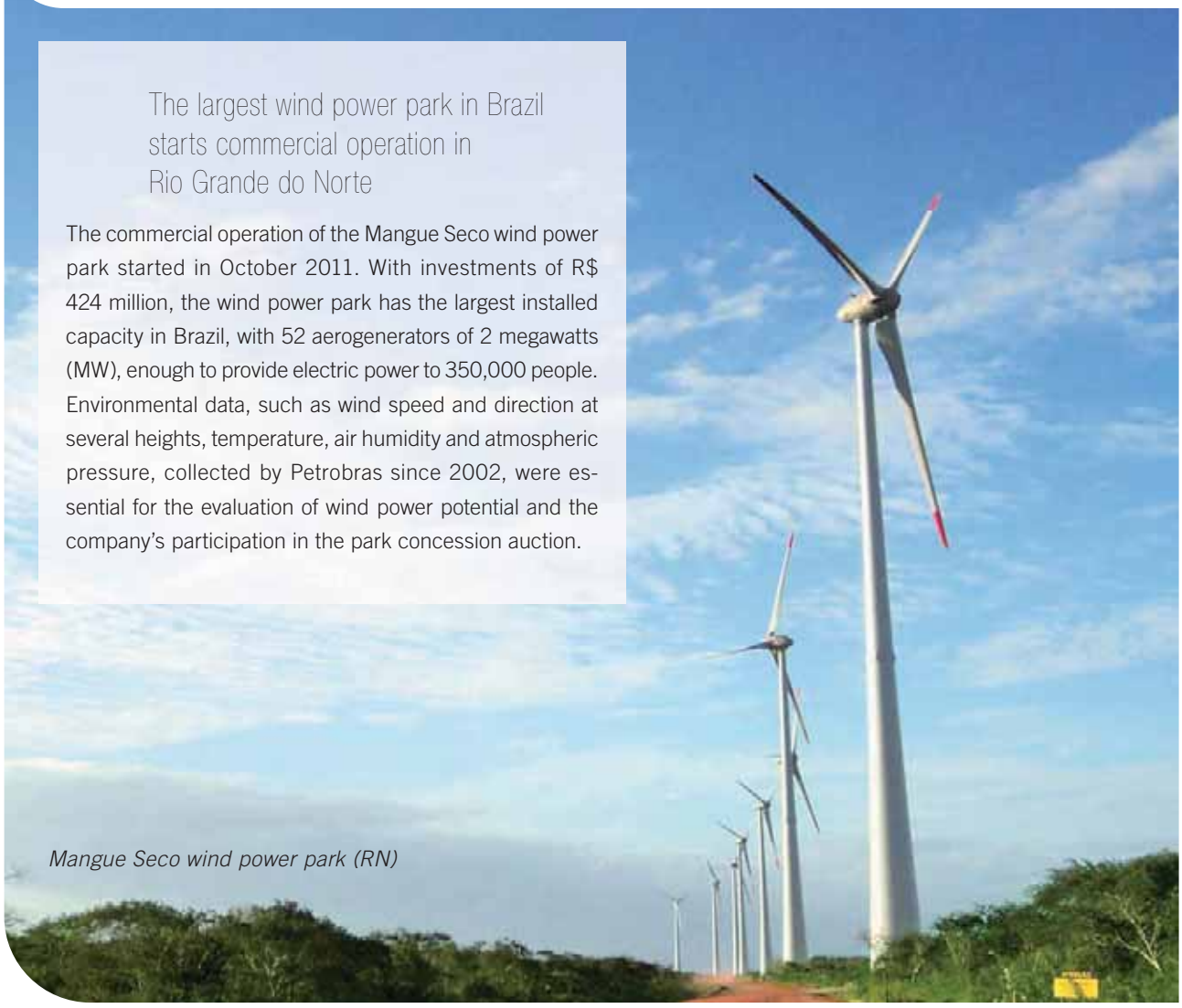
Through an agreement of joint development established in 2010 with KL Energy Corp. (KLE), 80,000 liters of second-generation ethanol have been produced from sugarcane bagasse at KLE demonstration plant in Upton, Wyoming (USA). Thirteen batches of 25 to 60 tons of dry bagasse each were processed, producing 290 liters of ethanol per ton of dry bagasse. Petrobras initially invested US$ 5.6 million in the adaptation and operation of the demonstration plant, which was originally built to test wood ethanol production as well as its previously acquired technical expertise. The promising results encouraged a new phase of process optimization, with additional investments of US$ 8.6 million, which will be undertaken in the first half of 2012 to improve performance and consolidate the technology. With these complementary actions, Petrobras intends to have all required data to start, also in 2012, the basic design of an industrial plant for second-generation ethanol, and to start operating in 2015. The second-generation ethanol technology may increase the production of ethanol from 15% to 40%, without increasing the sugarcane plantation area, with sugarcane bagasse collection and processing.

KLE demonstration plant of ethanol production from sugarcane bagasse in Upton, Wyoming (USA)

Energy
from other
renewable
sources

The largest wind power park in Brazil starts commercial operation in Rio Grande do Norte

The commercial operation of the Mangue Seco wind power park started in October 2011. With investments of R$ 424 million, the wind power park has the largest installed capacity in Brazil, with 52 aerogenerators of 2 megawatts (MW), enough to provide electric power to 350,000 people. Environmental data, such as wind speed and direction at several heights, temperature, air humidity and atmospheric pressure, collected by Petrobras since 2002, were essential for the evaluation of wind power potential and the company's participation in the park concession auction.



Mangue Seco wind power park (RN)

SUSTAINABILITY

Management
of water and
effluents

Mobile effluent treatment unit

First mobile effluent treatment unit is inaugurated aiming at water reuse

In June 2011, CENPES inaugurated the first Petrobras Mobile Unit of Water Reuse, to support initiatives of the company's operational units (refineries and terminals, for instance) in the selection of the best technology solution for effluent treatment. With investments of R$ 10 million, the station has two haul trucks with equipment operating on a pilot scale that can test up to 90 technological solutions. It is possible to test at the company´s refineries, for example, processes to remove solid materials and organic load, as well as demineralization and polish processes, simulating specific operational conditions for the various water and effluent characteristics. After tests on location, it will be possible to recommend the best option for water reuse at each unit, from technical and economic perspectives. As a result, it will be possible to plan industrial installations with shorter times and reduced costs. The Mobile Station is currently at the Gabriel Passos Refinery (REGAP), in Betim (MG), and other applications have already been planned for the coming years at the company's refineries and terminals.

Industrial unit for high salinity effluent treatment starts operating

The Effluent Treatment Station at São Sebastião Terminal (TEBAR – São Sebastião, SP, Brazil), in pre-operation since September 2011, is the first unit in the world to treat high-salinity produced water (up to 80,000 mg/liter of NaCl – sea water has 35,000) using a biological process, with high efficiency in pollutant removal, above the environmental legislation requirements. When compared to the conventional physico-chemcial process, the biological process offers a more effective treatment, with lower cost and using ecologically adequate products. The plant, whose treatment capacity is 300 m^3/h, received investments of R$ 480 million. The start-up of a similar plant, with production capacity of 150 m^3/h, is planned to occur in May 2013 at TEBIG (Angra dos Reis, RJ).

Effluent Treatment Station at Almirante Barroso Terminal (TEBAR), São Sebastião (SP)

Bioreactor technology with solid separation through membranes

Water reuse plants start operating at REVAP and REGAP

The membrane bioreactor technology was adopted for the first time at Petrobras in the Henrique Lage Refinery (REVAP), in São José dos Campos (SP, Brazil). After the biological treatment, the effluent is filtered by membranes for microorganism removal. The improved effluent quality of this new station, which can treat up to 300 m^3/h, combined with the modernization of existing treatment station, enabled 25% savings due to water reuse, which allowed the REVAP to obtain an expansion licensing. Other units using the same technology of membrane bioreactors will be inaugurated at the Presidente Getúlio Vargas Refinery (REPAR) and at CENPES in 2012, and at the Northeast Refinery (RNEST) in 2013. At the Gabriel Passos Refinery (REGAP), the prototype plant for salinity removal started operating using reversed electrodialysis, with treatment capacity of 60 m^3/h, for water reuse tests. Reversed electrodialysis performs water desalinization by membrane separation. This technology is planned to be applied at the Paraná Refinery (REPAR) in the second half of 2012, at the Northeast Refinery (RNEST) and at the Petrochemical Complex in Rio de Janeiro (COMPERJ).

Management
of CO2 and
other emissions

First test performed with oxy-combustion technology for CO_2 capture in FCC units

This test was the first on a demonstration scale in the world. At the FCC multipurpose unit U-144 in SIX (the Shale Industrialization Unit, in São Mateus do Sul, PR, Brazil), it applied oxy-combustion for CO_2 capture in FCC units. Performed in June 2011, the test is part of the CO_2 Capture Project world consortium (www.co2capturepro-ject.org), the association of seven large energy companies in search for industrial technologies of CO_2 capture and storage. The oxy-combustion technology replaces the air used in coke burning in the FCC regenerator with the CO_2 produced in the burn, mixed with pure oxygen. The process enables us to obtain a CO_2 chain of higher purity, ready for capture, and has the potential for reducing CO_2 emissions by up to 32% in the refining area, with 50% cost reduction when compared to the current technology that uses amine absorption. The test also demonstrated that the technology can ensure greater operational flexibility for the FCC unit, with the possibility of increasing the processed load or improving the load conversion, which may bring further cost reduction. This is the first of a series of tests that will be performed by March 2012. After that, the possibility of technology escalation will be evaluated.

Multipurpose unit of FCC at SIX, São Mateus do Sul (PR)

Basic design for the production of S-10 Diesel at REDUC

The purpose was to adjust the hydrorefining park of REDUC to meet the new specification of S-10 Diesel (10 ppm of sulfur), including the units for hydrotreatment, generation of hydrogen, treatment with amines, sulfur recovery and acid water. With the production capacity of 7,500 m^3 of diesel per day, the new hydrotreatment unit for unstable products (UHDT-5200) has the largest reactor ever designed by Petrobras (38 meters high). The unit is planned to start operating in 2016, and has followed project simplification and cost reduction guidelines (in 2010 REMAN was the first Petrobras refinery to receive a basic design for S-10 Diesel production).

On the computer screen, the basic design for REDUC modernization

Implementation of new emission evaluation methods

Petrobras has brought forward its studies into the effects of diesel and biodiesel on emissions of pollutants not yet regulated, such as aldehydes and polyaromatic and monoaromatic hydrocarbons. For this reason, the company has invested around R$ 2.6 million in equipment acquisition, method implementation and testing at the laboratories of the Development Technology Institute (LACTEC) and also at the State University of Rio de Janeiro (UERJ). At LACTEC, trials were performed with S-50 Diesel (with 50 ppm sulfur) and B5 and B20 biodiesel (with 5% and 20% content respectively, with soybean oil and tallow) to analyze the emission of aldehydes, while the UERJ laboratory evaluated emissions of polyaromatic and monoaromatic hydrocarbons. As a result, with the analyzed methods, vehicles and fuels used in the project did not present significant increases of these pollutants when adding up to 20% of biodiesel to S-50 Diesel. The aldehyde measurement method is being used in research, including the new formulation of Podium Diesel and biodiesel evaluation projects, in a partnership with Petrobras Biocombustível. As stipulated in CONAMA P7 legislation, IBAMA will receive, by December 2012, the typical values of aldehyde emissions from diesel engine and vehicle manufacturers, to decide about the possibility of regulating this pollutant.

Tests in engines at a laboratory of the Development Technology Institute (LACTEC) at the Federal University of Paraná (UFPR)

Energy
efficiency

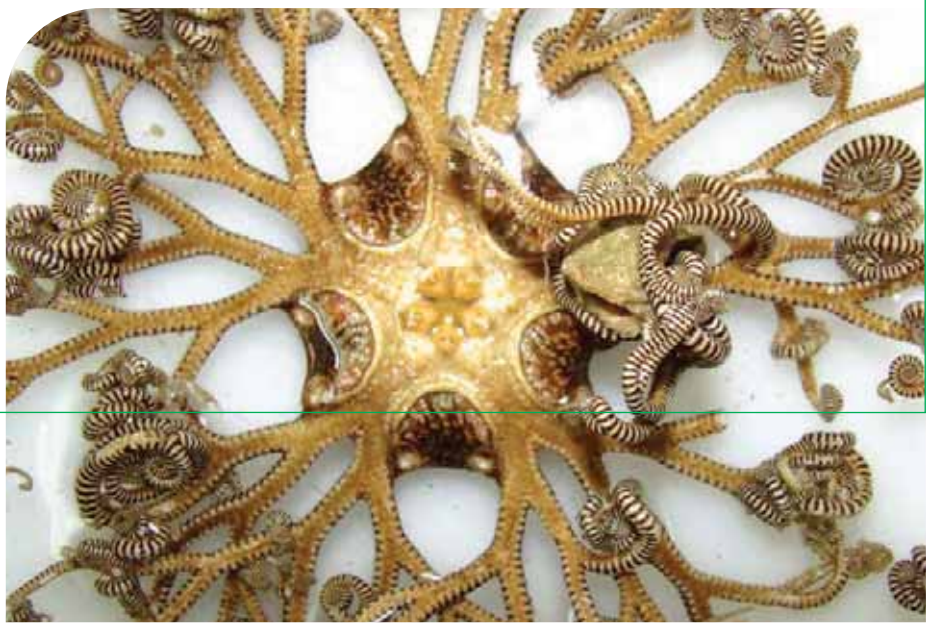
Advanced control implemented at hydrotreatment units (HDT) in the Paulínia (REPLAN), Presidente Bernardes (RPBC) and Presidente Getúlio Vargas (REPAR) refineries

Advanced control brings more operational stability, increased reliability and profitability through control and optimization algorithms that determine and keep the best operation points, based on predictive calculations of the properties. Several benefits are obtained with this technology, including: reduced residual naphtha production, reduced emissions, reduced steam consumption, maximized HDT load, optimization of the diesel sulfur content, optimization of production time of catalysts and maximized incorporation of unstable products into the diesel. With annual return of US$ 7.8 million, the advanced control project of HDT at REPLAN has reduced CO_2 emissions from this unit by more than 9,400 tons each year, also ensuring the production of S-50 Diesel (with a maximum of 50 ppm of sulfur).

HDT Unit at REPLAN

The most complete study of Regional Environmental Characterization of the Campos Basin submitted to IBAMA

This unprecedented study collected environmental data from a 100,000 km² area of the Campos Basin. More than 40,000 chemical analyses and 10,000 biological analyses were performed, involving around 250 professionals, including researchers and laboratory technical staff from twenty Brazilian universities and R&D institutions (UFRJ, UNIRIO, USU, UFES, UVV, UFPE, UFRPE, UFCG, ULFAL, UNIVALI, FURG, FIOCRUZ, UERJ, PUC-Rio, UENF, USP, UFF, IEAPM, UFPR and INPE). With investments of R$ 40 million, the study was conducted over four years, totaling 365 days of offshore data collection, with dedicated vessels and teams. The resulting scientific characterization enables more efficient environmental management by Petrobras and IBAMA, including faster environmental licensing in the Campos Basin region. Data were submitted to IBAMA in a database compatible with the system used by the Ministry of the Environment. Sensitive areas were identified, such as bird reproduction areas, physical and environmental data (geomorphology), socioeconomic resources (ports, airports, fishing areas) and biological resources (fauna mapping and identification of threatened species). Such data supported the production of resulting sensitivity maps. Other similar studies will be started or are in progress for Sergipe/Alagoas, Santos and Espírito Santo Basins, and they are planned to be concluded in 2014, 2016 and 2016, respectively.



Species of crustacean, cnidarian and echinoderm identified in the study of Regional Environmental Characterization of the Campos Basin

EXPERIMENTATION

INFRASTRUCTURE AT BRAZILIAN TECHNOLOGICAL AND SCIENTIFIC INSTITUTIONS

Most results presented up to here were obtained in partnerships with national science and technology institutions. Besides the effective results from research projects, important infrastructure deliveries occurred in 2011 at these institutions, the result of resources allocated to universities and research centers by means of associations that are part of the thematic research and development networks coordinated by Petrobras.

From January to December, 24 inaugurations were held at several institutions that undertook research activities on strategic themes for the company's businesses and the Brazilian energy sector. The Thematic Networks enable the associated institutions to acquire advanced technology, create world-class laboratories, qualify researchers and develop R&D projects in Petrobras areas of interest, such as oil and gas, biofuels and environmental preservation.

The resources allocated by Petrobras to national science and technology institutions follow the ANP guidelines. In 2006, the agency regulated the clause of concession contracts that determines that 1% of the gross revenue of petroleum fields subjected to special participation (large production or profitability) should be allocated to research and development, and at least half of this value to external Brazilian institutions accredited by ANP. The following pages present the principal laboratories inaugurated in 2011 funded by these resources.

PRINCIPAL LABORATORIES

INAUGURATED IN 2011

ENVIRONMENTAL RESEARCH LABORATORY (LAPAM)

Climate Change Mitigation Technologies Network

With 100m^2 and located in Cachoeira Paulista (SP) this laboratory is part of a Brazilian atmospheric monitoring system that studies the air quality and the climate, being implemented by the Weather Forecast and Climatic Studies Center of the National Institute of Special Reasearch (CPTEC/INPE). Inaugurated in February, the laboratory received investments of R$ 2 million.

BIOGECHEMISTRY LABORATORY

Bioproduct Research Network and Climate Change Mitigation Technologies Network

With investments of R$ 3.6 million, the laboratory, inaugurated in March by the Federal University of Rio de Janeiro (UFRJ), has 110 m^2 and is used to evaluate the use of different types of vegetation as CO_2 sequestration agent as well as to perform studies into microalgae production in hypersaline waters, for biodiesel production.

PHYSICAL GEOTECHNICAL MODELING LABORATORY

UENF Regional Center

In 180 m^2, this laboratory has unique equipment in Latin America, such as a geotechnical centrifuge to simulate situations of offshore platform anchoring by torpedo piles and suction stakes, as well as pipeline anchoring. Built by the State University of North Fluminense (UENF), this laboratory received investments of R$ 1.7 million and was inaugurated in April.

ENVIRONMENTAL SCIENCES' LABORATORY

UENF Regional Center

With investments of R$ 1.7 million and inaugurated in April by the State University of North Fluminense (UENF), this laboratory performs analyses of organic and inorganic pollutants, and molecular biomarkers for the Campos Basin.

APPLIED GEOPHYSICS LABORATORY

Applied Geophysical Studies Network

Inaugurated in May 2011, the Applied Geophysics Laboratory was built by the Federal University of Rio Grande do Norte (UFRN) with R$ 1.3 million invested by Petrobras. Located in Natal (RN, Brazil) and occupying 600 m^2, this laboratory will contribute to a better understanding of shallow oil accumulation structures – located in depths of between 300 and 400 meters – in the Potiguar Basin.

BRAZILIAN GEOPHYSICAL EQUIPMENT POOL (PEG-BR)

Geotectonic Studies Network

With investments of R$ 14 million made by Petrobras and inaugurated in June 2011, PEG-BR is the first pool of geophysical equipment in Brazil and offers instrumental and staff support to Brazilian projects in the areas of seismology, gravimetry and geoelectricity. It occupies 320 m^2, built by the National Observatory in Rio de Janeiro (RJ, Brazil).

ENGINES LABORATORY

Vehicle Development Network

Built by the Technological Research Institute (IPT) in São Paulo (SP, Brazil) and inaugurated in August 2011, the laboratory received R$ 4.6 million invested by Petrobras. It occupies 720 m^2 and is focused on research and development of fuels, additives and combustion engines, especially diesel cycle motors. This is the first test bench at a Brazilian institution with the capability of evaluating pollutant emissions in new automotive technologies, which meet the new environmental legislation of the Pollution Control Program for Motorcars (PROCONVE), more specifically the CONAMA P7 phase. The laboratory is also equipped to test the post-treatment system of exhaust gases with the SCR technology – a catalyst system – that adopts the injection of a urea-based solution for NOx pollutant reduction.

ARTIFICIAL LIFT LABORATORY (LEA)

Mature Field Revitalization Network

Inaugurated in August 2011 in Salvador (BA, Brazil) and built by the Federal University of Bahia (UFBA) with R$ 1.8 million invested by Petrobras, LEA will produce similar conditions to those found in real situations of oil wells with artificial production systems. Three full scale wells have been built, with reduced depth. This is the only laboratory in Latin America and one of the few worldwide with such capability.

ECOTOXICOLOGY LABORATORY AND STATISTICAL SUPPORT CENTER

Recuperation of Impacted Areas and Ecosystem Conservation and Recovery Network

Inaugurated in October by the Federal University of Rio Grande do Sul (UFRGS), the Ecotoxicology Laboratory and the Statistical Support Center occupy 150 m^2 and received R$ 400,000 invested by Petrobras. At these facilities, ecotoxicological tests are performed with marine microcrustaceans, freshwater fish and aquatic organisms.

FUEL AND COMBUSTION ANALYSIS AND MODELING LABORATORY

Fluid Dynamics in Refining Processes Network

Inaugurated in November by the Federal University of Minas Gerais (UFMG), the Laboratory for Fuel and Combustion Analysis and Modeling enables us to integrate, for the first time in Brazil, advanced studies for the correlation of physico-chemical properties, parameters for fuel combustion and performance in engines and vehicles. The new laboratory occupies 150 m^2 and received R$ 450,000 of investment from Petrobras.

NATURAL GAS RESEARCH LABORATORY

Natural Gas Network

Inaugurated in March in Florianópolis (SC, Brazil) and built by the Federal University of Santa Catarina (UFSC) with R$1.5 million invested by Petrobras, the laboratory will enable the development of new types of heat exchangers for Petrobras.

GUILIO MASSARANI FLUID DRAINAGE LABORATORY

Well Engineering Network

Inaugurated by the Federal Rural University of Rio de Janeiro (UFRRJ) in June 2011, the Giulio Massarani Fluid Drainage Laboratory is focused on the real-time evaluation of fluid properties and the interaction between fluids and saline rocks in the pre-salt region. With investments of R$ 1.6 million made by Petrobras, the laboratory, located in Seropédica (RJ), occupies 550 m^2.

ENGINE AND VEHICLE TESTING FOR FUEL DEVELOPMENT LABORATORY

Vehicle Development Network

Inaugurated in November by the Federal University of Minas Gerais (UFMG), the Engine and Vehicle Testing for Fuel Development Laboratory enables the development of new fuel formulations in shorter time frames, including their interactions with biofuels, by conducting advanced studies into reduction of consumption and pollutant gas emissions, and improves the development of engines and vehicles. Its new facilities occupy 470 m^2 and the laboratory received R$ 4.5 million invested by Petrobras.

PHYSICAL METALLURGY LABORATORY (LAMEF)

Subsea Structures Network

Inaugurated in November by the Federal University of Rio Grande do Sul (UFRGS), the new facilities of LAMEF received R$ 12.5 million invested by Petrobras. Its instruments enable mechanical tests in large components used in oil exploration. These tests can analyze, for instance, fatigue of risers – pipes that connect the exploration platforms to oil wells – under similar conditions to those found in real underwater environments.

MICROPALEONTOLOGY LABORATORY

Applied Micropaleontology Network

Inaugurated in December in São Leopoldo (RS, Brazil) by the Vale do Rio dos Sinos University (UNISINOS), the Laboratory of Micropaleontology occupies 1,500 m^2 and received R$ 3.5 million invested by Petrobras. It includes five pioneer laboratories at Brazilian universities that will enable it to study, date and correlate rocks (biostratigraphy) and to interpret sedimentation environments, as well as to provide environmental evaluation and monitor studies.

LUBRICANT RESEARCH CENTER PROFESSOR ÍCARO DE SOUZA MOREIRA

Lubricants Network

Inaugurated in December by the Federal University of Ceará (UFC), in Fortaleza (CE), the Lubricant Research Center Professor Ícaro de Sousa Moreira will perform research on biolubricant synthesis besides supporting research undertaken at the Experimentation Center of Fortaleza, of Petrobras, and the Refinery of Lubricants and Oil By-Products of the Northeast Region (LUBNOR), for Petrobras, one of the national leaders in asphalt production and the only one in Brazil that produces naphthenic lubricants (used as thermal insulators for high-voltage transformers, car dampeners and pneumatic equipment). It received R$ 1 million invested by Petrobras and presently occupies 420 m².

LABORATORY OF OIL STUDIES (LEPETRO)

Recuperation of Impacted Areas and Ecosystem Conservation and Recovery Network

Inaugurated in December by the Federal University of Bahia (UFBA), LEPETROis the first laboratory in the Northeast Region of Brazil qualified to evaluate and recuperate mangrove areas impacted by anthropic activities. The new facilities occupy 800 m² and received R$ 2.9 million invested by Petrobras.

LABORATORIES OF THE GEOSCIENCE INSTITUTE AT UNB

Geotectonic Studies, Geo-Chemistry and Studies into Sedimentology and Stratigraphy Network

Inaugurated in November by the University of Brasília (UNB), the new laboratories of the Geoscience Institute at UNB received around R$ 8 million invested by Petrobras. The building is part of a group of laboratories that occupy approximately 500 m² and is now one of the reference centers in Brazil in geochronological dating of rocks. The purpose of geochronological studies is to determine the absolute age, in millions of years, of rocks and minerals that constitute the earth's crust and that fill the sedimentary basins, where oil research and exploration takes place. Knowing the age of rocks is an essential guide to the exploration activity for oil and other minerals.

CORROSION LABORATORY

Corrosion Material and Control Technology Network

Inaugurated in September at the Federal University of Ceará (UFC), in Fortaleza, the Corrosion Laboratory received investments of R$ 2.7 million. Occupying 1,472 m², the laboratory will be focused on studying corrosion in equipment and metallic structures. In addition, it will provide an important support to Petrobras activities in the Northeast Region.

GLOSSARY

Abbreviations

BSR – Boia de Sustentação de Riser / Self-supporting Riser Buoy

Diesel S-10 – Diesel with 10 parts per million (ppm) of sulfur

DTS – Distributed Temperature Sensing

ERW – Extended Reach Well

FCC – Fluid Catalytic Cracking

FEED – Front End Engineering Design

FPSO – Floating Production Storage & Offloading vessel

LPG – Liquefied Petroleum Gas

GTL – Gas To Liquid (conversion)

HDT – Hydrotreatment

ICT – Science and Technology Institutes

LCGP – Liner Conveyed Gravel Pack

Original Oil in Place – Amount of oil in the reservoir expressed in standard conditions existing before the production starts

RHAS – Riser Híbrido Autossustentável / Self-supporting Hybrid Riser

S-BCSS – Sistema de Bombeamento Centrífugo Submerso em Skid / Skid-mounted Subsea Centrifugal Pump System

SLWR – Steel Lazy Wave Risers

SSAO – Separador Submarino Água e Óleo / Water-Oil Subsea Separator

SSGL – Sistema de Separação Submarina Gás Líquido / Gas-Liquid Subsea Separation System

UEP – Unidade Estacionária de Produção / Stationary Production Unit

WAG – Water Alternating Gas (injection)

Measurement Units

ºAPI – standard measure of oil density developed by the American Petroleum Institute

bbl – barrels

blpd – barrels of liquid per day

bopd – barrels of oil per day

bpd – barrels per day

m^3/d – cubic meters per day

m/h – meter per hour

Nm^3/d – normal cubic meters per day

ppm – parts per million

Institutions and Universities

ANP – Agência Nacional do Petróleo, Gás Natural e Biocombustíveis

ATM – Texas A&M University

BV – Bureau Veritas

DNV – Det Norske Veritas

FIOCRUZ – Fundação Oswaldo Cruz

FURG – Universidade Federal do Rio Grande

IBAMA – Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis

IEAPM – Instituto de Estudos do Mar Almirante Paulo Moreira

IFPEN – Instituto Francês de Petróleo e Energias Renováveis

INPE – Instituto Nacional de Pesquisas Espaciais

IPT – Instituto de Pesquisas Tecnológicas

LACTEC – Instituto de Tecnologia para o Desenvolvimento

ON – Observatório Nacional

PUC-RJ – Pontifícia Universidade Católica do Rio de Janeiro

PUC-RS – Pontifícia Universidade Católica do Rio Grande do Sul

UENF – Universidade Estadual do Norte Fluminense

UERJ – Universidade do Estado do Rio de Janeiro

UFAL – Universidade Federal de Alagoas

UFBA – Universidade Federal da Bahia

UFC – Universidade Federal do Ceará

UFCG – Universidade Federal de Campina Grande

UFES – Universidade Federal do Espírito Santo

UFF – Universidade Federal Fluminense

UFMG – Universidade Federal de Minas Gerais

UFPE – Universidade Federal de Pernambuco

UFPR – Universidade Federal do Paraná

UFRJ – Universidade Federal do Rio de Janeiro

UFRGS – Universidade Federal do Rio Grande do Sul

UFRN – Universidade Federal do Rio Grande do Norte

UFRRJ – Universidade Federal Rural do Rio de Janeiro

UFRPE – Universidade Federal Rural de Pernambuco

UFSC – Universidade Federal de Santa Catarina

UFSCAR – Universidade Federal de São Carlos

UNB – Universidade de Brasília

UNICAMP – Universidade Estadual de Campinas

UNIRIO – Universidade Federal do Estado do Rio de Janeiro

UNIVALI – Universidade do Vale do Itajaí

UNISINOS – Universidade do Vale do Rio dos Sinos

UPC – Universidade Politécnica de Cataluña (Espanha)

USP – Universidade de São Paulo

USU – Universidade Santa Úrsula

UVV – Universidade Vila Velha

Petrobras Units and Subsidiaries

CENPES – Leopoldo Américo Miguez de Mello Research and Development Center

COMPERJ – Petrochemical Complex of Rio de Janeiro

FAFEN-SE – Fábrica de Fertilizantes Nitrogenados de Sergipe (SE, Brazil)

FCC S/A – Fábrica Carioca de Catalisadores, in Santa Cruz (RJ, Brazil)

LUBNOR – Refinery of Lubricants and By-Products in the Northeast Region, in Fortaleza (CE, Brazil)

PBIO – Petrobras Biocombustível S/A

RECAP – Capuava Refinery, in Mauá (SP, Brazil)

REDUC –Duque de Caxias Refinery, in Rio de Janeiro (RJ, Brazil)

REFAP S/A – Refinaria Alberto Pasqualini S/A, in Canoas (RS, Brazil)

REGAP –Gabriel Passos Refinery, in Betim (MG, Brazil)

REMAN –Isaac Sabbá Refinery, in Manaus (AM, Brazil)

REPLAN – Paulínia Refinery, in Paulínia (SP, Brazil)

REVAP – Henrique Lage Refinery, in São José dos Campos (SP, Brazil)

RLAM – Landulpho Alves Refinery, in São Francisco do Conde (BA, Brazil)

RNEST – Abreu e Lima Refinery, in Ipojuca (PE, Brazil)

RPBC –Presidente Bernardes Refinery, in Cubatão (SP, Brazil)

SIX – Shale Industrialization Unit, in São Mateus do Sul (PR, Brazil)

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