



# Sustainable Brazil

An outlook on the oil, ethanol and gas markets



 **ERNST & YOUNG TERCO**  
*Quality In Everything We Do*



APOIADOR  
OFICIAL

## Table of contents

Foreword	1
Main determinants of price trajectories	4
Projections and scenarios for supply and demand	20
Oil and ethanol: variables that affect world behavior	26
Brazil: towards an international alignment	32
Looking ahead: changes by 2020	42
Vision of the future: what to expect after 2020	44
Challenges and opportunities	47



## Foreword

The series Sustainable Brazil proposes a new challenge by creating another study of paramount importance on the energy market. Bearing in mind the new correlation of forces brought about globally with the discovery and production of oil, gas and ethanol, the seventh edition of the series **Sustainable Brazil - An outlook on the oil, ethanol and gas markets** - provides a thorough analysis and well-grounded projections on supply, demand, growth and the impact of the fuel industry on the world economy by 2020.

After covering complex issues in the six previous studies - with analyses and perspectives on the housing, energy, consumer, industrial and agribusiness industries, as well as a special study on the World Cup 2014 - Ernst & Young Terco joins FGV Projetos once again for new thinking: understanding an industry generating enormous wealth to countries possessing the largest reserves, production, technology and strategic policies for their development. And the timing could not be better. Upon announcing its new discoveries of enormous oil reserves in ultra deep waters in the pre-salt layer to the

world, Brazil changed its position in the ranking of large global players.

With that in mind, the goal of this study went beyond the mere projection of what the end of this decade has in store - including pricing projections. We bore in mind risks, hardships, political challenges and opportunities typical in this sector. Besides a deep understanding of this industry, this study brought us some surprises regarding the impact that pre-salt discoveries will have on the country's overall economy. And more precisely, on how behind we are - or not - regarding current operations and investments in expanding the production and marketing of ethanol.

In order to provide guidance for the analysis and realization of projections, the technical team of FGV Projetos - under the guidance of Fernando Blumenschein - developed the Integrated Model for Energy Projections (MIPE), which consists of a conceptual, technical and computational framework applicable to various situations, scopes and markets. Using this model, it was possible to integrate and systematize the information gathered, simulate trajectories and generate plausible

price ranges for the energy products analyzed. It also includes an overview of significant data for energy markets in the post-2020 period.

As pre-salt discoveries became such an important new event for Brazil, we gave it generous space and careful thought. The final chapter brings itemized, detailed analysis of the critical points deserving attention, to allow the new findings to become real opportunities for the country. We therefore studied the ten major challenges facing pre-salt exploitation, such as:

- ▶ **Deficit of human capital**
- ▶ **Social and environmental concerns**
- ▶ **Technological innovation**
- ▶ **Challenges and operating costs**
- ▶ **Local Content**
- ▶ **Lack of specific tax environment**

▶ **Infrastructure and logistics bottlenecks**

▶ **Regulatory framework**

▶ **Volume of investments**

▶ **Execution of capital projects**

One purpose of this study was to understand not only the dynamics of world prices, but also the behavior of markets whose interactions condition the global supply and demand for energy. Thus we selected two national markets whose dynamics could not be more different: the U.S., a relatively open economy, where consumer prices follow the trends of international commodity markets, and Brazil, where fuel prices are determined more by domestic policies than by the international conjuncture.

Another goal was to discuss the interactions between markets of different energy sources, in view of complementarity and substitution effects. In order to identify and model the points of contact and crossover effects between markets in greater

depth, we chose to focus on the international markets for oil and ethanol and Brazilian markets for gasoline and hydrated ethanol.

Finally, another goal of the present study was to identify some of the key drivers and constraints of future price trajectories of the energy sources chosen. This enabled us to model the causal structures that condition price projections under the prospective scenarios for those drivers. These include technical aspects (expansion of supply), market conditions (energy efficiency and substitution), economic data (potential for growth and exchange rate scenario) and political-institutional considerations (energy policies in the U.S. and Brazil). In a context of uncertainty, we were still able to identify drivers whose variability will have the most impact on each of the markets analyzed.

The final aim of this study is, above all, to support the understanding, reflection and decision making process for corporations and governments wishing to work seriously in these markets.

**One goal was to understand the price dynamics as well as the behavior of domestic markets whose interactions condition the global supply and demand for energy products.**

## **Methodology: How does MIPE work?**

MIPE is a dynamic system where interactions between variables and parameters are represented by equations. These may involve variations over time. It is a stochastic model - parameters may be defined non-deterministically, in terms of probability distributions, so that they can represent sources of uncertainty in the model. This is set up in a platform using Runge-Kutta algorithms of the fourth order to solve the equations simultaneously. It also allows the automated execution of sensitivity analyses, where the model is simulated thousands of times (with different values for the stochastic parameters) in order to obtain confidence intervals for the variables of interest.

It is important to keep in mind the layer of abstraction between the model and the phenomena that this study aims to represent. That is, there is a modeling risk inherent to any projection exercise or prospective analysis. Energy markets in particular are subject to short-term effects, arising from transitory shocks, whose consequences may last indefinitely. This feature of markets, called hysteresis, is related to the irreversibility of decisions, and makes it exponentially more difficult to ensure the steadiness of the model when facing random events.

Moreover, the very exercise of causal and probabilistic modeling raises the question of whether “black swans” or rare, high-impact events - such as the financial crisis of 2008 and the oil shocks of the 1970s could occur. It is precisely because such events seem

unlikely that they are difficult to incorporate into statistical models.

Energy markets are affected by short-term effects, and the very exercise of modeling the causal structure and assigning probabilities raises the question of whether “black swans” may occur.

Another relevant point is that price increases that allow more expensive sources to become feasible simultaneously increase the profits of the traditional producers of light oils, which creates an intricate structure of incentives. Thus two opposite events may happen: either faster extraction, reducing the reserves, or else a tactical move to maintain them.

Similar considerations apply to ethanol, since in this market one must take into account its links with other global commodities markets (in the case of sugar cane, the sugar market), each with their own dynamics.

We must also bear in mind the fair share of simplifications, omissions and scope restrictions required in order to elaborate a model capable of producing results. That is to say that the results of a long-term model, such as MIPE, should be re-estimated and recalibrated periodically, in order to follow the evolution of market conditions. Above all, the user must be aware of factors not incorporated in the model, in order not to be taken by surprise if these elements should become relevant.

# Main determinants of price trajectories

## Drivers: price determinants by 2020

Energy consumption in its various forms pervades all human activity. Marketable energy (fuels for transport and heating, electricity for various purposes, among others) is a basic input for the production and marketing of any goods or services and represents a major item of household expenditure. Thus, the projected future trajectories for energy prices are of obvious interest to consumers and producers.

Towards 2020, the trajectories of oil and ethanol prices in international markets will be influenced by several factors. This survey selected seven conditions with a key influence upon the pricing of these fuels. They are:

### 1 ► Expansion of oil supply:

In the period 2004-2010, the supply of oil worldwide remained relatively constant at a level close to 80 million barrels / day. However, successive innovations in the processes

of exploration, development and production are enabling the identification of new and deeper reserves of oil and natural gas in Brazil, the Gulf of Mexico and the Coast of Guinea, among others.

### 2 ► Expanded production

**capacity of ethanol:** The use of ethanol as automotive fuel has been increasing since the 1980s at a rate of 5.6% per year in Brazil and 13.4% per year in the United States. Furthermore, new processes for ethanol production are expected to become commercially viable, generate substantial gains in energy payback and reduce the carbon footprint of biofuel production.

### 3 ► Subsidies policy for ethanol

**production:** In some countries, subsidies for ethanol production have functioned to ensure competitiveness when faced with imported gasoline and ethanol. With the implementation of laws setting the gasoline mixing ratio, there is a guaranteed market, and subsidies become a support tool for local production conditions and an additional barrier to imported ethanol.



**Energy intensity has been declining due to improvements in energy efficiency, fuel substitution and changes in energy-intensive industries.**

**4 ▶ Energy efficiency and substitution measures:** Energy intensity has been declining due to improvements in energy efficiency, fuel substitution and changes in energy-intensive industries. The need for energy efficiency gains, coupled with goals for energy security and reduction of emissions creates incentives for the replacement of energy sources.

**5 ▶ Potential macroeconomic growth:** The evolution of demand for energy is strongly linked to macroeconomic growth. That is to say, the higher the growth, the more energy is required by companies for the production of higher amounts of goods and services. Economic growth also translates into higher incomes for families, causing higher consumption of fuel, electricity and other energy uses.

**6 ▶ Exchange rate scenario:** Keeping the US dollar as the universal currency of international trade is proving to be an increasingly fragile principle. This is due to a progressive decay of the factors that enabled the rise and

maintenance of the US dollar as the reserve currency throughout the twentieth century. It is believed that the loss of value of the dollar accounts for a percentage of price increases for commodities in international markets, including oil.

**7 ▶ Pricing policy:** The current policy of effective stabilization of domestic prices of oil derivatives does not allow for price variations due to factors of a transient nature and effectively reduces the exposure of the national economy to shocks in international oil prices.

This section seeks to analyze each of the drivers in terms of relevance and presents the assumptions and scenarios adopted regarding the future trajectory of each one. A detailed analysis of each of these factors follows.



## Oil supply expansion

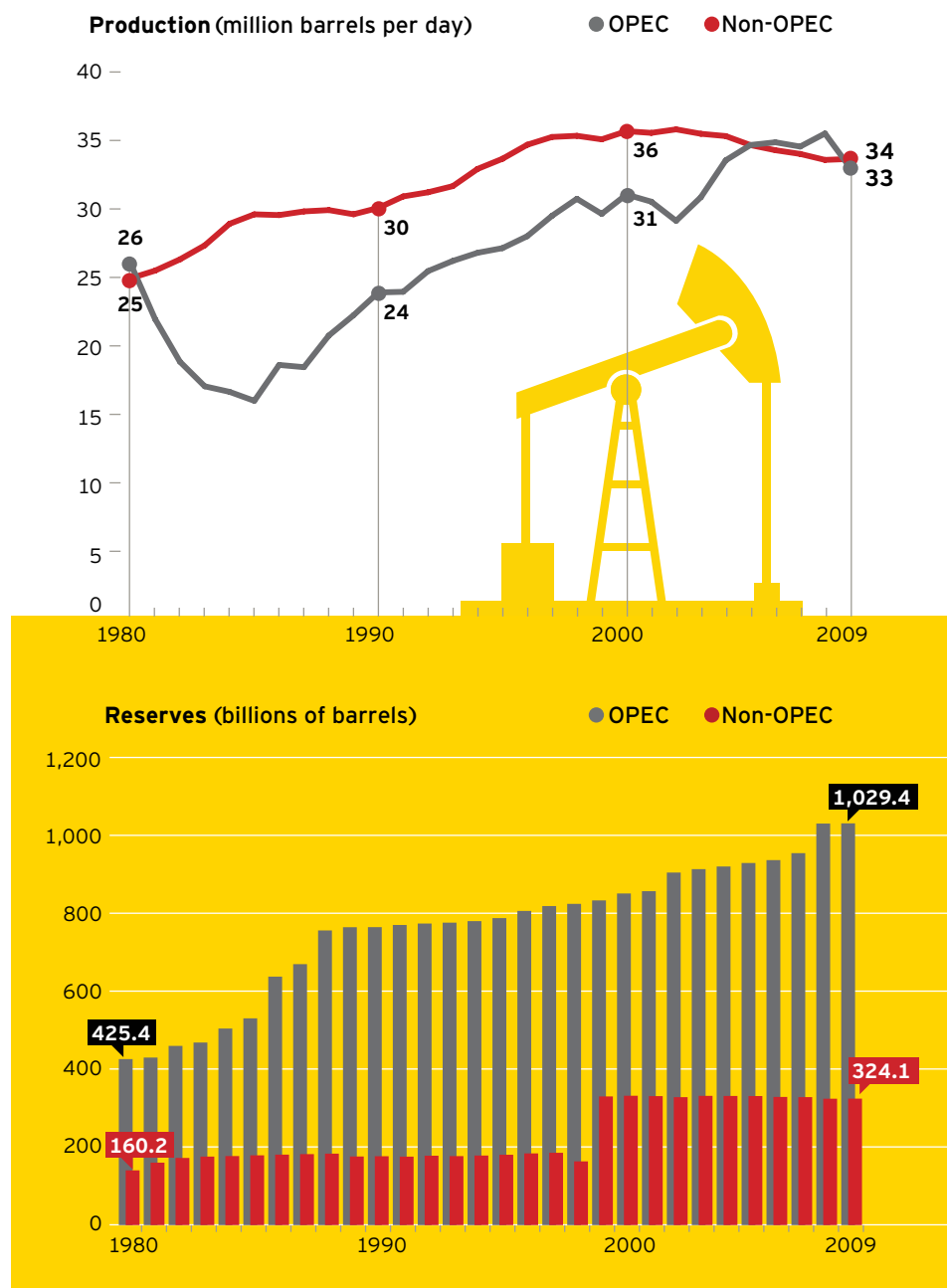
Over the period 2004-2010, the total supply of oil worldwide remained relatively constant at a level of approximately 80 million barrels / day. Thus, it is technological progress that drives the possibilities of expanding potential supply.

Since the 1990s, successive innovations have been introduced in the processes of exploration, development and production through the use of new tools, high-performance computers and advanced data processing. These technologies, which recently identified reservoirs of oil and natural gas in deep waters in Brazil, the Gulf of Mexico and the Guinea Coast, are costly, but allow for greater savings in other phases of field development.

In addition, exploration and development in ultra deep waters are consolidating a new technological standard for the prospecting of oil and natural gas, using high-performance drilling rigs, capable of drilling to depths of up to 10,000 meters.

The potential supply of oil has also increased due to the growth of reserves, either by reviewing

## Evolution of reserves and world oil production



Source: BP Statistical Review of World Energy 2010

**Energy intensity has been diminishing thanks to improvements in energy efficiency, fuel replacement and changes in energy-intensive industries.**

the method used in previous estimates, or else because initial estimates were low. As the methods for reserve assessment have become more accurate, these two forms of reserve estimate growth should not be as important in the future. The third form of how reserve estimates grow is through technological advances in the secondary recovery methods: currently only about 35% of total oil in a play is recovered.

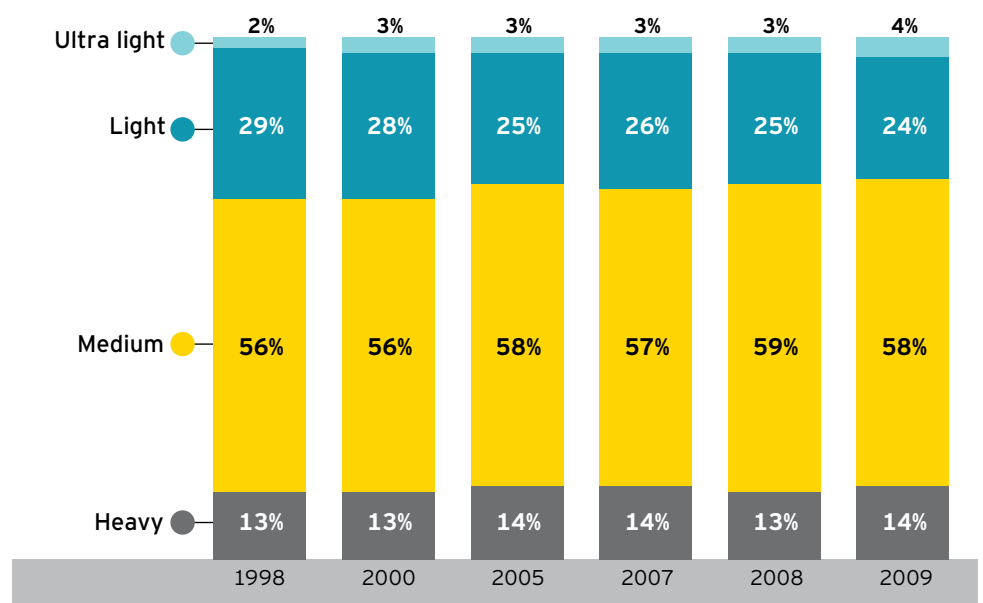
Market sources estimate that an additional 9 billion barrels / year will be required to meet the growth of demand by 2020. In order to meet this demand, future supply will have to include non-conventional oil: enhanced recovery, oil sands, extra-heavy oil, GTL (gas-to-liquids) and CTL (coal-to-liquids), that is, the conversion of natural gas into liquid fuels and conversion of coal into liquid fuels. The exploration of Brazil's pre-salt layer and the expanded production in Iraq will also become increasingly relevant.

The quality of oil, particularly its density and sulfur content, conditions future oil supply and the refining capacity that should meet future demand for liquid fuels. Consumption of medium weight oil products (such as diesel) and light products (such as gasoline) has been increasing, while consumption of heavy derivatives (such as fuel oil) is in decline. However, the future growth of demand will tend to be met, gradually, by increasing volumes of heavy oil (such as oil sands

in Canada and extra-heavy oil in Venezuela, as well as heavy oil fields in the Middle East). This will require an increase in the conversion capacity of refineries, a technical condition to expand the supply of light derivatives, and higher priced products.

A common feature of all new sources of oil in the next decade will be the high cost of production. There is a nearly universal consensus that all the "cheap" oil has already been found,

**World oil production by grade**



Source: ENI World Oil and Gas Review 2010

The discovery of the  
**pre-salt**

fields has changed Brazil's status in the international oil and gas market, enlarging its proven reserves and doubling its production capacity by 2020.



### New frontiers in pre-salt

The discovery of new oil fields in ultra deep water (water depths of 1,500 to 3,000 meters) in the Santos, Campos and Espírito Santo basins opened a new frontier for Brazil's oil and gas industry. This discovery has changed Brazil's status in the international oil and gas market, enlarging its proven reserves and doubling its production capacity by 2020.

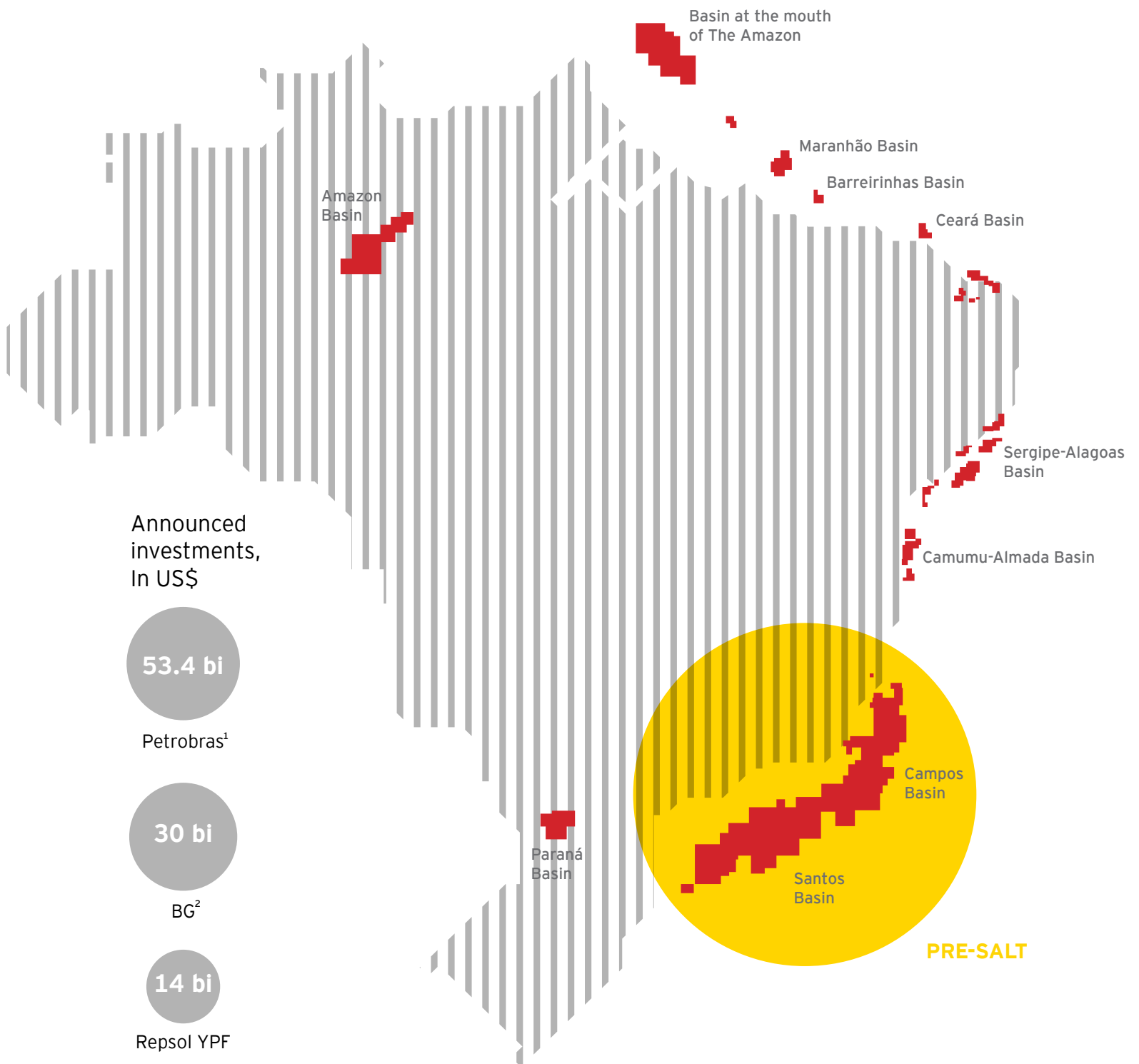
Operation under such geological conditions should require a greater number of plants in each field. The development of transport infrastructure for oil and natural gas at distances of about 300 km from shore is among the main challenges to be

overcome during the decade. Petrobras and other operators are studying options (such as support bases, ocean terminals and remote operation centers) to ensure logistical support for production and operations, as well as for their safety.

Large investments in the pre-salt fields are scheduled to take place by 2020. These are estimated to total over \$ 250 billion for the development of oil and natural gas production, including transport infrastructure. Among the investments already announced are: Petrobras, US\$ 53.4 billion (2011-2015), BG, US\$ 30 billion, Repsol YPF, US\$ 14 billion.

## Hydrocarbon Exploration and Production in Brazil

■ EXPLORATION BLOCKS



Announced investments, In US\$

53.4 bi

Petrobras<sup>1</sup>

30 bi

BG<sup>2</sup>

14 bi

Repsol YPF

1 - Investment for the period 2011-2015.

2 - Press office of BG Group - Release entitled "Brazil Receives Chairman of BG Group and Announces Investments of US\$ 30 billion in Brazil," released March 14, 2011.

and that technologies for the development and recovery of reserves will continue requiring high investment and high production costs.

## Growing ethanol production

The consumption of ethanol as automotive fuel has been growing since the 1980s at a rate of 5.6% per year in Brazil and 13.4% per year in the United States. In both countries, the main producers and consumers, ethanol

is used both as a gasoline blend and as pure fuel.

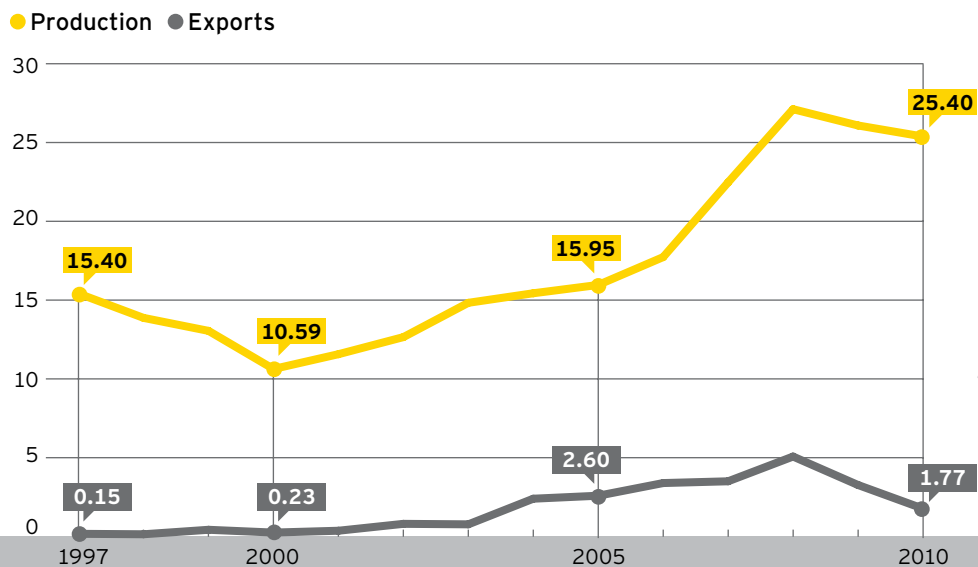
Ethanol, from sugar cane in Brazil, has become a competitive fuel helped by increased productivity (both in farming and processing) and by the strong domestic market. Between 1975 and 2006, the sugar cane farming area grew 4.3% per year and is currently about 7 million hectares. In this period, growth in agricultural productivity has been 1.49% *per annum* and in industrial productivity 3.77% per year.

In the United States, ethanol is produced from corn - using 20% of total corn production, a figure that may reach 30% in coming years. Corn farming occupies 28 million hectares. In the period 1975 to 2006, productivity growth was 2.7% per year.

The possibility of choosing to produce either ethanol or sugar allows Brazilian producers to develop the best strategy regarding the expected sugar and ethanol prices in both the international and the local

### Evolution of production and exports of ethanol

Total for Brazil, in billions of liters



Source: ÚNICA

**At the end of this decade, production of ethanol and other biofuels through second and third generation processes must be commercially viable.**

market. Mixed mills (85% of total) have the flexibility to produce ethanol or sugar, the choice being defined by the market price of either. It is worth mentioning that as the world's leading sugar exporter, Brazil's production costs determine prices and conditions of international market competition.

At the end of this decade, production of ethanol and other biofuels through second and third generation processes must be commercially viable. These technologies deliver substantial productivity gains over the methods currently adopted, involving the fermentation of sugars derived from food plants. Thus, we expect substantial gains in relation to energy return, the amount of biomass as raw material required and the need for fossil inputs such as fertilizers. It is believed that such processes will substantially reduce the carbon footprint of biofuel production as compared to its current level.

The main second-generation processes involve ethanol production from cellulose and lignin, structural elements present in all plant species available, including some with high agricultural productivity, such as millet.

It is estimated that the productive potential of cellulosic ethanol in the United States corresponds to 11 million boe (barrels of oil equivalent) per day, equivalent to about 60% of current oil consumption in that country. However, despite substantial incentives, investments are not following the pace foreseen by the plans and mandates set by the Energy Independence Security Act of 2007. While mandates are drivers of investment and promote funding to ensure the sale of the product, the crisis of 2008 saw funds available for clean energy projects re-directed to wind and solar power, which had greater support from the USA government.

This delay led the EPA to reduce the volume of the mandate set for 2010 and 2011 to 1.72 and 1.74 million liters of cellulosic ethanol. The original schedule sets the mandate of 4.3 billion gallons of cellulosic ethanol for 2022. Mandates involving the supply of cellulosic ethanol require distributors to blend certain pre-established proportions of the product with gasoline. A fee is levied on oil companies if the supply of cellulosic ethanol does not meet the volume set out in the mandate, leading them to finance the construction of cellulosic ethanol plants.

The U.S. currently leads the research and commercial development of such processes, but as large-scale production proves commercially viable, second-generation ethanol has the potential of becoming a major component of energy supply worldwide, the subject of major investments in ethanol-producing countries such as Brazil, China and India.



## Price support policies for ethanol production

In some countries, subsidies for domestic production of ethanol have worked as a guarantee of competitiveness against imported gasoline and ethanol. However, the implementation of mandates setting the blending ratio to gasoline or quotas for the various types of ethanol creates a guaranteed market and subsidies are seen as support to local ethanol production and as an additional barrier to imported ethanol.

In the United States, a set of federal and state subsidies provide incentives along the value chain of ethanol. In addition, an import tariff of \$ 0.14 per liter also contributes to ensuring the competitiveness of corn ethanol against the imported product. The policy of subsidies for ethanol began in the 1970s. It is estimated that due to this, ethanol currently produced in the U.S. is on average 30% cheaper. However, given

the fragile economic and fiscal situation in the USA as well as a growing awareness that imported ethanol will be needed to meet future demand, many believe that the trend over the next decade will include the gradual reduction of subsidies.

All included, the European Union's trade policy curtails the import of biofuels with a protective tariff on ethanol of 45% *ad valorem*. Paradoxically, in 2008 due to a lack of raw material, only 44% of the ethanol production capacity of the EU was used (5 million tons). Exemptions from excise duties, estimated at around € 2.8 billion in 2008, benefit ethanol produced in several member countries.

In addition, the EU provides subsidies for investments in production capacity which include technologies for the production of second-generation ethanol. Nevertheless, production in the EU region is modest when compared to the large producing countries, for whom EU's subsidy policies have relatively less impact on the international market.

Between 1980 and 2008, there was a reduction of 32% per year in global energy consumption, equivalent to the current consumption of the U.S. and the European Union put together.

## Measures of energy efficiency and substitution

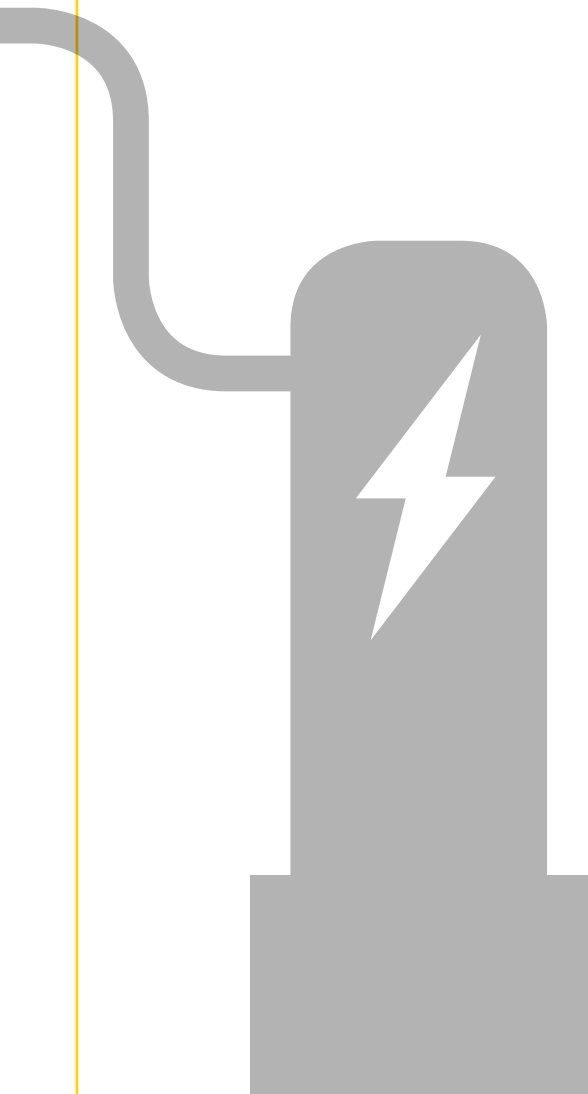
Energy intensity (i.e., the amount of energy used to generate one unit of GDP) has declined due to (1) improvements in energy efficiency, (2) fuel substitution and (3) changes in energy-intensive industries. As a result, between 1980 and 2008 there was a reduction of 32%, or 1.35% per year in global energy consumption, equivalent to the current consumption of the United States and the European Union put together.

This reduction varies from country to country due to different economic structures, the enforcement of energy efficiency measures, as well as several exogenous factors ranging from urbanization models (distance between home and work) and climate (whether or not air conditioning is used) to production structure (whether or not energy-intensive industries exist). It is estimated that differences in the production structure account for almost 50% of the variation in industrial energy intensity among countries.

## Good prospects for the hybrid electric car

Electricity has been responsible for a growing share of energy consumption worldwide. In Brazil, between 1970 and 2009, electricity's share went from 5.5% to 16.6% of the total, a growth rate of 0.6% per year. In OECD countries, electricity use has increased from 11% to 22% of total energy consumption over the period 1971-2008. Two innovations should have a decisive effect on the expansion of electrification in the decade of 2011-2020: the Smart Grid and the electric vehicle.

The introduction of the electric vehicle will start with the plug-in hybrid electric vehicle (PHEV), which is expected to gain a significant market share. The PHEV combines a small internal combustion engine with an electric motor, whose battery is charged by the engine combustion. The introduction of a pure electric vehicle depends on reducing the cost of the battery, a process that is presently the subject of intense competition among several companies and should be ready by 2020. These two innovations point to a fundamental shift in the auto industry's business model.



Fuel prices and taxation have a negative effect on energy intensity. This explains higher intensity in the United States and in countries that subsidize fuel, as well as in oil producing countries. It also explains the lower intensity demanded by economies with high taxation of consumption, such as European Union countries.

In the transportation sector, the need for energy efficiency gains coupled with the goals of energy security and reducing emissions lead to substantial incentives not only for the adoption of efficiency measures and technologies to reduce consumption, but also the replacement of energy sources. Among these, the main ones are the plug-in hybrid electric vehicle, ethanol and biodiesel.

In the U.S., government targets were being implemented by the CAFE (Corporate Average Fuel Economy) standard at a growth rate of 2.2% per year. They are now being intensified to follow the California standard, of reducing emissions by 2025 to 40%-50% of the 2016 level. In order to achieve this goal, it will be necessary to promote efficiency gains of 3% to 6% per year over the period 2016-2025. Furthermore, sales of E85 vehicles (running on an 85% ethanol 15% gasoline mix) are expected to increase in order to meet mandatory targets for ethanol consumption. Still in the U.S., federal credits were granted to manufacturers to produce cars running on alternative fuels.

In the European Union, targets for ethanol consumption are not mandatory, since markets cannot be divided along member state lines.

Nevertheless, a 2003 directive does establish a share of 5.75% of biofuels use by 2010. Recently, however, countries like France, Germany, Austria and the Netherlands have set mandatory targets.

It is also important to bear in mind the energy intensity of industry. In the OECD countries, this indicator decreased by 32%, or 2.3% per year between 1990 and 2006, mainly due to energy efficiency measures. However, this reduction was not uniform. In Japan, the country with the largest reduction, efficiency is a question of energy security, and continuous measures have been applied to decouple energy consumption from economic growth. In the period 1973-2007, while the country's GDP doubled, the industrial sector's consumption remained constant.

## Biodiesel: an expanding market

Biodiesel is a fuel obtained from vegetable oils or animal fats that can be mixed with diesel in varying proportions, usually 2%, 5% and 20% (called B2, B5 and B20) for uses similar to those of pure diesel. In Germany, the world's main producer and consumer, biodiesel has been used since 1991.

As with ethanol, the expansion of the biodiesel market relies on mandatory blending with diesel

and incentives to the purchase of vehicles, as well as production subsidies. In the EU there is still a 20% deficit of production, making imports necessary.

In Brazil, there are 48 biodiesel plants in operation, of which 42 use soybeans as raw material. The participation of family farmers in biodiesel production has been the subject of special federal government policies.

**For the end of this decade we adopted assumptions of lower average growth, due to the physical and financial limits to the expansion of the developing world.**

## Potential macroeconomic growth

The evolution of demand for energy is strongly linked to macroeconomic growth. On the one hand, more energy is demanded by companies to facilitate greater production of goods and services; on the other hand, economic growth translates into more disposable income for families, enabling more consumption of fuel, electricity and other energy uses. In fact, several studies show that the income elasticity of energy consumption is close to 1, i.e., under constant conditions, percentage increase in an economy's GDP entails corresponding increase in demand for energy<sup>1</sup>.

From the point of view of the world economy, the end of the last decade was particularly turbulent. The growth path outlined in previous

years, until then considered by many as unwavering and destined to last forever, was abruptly interrupted by one of the biggest financial crises in history, which exposed the vulnerability of the global financial system.

This study does not aim to model or analyze future macroeconomic trends in detail. Therefore, we chose to base our analysis on future scenarios outlined by the International Monetary Fund in its World Economic Outlook. This report reflects the assumption that the coming years, until 2015, will be marked by a resumption of economic growth which will gradually return to its pre-crisis level. This path was considered to represent the "growth potential", i.e., the trend most likely to continue in the absence of shocks, whether in exchange rates, geopolitics or energy availability. For the end of this decade we adopted assumptions of greater uncertainty and lower average growth, due

to the obvious physical and financial limits to the continued expansion of the developing world at the current rate.

## Exchange rate scenario

A related but distinct aspect of the macroeconomic growth pattern is the exchange rate scenario. Overall, maintaining the dollar as the base currency of international trade is proving an increasingly fragile option. This is mainly due to the erosion of the factors that enabled the rise and maintenance of the U.S. dollar as a reserve currency of value throughout the twentieth century.

Perhaps the main issue involves historical levels of public and private debt in the U.S. economy, coupled with a systematic expansion of the monetary base (fiat money and credit) whose reflections on the inflation rate, according

<sup>1</sup>- The effects that will occur if this demand cannot be fully answered, and its impact on economic activity, will be discussed within the next section.

to some researchers, have been systematically masked. It is believed that the dollar's loss of value accounts for a substantial fraction of the price increases of commodities in international markets, including oil.

In this study, prices are denominated in constant 2010 values, and the inflationary effects can be disregarded. However, the evolution of the Brazilian fuel market is impaired by the behavior of the real *vis-à-vis* the U.S. currency, which should be considered as a separate driver, with particular relevance in this market.

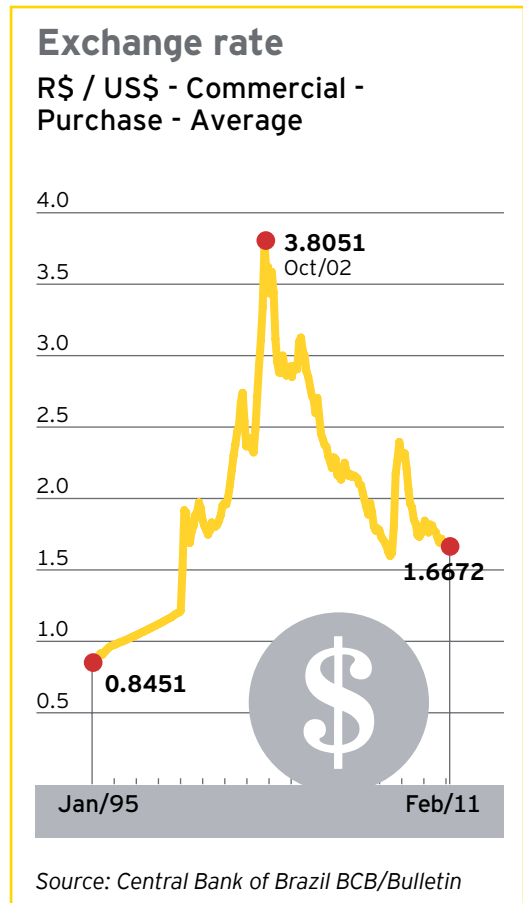
The loss of the dollar's value throughout the world, coupled with the development of the Brazilian economy, has resulted in a general trend of appreciation of the real since its historical peak of 2002 (interrupted by sporadic shocks of trust - such as, ironically, the very financial crisis that originated in America). Nevertheless, the structure of demand for Brazilian currency is still fragile and too exposed to uncertainty and speculation. Furthermore, some experts believe that the present

value of the real is incompatible with the desirable volume of exports which long-term, robust economic growth should aim for: an adjustment is required in the exchange rate. Thus, the scenario for the next decade is one of uncertainty and potential volatility.

### Pricing policy

To complete the list of drivers analyzed, we selected an example that is specific to the national fuel market, but which has strong impacts that go well beyond its immediate consequences. The current policy of real stabilization of domestic prices and of oil derivatives does not pass on variations considered transient and effectively reduces the exposure of the national economy to shocks in international oil prices.

This policy is clearly seen in moments of sudden price peaks, as happened several times in the past decade. One can see that the price of gasoline in the United States - a country that does not enforce price



**In the U.S., the price of gasoline has maintained a course roughly parallel to international prices, rising in times of crisis. In Brazil, the price remains stable.**

controls - has kept a course roughly parallel to the international prices of the raw materials, rising in times of crisis, while the price observed in Brazil remains relatively stable.

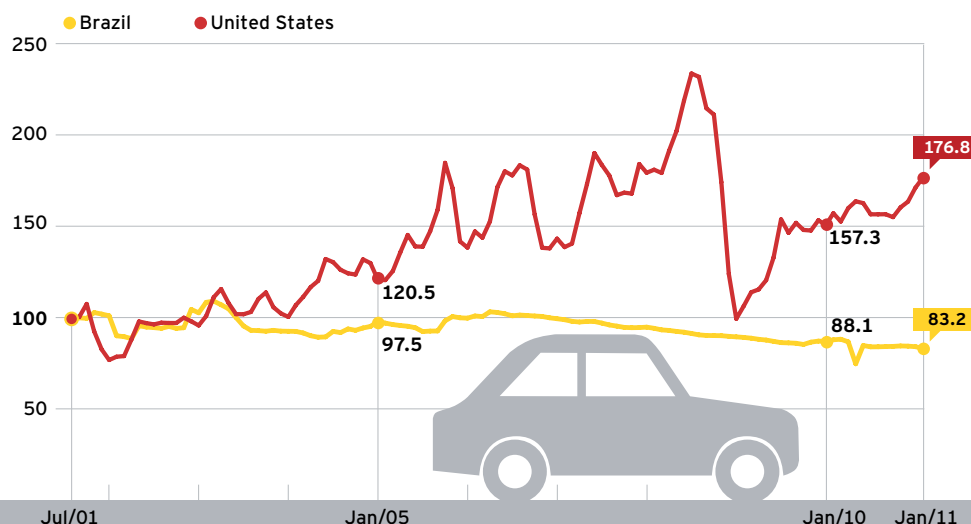
The degree to which domestic prices of oil products are decoupled has significant implications on national energy markets; therefore, the future trend of oil prices and products in the Brazilian market depends critically on assumptions made about Petrobras' policies. Those policies are independent from international prices (although

they do depend on the political and financial feasibility of assuming these costs), but are also influenced by other considerations such as the role of price stabilization in the broader framework of the government's economic policies.

The present study has taken into account the possibility that, during this decade, a transition may occur, leading to a price system which is more compatible with the international reality. In this case, Petrobras would effectively act as a price-taker in a competitive market, setting a markup necessary

to cover taxes, trade and transport costs and adjusting domestic prices according to changes in international prices. In the analysis and simulations carried out, the most relevant parameter identified was the year in which such transition schemes would begin.

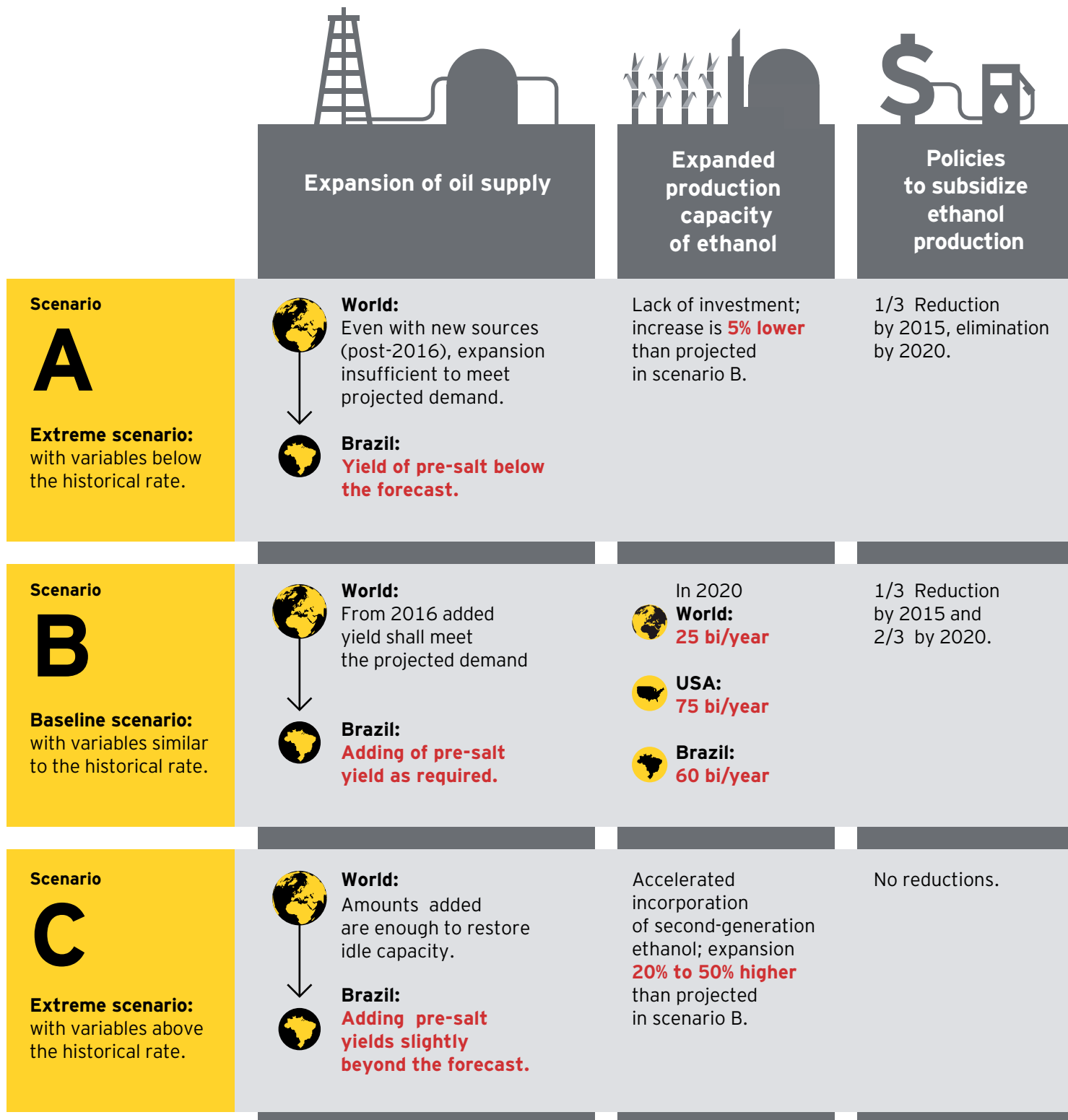
**Retail price of gasoline**  
(July 2001=100)



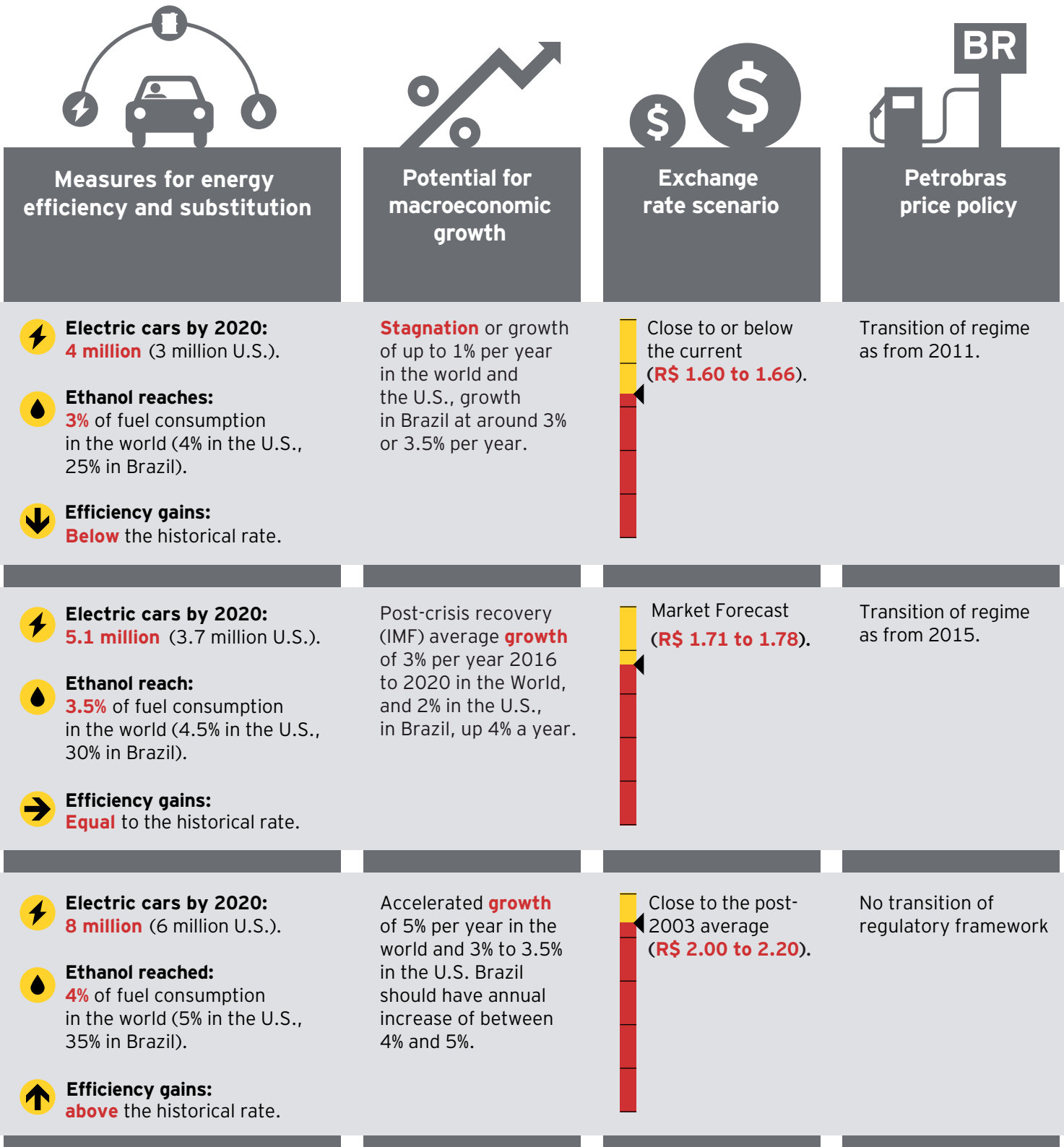
Standard pricing; prices in Brazil and in the USA in July 2001 = 100

Source: U.S. Energy Information Administration - Gasoline and Diesel Fuel Update & Agência Nacional de Petróleo - Statistics Yearbook 2011

# Assumed scenarios

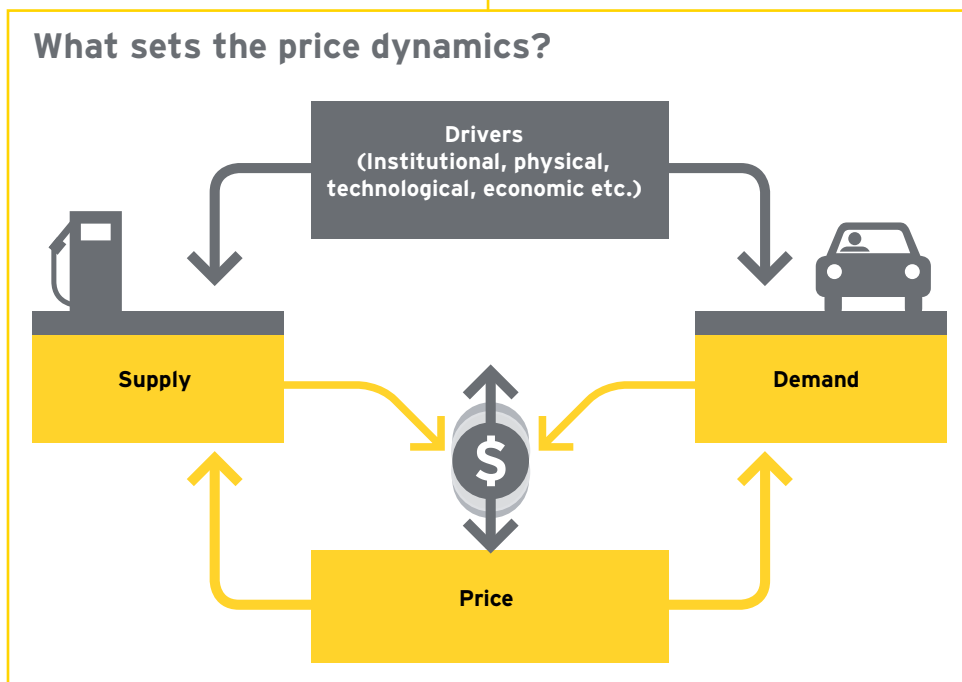


The study designated the possible trajectories for each driver, characterized by three scenarios: a baseline and two extremes (referred to here as A, B and C). Each driver is considered as a group of other independent variables, so that the plausibility of the scenarios should be considered in isolation for each driver. It is also worth noting that scenarios A and C represent the extremes of a range of different



possibilities, prepared in order to be consistent with the quantitative and qualitative projections assembled above. This study does not intend to make categorical statements regarding the maximum and minimum values that any variable or indicator can achieve in future years.

# Projections and scenarios for supply and demand



whereby it was possible to make consistent projections and scenarios, credible trajectories and probabilistic confidence intervals regarding the prices of energy sources studied in the period 2011-2020.

In each of the markets analyzed, we can identify which of these drivers should be considered as the most relevant and, therefore, to be more closely monitored by stakeholders and decision makers. These results are achieved through an analysis in which the variation of each driver - keeping the others constant - separately translates into a variation in selected indicators. Thus, it can be assumed that the impact of a driver on a given market depends not only on the responsiveness of supply and demand to that driver, but also on the range of fluctuation considered acceptable for it. For example, technical and physical parameters, whose evolution in the medium term is associated to a relatively low degree of uncertainty may have less impact, measured in this way, than economic parameters that impact upon the markets in a less systemic way, but which are related to high degrees of uncertainty.

## Getting to know the transmission chains

Having identified and analyzed the seven major drivers of energy prices for the medium and long term in this decade, this chapter seeks to identify and analyze the chains of transmission whose effects on these drivers impact supply and demand.

In order to quantify such chains, we used the MIPE (Integrated Model for Energy Projections),

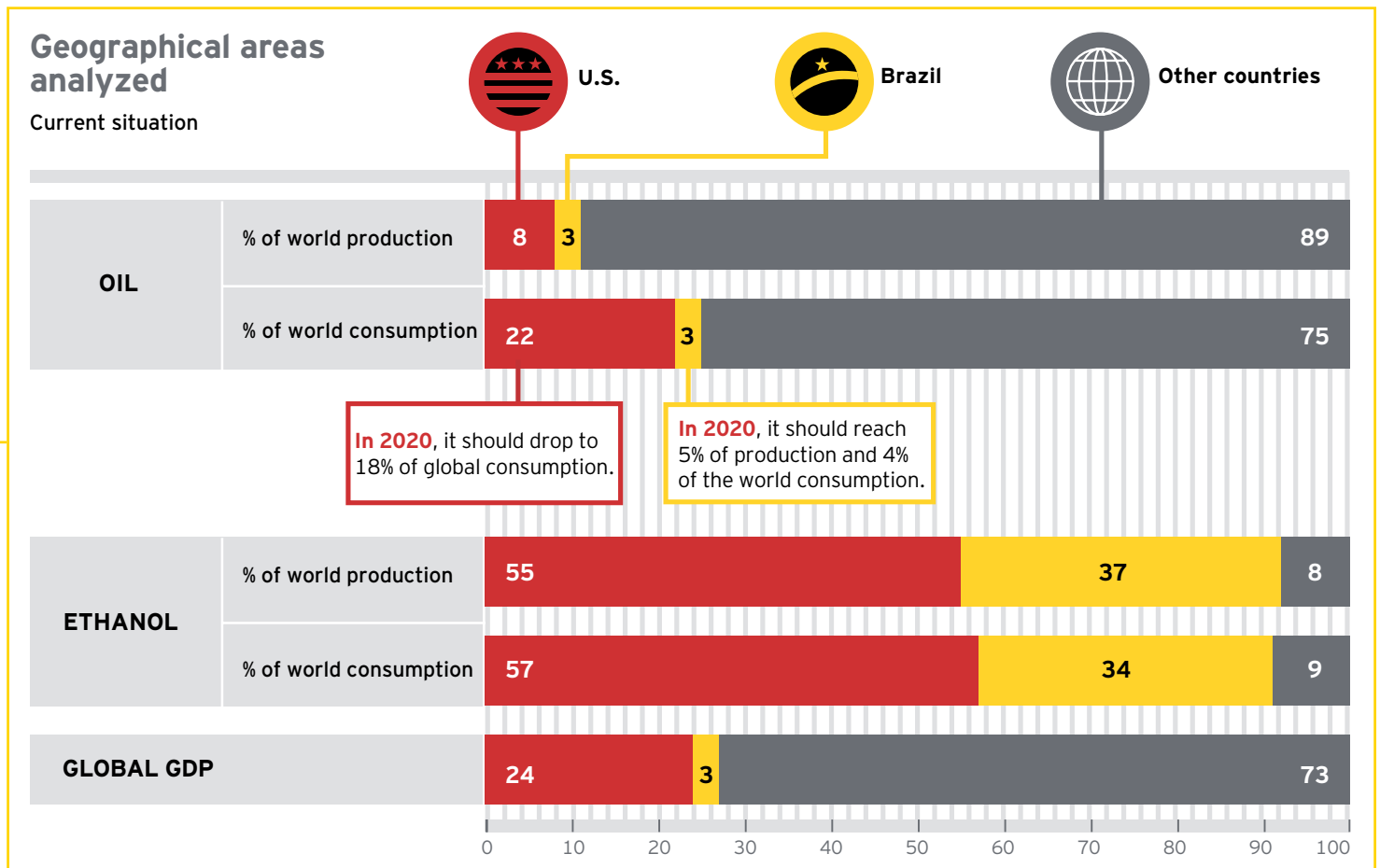
## What determines price dynamics?

We know that domestic and global energy markets are substantially interconnected and, as noted earlier, subject to different technical, economic and political-institutional variables. In order to read this complexity systematically, each

market is modeled in MIPE through separate components of supply and demand whose interaction causes price changes.

One purpose of this study is to understand not only the dynamics of prices globally, but also the behavior of markets whose interactions structure the global supply and demand for energy.

To illustrate the possibilities offered by such a disaggregated analysis we highlight three geographical areas: the United States (the largest producer and consumer of ethanol, and the world's largest consumer of oil) and Brazil (the second largest producer and consumer of ethanol, and the largest exporter of ethanol). The third area corresponds to the rest of the world.



## Supply

Historically, the dynamics of oil prices have been influenced by the market power exercised by countries known as swing producers (i.e., able to quickly increase or reduce production): first the U.S., then OPEC countries and particularly Saudi Arabia. Thanks not only to their significant market share but mainly to the substantial excess capacity, swing producers at various times were able to control prices in the international market, or at least to slow down price reducing movements.

However, while OPEC will continue accounting for a large

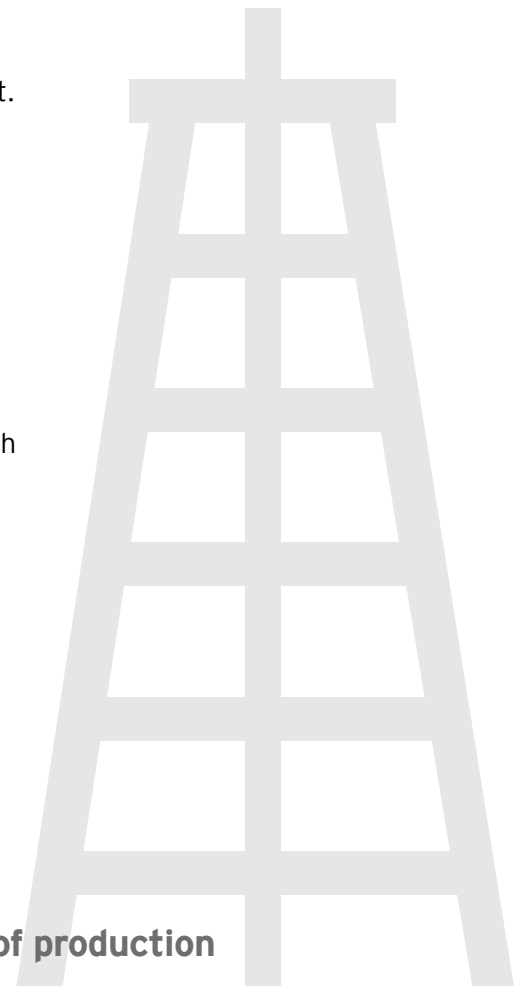
share of world production, the scenario for the medium and long term is qualitatively distinct. In fact, four decades after the peak of the U.S. oil production and facing the possibility that some producing countries are going through their own peak, we can assume that the future supply of oil will be more fragmented and not enough to allow the formation of the massive surplus capacity which enabled the performance of swing producers in the past.

Thus, the behavior of oil supply in MIPE is essentially modeled as competitive, i.e., subject to the expansion of both capacity and production costs. Furthermore,

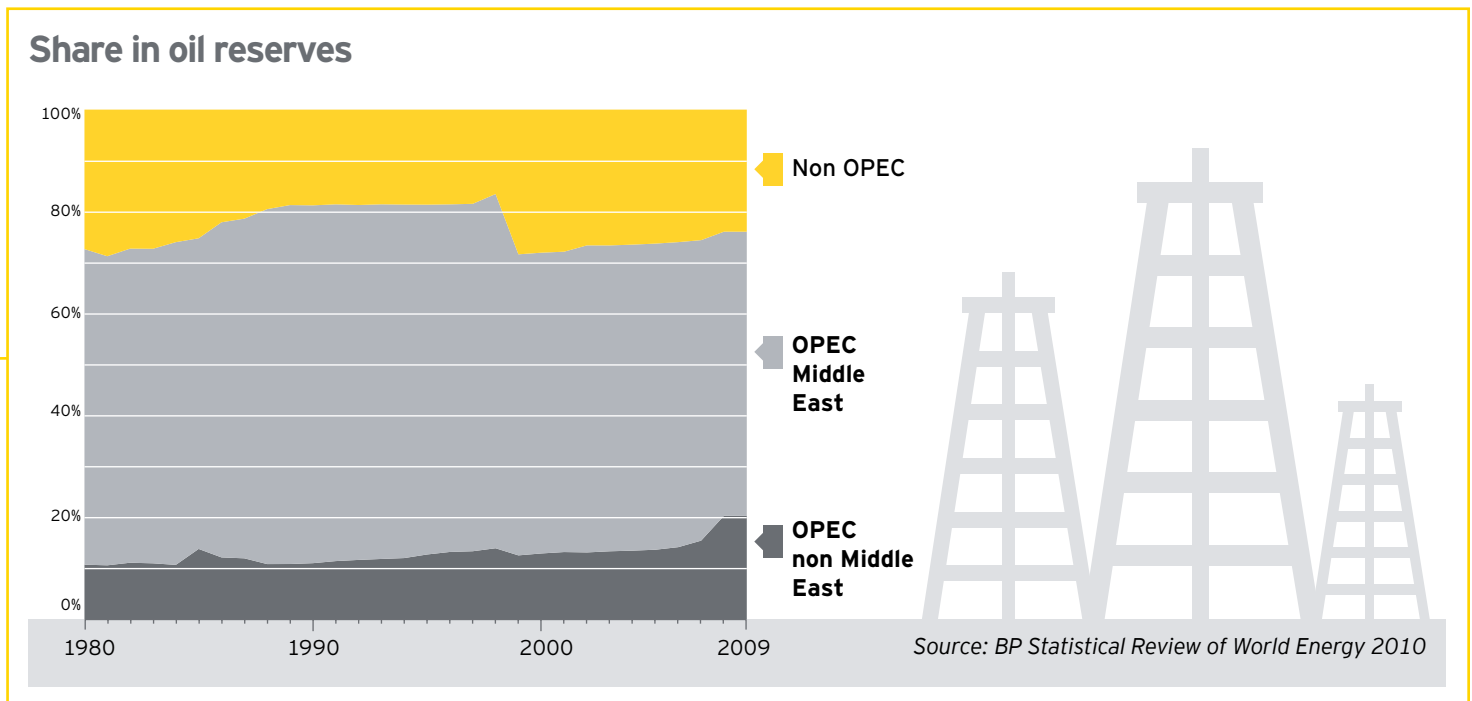
### Peak Oil: growing uncertainty about the physical limits of production

It is understood that “peak oil” is the moment when oil production in a given region reaches its historic high. New discoveries or recovery technologies can extend the life of producing fields or else generate “overlapping peaks”; none of this invalidates the conclusion that oil, like natural gas, is a finite resource. This was the conclusion reached in the U.S. during the 1970s, when the decline of domestic production proved inexorable, bringing with it a dangerous dependence on imported oil.

Worldwide, it is clear that the estimated reserves of OPEC countries, among others, do not convey their real sizes in the most accurate way, which can hide the occurrence of peaks in producing countries. Therefore, proven reserves, as disclosed by the oil companies and producing countries, may contain errors of data consolidation. Even if this apparent opacity does not hide a scenario of an immediate lack of resources, it is undeniable that new reserves, if and when found, will have lower quality oil and higher production costs.



As cheaper oil supplies are replaced by others more difficult to extract, the cost of production rises. In contrast, ethanol has the dynamics of its supply curve separated from production.



based on the observation that the cheapest reserves are those first discovered and exploited, it was possible to model the dynamics of production costs. As cheaper oil supplies are exhausted and replaced by others more difficult to extract, the marginal cost of production rises, causing a gradual but inexorable shift of the supply curve to the right, regardless of whether the total capacity increases or not.

In contrast, ethanol, as a renewable energy source, has the dynamics

of its supply curve separated from the volume of production or added production capacity. This curve is defined mainly by exogenous factors, whether technical (production technology, the physical-climatic characteristics of the producing region, among others), economic (costs of inputs, labor and other operating expenses) or political-institutional (agricultural and energy policies). In the context of ethanol production in the U.S. and the rest of the world, we chose to focus on these two factors, namely the price of oil (whose products -

fertilizers, herbicides, diesel and fuel oil - are widely used in all agro-industrial activities) and the policy of subsidies for ethanol fuel, especially in the U.S. In contrast, in Brazil, the most important variable to take into account is the ability of most mills to choose between producing ethanol or sugar, according to the relative prices of these two commodities.

Although global oil and ethanol markets have essentially competitive structures, in many countries they are closed and controlled

by monopolies, be they legal or market conditioned. In Brazil, in particular, as discussed earlier, the government enforces a pricing policy for petroleum products whose declared goal is to “protect” consumers from volatility in the international market.

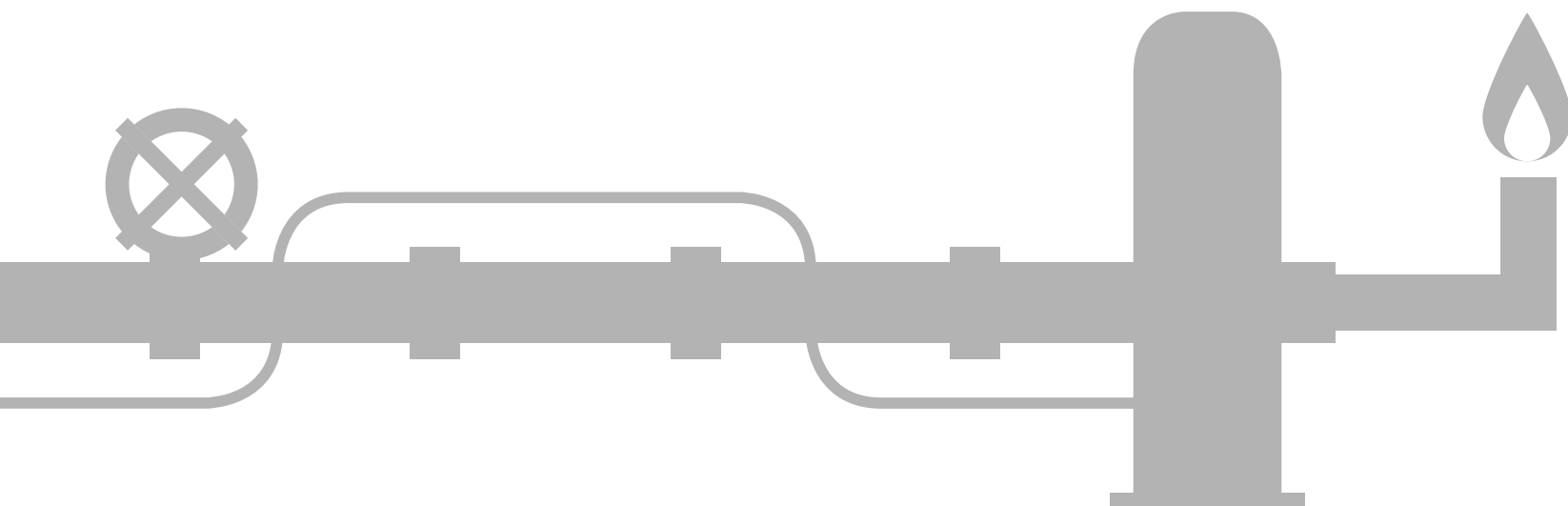
In the present study, this policy is modeled using a decision rule in which Petrobras controls the markup on gasoline prices, i.e., the difference between the price at home and the “fair price” dictated by the international market (adjusted for differences in transport margins, taxes and marketing). While the markup remains within a range considered “acceptable” (estimated from historical data), the price is kept

constant. In case the international price should deviate in such a way as to make the markup go beyond the “acceptable range”, the domestic price is adjusted *pari passu*.

This decision rule has been maintained over the very different conditions that the market has faced along the last decade; nevertheless, many believe that in the long term such a policy is not sustainable and should be relaxed progressively sooner or later. Thus, the timing of this transition is one of the factors that determine to what extent the Brazilian market will have been aligned to the international one by 2020. Specifically, the more that regime change is delayed,

the closer the prices in place by the end of the decade will be to those in use today.

As we will see, the pricing policy for derivatives also has a substantial impact on the ethanol market. Since Brazil is a relatively closed market with regard to alcohol, not only do ethanol producers have the option of producing sugar, but also of exporting ethanol rather than selling it on the domestic market, depending on the price differential between the two markets.



The degree of importance that ethanol as a fuel has in Brazil has no parallel in any other country today; it is the result of a historical process where a convergence occurred among many factors.

## Demand

Both energy sources studied are mainly destined for the transportation sector - in the form of oil derivatives such as gasoline, diesel and jet fuel; and ethanol as a fuel or additive. As new practices and technologies are developed, efficiency and old measures are put to use, the energy gains expected will impact the demand for fuel in all its forms<sup>2</sup>.

In Brazil, the demand for fuels in the transport sector is increasingly impacted by the interaction between gasoline and ethanol consumption - especially given the increasing adoption of flex-fuel engines. As stated in the Introduction, one of the objectives of the study is to analyze this interaction, giving special attention to these two fuels<sup>3</sup>.

Flex technology allows drivers to choose the fuel with the lower

effective price (possibly not only accounting for energy efficiency but also maintenance cost differences or other aspects). Thus, the mileage demand for the growing flex fleet translates into a demand for the fuel with the lowest effective price at the gas pump at the time of purchase, featuring an almost perfect replacement model.

However, the impact of replacement power on the market for ethanol is partially amortized, since gasoline in Brazil also has a substantial proportion (20% to 25%) of anhydrous ethanol in its mix. Thus, any possible increase in the share of gasoline on the one hand reduces the demand for hydrated ethanol, but simultaneously increases (although to a lesser extent) the demand for anhydrous ethanol.

As previously noted, the degree of importance that ethanol

as a fuel has in Brazil has no parallel in any other country today; it is the result of a historical process where a convergence occurred among political and institutional factors (the Pro-Alcohol program), marketing (the high prices for oil and oil products in the country) and technical conditions (the country's important physical and technological potential for sugar cane farming, as well as the existing agro-industrial base).

Around the world, the ethanol market is still at an early stage, and the product is part of a growing portfolio of energy alternatives, of which the most pressing in the near future is the electrification of the fleet.

<sup>2</sup> - Consumption for other purposes (such as heating and the chemical industry), although relevant and expressive, has a more linear behavior. This consumption was modeled in a simplified manner, affected only by energy efficiency gains, GDP elasticity and price elasticity.

<sup>3</sup> - Consumption of other petroleum-based fuels is modeled linearly, also as a function of energy efficiency gains, GDP elasticity and price elasticity. The same holds for the consumption of the non-flex fleet, as well as vehicles powered by CNG (compressed natural gas). Biodiesel is produced primarily for consumption in the national fleet, according to mixtures determined by federal laws and resolutions. Thus, the dynamics of demand is essentially tied to diesel. This is the reason why this fuel has not been considered in a disaggregated form.

# Oil and ethanol: variables that affect world behavior

As discussed earlier, Brazil is a relatively closed economy, where retail fuel prices are managed by, and subject to the direct influence of both the federal government and Petrobras. In the U.S., by contrast, prices of oil-based products, as well as ethanol, follow the movements of international markets. Thus, within the scope of this study, we have highlighted four variables of interest, corresponding to different price curves of energy products in Brazil and in the world markets.

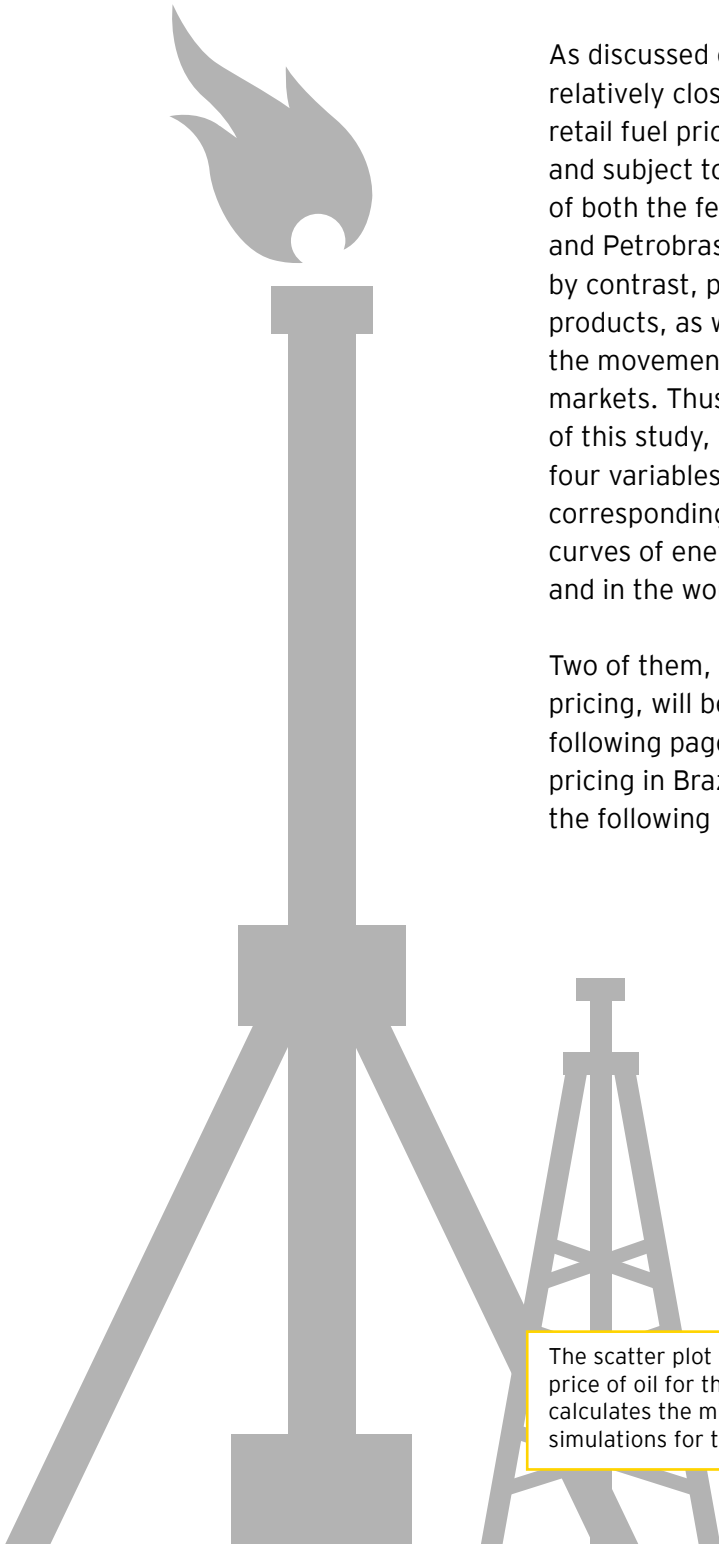
Two of them, referring to world fuel pricing, will be dealt with in the following pages. Those related to pricing in Brazil will be detailed in the following chapter.

## Global oil: towards a new price level

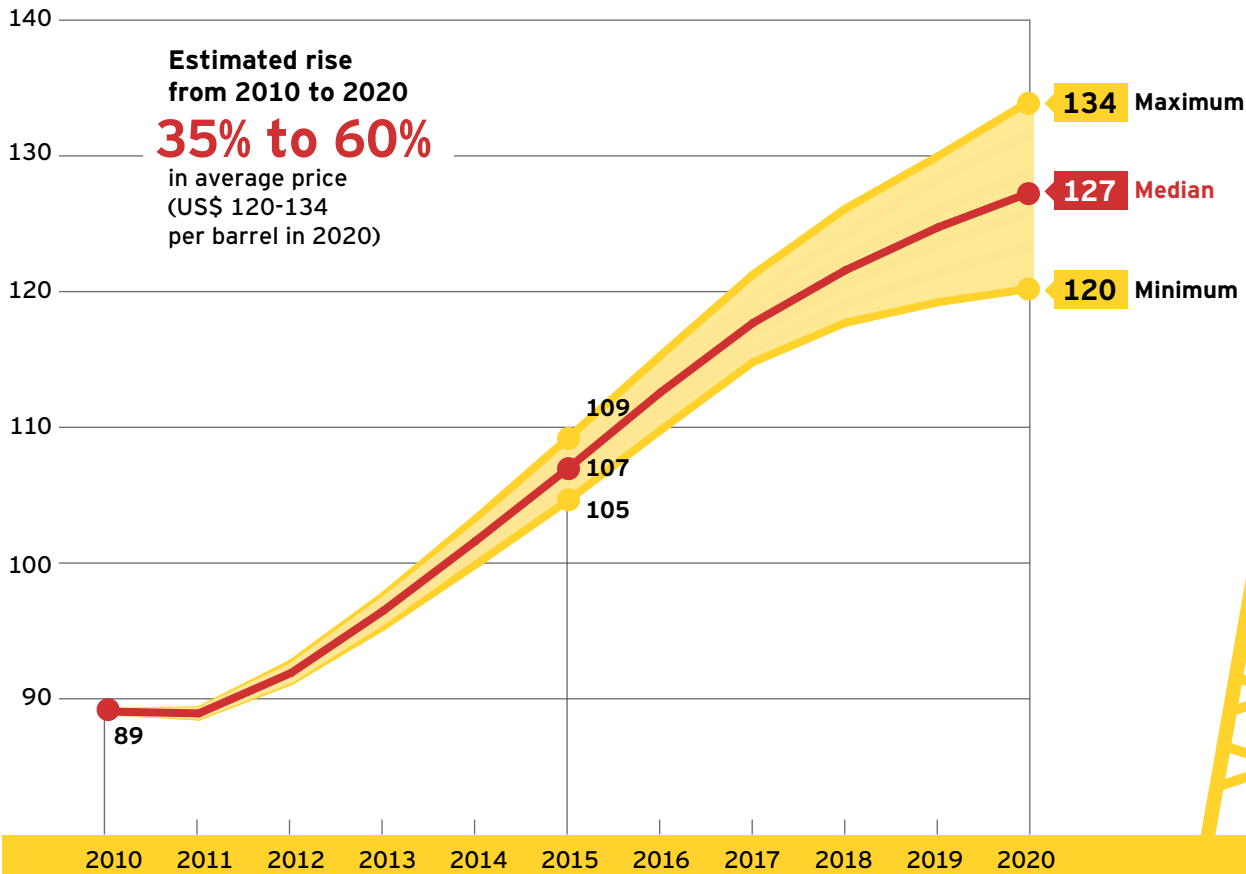
The first variable of interest to be analyzed is the price of oil in the international market (measured in \$/bbl of West Texas Intermediate oil in December 2010). As seen, the oil market in this decade will be marked by an interaction between growing demand and insufficient and early attempts at alternative energy sources and at energy efficiency; economic growth that is still dependent on oil; and an uncertain supply expansion, concentrated in the post-2015 period.

Due to these factors, the price of oil will tend to rise steadily beginning in 2011. From 2017 onwards, as the majority of new reserves comes on stream and the substitution and energy efficiency measures finally begin to align demand and feasible supply, this rising trend will start to cool down.

The scatter plot shown represents the range of different curves generated by MIPE for the price of oil for the period 2011-2020, after a number of simulations. Each year, the model calculates the minimum, maximum and median values among all values obtained in the simulations for that year and plots them on the graph.



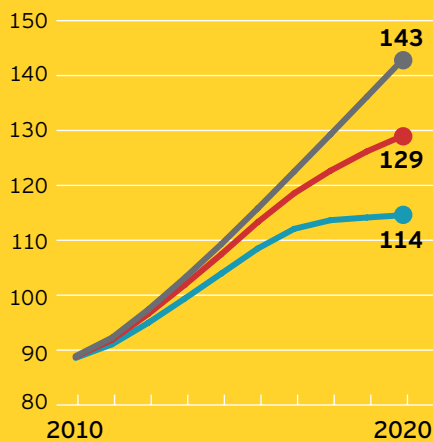
## Scenario for the price of oil in the international market In US\$



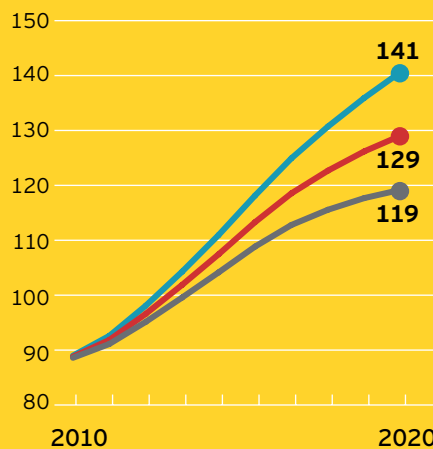
## Influence of the main drivers in the oil market In US\$

● Scenario A ● Scenario B ● Scenario C

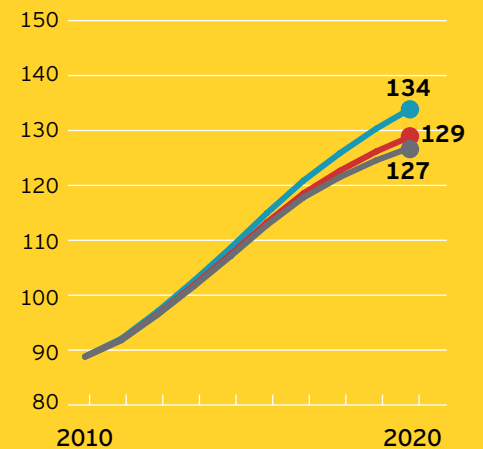
### Growth potential



### Efficiency and replacement



### Enhanced supply



Price curves for oil price in scenarios A, B and C are defined for each driver (see page 18). In each graph, only the driver in question varies, the remaining six factors are held constant.

However, the minimum production cost of new oil will be far higher than that of the current supply, preventing prices from falling back to their

previous levels. Average prices for 2020 are estimated to be 35% to 60% higher than the 2010 average in real terms (\$120-\$134/bbl).

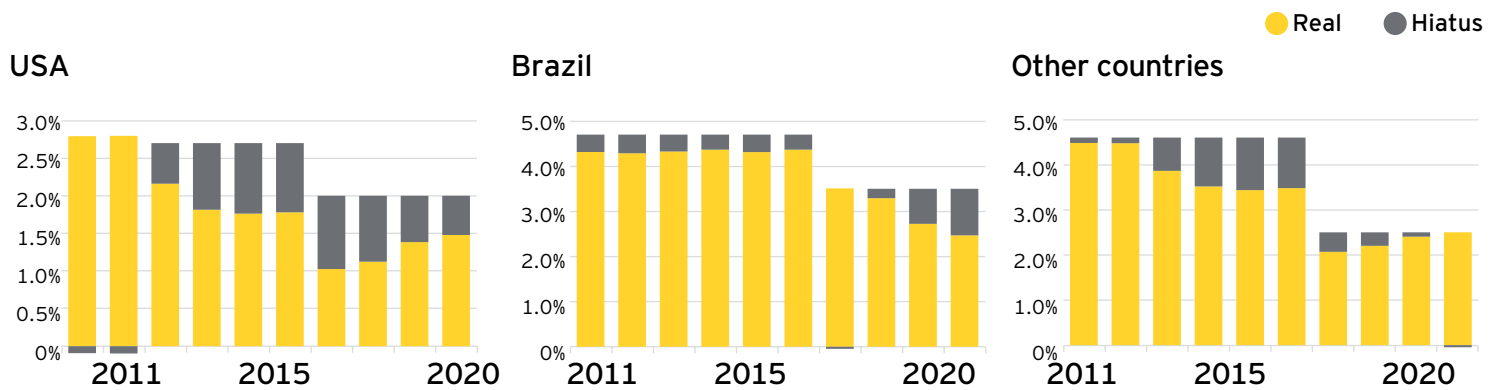
Within these projected price curves, the biggest impact drivers are, in descending order: the potential for economic growth (accounting for a variation range of \$28/barrel compared to the baseline scenario); inclusion of efficiency and substitution measures (accounting for a range of \$21/bbl); and supply expansion (\$7/bbl). It becomes apparent that, although the possible ranges for these drivers bring uncertainty to the price curves, all instances show a trend to sharply climbing prices and subsequent stabilization.

### Macroeconomic consequences of the new price structure

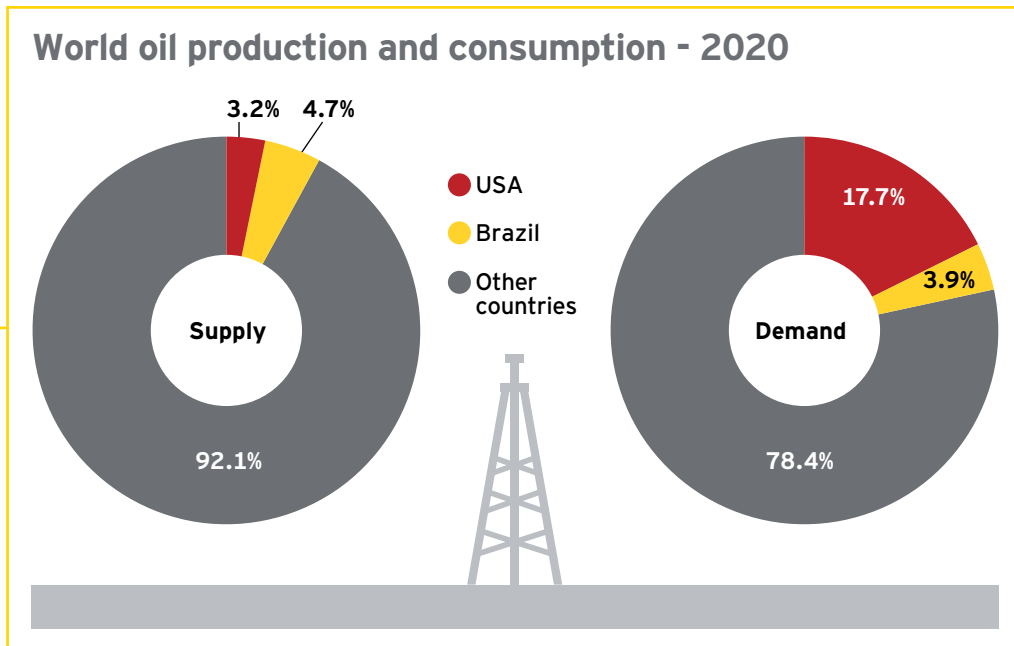
Based on robust econometric evidence and on the experience of the oil shocks of the 1970s, it is known that the role of oil as the main source of world primary energy translates into a significant sensitivity of economic growth to the market price of energy products. As a result, the falling availability of a “cheap supply” of petroleum products will be a limiting factor on the development of virtually all economies.

It is estimated that this restriction will result in a gap of 0.52 percentage points in relation to the potential growth of global GDP each year over the period 2011-2020. This gap is larger in some countries, as the U.S. (average gap of 0.61 percentage points per year), and lower in others, such as Brazil (average gap of 0.42 percentage points per year).

### Restriction of oil supply related to growth of world GDP



The average oil prices for 2020 are estimated to be 35% to 60% higher than the 2010 average in real terms (\$120-\$134/bbl).



## Regional and global evolution of oil consumption and production

It is forecast that world oil consumption in 2020 will be around 85 million barrels per day, a total increase of about 2% over 2010. This low growth rate reflects the scenario of supply constraints and increasing production costs outlined above. The growth in oil consumption will occur mainly in developing countries like Brazil. With a 29% increase in demand, Brazil will account for 4% of world consumption in 2020. The developed world, by and large, will probably see a pullback in demand. The U.S., for example, will reduce its oil consumption by 15% for the period, but nevertheless will remain the largest individual consumer, with a global share of almost 18%.

Meanwhile, production expansion will occur mainly in new oil frontiers, such as the Brazilian pre-salt, which by 2020 will expand the effective supply of the country by 77%. Substantial additions like the pre-salt oil, that will allow Brazil to produce nearly 5% of the world's oil, will be needed to offset the diminishing yield of reserves in several producing areas.

It is important to note that due to the high production costs of developing new reserves, capacity expansion will not be fully translated into an effective supply increase, with oil reserves physically accessible, but not yet economically viable within the projected price levels.

## Global ethanol: the rise of an alternative source

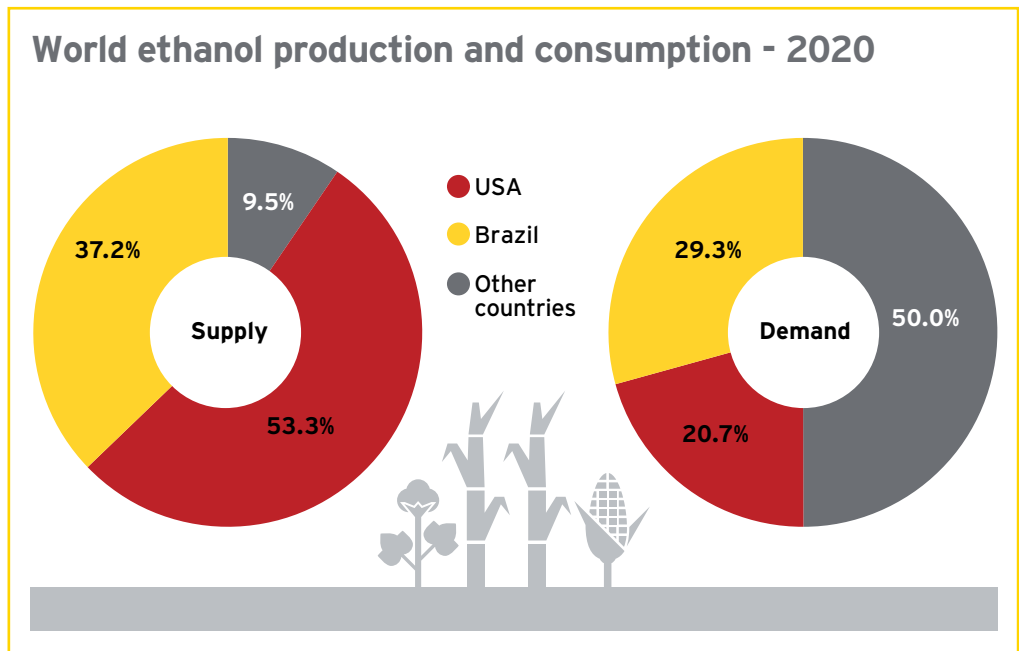
One of the goals of the political and institutional measures discussed earlier is to get a significant replacement for oil consumption by alternative energy sources, notably ethanol. In fact, the targets (whether mandatory or not) adopted in much of the developed world involve a substantial ethanol consumption rise by 2020.

However, the structure of global ethanol production is not scaled to meet this new rise in demand. Its expansion faces physical and geopolitical limits, such as the availability of land suitable for cultivation in exporting countries, as well as competition with food production. A large gain in industrial productivity is expected of the introduction of second generation ethanol, but it will occur only by the end of the decade. Until then, the forecast scenario shows a growing gap between supply and demand, with resulting price rises. In 2020 the actual average price of an ethanol boe (barrel of oil equivalent) is expected to range from \$292 to \$374,

an increase of 99% to 154% over current prices.

The strongest drivers in the range of possible scenarios for the world ethanol markets are: potential

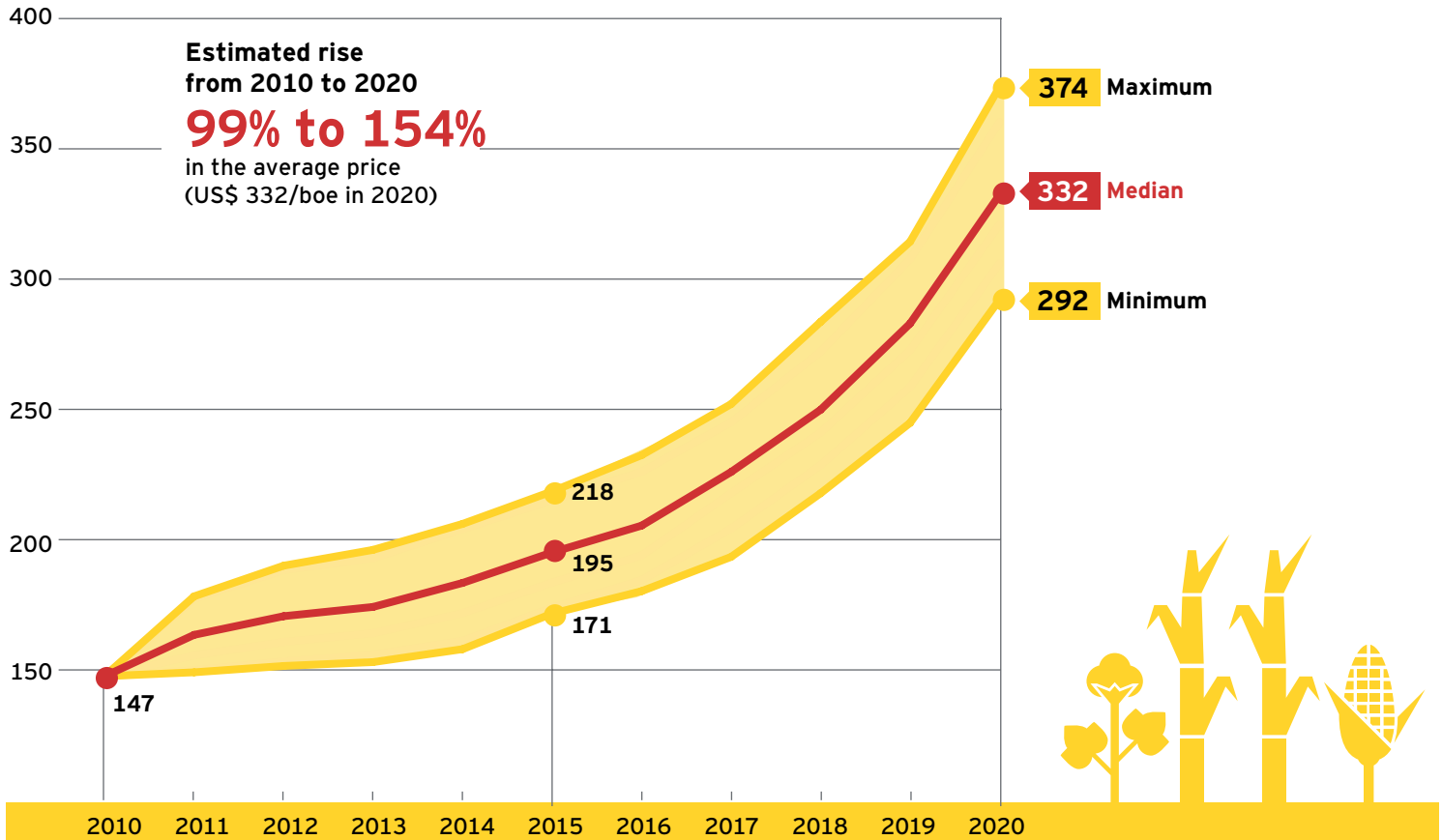
for economic growth (accounting for a range of \$78/boe); expansion of ethanol production capacity (accounting for a range of \$53/boe); and the subsidy path for this fuel (\$47/boe).



### Development of Ethanol Consumption and Production

Due to the growing trend towards replacing fossil energy sources, ethanol consumption will grow until 2020 to 2 million boe per day, or 177.7 billion liters per year, 148% higher than the 2010 consumption. As countries with emerging demand for ethanol are starting to get a share of their energy from this source, the rest of the world (countries outside the U.S. and Brazil) will consume 50% of all ethanol produced. This new demand will generate an expansion in production capacity around the world.

## Scenario for the price of ethanol in the international market In US\$

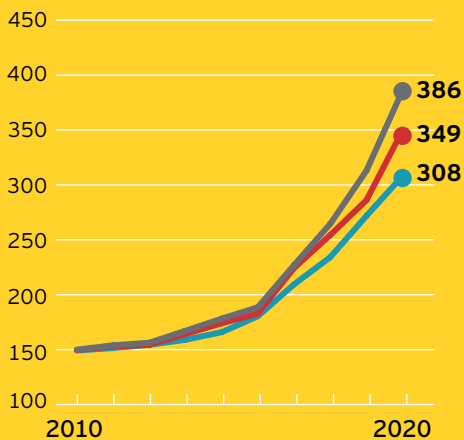


### Influence of the main drivers in the oil market

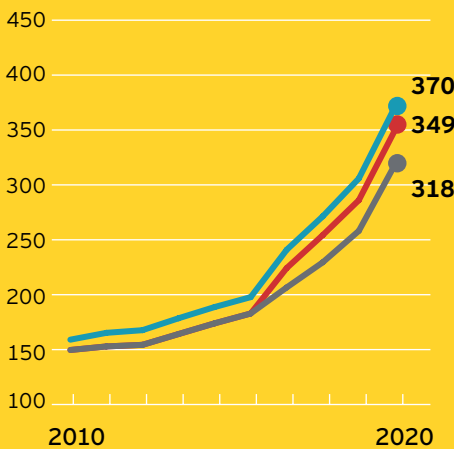
In US\$

● Scenario A ● Scenario B ● Scenario C

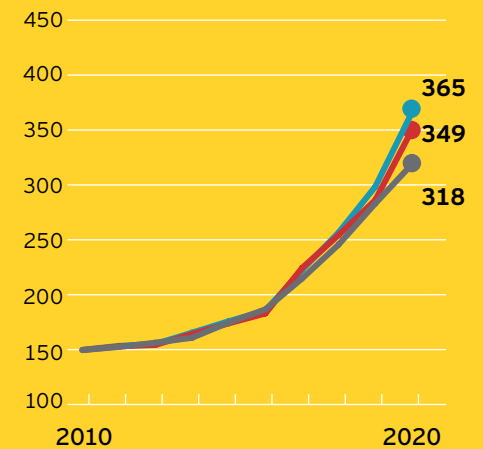
#### Growth potential



#### Enhanced supply



#### Subsidies to ethanol



The scatter plot shown represents the range of different curves generated by MIPE for the price of ethanol for the period 2011-2020, after a number of simulations. Each year, the model calculates the minimum, maximum and median values among all values obtained in the simulations for that year and plots them on the graph.

Price curves for the price of ethanol in scenarios A, B and C are defined for each driver (see page 18). In each graph, only the driver in question varies; the remaining six factors are held constant.

# Brazil: towards international alignment

## Heading to 2020, gasoline prices in Brazil will follow the international markets

As seen in the previous chapters, gas prices in Brazil tend to remain constant while the mark-up in relation to the international market remains within an “acceptable” range. In the recent years this range has been quite wide.

It is believed that sooner or later it will be necessary to move to a framework in which prices in Brazil follow more closely those practiced in the international market, i.e., narrowing the range of acceptable mark-ups. As a result,

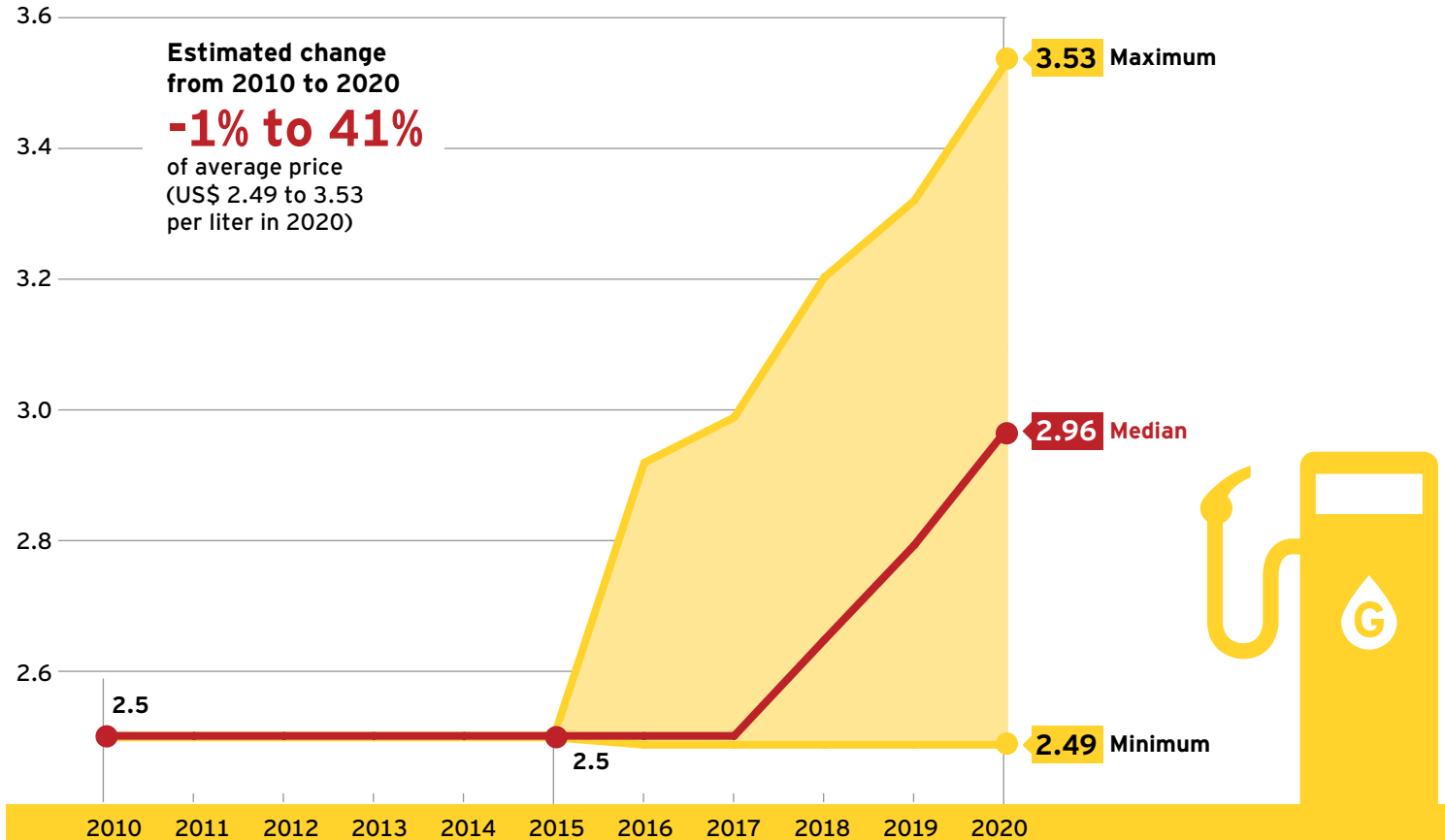
in 2020, gasoline in Brazil can reach an average price of R\$ 2.49 to R\$ 3.53 per liter, moving ranging from a decrease of 1% to an increase of 41%.

The main factors that will determine the time at which this policy transition will translate into price changes are, in descending order: the curve of the Brazilian currency against the dollar (accounting for a range of up to R\$ 0.99 per liter), the transition timing (accounting for up to R\$ 0.52 per liter) and the potential for economic growth, especially in Brazil (accounting for R\$0.46 per liter). Confirming the scenario described above, all these ranges represent increase variations relative to the current gas prices, illustrating the upward trend of prices toward the new international market levels.

The scatter plot shown represents the range of different curves generated by MIPE for the price of gasoline for the period 2011-2020, after a number of simulations. Each year, the model calculates the minimum, maximum and median values among all values obtained in the simulations for that year and plots them on the graph.

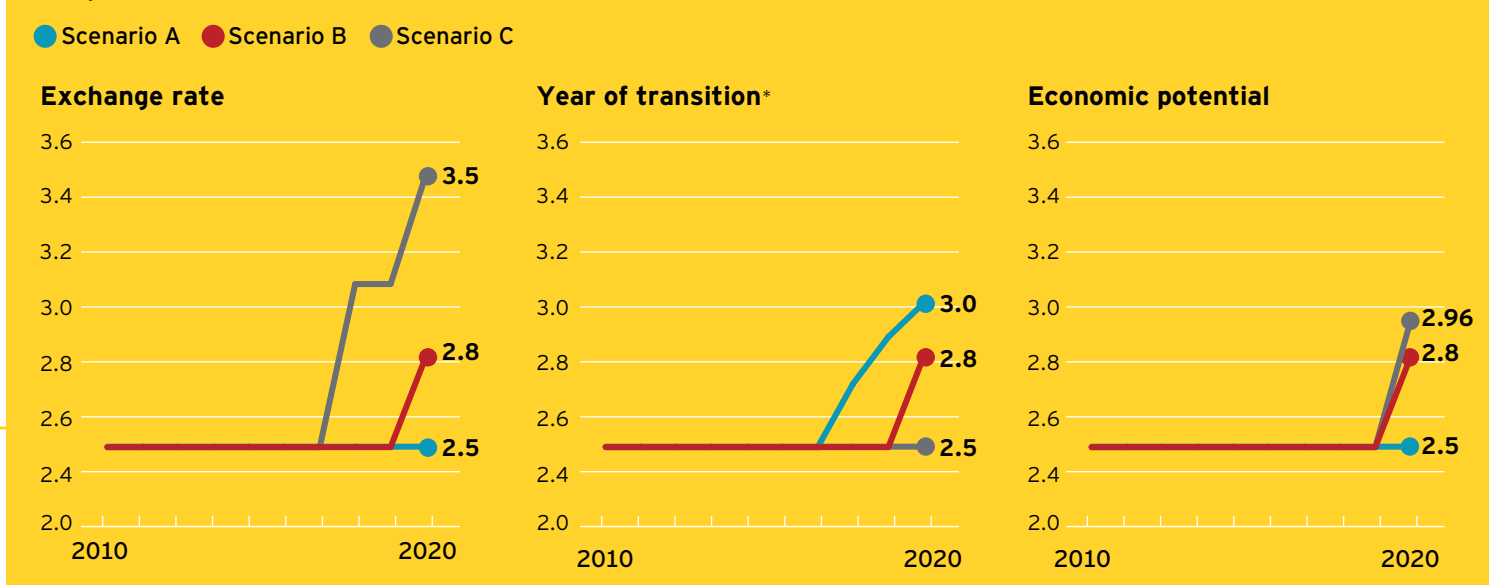
## Scenarios for the price of gasoline in Brazil

In R\$



## Impact of main drivers in the gasoline market

In R\$



Price curves for the price of gasoline in scenarios A, B and C are defined for each driver (see page 18). In each graph, only the driver in question varies; the remaining six factors are held constant.  
 \*Refers to the pricing policy of Petrobras. In scenario A, the transition of regime starts in 2011; in scenario B, in 2015; in scenario C, no regime transition occurs.

## Ethanol should follow exchange rates and Petrobras policies

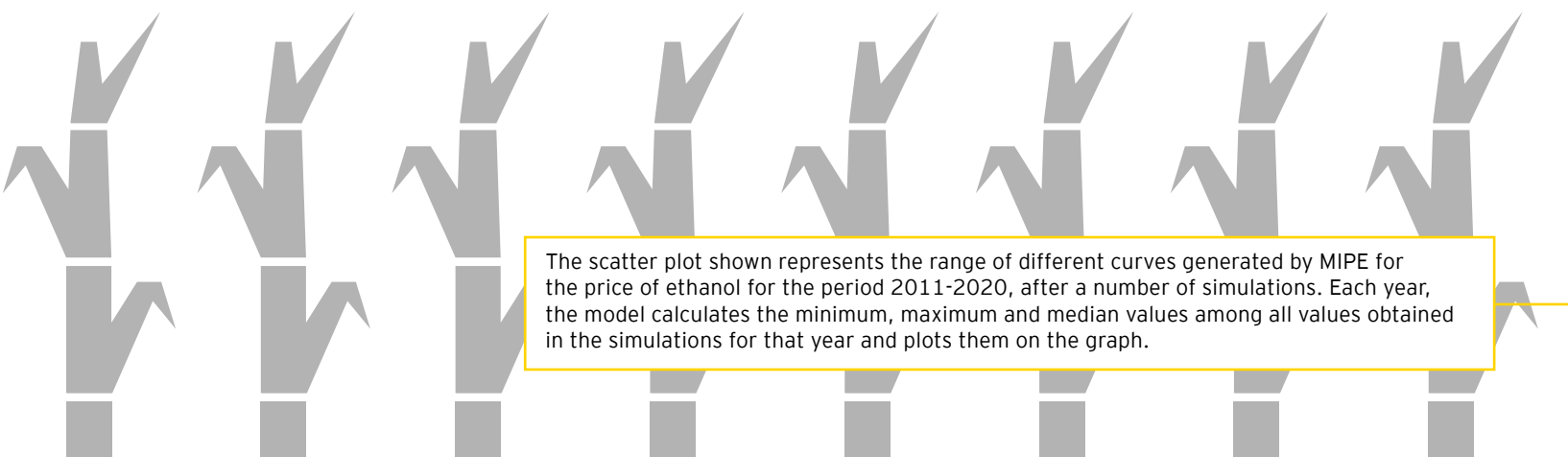
Flexible fuel cars offer consumers the possibility of a near-perfect alternation between ethanol and gasoline. So, the increasing share of those cars in the market causes an equalization of effective prices. For example, an increase in the relative price of ethanol (i.e., not only an increase in ethanol prices but also a decrease in gasoline prices) causes a drop in ethanol demand, as well as an increase in the desired gasoline share. This makes the supply markets of both fuels to be pushed in opposite directions, towards a balance in which their effective prices are equal.

Since gasoline prices are basically determined by political and institutional factors, its supply is not entirely responsive to prices. Thus, the cost of ethanol to the consumer ends up being substantially more affected by variations in gas prices than the other way round.

In particular, the ability of ethanol suppliers to determine prices is quite limited. Although ethanol production is seasonal, subject to agricultural factors and its own switching with sugar production, price swings tend to be temporary, tending towards an equalization of relative prices. As a result, the ethanol retail price curve in Brazil is relatively stable. Thus, by 2020 ethanol could reach an average price of R\$ 1.37 to R\$ 2.03 per liter, representing from a 13% drop to a 29% increase over its

current prices. This gap between the national and international prices makes the Brazilian domestic market increasingly unattractive to local producers *vis-à-vis* the export markets.

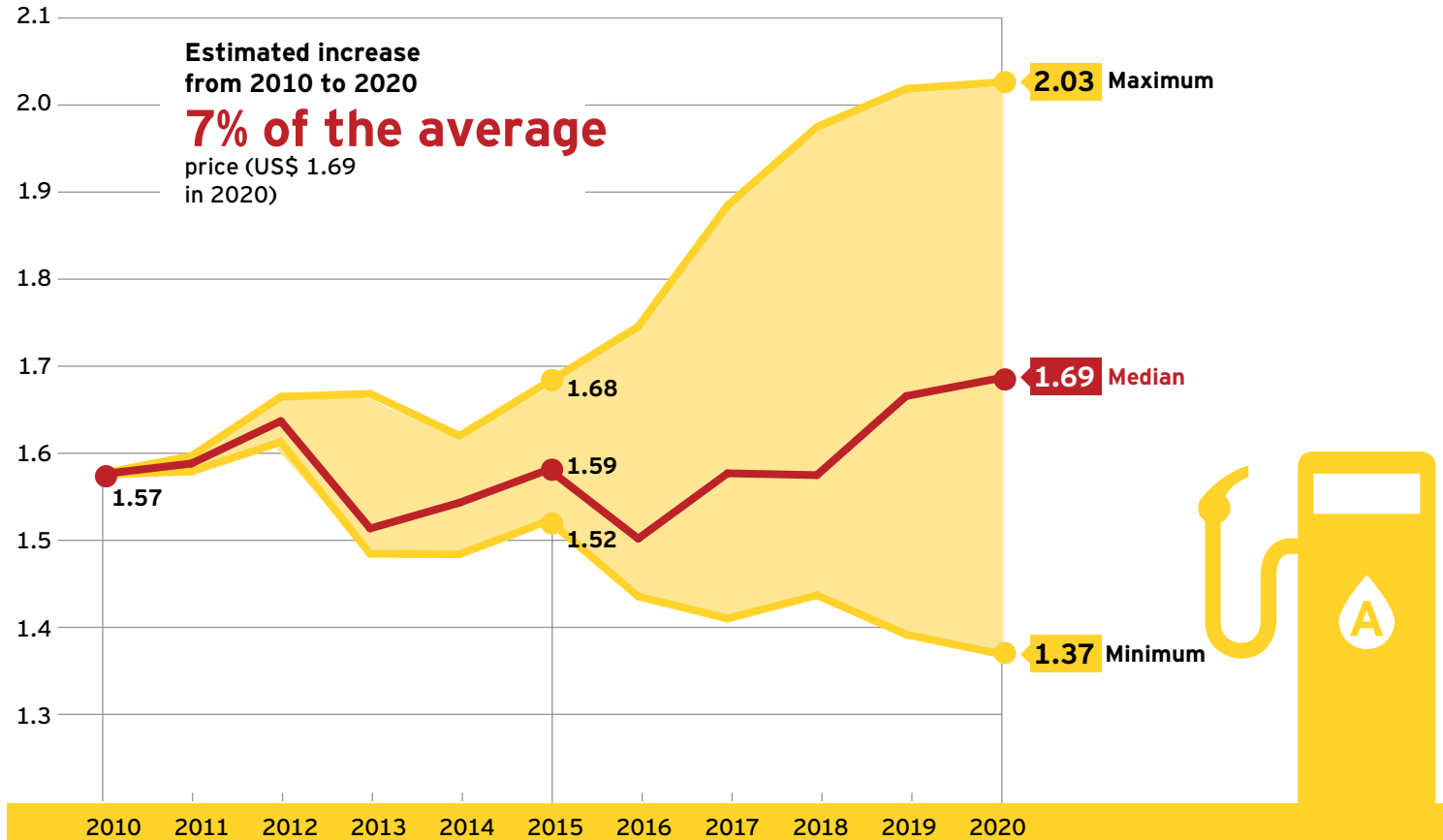
Since ethanol prices are so heavily dependent on gasoline prices, the two major drivers on the range of possible scenarios are, in equal measure, the timing of Petrobras policy transition and the currency exchange rate. The first is the most important for the ethanol market (accounting for a potential range of R\$ 0.31 per liter, while the exchange rate accounts for a range of R \$0.28 per liter). In third place is the expansion of ethanol production capacity, a variation which corresponds to a range of R\$0.22 per liter in 2020.



The scatter plot shown represents the range of different curves generated by MIPE for the price of ethanol for the period 2011-2020, after a number of simulations. Each year, the model calculates the minimum, maximum and median values among all values obtained in the simulations for that year and plots them on the graph.

## Scenarios for the price of ethanol in Brazil

In R\$

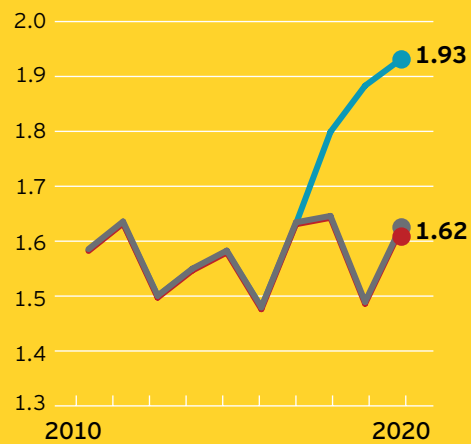


### Impact of main drivers in the ethanol market

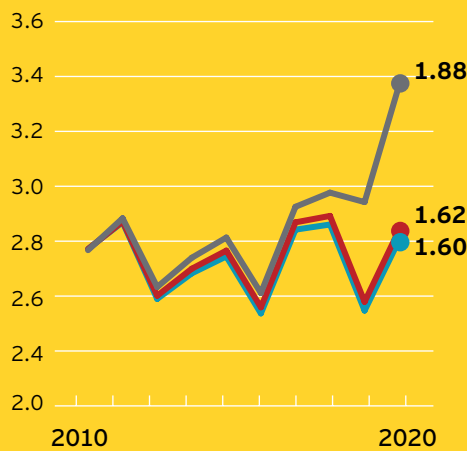
In R\$

● Scenario A ● Scenario B ● Scenario C

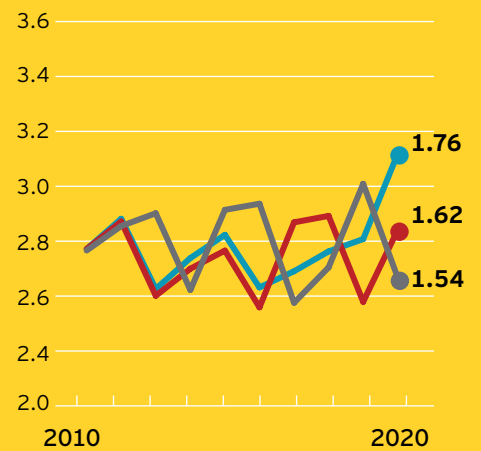
#### Year of transition\*



#### Exchange rate



#### Increased supply



Price curves for the price of ethanol in scenarios A, B and C are defined for each driver (see page 18). In each graph, only the driver in question varies, the remaining six factors are held constant.

\*Refers to the pricing policy of Petrobras. In scenario A, the transition of regime starts in 2011; in scenario B, in 2015; in scenario C, no regime transition occurs.



## Natural gas: an expanding market

Natural gas is poised to have a more important share in energy supply in Brazil over the next decades. Largely associated with oil production, natural gas use will expand when the pre-salt oil fields begin to operate and gas distribution networks are extended.

In 2010, total supply of natural gas in Brazil was 61.7 million m<sup>3</sup> per day, of which 45% was produced domestically, 43% imported from Bolivia and 12%, imported from Trinidad-Tobago and Nigeria in the

**The main consumers of the natural gas sold by distributors (50 million m<sup>3</sup>/day) are the states of São Paulo, Rio de Janeiro and Bahia.**

form of liquefied natural gas (LNG). In the period 2000-2010, local production grew at a rate of 5% per year. Meanwhile, imports from Bolivia increased at a rate of 16% per year, under a 20-year contract between the two countries. The contract will be renegotiated in 2019, when it is estimated that natural gas production in Brazil will have reached 176 million m<sup>3</sup> per day, further increasing Brazil's bargaining power *vis-à-vis* Bolivia.

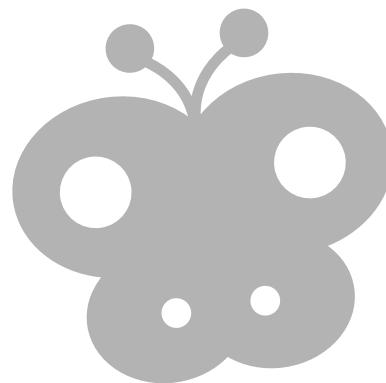
Over the decade 2010-2020, in addition to the pre-salt fields to be developed, two new fields should become operational - the Mexilhão field of non-associated gas, in the Santos basin (with 70 billion m<sup>3</sup> of reserves and production estimated at 10 million m<sup>3</sup> per day), and the Camarupim field, in the Espírito Santo basin (estimated production of 10 million m<sup>3</sup> per day).

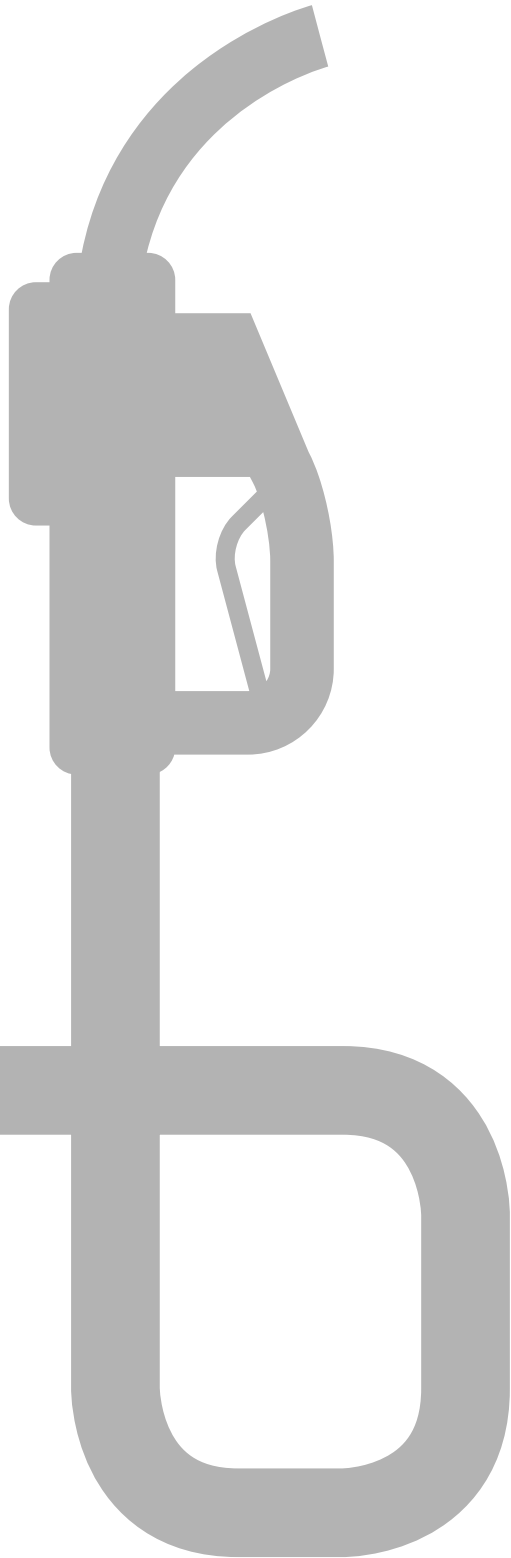
Most of the natural gas reserves (68% of the total) and production (80% of the total) consist of gas associated with oil, which is partly flared during oil production for lack of proper exploration infrastructure.

ANP regulations state that flaring cannot exceed 3% of production, so it is a priority to establish the infrastructure for natural gas flow in pre-salt production systems. About 13% of the volume of natural gas produced is used for Petrobras' own consumption.

The Southeast region consumes 70% of the country's natural gas, the Northeast region 18%, the North 2% and, the South 10%. The interconnection of gas pipelines in the Southeast and Northeast regions through Gasene (Gasoduto Sudeste-Nordeste, or Southeast-Northeast Gas Pipeline) should increase consumption in the Northeast, where gas demand was weak throughout the 2000s due to lack of product availability.

As for the natural gas marketed by distributors (50 million m<sup>3</sup> per day), the main consumers are the states of São Paulo (16 million m<sup>3</sup> per day), Rio de Janeiro (15 million m<sup>3</sup> per day) and Bahia (4 million m<sup>3</sup> per day). The industrial sector is the main





consumer (26 million m<sup>3</sup> per day), primarily in the Southeast (70%), in the states of São Paulo (49%) and Rio de Janeiro (15%). Home consumption is relevant in the states of São Paulo and Rio de Janeiro, which have a significant distribution network. In the remaining states the distribution network is still expanding and caters primarily to the industrial and electricity generation sectors.

In 2010, with greater reliance on thermal sources, electricity generation consumed about 16 million m<sup>3</sup> of gas per day. Cogeneration (steam and electricity generation), with consumption of about 3 million m<sup>3</sup> per day, has advanced in the service sector and tends to compete with electricity utilities. The consumption of Liquefied Natural Gas, or LNG, as a fuel for vehicles, was about 7 million m<sup>3</sup> per day.

A study carried out by the Energy Research Company (EPE) found that, in 2019, total consumption of

natural gas will be 169 million m<sup>3</sup> per day. The industrial sector will consume 50.7 million m<sup>3</sup> per day (30% of the total), industrial cogeneration will reach 4.6 million m<sup>3</sup> per day and electricity generation will consume 15.9 million m<sup>3</sup> per day. LNG consumption will be 10.7 million m<sup>3</sup> per day. The growing supply opens new opportunities for natural gas for that period, particularly in the industrial and transportation sectors, where it can be used for cogeneration, for generation of electricity in peak hours and for public transportation.

The development of networks of liquefied natural gas (LNG) in many producing countries is giving a global dimension to a market with regional characteristics, organized around the Atlantic Basin and the Pacific Basin, with an interface in the Middle East. The development of shale production gas in the United States shows that dynamic, by changing demand and price conditions in the global natural gas market. The United States was a major importer

**Due to the distance of gas fields from the Brazilian coast, gas companies should implement Floating Liquefied Natural Gas facilities.**

of the product, with a yearly average of 115 billion m<sup>3</sup> from 1990 to 2008, with a forecast for growth in the coming decades. For this reason, many recent investments in natural gas liquefaction plants in producing countries were aimed especially at the U.S. market.

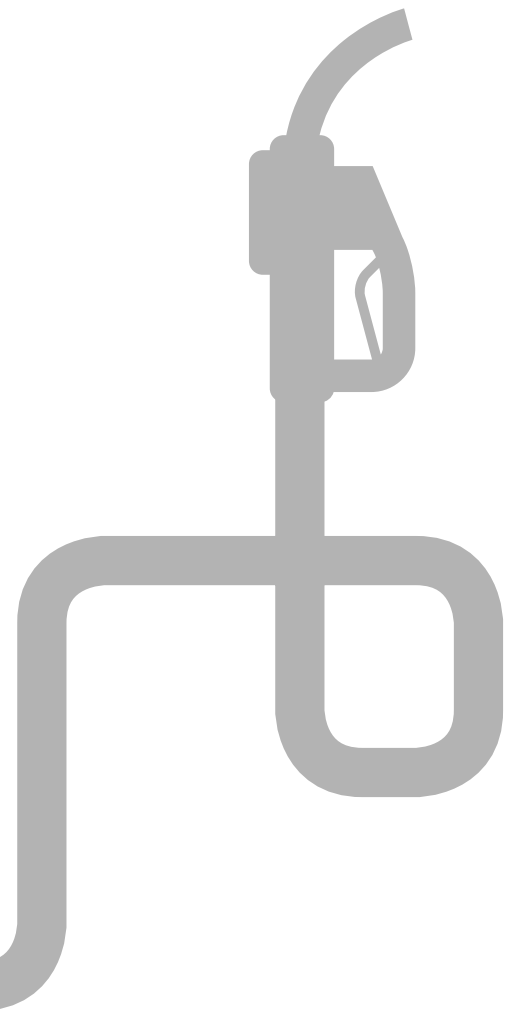
The production of shale gas in Brazil is being developed by several companies and should reach 88 billion m<sup>3</sup> in 2009. This should lead to a redirecting of LNG flow, previously directed towards the U.S. market, to the European Union and the Pacific Rim (Asia and Oceania).

The LNG supply from Qatar (the third largest world reserve, with 25 trillion m<sup>3</sup>) has a capacity of 77 mtpa (millions of LNG tons per year), built over the decade 2000-2010. The transition strategy to be adopted by this country should steer it to join competition with other suppliers that cater to the European Union (which would thus lessen its dependence on Russia) and the demand for

natural gas for electrification of the oil-producing countries in the Middle East.

Throughout the decade, new areas of shale gas production can be explored in the EU and Russia and in Asia, but there is still much uncertainty about the likely volume of extraction and production costs. In Brazil, it is estimated that the production of natural gas fields to be developed in the pre-salt layer will correspond to 20% of the country's oil production.

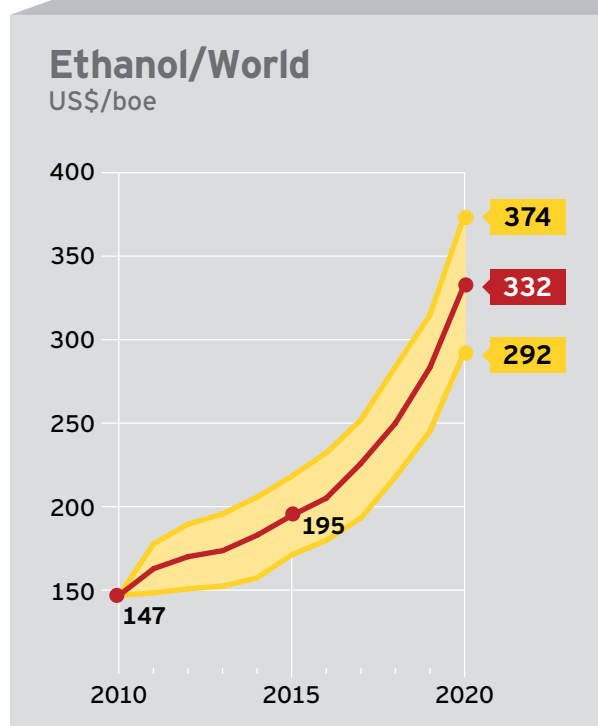
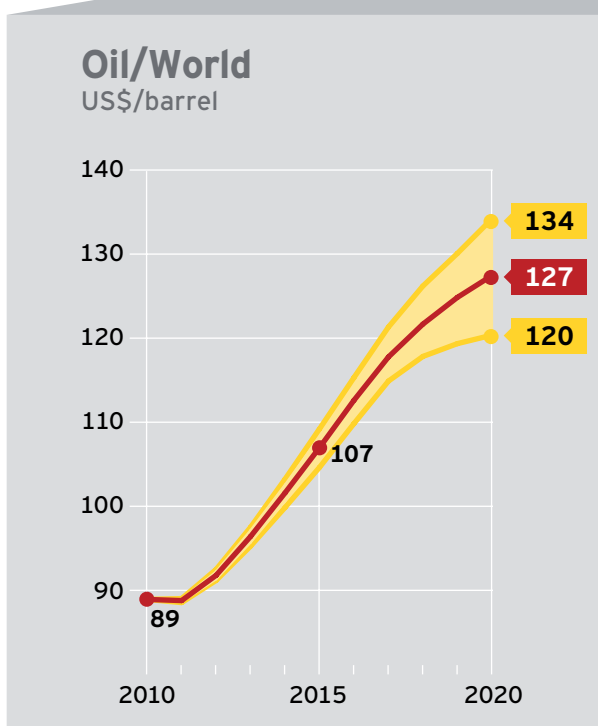
Due to the distance of gas fields from the coast, gas companies should implement Floating Liquefied Natural Gas facilities, from where the product will be shipped by tankers to regasification plants located on the coast of Brazil, or else exported. With the start of the liquefaction operations in the pre-salt layer, new regasification units should be installed along the Brazilian coast. The purchase of LNG from other natural gas producing countries can also be negotiated.



# THE DRIVERS PRICE SCENARIO

The importance of drivers in the oil, gasoline and ethanol markets

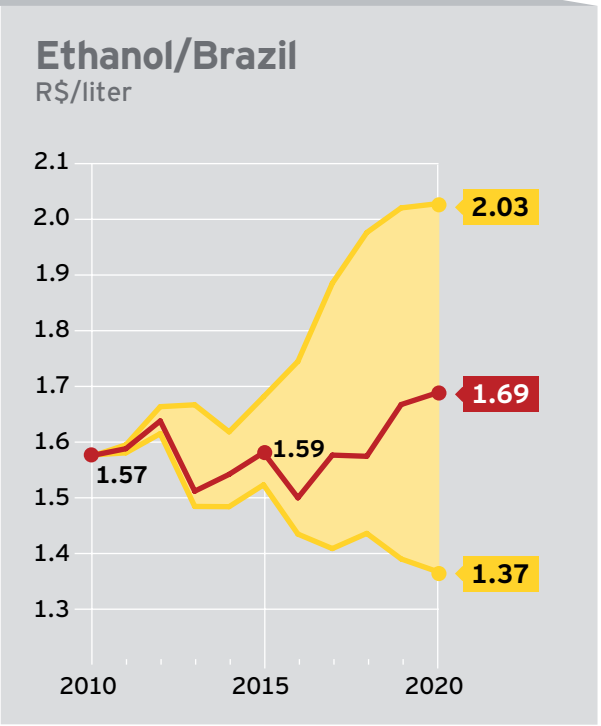
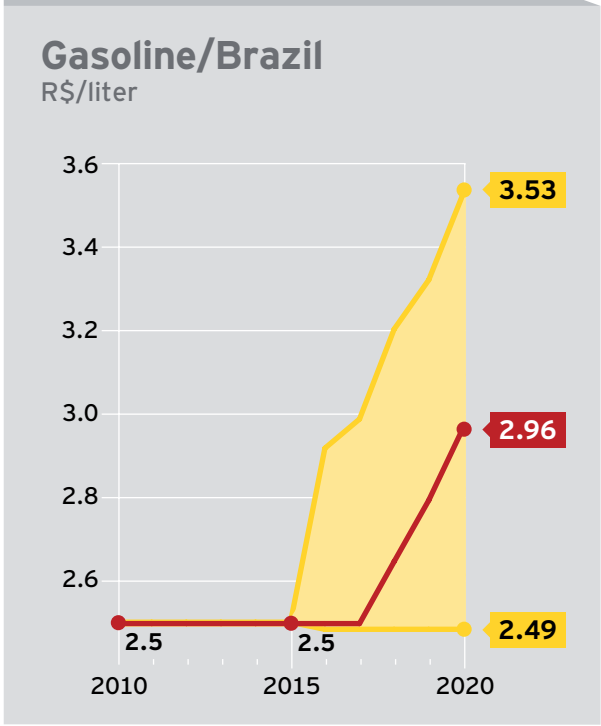
	Oil/World	Ethanol/World
1 <sup>st</sup>	Economic potential	Economic potential
2 <sup>nd</sup>	Efficiency and replacement	Subsidies for ethanol
3 <sup>rd</sup>	Expansion of oil supply	Expansion of ethanol supply



# RIOS



Gasoline/Brazil		Ethanol/Brazil	
Exchange rate	Transition year at Petrobras	1 <sup>st</sup>	
Transition year at Petrobras	Exchange rate	2 <sup>nd</sup>	
Economic potential	Expansion of ethanol supply	3 <sup>rd</sup>	



Average price of gasoline in Brazil:  
**R\$ 2.96**  
 up 18.7% by 2020.

Average price of ethanol in Brazil:  
**R\$ 1.69**  
 up 7% by 2020.

# Looking ahead: changes by 2020

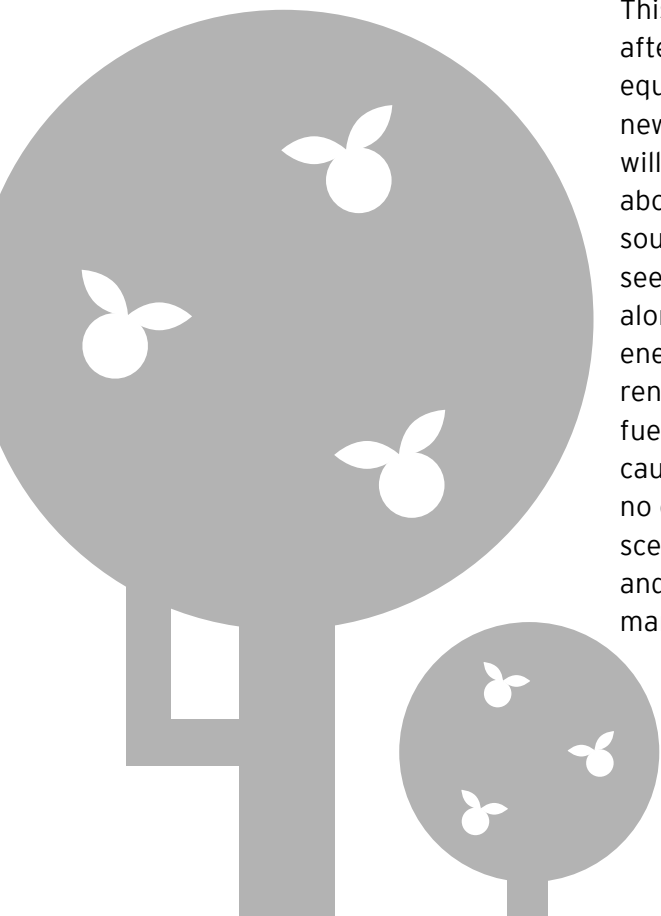
## In the picture by 2020, rising prices and promotion of renewables

The years up leading to 2020 have substantial changes in store regarding the outlook for international energy markets. Prices tend to rise steadily as of 2011, driven by the mismatch between demand growth and the incorporation of new reserves. This trend begins to plateau only after 2017, pointing to a new equilibrium made possible by new sources, which nevertheless will have production costs far above the average of current sources. This trend does not seem likely for the ethanol market along this period; as the global energy matrix tends to favor renewables, the demand for this fuel tends to stay ahead of supply, causing a rise in prices with no end in sight. According to this scenario, the average prices of oil and ethanol in the international market should reach median

increases of 43.1% and 125.9%, respectively, by 2020.

How these changes in the international scene will impact upon the Brazilian fuel market will be dictated, first of all, by Petrobras's pricing policy and by exchange rate variations. The average price of gasoline should not start to rise systematically before 2015 and, in fact, may not change at all during the entire period, with a median increase of just 18.7% by the end of the period. This prevents ethanol prices from following world quotations. In fact, depending on the pressures of demand, price tends to be stable and then follow gasoline in its post-2015 climb, or even fall. The trend is for a median increase of only 7.0% by 2020.

Such trajectories can be affected by various conditions, and each of the seven drivers considered at the beginning impact the markets analyzed with different intensity. The analysis, supposing unchanged conditions, highlights the potential



**Taking into account the country's GDP growth over the decade, exports generated by pre-salt oil will only have a positive impact of about 0.4 percentage points on the Brazilian GDP by 2020.**

for economic growth, which appears as the main condition for global oil and ethanol markets, followed by the Brazilian market for gasoline.

Regarding the national scene in general, exchange rates and the year of transition regimes for Petrobras are the most prominent drivers, occupying the top two spots in the markets for gasoline and ethanol. More technical constraints, such as increasing the supply and efficiency and replacement initiatives, even though subject to less uncertainty, are also of high impact. Finally, the trajectory of ethanol subsidies, especially in the U.S., appears to be an important driver for the evolution of world prices of this fuel.

### Impacts of pre-salt on oil exports

Thanks to the huge investments being made in its exploration, some believe that pre-salt oil will have significant impacts on Brazil's export profile and economic development. However, for the horizon analyzed here, these conclusions are not well grounded.

As previously mentioned, Brazil's domestic oil consumption will grow significantly by 2020. As a result, the expansion of pre-salt production will only be partially directed for export, which, by the end of the decade, is expected to reach approximately 600,000 barrels / day in 2020. This volume corresponds to revenues of \$ 27.9 billion / year, which is a significant value, but only represents a 73% growth as compared to the country's crude oil exports, which in 2010 amounted to US\$ 16.1 billion. In addition, oil is not expected to replace ores (US\$ 30.8 billion in 2010) as the main export item.

Additionally, supposing that during the next decade the country's exports were to grow at a rate equal to its historical average (1991-2010), then in 2020 oil export revenues (US\$ 27.9 billion mentioned above) will represent 5.2% of total exports.

Finally, taking into account the country's GDP growth over the decade, exports generated by pre-salt oil will only have a positive impact of about 0.4 percentage points in Brazilian GDP by 2020. It becomes clear therefore that the importance of oil exports to the Brazilian economy will grow moderately in absolute terms, and may even decline in relative terms. This is especially true if the industry continues to emphasize on crude oil production and export, not refining and adding value.

# Vision of the future: what to expect after 2020

In the literature on the future of energy markets, there is ample room for contradictions and differing views. Some authors of the peak oil current bet on drastic scenarios of energy shortages. In these projections, the world, and especially the U.S., will be unable to reinvent its energy structure in order to smoothly adapt to new price conditions. This would lead to serious consequences not only for economic growth and continued investment, but also for power relations, geopolitical structure and food security globally.

At the other extreme, there is a current of thought marked by “technological optimism”. According to these analysts, economic pressures always generate incentives for the development of new energy sources at low cost, so that chronic shortage scenarios generate their own solutions. Unfortunately, history shows several examples of situations where technologies of high potential for profit or social benefit have not been able to overcome the entrenched positions and networks of perverse incentives. Thus, this study does not adhere to

either of the two positions, opting for a “middle way” based on physical, technological and economic evidence.

## Energy payback determines long-term sustainable sources

Although the post-2020 scenario involves a greater degree of uncertainty, it is possible to draw some clear conclusions regarding the factors most relevant for that timeframe. First, one should expect an increase in the relevance of the concept of “energy return on energy investment” (EROEI), or energy payback.

Explained, the EROEI is the ratio between energy used to obtain a given resource and the energy gained in its use. It is an interesting indicator as it bypasses the mediation of the price system and provides an engineering parameter that can be estimated for a given technology which uses a particular energy resource.

**On the demand side, the main factor in sight in the post-2020 period is the electrification of the automobile fleet, which is expected to be substantial.**

As fossil fuels become scarce and the stability of input prices is no longer considered a given, traditional analysis on economic feasibility of resources is to be replaced by EROEI analysis, which identifies energy sources with greater potential for being physically and technically sustainable in the long run.

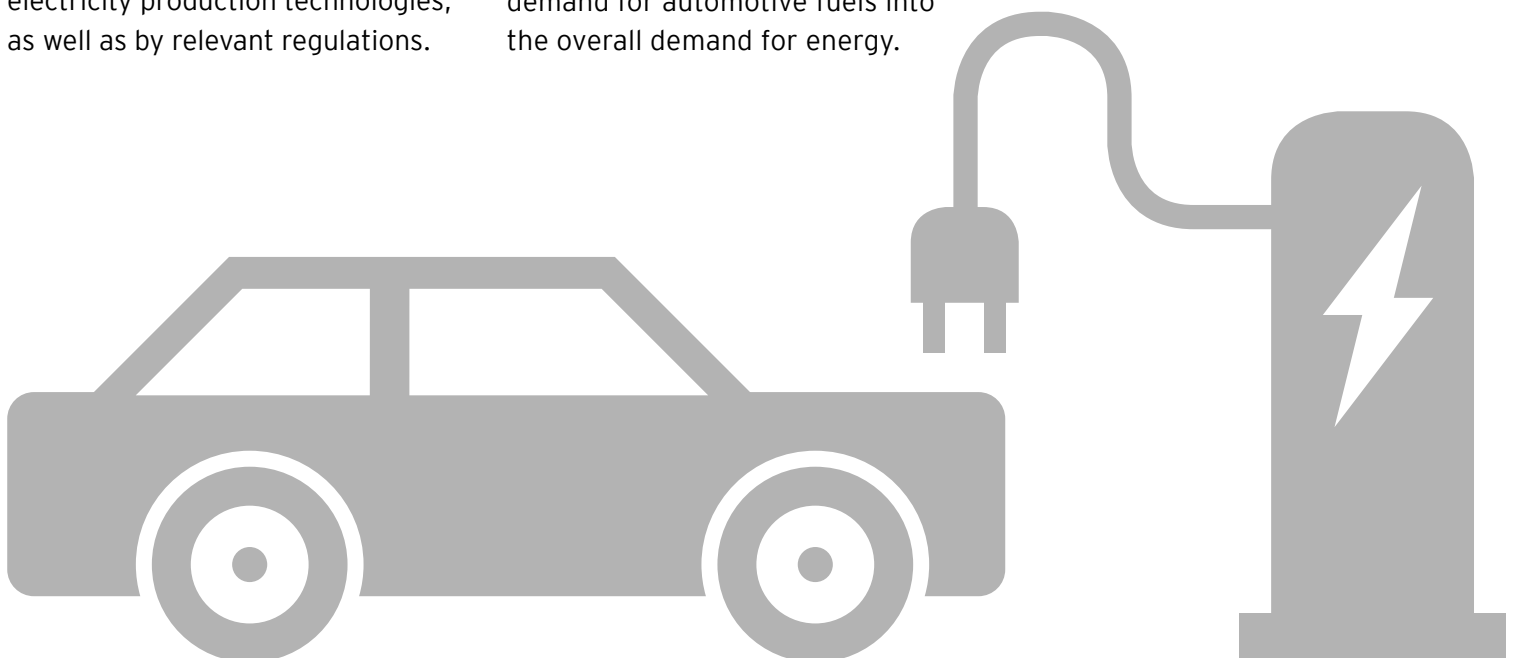
On the demand side, the main factor in sight in the post-2020 period is the electrification of the automobile fleet, which becomes substantial. In a scenario where technologies such as the plug-in hybrid car gain importance in the fleet's composition, fossil and renewable fuels become partially replaced by electricity and therefore the demand for them will be affected by the EROEI of electricity production technologies, as well as by relevant regulations.

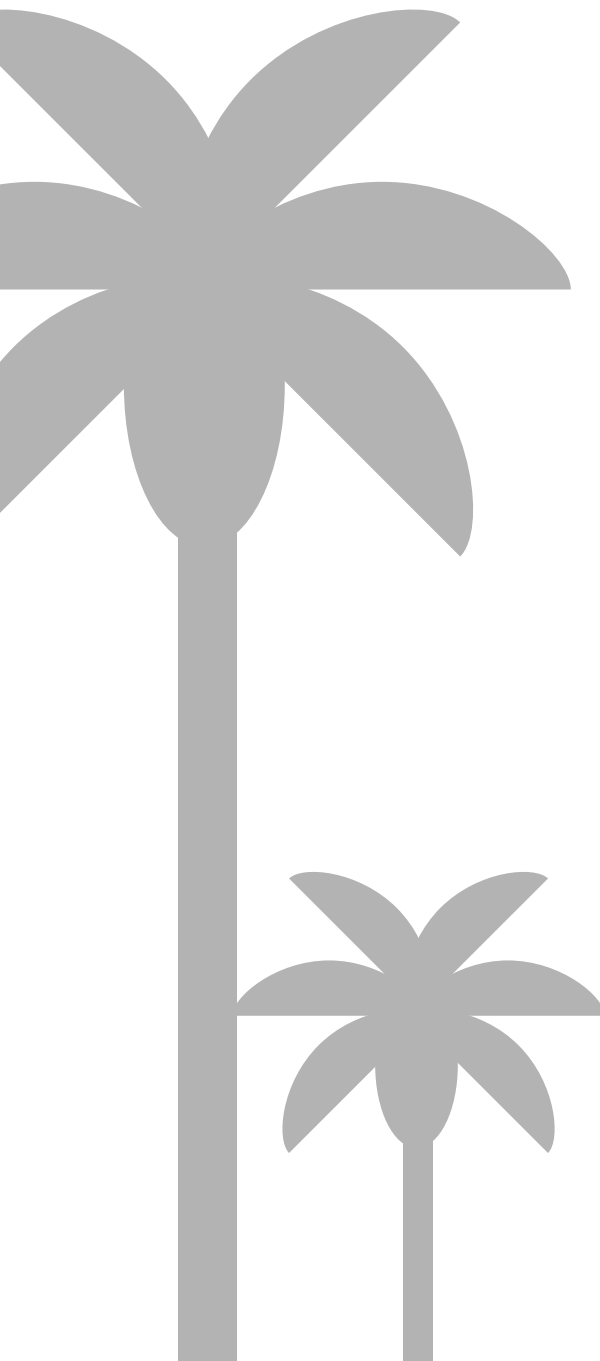
## **Restrictions on supply may limit growth**

In the post-2020 period, the feedback structure between economic growth and energy demand deserves careful examination. This feedback has been represented so far by an isoelastic model, i.e., one where the demand curve has constant proportions and is free from the effects of sudden cuts. In fact, excluding moments of artificial supply restriction, this hypothesis has proved to be historically valid, and it is highly likely to continue to be valid, particularly as electrification of the fleet advances, integrating the demand for automotive fuels into the overall demand for energy.

In this sense, a scenario where energy prices remain high for a long time or indefinitely, can generate different effects on the consumption pattern, effects that will generate macroeconomic impacts well beyond the isoelastic model. For example:

- ▶ A low price-elasticity ratio in the short term (unwillingness of families and businesses to reduce their energy consumption in the face of high prices) may reduce the added value of production as well as available income, decreasing consumption of other goods and investment capacity of the economy;

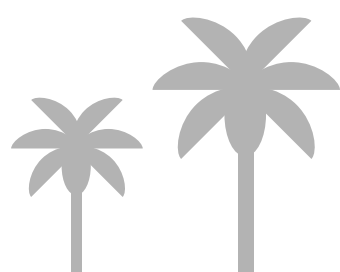


- 
- ▶ On the other hand, high price-elasticity in the short term (an option for dramatically reducing energy consumption) can derail the production of a substantial fraction of the economy, affecting its feasibility;
  - ▶ Finally, given a sufficiently long-lasting change in energy prices, long-term effects become relevant. Consumer preferences are radically altered, either by introducing new modes of transportation and production, or through cultural changes in response to prices above a certain threshold - for example, shifting demand for consumer goods to electronic commerce.

Given the historical stability already mentioned, it is reasonable to believe that prices will never reach such peaks so as to activate the effects described. However, these adaptations have a historical precedent, as evidenced by the successive replacement of sources in global energy production over the centuries.

In this context, recent events have brought substantial uncertainties regarding the future supply of energy and its cost. On the one hand, geopolitical instability in the Middle East calls into question much of the oil production capacity, and this situation may remain negative for a longer term.

On the other hand, the nuclear disaster in Fukushima, Japan, could have substantial consequences on the planning and restructuring of global energy in the long term, increasing demand pressures towards other sources. Nevertheless, it is more likely that companies, governments and consumers will gradually break the technological, political and psychological shackles that keep them dependent on fossil fuels and thus create the conditions for a sustainable market for renewable energy.



# Challenges and opportunities

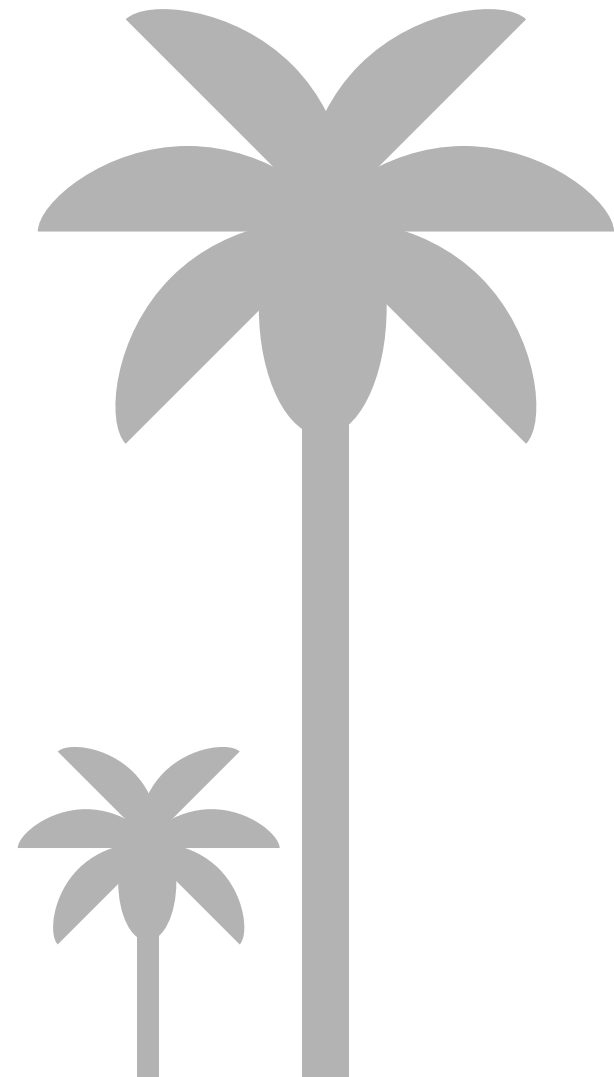
## Pre-salt: promise of riches, but with great challenges

Having achieved oil self-sufficiency for the first time in 2006, Brazil is now facing the possibility of becoming a major world producer. Pre-salt reservoirs, according to predictions based on the results obtained from more than 30 exploratory wells, may be of a magnitude of 50 billion to 100 billion barrels or more.

The beginning of the exploration of deposits in the pre-salt fields off Santos, Campos and Espírito Santo gave a new dimension to local oil and gas industry, with great repercussions on the international market. Exploitation and production should attract investments exceeding \$ 250 billion over ten years, including infrastructure and transport, as mentioned in previous chapters. However, some believe that overall spending in this market may reach \$ 1 trillion, as Brazil currently offers the greatest opportunities for the global high seas offshore oil industry.

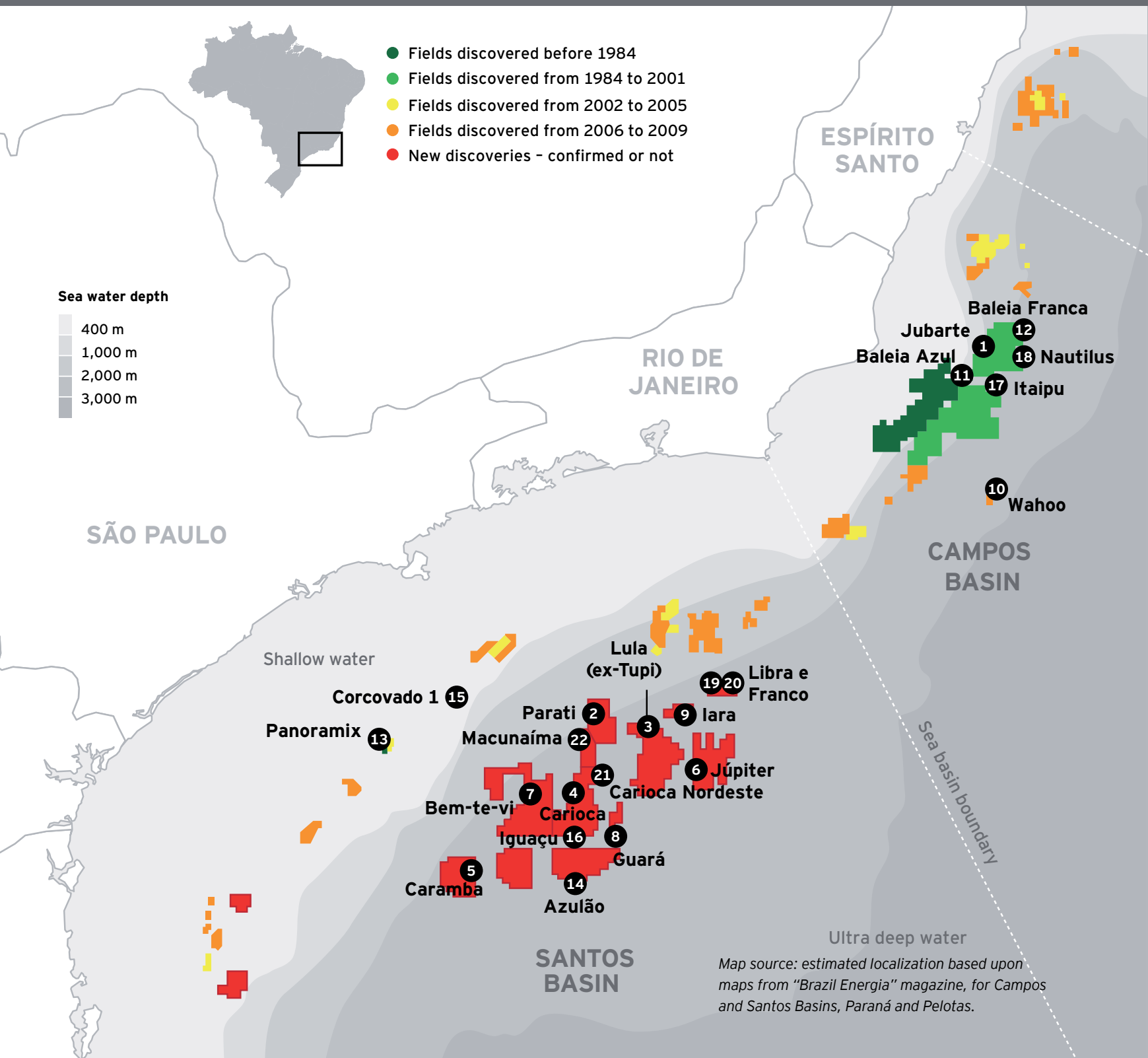
Pre-salt operations involve extracting oil 7,000 meters below the water surface, at distances of up to 300 kilometers offshore. The complexity of this challenge will require the participation of a broad value chain, composed of hundreds of companies focused on developing new technologies and thousands of providers of services, equipment and supplies for both the industry giants such as Petrobras and large multinationals, as well as for smaller domestic companies.

Individually, it can be said that the greatest legacy of the pre-salt exploration for Brazil is not the oil by itself or the accumulation of more reserves, but the development of a high-tech industry - with global suppliers located in Brazil and a capacity to meet comprehensively complex and sophisticated demands from both the oil and gas industry as well as from many others. It will also lead to the arrival of a number of highly skilled technicians, trained on large projects as well as new technologies and technical and environmental standards, which could be the drivers of new

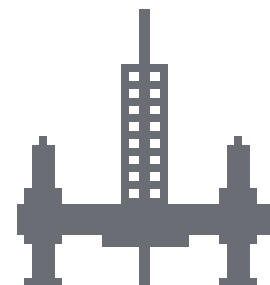




# Pre-salt fields



Map source: estimated localization based upon maps from "Brazil Energia" magazine, for Campos and Santos Basins, Paraná and Pelotas.



						ESTIMATED RESERVES (BARRELS)
NAME	DATE	BASIN	BLOCKS	OPERATORS	PARTICIPANTS	
1 JUBARTE	Jan/01	Campos	BC-60 (Parque das Baleias)	Petrobras (100%)	Petrobras	n/a
2 PARATI	Jun/05	Santos	BM-S-9	Petrobras (65%)	BG (25%), Partex (10%)	n/a
3 TUPI	Jul/06	Santos	BM-S-11	Petrobras (65%)	BG (25%), Galp Energia (10%)	5 to 8 bi
4 CARIOCA	Sept/07	Santos	BM-S-9	Petrobras (45%)	BG (30%), Repsol YPF (25%)	2 to 6 bi
5 CARAMBA	Jan/08	Santos	BM-S-21	Petrobras (80%)	Galp Energia (20%)	n/a
6 JÚPITER	Jan/08	Santos	BM-S-24	Petrobras (80%)	Galp Energia (20%)	5 to 8 bi
7 BEM-TE-VI	May/08	Santos	BM-S-8	Petrobras (66%)	Shell (20%), Galp Energia (14%)	3 to 4 bi
8 GUARÁ	Jun/08	Santos	BM-S-9	Petrobras (45%)	BG (30%), Repsol YPF (25%)	3 to 4 bi
9 IARA	Aug/08	Santos	BM-S-11	Petrobras (65%)	BG (25%), Galp Energia (10%)	3 to 4 bi
10 WAHOO	Sept/08	Campos	BM-C-30	Anadarko (30%)	Devon Energy (25%), EnCana (25%), Maersk (20%)	300 mi
11 BALEIA AZUL	Nov/08	Espírito Santo	BC-60 (Parque das Baleias)	Petrobras (100%)	Petrobras	1.5 to 2 bi (including Baleia Franca)
12 BALEIA FRANCA	Nov/08	Espírito Santo	BC-60 (Parque das Baleias)	Petrobras (100%)	Petrobras	1.5 to 2 bi (including Baleia Azul)
13 PANORAMIX	Jan/09	Santos	BM-S-48	Repsol YPF (40%)	Petrobras (35%), Woodside Petroleum (12.5%), Companhia Vale do Rio Doce (12.5%)	n/a
14 AZULÃO	Jan/09	Santos	BM-S-22	ExxonMobil (40%)	Amerada Hess (40%), Petrobras (20%)	5 to 10 bi
15 CORCOVADO-1	Apr/09	Santos	BM-S-52	BG (40%)	Petrobras (60%)	n/a
16 IGUAÇU	Apr/09	Santos	BM-S-9	Petrobras (45%)	BG (30%), Repsol YPF (25%)	n/a
17 ITAIPU	Jan/10	Campos	BM-C-32	Devon (40%)	Anadarko (33.3%), Maersk (26.7%)	n/a
18 NAUTILUS	Jun/10	Campos	BC-10 (Parque das Conchas)	Shell (50%)	Petrobras (35%), Oil and Natural Gas Corp. (India) (15%)	n/a
19 FRANCO	May/10	Santos	2-ANP-1 RJS	Petrobras (100%)	Property of the Government	4.5 bi
20 LIBRA	Oct/10	Santos	2-ANP-2 RJS	Petrobras (100%)	Property of the Government	7.9 bi
21 CARIOCA NORDESTE	Jan/11	Santos	BM-S-9	Petrobras (45%)	BG (30%), Repsol YPF (25%)	n/a
22 MACUNAÍMA	Feb/11	Santos	BM-S-10	Petrobras (65%)	BG (25%), Partex Brasil (10%)	n/a



intellectual, capital-intensive companies in the XXI century.

### **Dependence on natural resources**

A common concern for countries that find a great source of natural wealth is that of becoming too dependent on that wealth without the benefits reaching the majority of the population and other economic sectors. Such concern has been shared by market entities, regulators and the federal government. Several elements of the legal and regulatory framework of the industry see to issues such as this in order to capture and leverage the benefits of pre-salt for the country.

In any case, despite the Brazilian government's efforts to ensure that in pre-salt times development is carried out in a sustainable manner, many bottlenecks need to be addressed. Any industry subject to strict regulations imposed on companies taking part in its productive chain face important organizational and managerial challenges in order to maintain their operations and growth rate. In complex environments, such as that of the regulatory framework created for the Brazilian oil and gas industry, operators and vendors will be required to be well aware of the risks

involved in the activity and be able to meet the increased demand for products and services.

Furthermore, it must be clear that, in order for the promise of wealth and socioeconomic development to be accomplished, immense challenges need to be overcome. These lie in the areas of technology, infrastructure and logistics, legislation (the regulatory framework), taxes, human capital and attracting investment, as detailed in the following pages.

## **The radar view of critical challenges**

For a better view of the immense challenges that come with the pre-salt opportunities, our analysts have developed, based on our studies and consultation with market sources, a "radar screen" with the top ten challenges for pre-salt development, based on the promise this project represents for the country.

The challenges closer to the center of the radar scan are seen by analysts as those most relevant to be overcome by Brazil and by the players in this market. The radar is divided into four

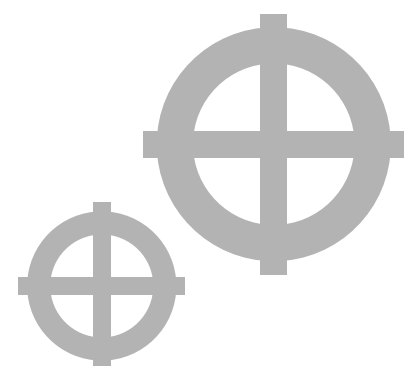
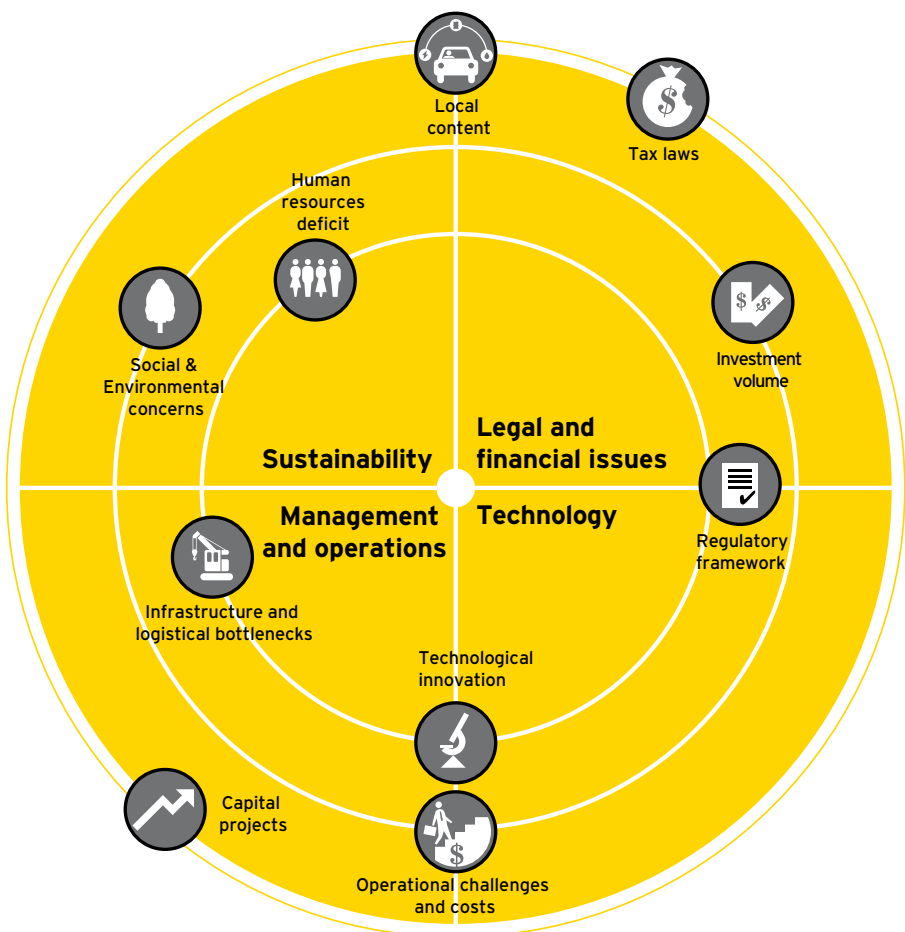
In order for the promise of wealth and socioeconomic development to be accomplished, immense challenges need to be overcome.

quadrants: Sustainability, Legal and Financial issues, Technology and Operations.

Sustainability involves environmental and socioeconomic responsibility issues, while the quadrant of legal and financial issues covers the regulatory framework as well as finance and investments. The challenges of operations, logistics, supply chain and technology, are in turn covered by the sections Technology and Management and Operations.

Given the complexity and magnitude of the challenges, by using this graph we intend to show synthetically the immense challenges that Brazil should keep on its radar so that these riches do in fact become the main foundation for development of the country, its economy and its people.

### Radar: The ten biggest challenges of pre-salt



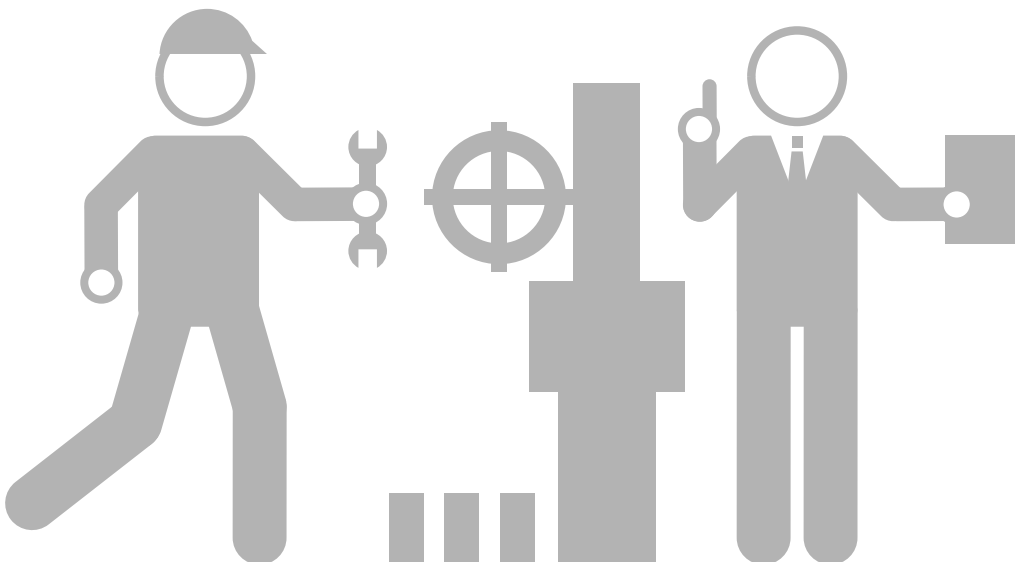
## Shortage of human capital

The shortage of skilled labor is one of the country's major bottlenecks. The number of technicians and engineers that the country has - or will have in the coming years - is not enough to cope with the demands expected from the large volume of investments allocated to pre-salt exploration and production. One of the most immediate consequences has been the arrival of foreign skilled labor in large numbers. According to the Ministry of Labor, since 2006 the number of requests for work permits for foreigners has increased steadily year on year.

In 2010, a total of 56,006 work permits were issued, compared to 42,914 in 2009. Of the total permits issued last year, 53,441 were temporary, allowing for a stay up to two years. The oil and gas industry is the main source of these requests, generally aimed at engineers specialized in the supervision of assembling equipment and managerial tasks, for example, on drill ships in high seas.

### The inflow of foreign skilled labor is expected to double

Applications for work permits have been increasing in recent years not only for exploration and production activities, but also in building refineries, ports, shipyards and infrastructure. The inflow of foreign labor is expected to double in a decade, introducing a new profile of immigrant status in the country: highly skilled professionals of different nationalities. In the oil sector, vessels and platforms arrive with their full crews already on board: hundreds of workers who need work permits to enter Brazil or to work on board, offshore.



## The number of technicians and engineers in the country is not sufficient for the demands created by pre-salt investments.

Nowadays, there are already more expats than Brazilians on the oil rigs. The average capacity of a rig is 100 to 150 people, i.e., a total between 200 and 300 people employed, on account of the various shifts. We have come to a point of questioning the need for more flexible legislation for these workers: there is a bill in Congress requiring minimum percentages of Brazilian nationals in various stages of production on the platforms.

### Work visas: a critical issue

Companies bringing foreign workers face different problems when applying for work visas. These must be carefully analyzed and require expert advice and much planning. An example is the case in which the visas of technicians whose skills are essential for operations expire: sometimes it may take months to get new visas, with the risk of production stoppage. Furthermore, one must make sure that the company requests the right visa, at the risk of paying heavy fines. There are different types of visas, such as one for technical assistance, another for

technology transfer, and others for experts who will stay on board the rigs with no right to land (except to go straight to the airport) and even permanent visas for directors, executives and other management staff.

Hundreds of visas for embarked / offshore personnel are issued simultaneously, which requires collective efforts to ease bureaucracy.


### Specific tax and social security issues

There are tax and social security issues that need to be studied and applied to the specific characteristics of the oil and gas industry. With regards to expats, for example, the first step is to determine the date the person's tax residence in Brazil is acknowledged, which depends

on the nature of visa granted to the foreigner and their physical presence in the country.

Once a tax resident, the alien becomes subject to the same tax regime as a Brazilian, for example, the Individual Income Tax Return (IRPF) and the monthly mandatory tax prepayments (Carnê-Leão). Holders of permanent or temporary visas with an employment contract become tax residents from the date of entry into the country, whereas





temporary visa holders not employed by a Brazilian company become subject to tax laws only after 183 days (consecutive or not) of physical permanence in the country within a period of 12 months.

### **Double taxation - a warning**

Easing the red tape for the arrival of foreigners is not enough to solve the skilled labor “blackout”. Besides, another question must be addressed urgently: the double taxation of these workers, which occurs when two or more countries believe they have the right to tax the same income. Currently, Brazil has international treaties with 29 countries to avoid double taxation; it also records reciprocal tax treatment with the United States, Britain and Germany, in order to minimize double taxation.

However, many foreigners come from countries with which there is no treaty or agreement, making the transfer of these professionals more expensive. In addition to the income tax, it is common for the payment of social contributions to be duplicated by both the employee and the employer.

In contrast, on the issue of Social Security, Brazil has 25 agreements signed, allowing for the payment of contributions in just one country (country of origin or destination, depending on the location of the professional at the time of retirement), the guaranteed benefits insured. In this regard, the Ibero-American Multilateral Agreement is the latest agreement, signed between the country and Bolivia, Ecuador and Spain.

### **How to minimize the surcharge?**

In the case of expats from countries with which Brazil has no treaty or agreement, double taxation is likely to occur. To prevent the tax burden falling on the expat, or else being covered by the employer, planning the transfers of personnel must come beforehand, anticipating the business needs. When this is not possible, the policies most often practiced are tax equalization, followed by tax protection, mechanisms to remedy or prevent excessive taxation harmful to the expatriate. On the other hand, they may increase transfer costs to the employer.

**In the coming years, universities will have to train more oil, marine and drilling engineers, environmental experts, geologists and IT specialists.**

Regarding social security contributions, if the transfer occurs between countries members of the Totalization Agreement, the employer / employee must request the appropriate documents for Social Security in their country of origin in advance, as these must be handed to the social security authorities of the destination country at the time of transfer.

### **Specific labor laws**

Although offshore employees regime is dictated by Brazilian labor legislation (CLT), Law No. 5811/72 - which regulates this regime - contains specific rules and benefits applicable to that category of workers:

- ▶ Bonuses for night shift work;
- ▶ Free meals;
- ▶ Free transportation to the workplace;
- ▶ 24-hour rest for every 8-hour shift on shore and every 12-hour shift off-shore;
- ▶ Double pay bonus in case time for rest or meals is cancelled;

- ▶ Free collective accommodation in lodging facilities suitable for resting and hygiene, and
- ▶ Special retirement for length of service of 25, 20 or 15 years, depending on the hardship of working conditions.

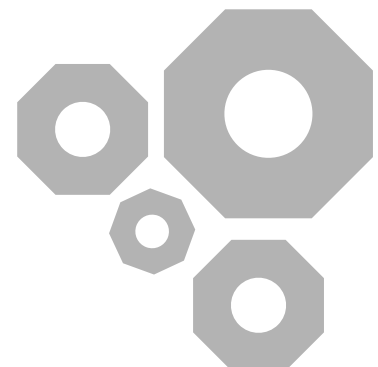
Moreover, according to Law No. 5811/72, an employee cannot remain onboard for a period exceeding 15 consecutive days.

### **Labor shortage**

The issue of human capital in oil and gas activity should not only be looked at from a legal point of view, i.e., immigration, labor, social security and tax issues, that may hinder and / or increase costs of hiring expat workers. This issue also involves the urgent need for training new workers, in order to prevent the much discussed "labor blackout".

If the ultimate goal of pre-salt exploitation is the country's socioeconomic development, it is necessary to train Brazilian workers. In the coming years, universities will have to train more oil, marine and drilling engineers, environmental experts, geologists and IT specialists. Still, these will be young

professionals with little experience, a reason that may increase the risk of accidents. Hence the importance of having Brazilian technicians work alongside foreigners, to make the transfer of knowledge effective. We should consider whether the time has come to relieve tax on the introduction of new technologies into the country, by cancelling the collection of a tax called "Cide", Contribution for Intervention in the Economic Domain.



## Socio-environmental concerns

One cannot talk about pre-salt and avoid the issue sustainability. However, the serious issues that should be treated as a priority to prevent serious social and environmental problems remain on the backburner. While much of the attention on this question is still focused on the economic and technological aspects, research and regulations aimed at environmental issues earn a sense of urgency.

The increase in economic activity due to the scale of the pre-salt layer fields is clearly visible: with this discovery, Brazil will soon join the ranks of the world's major oil producers. This is likely to enlarge Brazil's carbon footprint, not only

due to its burning more fossil fuels, but also due to the natural increase in economic activity as a growing number of companies and businesses that will set foot in the Brazilian market for new business opportunities.

Although this increase may hinder Brazil's share in global campaigns for the reduction of greenhouse gas emissions, this concern does not seem to be seen as a priority yet. Likewise, it is not known whether existing facilities for waste and effluent disposal or treatment will be able to cope with the additional volume to be generated by pre-salt related operations.

The possibility of increased environmental accidents should also be assessed. Exploitation of oil in pre-salt fields is a very complex operation, besides being a technological novelty. As a result, small mistakes can cause major environmental disasters, no matter how much care is given to avoid such mishaps. In this sense, a vital issue is to have



**Besides being a technological novelty, the exploitation of pre-salt oil is a very complex operation - any minor mishap can cause major environmental disasters.**

the chain of suppliers meet sustainability criteria.

### **Challenges and solutions**

In view of these challenges, urgent initiatives must be taken. One of them is the need to develop studies to reconcile the goals of reducing global greenhouse gases with increased domestic oil production and the number of oil companies operating in the country. In a scenario where socio-environmental issues grow in importance, the country should avoid taking a negative attitude towards the environment.

As a result, the following projects and actions are highlighted:

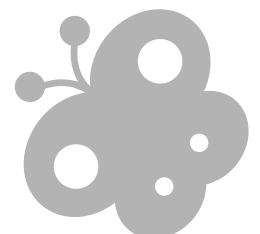
- ▶ Resizing existing facilities for waste and effluent treatment, and developing a system to monitor and control emissions and waste generation throughout the entire supply chain;
- ▶ Strengthening the model of effective partnerships with stakeholders such as NGOs,

government agencies and communities; this is already a worldwide trend and works in everyone's favor: government, private sector and stakeholders;

- ▶ Definition of the percentage of profits that will be allocated to the Social Fund. This fund was established by the federal government in order to allocate part of the proceeds of oil exploration to a long-term savings scheme, whose dividends are to be used for fighting poverty, improvements in education and in scientific and technological innovation. It also waits to be defined the use to be allocated to the Fund's money. For that to happen, it is necessary first to define an Investment Policy to be defined by a Financial Management Committee. This body will have its composition and working methods determined by the Executive but is not yet active. Accordingly, measures of socio-environmental development and research on renewable

energy are welcome, however they should be put into practice. It is essential to know whether the fund will have a chart and management that would have these measures adopted;

- ▶ Deeper assessment of risks of environmental accidents and safety. Investments to prevent accidents always take into account the risk versus impact matrix. In the oil industry, however, it has become standard practice to change the approach, and give priority to the assessment of the impact's magnitude, regardless of the risk. For example, if the impact associated with a particular risk is huge (like the BP accident in the Gulf of Mexico), even if such event is only slightly likely to happen, it should be considered a priority in the company's investments matrix. This concept is already clear to all oil operators: it must now be urgently extended to the entire supply chain involved in the process.



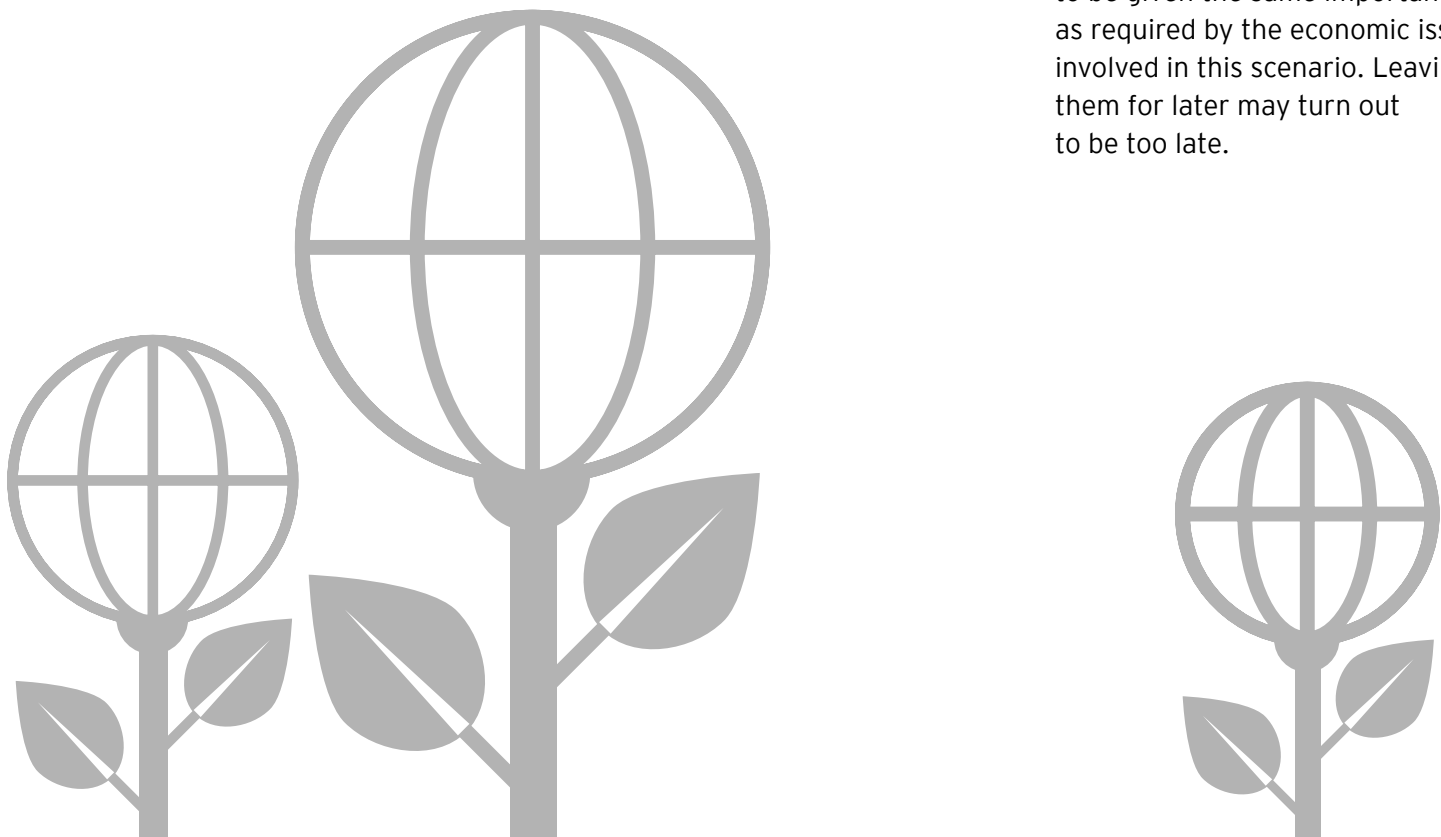
Regarding the Social Fund specifically, it is extremely important and urgent to establish an Investment Policy that will earmark these resources for solving actual socio-environmental problems that will inevitably arise from pre-salt exploration. We must make sure that the abovementioned issues are duly and timely addressed. Such legislation should also ban the use of these resources on actions that are not focused on or which have little to do with the compensation

of environmental and social impacts created by pre-salt operations.

Finally, it is essential to integrate social and health factors in the so-called Environmental Impact Assessments (EIA), which are a mandatory part of licensing for any potentially polluting large size facility. Many multinational companies have already adopted this guideline, especially those in the oil industry. Socio-environmental and Health Impact Studies can help

predict, in addition to environmental risks, those of a social nature and those related to workers' health. They can identify compensatory measures that can be put to work even before new oil exploitation and processing facilities start operations.

The magnitude of the challenges identified in order for the pre-salt operations to be conducted in a sustainable way and the difficulty in implementing the necessary actions to overcome them are enormous. Nevertheless, their urgent implementation should be treated as a priority: they need to be given the same importance as required by the economic issues involved in this scenario. Leaving them for later may turn out to be too late.



**The pre-salt scenario combines a deficit of human capital with sophisticated operations in an extremely remote and hostile environment.**

## Technological innovation

Oil extraction and production in the pre-salt area is a daunting challenge even for Petrobras, a world-class company in deep water operations.

In addition to being located at a much greater depth, these reservoirs have a different type of rock, based on carbonates. This kind of rock is more heterogeneous and unstable than those found drilling in post-salt layers, more familiar to the company. There is also the difficulty of drilling through 2 km of salt to get to these reservoirs. Due to its plastic nature, salt can jam the drill string and cause well closure, besides of damaging the steel used in the operation. Therefore, there is ongoing investment in the development of more resistant materials.

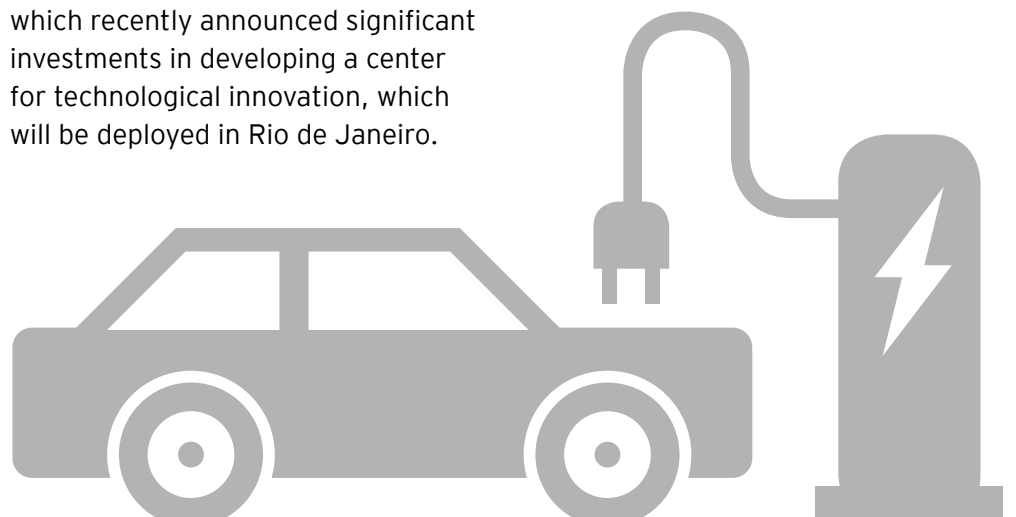
Another major challenge is the high content of carbon dioxide associated with pre-salt oil. When combined with water, carbon dioxide forms carbonic acid - a major cause of the corrosion of the equipment steel linings.

## Advances in scientific research

To address these obstacles, Petrobras has invested in scientific and technological research, conducted by its Research Center (Cenpes), and based on programs established in partnership with universities and R&D centers throughout the country. There are, however, a large number of services and high-tech equipment that need to be supplied by major international oil companies participating in the operation. Pre-salt presents a challenge to innovation for them as well and therefore, some have already anticipated and set up laboratories in the country. One example is OFS - Oilfield Services - companies, such as Schlumberger, that have already opened research centers in Brazil. Others follow the same trend. This is also the case of BP, which recently announced significant investments in developing a center for technological innovation, which will be deployed in Rio de Janeiro.

The offshore oil industry involves immense structures, such as platforms and ships with cranes capable of lifting tons of piping, tubes, drilling rigs, underwater robots and a complex array of electronic instruments and valves that control the flow of wells. Still, there is a second major technological challenge, besides the peculiar geological features of the pre-salt layer, related to information technology (IT).

The pre-salt scenario combines a deficit of human capital with sophisticated operations in an extremely remote and hostile environment. In this context, the integration and monitoring of operations in real-time are major challenges for the industry.



In the last decade, much has been said of the concept of a digital oil and gas industry. Experts use different names and acronyms to define this concept - DOFF (Digital Oilfield of the Future), Smart Field, Intelligent Oil Field, Smart Oil, among others - but all refer to a collaborative, interconnected and intelligently monitored real time environment.

When analyzing the evolution of technology in the industry, one can clearly see this trend. While in the 80's the emphasis was a non-integrated in-depth treatment of specific areas (wells, seismic etc.), the 90's brought about a radical change, the adoption of an integrated vision on the assessment of the reservoirs.

As early as 2000, a new concept in information and services management was established

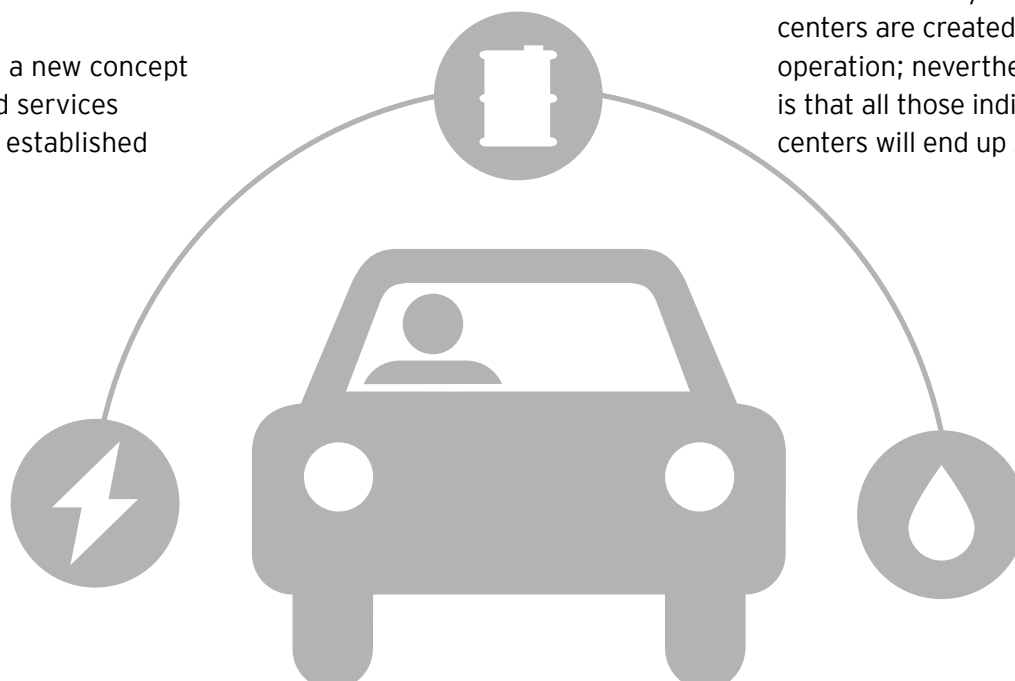
in a collaborative environment based on knowledge management. It was aided by technological tools enabling virtual teams to be set up to share best practices, such as ASP (short for Application Service Providers), Data Centers, B2B and Virtual Reality Centers.

In the pre-salt environment, the adoption of best practice technology becomes even more relevant: by monitoring the operation in real time a structure for technology, compatible with the complexity of the operation, can be established. Moreover, it should be pointed out that this concept goes beyond the limit of each organization: a collaborative environment integrated and interconnected in real time

should include various actors in the chain as appropriate (operators, vendors, agencies and governments).

### Management in the digital age

The oil and gas industry has always collected and managed information, but for a long time this was done in silos and statically. Later, through the intense use of measuring instrumentation, the digital oil and gas industry began aggregating all data sources, including those external to its operations, in order to obtain a complete real-time view of their projects. This made quick decision making possible, regardless of where its assets or the technicians who manage them were physically located. In many cases, local support centers are created for a specific operation; nevertheless the trend is that all those individual support centers will end up set together



**Accessing anything at any time and anywhere: this is the challenge of information technology for the industry. The goal is to create an environment of networked collaboration.**

in global remote operations centers mandated to track multiple operations.

Accessing anything at any time and anywhere: This is the challenge of information technology for the industry. The goal is to create an environment of networked collaboration for and between everyone (including external partners, departments, agencies etc.), and no longer from person to person.

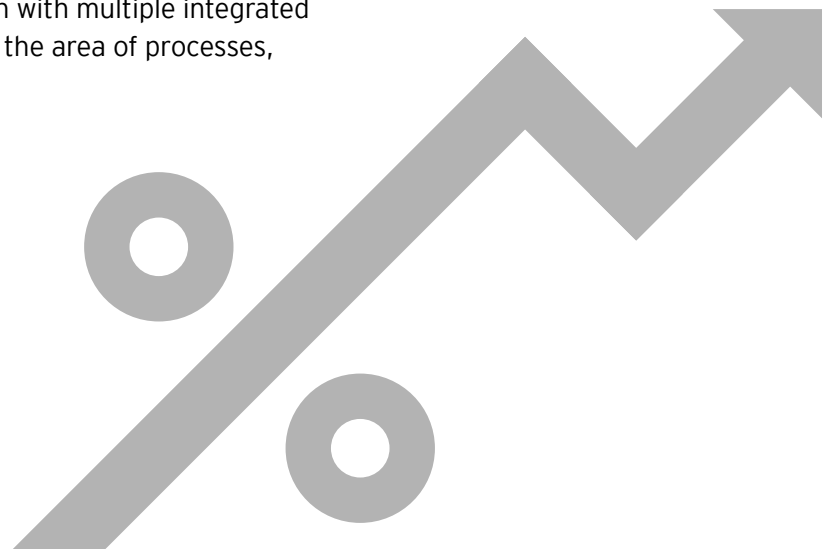
In this context, not only are the technological aspects important as enablers, but they must also focus on processes and knowledge management. Experience confirms that processes should be the central element in the concept of the digital oil and gas company. It should be based on a comprehensive approach to BPM (Business Process Management): flows, roles, responsibilities and performance indicators for projects must be defined based on a BPCC - Business Process Competence Center. As such processes begin to include global operations, specific

customizations must be designed in order to meet cultural and operational needs, to ensure the compliance and effective participation of individuals in this collaborative network.

Finally, all the trappings of technology, processes, culture and individuals connected in a large collaborative network should underpin a system of knowledge management, a crucial factor for the industry's success. In line with this, the adoption of virtual communities of practice and knowledge has been a key element of the technological development of companies and of operations led by them.

In short, a transformational journey is necessary, starting from a model of local collaborative environments towards an organization with multiple integrated networks in the area of processes,

knowledge and collaborative work. The focus should be on the changes required in people, cultures, processes and organization, so that knowledge can be leveraged and shared. The next big challenge is to ensure that this environment covers the operations chain as a whole, integrating and ample sharing of information securely between companies, suppliers and all economic stakeholders involved.



## Focus on operational costs

As an increasing number of companies invest in Brazil - in different industries, but specially in the oil and gas industry - one notes, at first, clear signs of inflationary effects upon the cost elements of this industry. If we were to add to these rising costs in the various inputs in the industry chain other costs related to "doing business in Brazil," a point of major concern is reached, demanding much attention from managers, as it needs to be properly steered and remedied so as to ensure the profits expected by shareholders upon deciding to invest in the country.

Furthermore, as the world economic outlook shows a downward trend, and, consequently, dividends of corporations also drop, shareholders have become more critical and require improvements in returns on investments and the adoption of policies leading to risk reduction and greater transparency. Since capital projects in the oil industry consume a significant share of corporate spending, special attention must be given to the predictability, reliability,

control and cost-cutting initiatives associated with these projects.

These cost elements can be seen from different perspectives:

### Structural costs of the segment in Brazil

#### Commodities on the rise

The local market for oil and gas is embedded in a broader context of overheating due to commodities such as steel. Even with the "W" shaped recovery curve of the 2009 economic crisis in the United States (when an economy goes into recession, emerges for a short period, and then dips again) and the "L" shaped stagnation in Europe (a more severe event, also known as depression), there is still an unmet demand for commodity producers and suppliers of natural resources in general, which has raised the cost of the main assets associated to major capital projects. On the one hand, the oil consumer market continues to press demand, and on the other hand, the surplus production margin of major producers remains tight, as in the case of Saudi Arabia. Furthermore, structural limitations are seen among secondary



**One challenge is the ageing of skilled workers and their proximity to retirement, which makes training new employees crucial so as to ensure the generational transition.**

producers who are also important to the smooth running of the whole chain.

On the international market on the other hand, with oil prices stabilized at a level consistently above US\$ 80/bbl a number of new investments continue feasible in greenfield areas in Brazil, on the west coast of Africa and in southwestern Russia, as well as the expansion of investments in brownfield areas in different locations in the Middle East.

As a result of all of the above, one notes a significant price rise of critical assets in the exploration and production chain. For example, the daily cost of a drilling rig for shallow waters is estimated to be around \$ 250,000 today and this figure nearly doubles when the rig is destined for deepwater exploration.

### **Specialized manpower**

In addition to commodities, the salaries of specialized personnel - whether graduates, such as engineers or technicians or welders and automation specialists - are also a challenge, since in the last five years these costs grew at a rate

of over 20 % CAGR (annual growth rate). This is not only due to a shortage of skilled personnel, but also to the increasing sophistication of new technologies that requires much better trained personnel to operate them.

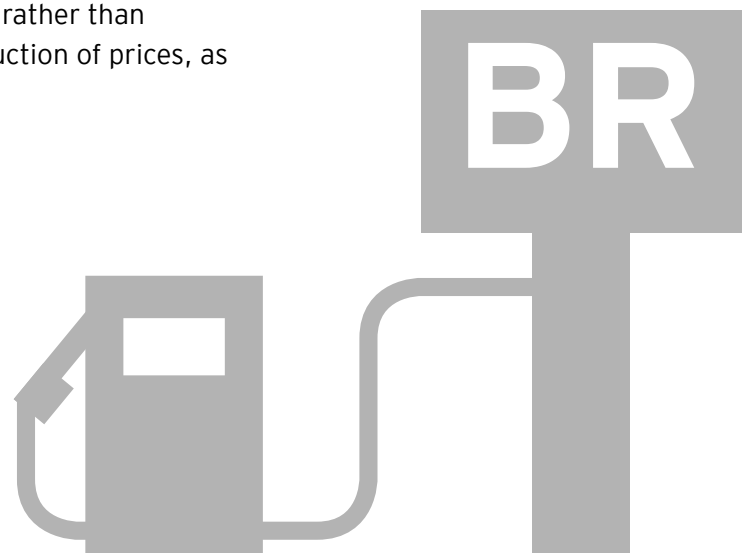
Another challenge, which seems to pervade the industry globally, is the ageing of skilled workers and their proximity to retirement, making it crucial for the players in this sector to train new employees and to ensure the transition of generations without losing experience and knowledge acquired.

### **Pressure on price**

It is argued that a second round of global economic slowdown could bring prices down. However, we should see this as being a scenario of stabilization rather than a systemic reduction of prices, as

the consumption of crude oil and its derivatives has a history of inelastic behavior in the short and medium term in times of economic crisis.

In this context, due to different reasons, companies face increasing pressures to contain costs. The operating environment has become more complex, imposing physical challenges due to the fact that "easy oil" is increasingly scarce, and also due to changes in regulatory regimes and pressures for minimizing environmental risk. The spill in the Gulf of Mexico brought lessons about prevention and the need for quick answers in case of incidents - and exposed the reality of the technical difficulties in dealing with leaks at great depths.



### Costs of domestic products in the Brazilian supply chain

When assessing the Brazilian context, one sees at first a second cost aggregator element. The decision to develop an innovative local industry able to meet the demands of large IOCs (International Oil Companies) and the NOC (National Oil Company - in this case, Petrobras) required a legal-institutional framework to be established, with Local Content Law as one of its pillars.

Independently of whether the above mentioned framework will in fact achieve its long-term goals, one can say that the establishment of quotas for domestically made supplies, equipment and services leads to additional costs in the short term - whether due to the absence of economies of scale among the suppliers, or the need to dilute the investment in expanding

local production or even due to the need to amortize the R&D necessary to develop solutions for pre-salt operations.

Additionally, in Brazil, where exploitation moves increasingly into deeper waters, the challenges and costs of remediation and prevention systems come to the fore. By 2007, the ANP had already implemented an ordinance aimed at the operational safety of offshore facilities for exploration and production. The supervision of its compliance was strengthened in 2010, requiring several adjustments by operators, which in turn resulted in higher costs.

Whatever the root element of a price hike, it must be underlined that short-term additional costs of this model add to the cost structure of an industry that is already undergoing a severe process of inflation.

### The “Brazil cost”: a general approach

Last but not least, one must add to the entire chain the so called “Brazil Cost”; widely discussed but not completely solved. Taking into account the local tax burden, exchange rate costs and other indirect costs (e.g. logistics bottlenecks and training needs for the workforce), the resulting balance shows that a lot of pressure is put on spending.

The moment they decide to invest in Brazil, companies realize that, despite the immense opportunities, they need to study the options that will have the least possible impact on their costs in depth. Decisions such as the company and its suppliers’ location have an impact on the formation of logistical and tax costs, which must be analyzed in an integrated manner. The corporate structure in itself may lead to differences in

**Decisions such as the company's location impact upon the formation of logistical and tax costs, which must be analyzed in an integrated manner.**

the taxation of personnel and financial costs.

In this sense, the optimization of processes to reduce personnel and administrative costs, optimizing logistics costs, and using technologies that are effective and resource sharing, as well as

the use of a shared services center, are among some of the actions that companies can take to alleviate the pressure on the profitability of their businesses.

After assessing these variables, many companies seek to optimize processes and use more robust

controls as a way of controlling rising costs - instead of adopting cost-cutting measures. Considering the growth prospects throughout the oil chain in Brazil, the natural rule should be to understand the reason for a particular expenditure, to be selective and seek to optimize it.

	US\$ / boe				
	2005	2006	2007	2008	2009
<b>Production costs (a)</b>	8.1	10.1	11.9	15.4	11.8
<b>Exploration expenses</b>	0.9	1.2	1.6	1.8	1.8
<b>Depreciation, depletion and amortization (b)</b>	5.2	6.2	7.6	12.5	11.2
<b>Other expenses (c)</b>	1.2	1.2	1.2	1.4	1.2
<b>Exploration and development costs (d)</b>	14.13	15.91	17.46	25.8	13.51

**Source:** Ernst & Young Global E&P Benchmarking Study 2010, consisting of data on 100 companies based upon statements filed with the US SEC.

- a)** Including production taxes, transportation costs and general- and production-related administrative expenses.
- b)** Including impairments.
- c)** Including abandonment liabilities.
- d)** Calculated as acquisition costs of unproven assets, exploration and development costs and abandonment liabilities divided by discoveries, extensions, revisions and recoveries of proven reserves. Does not include acquired proven reserves.

## Local Content

Since enactment of the Petroleum Law (Law No. 9,478/97), the federal government had made clear its goal of establishing guidelines for the oil and gas industry. These should focus on the preservation of national interests, promoting the development and expansion of the labor market and competitiveness of Brazilian industry. This issue has, in turn, given rise to polarizations in the market - particularly between operators and suppliers. On the one hand, there are those who warn that the law in fact risks creating a market reserve, which would reduce the competitiveness of projects and, on the other hand, there are those who bet on the risk of the sector de-industrialization through the import of goods and services.

The ANP, under the federal government's guidance, highlighted in the concession contracts the use of equipment and services of domestic origin in the stages of both development and production of oil

and gas. The requirement of a minimum percent of domestic content was introduced as from the Fifth Round of bidding when this criterion began to be taken in account on the bidders' scorecard. From the Seventh Round onwards minimum and maximum values were defined, more details were required on minimum commitments undertaken, and the rules hitherto in force were improved - through the Local Content Booklet, created under the Program for Mobilization of the National Industry ( Prominp) - and the System of National Content Certification, regulated by ANP.

The process of examining compliance with Local Content law requires that suppliers certify their products and services through Local Content Certificates issued by companies accredited by the ANP. These certificates are valid for four years if the variation of local content index remains within the limit of 10% higher or lower. The need for certification has added a new cost to the domestically made product,

**The actions of the ANP and the federal government are aimed at increasing the participation of domestic suppliers in the exploration and development of oil and gas.**

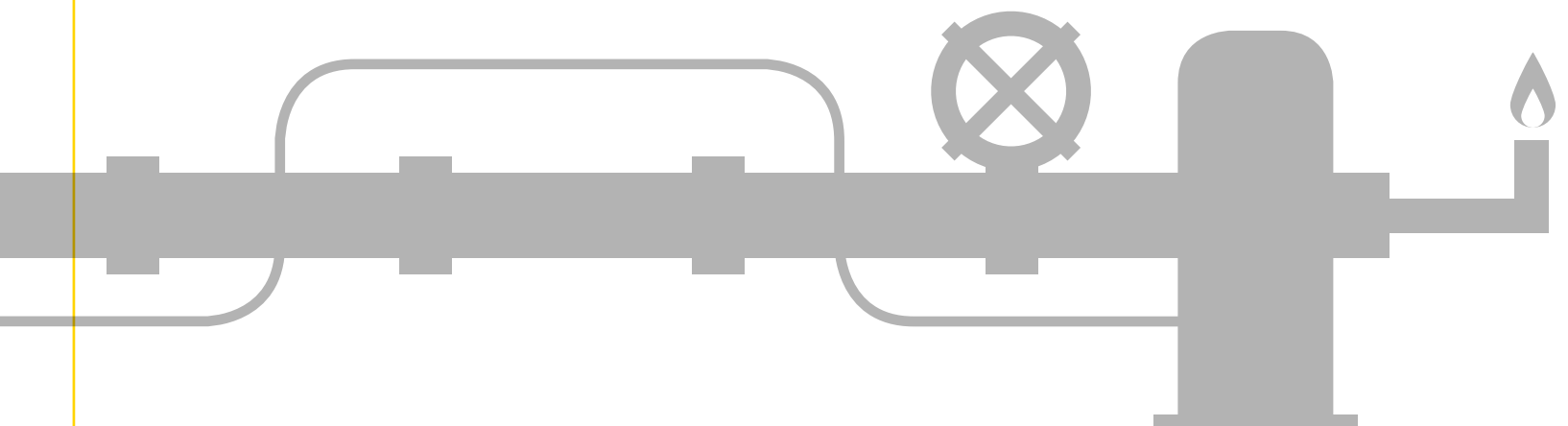
causing the industry to mobilize for a proposal introducing a criterion of selectivity for the items to be submitted to the certification process.

The new regulatory framework established by Law No. 12,351/2010, which introduced the system of production sharing contracts for the exploration and production of oil, natural gas and other hydrocarbon fluids in pre-salt and strategic areas, did not bring any novelties regarding Local Content rules, leaving the responsibility for the establishment of rules to ANP. The great expectation at this point is the minimum percentage of local content required, to be defined in the announcement of the 11th Bidding Round.

The actions of the ANP and the federal government are aimed at increasing the participation

of domestic suppliers of goods and services in the exploration and development of oil and natural gas - driving technological development, training human resources, creating jobs and income in Brazil, whilst also encouraging small and medium-sized businesses to participate in the opportunities presented by sector.

In line with this, data indicates that local content requirements have allowed a broad array of domestic suppliers to harness the benefits stemming from the investments made in the exploration and development stages. Considering the investments already committed to current projects, those announced for the pre-salt and post-salt operations, and the expectation that the ANP's bidding rounds continue, there are emerging risks causing concern to dealers, the government and the industry in general. One of these refers to the ability of domestic suppliers to provide



competitive goods and services in an international market place and on the volume of expected demand.

According to a study by the National Organization of the Petroleum Industry (Onip), only 15% of Brazilian suppliers in this industry had annual sales of over \$ 100 million - those classified by the BNDES as medium and large-size companies. Therefore, 85% of suppliers are micro, small and medium enterprises, whose drive to increase the volume of business may be subject to limiting conditions such as the availability of working capital, profile to obtain financing, access to technology, managerial capacity,

scale for acquisition of raw materials without intermediaries, efficiency of production processes and availability of human resources, among others.

Trying to sort out the issue of limitation, BNDES has recently launched a program to support the supply chain of oil and gas, which aims to finance projects for: a) implementation, expansion and modernization of productive capacity; b) consolidation, merger, acquisition and globalization of the supply chain; c) financing working capital and support for research, development and innovation activities. The program also foresees an anchor company, with revenues exceeding R\$ 90 million, which would consolidate a Supplier Development Plan, transferring finance resources to its suppliers



**BNDES recently launched a program to support the supply chain, which aims to finance projects for implementation, expansion and modernization of productive capacity.**

and subcontractors. That is to say, access to finance for the majority of micro, small and medium-sized enterprises will depend on the development of alliances with larger companies that can commit themselves to obtaining funds from the BNDES.

Despite the availability of funding to support research, development and innovation, it is understandable that cash availability of small and medium enterprises is always small when compared to large international companies. In this respect, there is also the risk which arises from the possibility that investments in research and development would not result in an increase in market share, since there are no guarantees pegged to these contributions.

When considering the possibility of expanding the supply chain for the oil and gas industry, there are other potentially inhibiting factors as, for example, the conditions imposed by their largest buyer - Petrobras. The first hurdle to be overcome is to register

as a supplier. Due to the outsourcing of important technical and support functions, Petrobras has developed methodologies for the evaluation and selection of companies interested in becoming its suppliers.

If, on the one hand, all these criteria of selection and contracting suppliers and service providers means that local small or medium-sized enterprises must meet a wide variety of requirements simply to be registered as potentially suitable suppliers for a particular function, they also mean on the other hand that such requirements can help them look to safer and well managed operations. Some of the requirements to be met in order to meet Petrobras's quality standards may range from the solution to a relatively simple issue, such as producing a missing document, to establishing training programs for the workforce, or improving management mechanisms - such as the Budget Management and Cost Management - or even the creation of a Benefits Program compatible with a certain type of service to be provided.

Despite the effort that this may require from some companies, the domestic industry is working hard to meet the increased demand for goods and services, at the prospect of numerous business opportunities. The moment could not be more timely. There is scarcity of resources in most segments of the production chain, which increases the number of opportunities for better prepared companies.

As seen earlier, this preparation involves training skilled labor. According to the survey by Onip, there is an estimated demand of around 68 million engineering man-hours for 2020. That would be great news, if it were not also a risk to be mitigated: the ability of educational institutions, both at technical and at higher levels, to train the workforce in keeping with the pace and expertise required for this market. This becomes even more worrying if we compare statistics on the number of trained engineers in Brazil and other emerging countries. While here 1.9 engineers graduate out of every

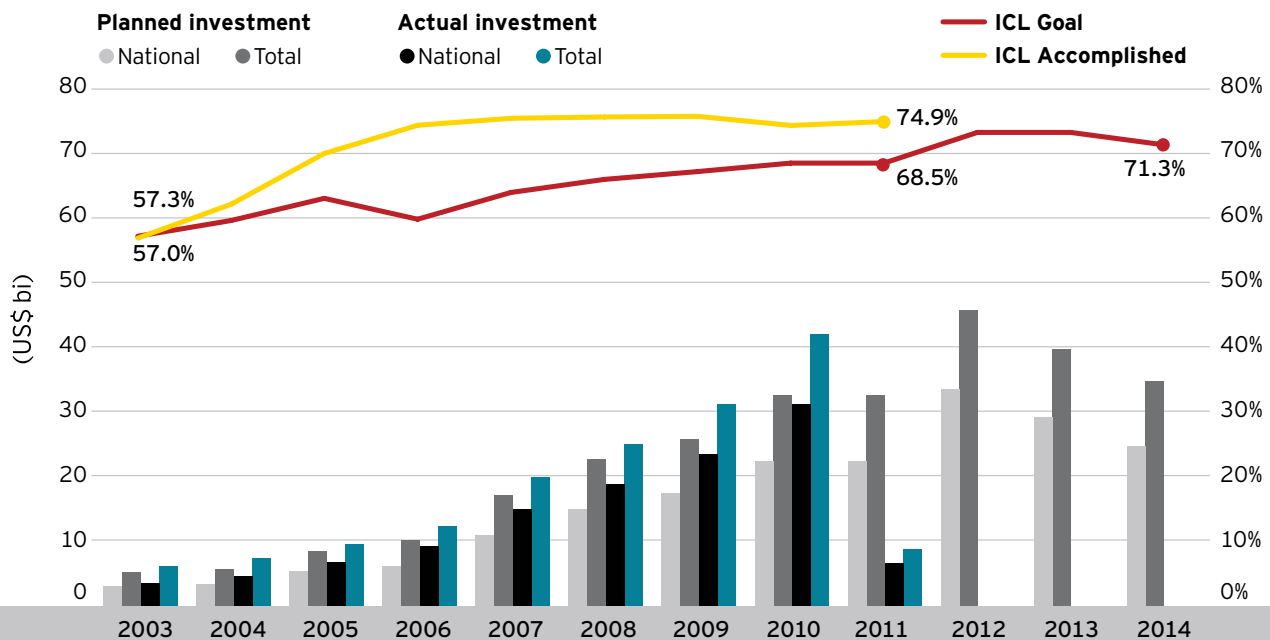
10,000 inhabitants, in China the ratio is 13.4, and in South Korea, 16.4.

Engineers are not the only people needed: we also need technical level manpower. Prominp - the National Program for Mobilization of the Oil & Gas Industry - foresaw the need to train 207,000 technicians in 185 occupational categories, in order to

meet the needs of the Petrobras Business Plan for the period 2009-2013. This deficit seems to be confirmed by the jobs that have been offered to foreign skilled labor, driven by reduced opportunities in those countries most affected by the economic crisis of 2008. Data from the Ministry of Labor and Employment show that there was

a 50% increase in work permits issued to foreigners between 2007 and 2008. Among these, 80% were in technical and higher levels or equivalent. And in 2010, professionals with this level of education made up 96% of the total figure for foreigners having been granted work permits or working visas.

### Local content indicator - 1st quarter 2011



Source: PROMINP - Programa de Mobilização da Indústria Nacional

**An industry with such unique characteristics as those of oil and gas must be endowed with a clear set of specific legislation - but so far the country still lacks such a legal environment.**

## **A specific tax rule is needed**

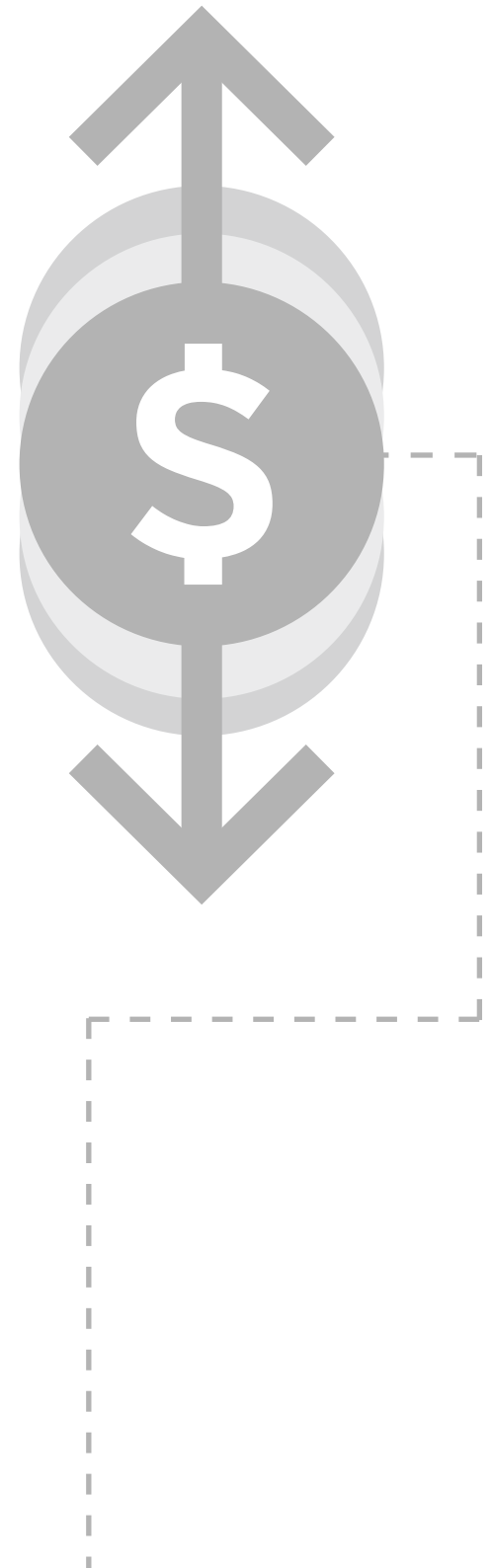
In order for the oil and gas industry in Brazil to develop in a sustainable way, clearly defined tax rules are urgently needed, so as to provide transparency to investors and potential entrepreneurs. While much has been done since the end of Petrobras' monopoly over oil exploration and production in 1997, the country still has a long way to go before achieving a modern regulatory environment, primarily in regard to the tax burden. Without such conditions, a certain legal instability is felt; companies must constantly seek clarification from the tax authorities in a strenuous effort to interpret the law.

An industry with such unique characteristics as those of oil and gas must be endowed with a clear set of specific legislation - but so far the country still lacks such a legal environment. The existing legislation focuses mostly on contracts formulae, royalty payments and other equity due to the Treasury; too many gaps are left open, e.g. the definition of the accounting criteria for the industry, essential for calculating taxes. In order to deal

with this legal limbo, companies use different accounting methods, based on international experience, leading to an unnecessary mismatch of accounting methods within the industry.

Perhaps the biggest gaps in the tax laws relate to indirect taxes. In the specific case of ICMS, a Brazilian state tax roughly equivalent to VAT, for example, the specificity of the industry, associated to a lack of detail in the legislation, eventually leads to companies not using potential tax credits to which they are entitled. In the case of ISS, a tax on services, a classic example of this lack of legal clarity is how to tax services rendered offshore: for years, a debate has been raging on to how to define the location where the services were provided and therefore which municipality would be entitled to receive the tax credit.

Among the tax rules aimed at the oil and gas sector are the rules for temporary entry of goods and industrial equipment - Repetro - which, in effect until 2020, waives the collection of federal taxes. For these temporary import operations, there is also special treatment for ICMS, the state tax, which is reduced or exempted in some states.



### An uncertain environment

Despite Repetro's tax incentive being a key pillar of industry in Brazil, it has been intensely questioned vis-à-vis the development of domestic industry, which contributes to an environment of insecurity.

Although Repetro also covers products manufactured locally - which are then exported and imported with the same benefits as those manufactured abroad - local industry has always resented a potential residual tax from the previous step in the manufacturing chain, which would put it at a disadvantage compared to the foreign supplier.

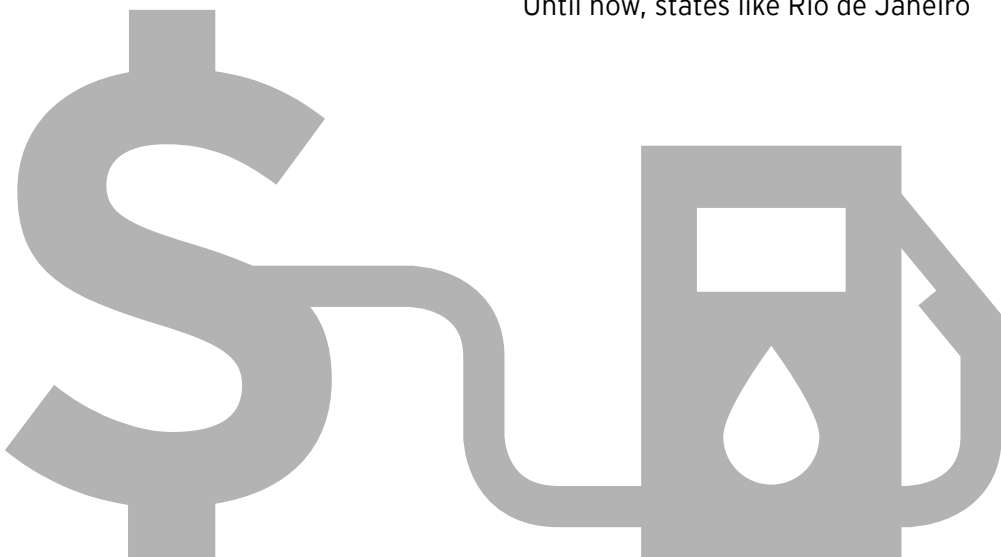
A recent study by the Brazilian Association of Machinery and Equipment (Abimaq) questions this

incentive that would have led Brazil to lose \$ 25 billion in taxes on purchases made by operators between 2005 and 2009, or \$ 100 billion, including indirect taxes generated within the supply chain.

The states themselves have never accepted the tax waiver for Repetro and for many - including Rio de Janeiro, until now the main anchor of the industry - this has been one of the most important items on their agenda for more than a decade. Currently, there is already an alignment with the other states, which resulted in a reduced collection of ICMS for the temporary admission of goods aimed at production and, in most cases, the exemption for those aimed at the exploration phase. But industry and the states were not at odds only on temporary admission of equipment, creating uncertainty for investors. Until now, states like Rio de Janeiro

struggle to be allowed to collect ICMS on the extraction of oil, i.e., at the place of origin of production, as if there was some sort of transfer of custody. In this scenario of increased activity in mergers and acquisitions involving large volumes of financial resources, tax issues become even more important. The legislative vacuum on the one hand and over-taxation on the other, in addition to excessive red tape, creates legal uncertainty. The situation reinforces the demand for risk management and sound fiscal guidance as a way to provide some reassurance to investors.

It is also crucial that companies operating in the country seek to align themselves with governments and their representative bodies, to act reactively or proactively, but always avoiding the generation of tax contingencies that may increase their production costs further.



**Infrastructure bottlenecks - particularly evidenced by the problems in the outflow of production - show the importance of logistics in the oil industry.**

## **Infrastructure and logistics bottlenecks**

The long distance to shore (the current average distance being 150 km, while in the pre-salt it is approximately 350 km) and greater depth of exploration are some of the difficulties that must be overcome to enable production in pre-salt. This remote location of the exploration blocks represents an unprecedented situation in the world, and will require innovative solutions to operate the logistics of transporting people, materials and equipment.

It is known that the trend in the Brazilian oil industry for the coming years is to increase their investments in partnerships between private companies and the state owned Petrobras, leading to an increase in oil production. As a matter of fact, the growth of production and consumption of fuel requires good logistics, which is very worrying, especially in view of the important bottlenecks that plague the logistics infrastructure in Brazil.

It has been noticed that, regarding logistics, the Brazilian oil industry is facing a major challenge: expanding infrastructure and eliminating bottlenecks. This decision to act is probably not solely down to private actors, but is rather a joint decision with Petrobras and the government. Infrastructure bottlenecks - particularly evidenced by the problems in the outflow of production - show the importance of logistics in the oil industry.

In order to illustrate outflow bottlenecks, one can take one example out of the national reality, where a significant portion of projected growth depends directly on the use of road transportation - a solution that does not meet the industry's economic interests or the society environmental interests. Today, road transport hauls approximately 90% of ethanol in the Midwest and Southeast areas. If we were to extrapolate, given the growth that the country is undergoing, we will reach 2020 with significant disturbances to major outlet routes.

This case brings about many issues regarding a better use of different modes, such as pipelines, railways and waterways, still scarcely exploited in Brazil. Although pipelines offer the lowest modal transportation rates - besides being one of the safest - this mode is still underused in Brazil. There are few pipelines in operation - about 10,000 kilometers - mostly concentrated in the South and Southeast areas. In addition is the problem of tanking, which currently does not have enough capacity to respond to the demand projected for the coming years.

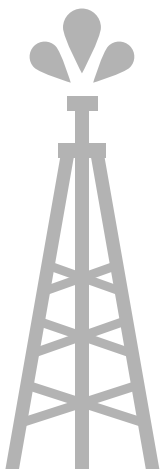
Another important issue for the oil and gas industry is waste requiring special disposal procedures for being highly polluting. The National Policy on Solid Waste, recently signed by the government, will require even greater responsibilities from the industry, leading to additional costs and new regulatory challenges. Among these, one of the most important is the logistics of transporting this waste to the treatment centers, often far from the production area.

The difficulty to operate the transport of persons, materials and equipment, the need to expand the use of different modes of transportation, the waste reverse logistics are just some of the challenges the industry must face using innovative logistics solutions.

### **Infrastructure**

The set up of the logistics infrastructure for oil in the Brazilian downstream follows the model used in the formation of national industry as a whole. That is, the Brazilian oil industry follows the same pattern of late industrialization followed in all developing countries in Latin America, characterized by a strong state presence in the formation of the industrial backbone through the creation of state owned companies.

Thus, unlike the U.S., where the development of the oil industry - including its logistics infrastructure - was led by the private sector, in Brazil, this responsibility has been



**Unlike the U.S., where the development of the oil industry was led by the private sector, in Brazil, this responsibility has been assigned to the government.**

assigned to the government, using public investment as a base. Other factors also contributed to the present situation in the Brazilian oil industry, among which is the fact that Brazil did not discover large reserves until the 1970s. Thus, it becomes evident that the creation of the Brazilian oil industry's logistics infrastructure has not evolved to meet its needs, but rather evolved together with the implementation of Brazil's infrastructure as a whole.

Historically, the Brazilian oil logistics design was established for refining imported oil, mainly by sea; so the intake end of the logistics chain was placed primarily on the coast. The downstream logistics process starts in each of the country's existing refineries. From the refineries, products are shipped and stored in primary distribution facilities, from where they leave for secondary distribution bases or else to go to the final customers: petrol stations, large consumers and wholesalers.

Thus, the location of a refinery implies an extremely complex logistical process, which involves supply bases, systems for planning transportation and network sizing. The connections of the refineries or the Brazilian port terminals to the final consumers are conditioned by the size of the country, and the supply chain is defined by the area of influence in the consumer market. This complex logistical design presents significant opportunities for location analysis and optimization of transportation costs, both for the distribution of derivatives and for the supply of oil to refineries.

An enterprise such as the exploitation of the pre-salt layer - with the participation of more than 60 oil companies (Brazilian, foreign and Petrobras itself) and the prospect of doubling current domestic oil production and gas in a few years - requires investment in the expansion of ports and airports, the shipbuilding, hotel and real estate industries, and all sorts of activities to support offshore operations. In the case of port

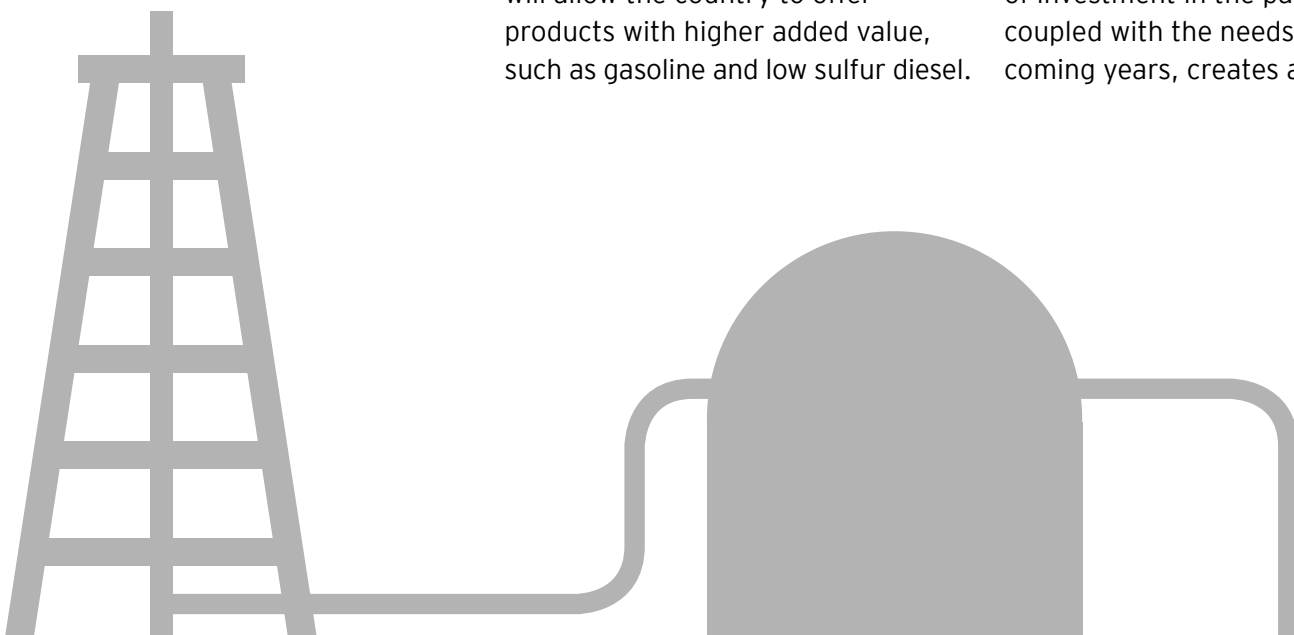


infrastructure, expansion also depends on investments in highways and railways and on cutting red tape and speeding up operations. Other segments - such as refining and the marketing of fuels - will also require large investments of resources in the modernization and construction of new refineries, highways, railways and pipelines.

The expansion of domestic refining capacity, for which Petrobras has earmarked substantial investments over the next year, is essential to add value to the oil industry, since this is the commodity's processing stage. Today, Brazil has 13 refineries - of which 11 belong to Petrobras - almost all built more than 40 years ago and initially designed to process light oil imported mainly from Arab countries. Investment in this sector will allow the country to offer products with higher added value, such as gasoline and low sulfur diesel.

Looking at the gas issue, it is expected that regulation on specific legislation will encourage investment in building pipelines. To make it commercially viable, gas requires a physical network of transport pipelines that is still very small in Brazil, given the size of the country's territory: there are fewer than 8,000 kilometers of pipelines installed, most of which are concentrated in the South and Southeast.

In short, Brazil would need to structure its full transportation matrix better, and allocate extra investments for ports and railways. Only then will the country be able to reduce its logistics costs, currently in the range of 11.5% of GDP - 8.5% higher than the U.S. Brazil's need for investment in infrastructure is more than urgent. The low level of investment in the past decades, coupled with the needs of the coming years, creates a picture



**Broad and effective risk management can also be applied to the supply chain, responsible for ensuring compliance with safety procedures and for assessing sensitive operational aspects.**

where the prospects for sustainable economic growth in the oil, ethanol and natural gas industry are hindered by the limits imposed by the country's infrastructure.

### **The supply chain**

The production chain of the oil and gas industry is extensive and heterogeneous. Several industrial and service sectors - metallurgy, electronics, and chemicals, among others - make up its value network by setting a vertical and multisector supply chain. Therefore, a major challenge in the production chain not requiring large physical infrastructure is planning and organization.

The concept of supply chain, i.e., of management focused on the integration of all businesses active in the chain of supplies, would be appropriate to deliver solutions already at the stage when the activity is set on installation and operation. The great movement of personnel and equipment - which often involves third parties - raises the challenge of managing contractors and vendors. The

planning and visibility of demand and of flows of materials are also critical to the smooth running of operations, especially in an activity where the lack of essential supplies may cause large operating stresses and financial losses. Broad and effective risk management can also be applied to the supply chain, responsible for ensuring compliance with all safety procedures and for assessing the sensitivities of all operations, including those related to environmental issues.

In this context, a need arises for developing strategies and operating models that work upon the efficiency of the supply chain through a systematic approach aimed at increasing the capacity of local suppliers, enhancing their technological content, diversifying their business areas and making them competitive on a global scale.





## Regulatory framework

The recent discoveries of the pre-salt layer have been considered important enough to require the creation of a new regulatory environment to ensure its attractiveness to domestic and foreign investors on the one hand, and on the other hand to ensure the wealth obtained is shared out fairly among the whole society. It was with this objective in mind that the government proposed changing the system of granting concessions for the model of exploration and production sharing in the pre-salt fields.

According to the production sharing model, which will be enforced in all future biddings, contractors assume the risks of activities, then get paid with a part of the production - the "profit oil" - and are entitled to another part called "cost oil", enough to compensate their expenses. The "profit oil" is shared among the participants in the investment and the federal government. Under the concession system, valid for the old contracts,

the private company assumes all costs and risks, and owns all facilities and production. It pays royalties, signature bonuses and other government fees to the Federal Government.

The argument for the government to change the system is the need for the Treasury to earn a significant portion of pre-salt profits in order to lead the country onto a new level of socioeconomic development. According to the rules of the production sharing contracts, the Federal Government may contract Petrobras directly to produce in certain areas in the pre-salt within a limit of 5 billion barrels of oil and natural gas, in a no-bid basis (through onerous assignment of rights). In addition, the company will be the operator of all exploration blocks, where it will have at least 30% participation. The winning bidder will be the one that offers the highest percent of "profit oil" paid to the Treasury.

### Nationalistic bias

The greater control of the state and the nationalistic bias, evident in the new rules, is justified, according

**A regulatory framework created a new state-owned company - Pré-Sal Petróleos SA - mandated to represent the government in joint ventures and operating committees.**

to the government, among other reasons, due to the sheer size of the reserves, the need to develop a national chain of suppliers of goods and services, and because the current scenario is very different from that of 1997, when the concession type contract was chosen.

At that time, the blocks held high risk and low profitability, in an environment where the price of a barrel was lower and Petrobras did not have resources to invest. Then it was necessary to make the system more attractive to foreign capital. Today, by contrast, the risks of the operation are smaller and Profitability is higher, Petrobras is better capitalized and has part of the technology needed for production in the pre-salt fields (the remainder is being developed or has to be brought in by other companies).

The new regulatory framework also created a new state-owned company, that will be called Pré-Sal Petróleos SA (the name was defined in the agreement, when the new regulatory framework was published), mandated to represent the Federal Government in joint ventures and operating committees to be

established to manage the various production share agreements, to ensure the highest payback possible for the State - and also to manage the Social Fund, whose mission is to allocate part of the funds primarily to poverty reduction, quality education and innovation in science and technology.

As of press time, the model for production sharing contracts that will regulate the operations in light of the new regulatory framework had not yet been published, and apparently will not be until the issue of the distribution of royalties, the next item to be dealt with here, is solved.

### **Royalties still under discussion**

One of the most controversial regulatory issues related to oil and natural gas from pre-salt is the criteria for distribution of revenue collected in the exploitation under the new production sharing contract model. Royalties' allocation rules are in study at the Congress. There is strong political pressure from representatives of states that do not produce oil to ensure that royalties



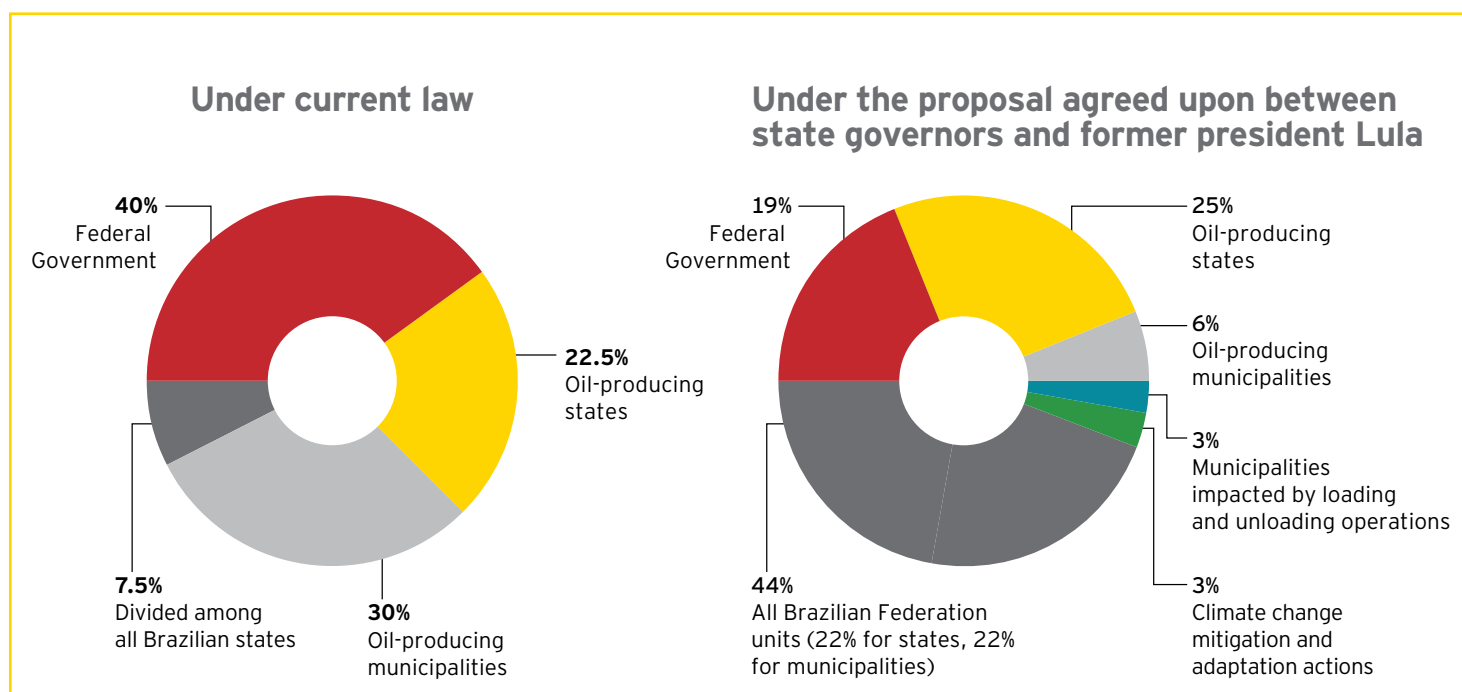
from pre-salt do not just favor producing states, but rather are equally distributed among all. However, there is risk that this system, if approved, would cause the producing states, such as Rio de Janeiro and Espírito Santo, to go bankrupt, since these states will lose a portion of their revenues.

Under the proposal agreed between the governors and the Lula government at the time, still under discussion (up to press time), the sharing formula would be as follows: 25% for the producing States, 6% for producing municipalities, 3% for

municipalities affected by loading and unloading operations, 19% for the Federal Government, 3% for mitigation and adaptation to climate change, and the remaining 44% distributed among all the Federation entities (22% for the states and 22% for the municipalities). Under current law, states and municipalities that are producers or which have shores facing the fields, and the Union keep most resources - 40% for the Federal Government, 22.5% for the producing states and 30% for producing municipalities. Only 7.5% is divided among all states. In addition to the above concerns,

the fact of Petrobras acting as the sole operator of the blocks is also the subject of constant discussion, which creates a scenario of more responsibilities for the company and for the Federal Government.

It will not be an easy task for a single company to coordinate so many human, technical and logistical resources. The need to attract capital for an endeavor that requires investment of over US\$ 250 billion may become more difficult in a system less attractive to foreign investors. And Brazil alone does not have this money.



**According to the Ministry of Mines and Energy, the scale of investment needed to meet energy demand in Brazil will reach US\$ 1 trillion over the next ten years.**

## Volume of investments

According to the Ten-Year Plan for Expansion of Energy 2019, from the Ministry of Mines and Energy, the scale of investment needed to meet Brazil's energy demand is enormous, with estimates close to \$ 1 trillion over the next ten years. Of this amount, about 70% of the investment required would be dedicated to oil and gas, including exploration and development of the pre-salt resources, expansion and modernization of the country's refining capacity and petrochemical industry, as well as investments in expansion of the network of transmission and distribution of fuels.

The scenario described here is impressive because of its figures, which should mean even more dramatic opportunities for the country's oil and gas industry in the coming years. However, among the challenges to be overcome carrying out investment projects and meeting the different needs of the industry, the issue of funding and access to capital play a fundamental role in the discussion, especially for local business and smaller suppliers set up in Brazil.

## How to finance pre-salt

The oil and gas industry involves gigantic numbers, starting with the figures corresponding to the resources needed to finance their activities. With the pre-salt discoveries, this sector in Brazil is expected to attract additional volumes of investments, close to the GDP of several countries. The numerous companies that are already part of the supply chain and others that intend to join in are out looking for funding to meet the demands. But the big question is: where to get such funding and which is most effective?

### Project may have low-cost financing

Some finance models may fit the investment plans of companies of different sizes and specialties. Project finance, for example, is the ability to finance new projects from its own cash flow. This method assumes an economically feasible project, low exposure to risk and a transparent and stable regulatory environment. It is a customized model of complex structure, but low-cost financing.

This formula would be appropriate, for example, for a supplier of Petrobras that has just signed



a contract worth around R\$ 500 million to provide certain equipment and that, to meet the demand, needs to invest in production. This contract, which provides cash flow, is the assurance that the financial institution needs to structure the loan.

### **Private equity makes management more professional**

A second form of funding, is through private equity funds. This type of investment involves the purchase of shares in companies with good growth potential. These funds can take an active role in corporate management and act as a lever to their development. In Brazil, there are presently sectoral private equity funds, focused on the oil and gas chain.

This model may be interesting for small and medium suppliers and service providers for Petrobras who are fully Brazilian capital companies, often family owned and many of them technical in nature. Private equity funds should increase their participation in this sector and may have an important role in strengthening the supply chain, helping to consolidate the domestic market for oil and gas.

### **Traditional finance is more expensive**

Two other more traditional forms of financing are short and long finance plans. The first one, available at commercial banks, has little red tape. It meets the most immediate needs, such as financing for working capital, but the cost of the fees charged by the financial institution is high. The second, with smaller financial value, is financing obtained from public financial institutions and multilateral agencies, such as the National Bank for Economic and Social Development (BNDES), the Federal Savings Bank (CEF), the Merchant Marine Fund (FMM), the Inter-American Development Bank (IDB), among others.

### **Governance from the start**

Whether it is for performing transactions or obtaining financing - especially in terms of project finance and private equity - companies need to tackle corporate governance, such as establishing clear methods and processes that reassure the partner or investor. Success in fundraising, essential to move this sector so dependent on large-scale investment will depend crucially

on the preparation and structure of the companies involved.

### **Mergers and acquisitions should continue**

The definition of local content by the regulatory framework of pre-salt and the increased inflow of capital in this industry led to an increase in mergers and acquisitions aimed mainly at the chain of equipment vendors and service providers in the industry. There are various types transactions: foreign companies that buy Brazilian companies established in the country, abroad, or still other foreign capital companies operating in Brazil; and Brazilian companies that acquire other Brazilian companies, or foreign capital companies established outside of Brazil or having operations in this country.

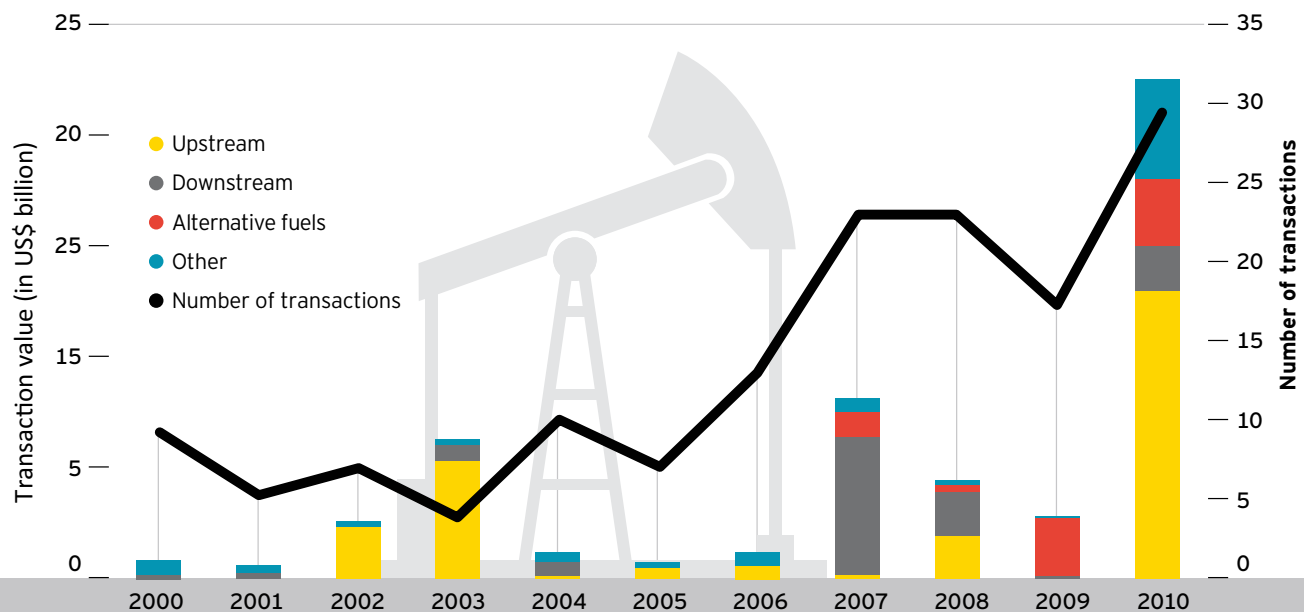
Among examples of business concluded in 2010, there are two major acquisitions involving Chinese capital. The Chinese companies Sinopec and Sinochem bought 40% of the Brazilian subsidiary of the Spanish company Repsol (for \$ 7.1 billion) and 40% of the Peregrino field in the Campos Basin, operated by Norway's Statoil (for \$ 3 billion), respectively.

Whether it is for performing transactions or obtaining financing, companies will need to face corporate governance in order to reassure investors and gain their confidence.

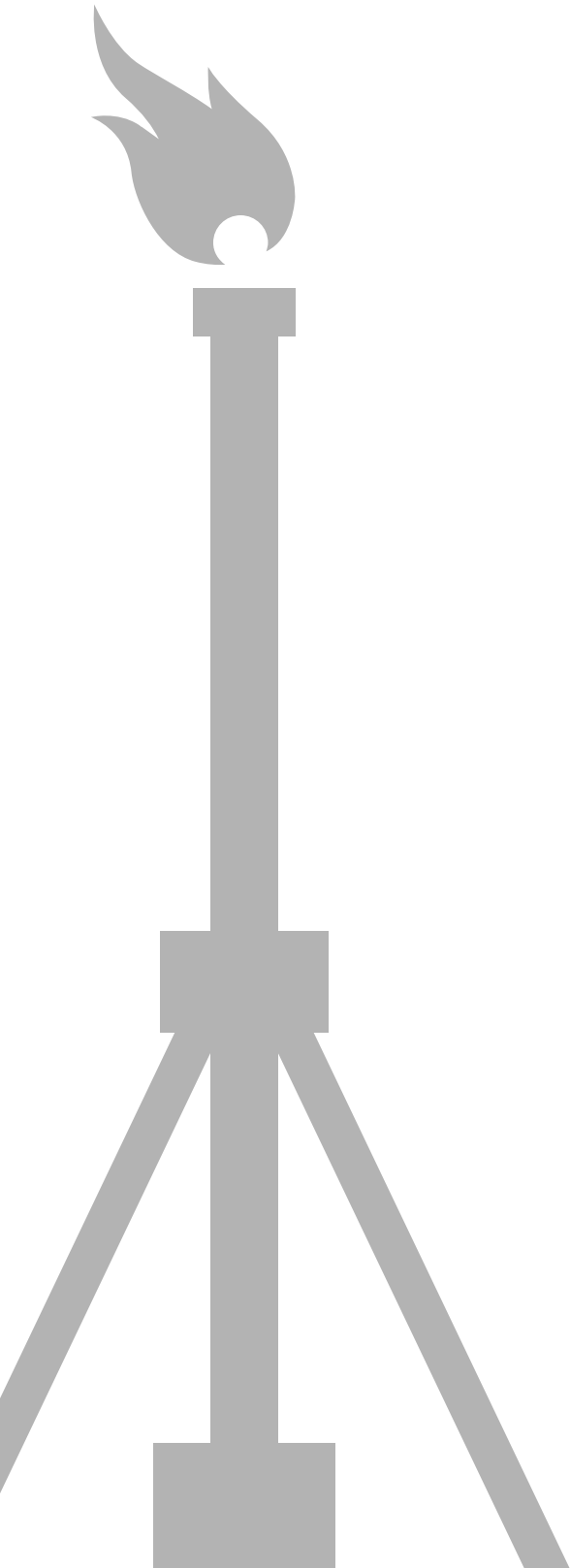
It is estimated that the volume of resources to enter the oil and gas industry in Brazil in the coming years will further increase this movement. In order to fulfill the Local Content rule, foreign companies willing to take part in the pre-salt chain

have the option of investing in manufacturing plants in Brazil to produce goods locally or else of speeding up the process by buying companies already established here, which have services required within the chain in their portfolios.

### Mergers and acquisitions in the Brazilian oil & gas sector



Source: Herold M&A Transaction Database, IHS Herold Inc. (October/2010)



## Successful capital projects

The pre-salt opportunities should attract significant investment for the whole industry and in this context, the complexity of managing capital projects is a crucial challenge. The successful delivery of projects will impact upon the market value of some companies more than ever, and achieving the expected results will be critical to secure and maintain market confidence.

In this sense, it is critical to overcome bottlenecks and issues limiting the performance of these projects. The following are among the issues to be addressed:

### Limitations of human capital

The current shortage of skilled labor for the delivery of projects is a reality of the industry, as already discussed in depth in previous chapters. Thus, many companies face the challenge of identifying “project specific personnel” that are experienced enough to meet the needs of these mega projects. Consequently, companies responsible for implementing capital projects are putting more pressure and giving more responsibilities

to their contractors, who are already facing difficulties in obtaining resources. This, in turn, creates even greater challenges to the execution of such projects.

### Cost control and timetable

In times when transparent and timely reports for the board of directors and for shareholders about ongoing projects are becoming more thoroughly analyzed, the ability of firms to predict costs more accurately and to provide a delivery schedule of projects becomes a competitive advantage. Due to deficiencies in human resources in the areas of Engineering and Project Control, several projects can be hindered due to an ill-defined scope of work and plans, leading to poor cost estimates and schedule.

### Supplier reliability and performance

Shortages of human capital, added to the sheer scale of the operations to new projects and the requirement of Local Content, create greater pressure on the suppliers of the entire chain: EPCs, (Engineering, Procurement and Construction) Technology, etc. However, in many of them, the skills, processes and systems do not meet all necessary requirements,

**One of the most important opportunities for a positive impact on the life cycle of a capital project arises during its initial planning - the stage that precedes the investment of resources.**

making them unable to optimally meet those of the mega projects.

### **Consistency of delivery**

Greater complexity of projects and the pressure on supply chains are forcing companies to review their management methods. Therefore many of them identify gaps in processes, controls and standardized systems - which are necessary to reduce the pressure on contractors and achieve global synergies.

### **Change of scope and litigation management**

Several changes of scope arise from poorly designed projects, leading to interface problems with engineering and the construction process itself. In addition, there are contracts with insufficient pay and resources to manage litigation.

### **Logistics**

Several projects never achieve the expected goals due to failures in analyzing all the logistics necessary. Critical analyses of the supply chain should be part of the early development stages of any project.

### **Economic estimate**

Difficulties in obtaining a sound cost estimate is causing economic losses in several projects, usually requiring the issuance of revised market updates. Issues such as access to infrastructure and bottlenecks in the facilities are underestimated, leading to errors in predictions.

### **Legal and regulatory compliance**

An unclear definition of legal responsibilities between the owner and the contractor in relation to obtaining licenses and permits can lead to project delays. In this case, it is necessary to pay greater attention to legal and regulatory obligations to ensure full compliance with regulatory requirements.

### **Efficient project management**

One of the most efficient ways to manage the complexity of capital projects is to conduct a holistic approach using a stage-gate model. This makes it possible to evaluate the project's progress and allows well grounded decisions to be made, as the project progresses in its life cycle, starting

from its design throughout the operational phase.

The implementation of a comprehensive life cycle analysis enables decision makers to have adequate knowledge of the investment required for the project's later stages, ensuring less rework and a better structured timetable, suited to meet all the stages of implementation.

One of the most important opportunities for a positive impact on the life cycle of a capital project arises during its initial planning - the stage that precedes even the investment of resources. This is particularly true for oil and gas companies, whose operations which extend beyond challenging operational boundaries are technically more complex. The combination of new technologies, new geographies, multibillion-dollar investments in capital and multiparty governance means that these projects require high levels of assurance of cost, schedule and risk management.





**São Paulo | SP**

Edifício Plaza Centenário  
Av. Nações Unidas, 12.995  
13º, 16º e 26º andares  
Brooklin Paulista - CEP: 04578-000  
+55 11 3054 0000

**Condomínio São Luiz**

Av. Presidente Juscelino Kubitschek, 1.830  
Torre I - 5º ao 10º e 13º andares  
Torre II - 4º ao 7º e 10º andares  
Torre III - 11º andar  
Itaim Bibi - CEP: 04543-900  
+55 11 2573 3000

**Centro Empresarial de São Paulo**

Av. Maria Coelho Aguiar, 215  
Bloco B - 4º andar  
Jardim São Luiz - CEP: 05804-900  
+55 11 2573 3000

**Rio de Janeiro | RJ**

Condomínio Edifício PB 370  
Praia de Botafogo, 370 - 5º a 8º andares  
Botafogo - CEP: 22250-040  
+55 21 3263 7000

**Edifício Argentina**

Praia de Botafogo, 228 - Ala B - 13º andar  
Botafogo - CEP: 22359-900  
+55 21 3736 9500

**Office Tower**

Av. Evandro Lins e Silva, 840  
17º andar - Sala 1712  
Barra da Tijuca - CEP: 22631-470  
+55 21 2178 2446

**Belo Horizonte | MG**

Edifício Phelps Offices Tower  
R. Antônio de Albuquerque, 156  
10º e 11º andares  
Funcionários - CEP: 30112-010  
+55 31 3232 2100

**Blumenau | SC**

Edifício California Center  
R. Doutor Amadeu da Luz, 100  
8º andar - Conjunto 801  
Centro - CEP: 89010-910  
+55 47 2123 7600

**Brasília | DF**

Edifício Brasil 21  
Bloco A - 1º andar - Sala 105  
SHS - Conjunto A - Quadra 06  
CEP: 70316-000  
+55 61 2104 0100

**Campinas | SP**

Galleria Corporate  
Av. Doutor Carlos Grimaldi, 1.701  
3º andar - Sala 3A  
Faz. São Quirino - CEP: 13091-908  
+55 19 3322 0500

**Curitiba | PR**

Condomínio Centro Século XXI  
R. Visconde de Nacar, 1.440  
14º andar  
Centro - CEP: 80410-201  
+55 41 3593 0700

**Porto Alegre | RS**

Centro Empresarial Mostardeiro  
Av. Mostardeiro, 322 - 10º andar  
Moinhos de Vento - CEP: 90430-000  
+55 51 3204 5500

**Recife | PE**

Edifício Empresarial Center III  
R. Antônio Lumack do Monte, 128  
14º andar  
Boa Viagem - CEP: 51020-350  
+55 81 3201 4800

**Salvador | BA**

Edifício Guimarães Trade  
Av. Tancredo Neves, 1.189 - 17º andar  
Pituba - CEP: 41820-021  
+55 71 3501 9000

**Goiânia | GO**

Edifício Vanda Pinheiro  
Av. República do Líbano, 1.551  
4º andar - Sala 402 - Setor Oeste  
Lotes 6 e 8 - Quadra D-1  
CEP: 74125-125  
+55 62 3212 0210

**Fortaleza | CE**

Centro Empresarial Iquatemi  
Av. Washington Soares, 55  
5º andar - Sala 508  
Edson Queiroz - CEP: 60811-341  
+55 85 3392 5600

Design and editorial direction: **Mitizy Olive Kupermann**

Publisher: **Clarissa Wahl**

Publishing support: **Michele Gassi, Osmar Maduro, Paula Quental and Roseli Loturco**

Layout: **Alexandre Rossetto and Alexandre Rugério**

Graphics: **Marlo Kanno**

Translation: **Mauro Lando**

Content Development and Technical Direction: **Ernst & Young Terco and FGV Projetos**

**FGV Projetos Team**

Project Manager: **César Cunha Campos**

Project Supervisor: **Ricardo Simonsen**

Project Coordinator: **Fernando Blumenschein**

Modeling and analysis: **Diego Pozo, Otavio Mielnik and Rafael Kaufmann**

Technical Support: **Gabriel Naumann, Raíza Adler and Rodrigo Dias**

**Ernst & Young Terco Team**

Advisory Services Partner: **Carlos Assis**

Tax Services Partner: **Beth Ramos**

Advisory Services Director: **Alexandre Rangel**

Advisory Services Manager: **Tânia Beyda**

Collaborators: **Luiz Claudio Campos, Fabricio Andreatti, Juliana Mello and Carlos Martins**

This is a publication of the Branding and Communication Department of Ernst & Young Terco. Reproduction of this content, in whole or in part, is permitted provided the source is cited.

## Ernst & Young Terco

Assurance | Taxes | Corporate Transactions  
Advisory | Middle Market | Government |  
Financial Services

### About Ernst & Young

Ernst & Young is a global leader in Assurance, Tax, Transaction and Advisory Services. Worldwide, our 152,000 people are united by our shared values and an unwavering commitment to quality. We make a difference by helping our people, our clients and our wider communities achieve their potential, in this integrated and competitive world.

In Brazil, Ernst & Young Terco is the most complete Advisory and Assurance firm, with 4,100 professionals that give support and provide services to more than 3,800 small, medium and large-sized clients.

In 2011, Ernst & Young Terco was selected an Official Supporter for the Rio 2016 Olympic Games and an exclusive provider of Advisory and Assurance services for the Organizing Committee. Having our values aligned to those of the Olympic Movement was a key factor that led Ernst & Young Terco to this distinguished position.

**[www.ey.com.br](http://www.ey.com.br)**

© 2012 EYGM Limited. All rights reserved.

This is a publication of the Branding and Communication Department.  
Reproduction of this content, in whole or in part, is allowed as long as the source is mentioned.

APOIADOR OFICIAL

