



Brazil's energy policies: An interview with Sérgio Rezende, former S&T minister

Brazil is a newcomer in science and technology (S&T) because the country woke up to this area only in the last 40 years. Brazil's scientific community was very small until the 1960s, when full-time faculty positions at universities and graduate programs were created. Investments in graduate education and research have been consistent since the 1970s, and the country currently has about 150,000 researchers, of which 85,000 have PhD degrees. In the last 10 years, federal funds for research and development (R&D) have been increased by a factor of 10. At the same time, a robust system has been structured to support R&D and technology innovation, and the legal framework has been improved to stimulate development in companies. According to former Minister of Science and Technology Sérgio Rezende (2005–2010), a materials researcher himself, Brazil is prepared within its research centers and industry for the energy challenges ahead.

MRS BULLETIN: Will Brazil work to develop the in-house knowledge that is needed to choose, adapt, and employ advanced materials and processes for petroleum-based industries, or will the country rely on existing petroleum industries for the required technologies?

SÉRGIO REZENDE: Materials use, development, and processing cover such a wide range of technologies that it would not be wise to follow exclusively one approach. Brazil is already following a mixed approach, working to develop or dominate the knowledge available in certain areas and also acquiring products, processes, or technologies that are not yet mastered and can be easily acquired. Of course sensitive technologies, which are often not accessible, must be developed locally.

Brazil has abundant energy resources in both offshore oil and biofuels, one representing traditional fossil fuel, the other a reduced carbon alternative.

What is Brazil's strategy for developing these two resources? How will they complement or compete with each other?

As it is well known, Brazil has been investing in renewable energy sources, such as hydro and biofuels, long before the issues of a low-carbon economy entered the global agenda. At the same time, we have been working hard to increase the offshore petroleum reserves, an effort that paid off with the discovery of the huge pre-salt layer fields. The main priority is to secure sufficient energy produced domestically at the lowest possible cost to allow economic growth at reasonably high rates so as to include the majority of the population in the process. This requires the development and use of all possible energy sources with a well-balanced energy matrix.

Brazil already has advanced technologies for exploration and exploitation of oil in deep waters. [The energy com-

pany] Petrobras, through its research center and many other partner institutions, has continuously developed for many years leading technologies in several areas. To meet the challenges of the pre-salt layer, the country is not only developing appropriate technologies for exploration and exploitation of oil and gas but also for recovery and environmental remediation. The tragic episode of the Gulf of Mexico [Macondo Prospect spill] has changed the global oil industry and also affected society's view on the subject. This has resulted in the allocation of larger budgets and efforts in environmental technologies for offshore production both in Brazil and other countries.

The private sector is also being stimulated to deploy about 100 wind farms in the years ahead.

Since we have large uranium mineral reserves, the government has deployed a nuclear energy program by which the construction of the power plant Angra III has been resumed, and four to eight nuclear plants should be built by 2030.

The existence of competition or complementarities depends on the consistency of an energy policy and industrial development, which should be dynamic and responsive to the challenges imposed by time and society to the market. Thus, in Brazil, ethanol does not compete with gasoline, and diesel does not compete with biodiesel. Rather, there is harmony among the different fuels that gives sustainability and longevity to the energy matrix.

Brazil is well into a transition from gasoline from petroleum to ethanol from sugarcane for transportation. Looking back, what were the hardest parts of this journey?

The sugar industry based on sugarcane was installed in Brazil almost 500 years ago, and it became part of the Brazilian culture producing, besides sugar, ethanol and other products. The world oil crisis of the 1970s was costly to Brazil because the domestic production was small, and the country heavily relied on imported oil for transportation fuel.

Then a bold program was launched,

the so-called *Pró Álcool*, to stimulate the sugarcane industry to produce ethanol as an alternative fuel. Ethanol was compulsorily mixed with gasoline in a proportion of 20–25%, and the automobile industry was challenged to produce pure ethanol vehicles. Initially, the ethanol production was subsidized so that its price at the pump station was lower than gasoline so as to stimulate consumers to buy ethanol cars. By the mid-1980s, ethanol had replaced over 30% of gasoline, the ethanol production chain became more efficient, and the *Pró Álcool* program seemed a success.

However, with the elimination of the subsidies in the 1990s the industry did not ensure the steady supply of ethanol at competitive prices, gradually the consumers lost confidence in the alternative fuel, and the auto industry stopped manufacturing ethanol cars. This was the hardest time for the bio-fuel journey in Brazil.

Then in 2003, with the introduction of reliable flexible-fuel vehicles, ethanol became fully competitive again. Combined with the concerns of society with the effect of greenhouse gas emissions on the global climate, the demand for flex-fuel vehicles increased dramatically. Today, over 90% of the cars manufactured in Brazil are flex-fuel, and the total amount of ethanol used for fuel has surpassed that of gasoline.



Sérgio Mascarenhas (University of São Paulo), Sérgio Rezende, and R.P.H. Chang (General Secretary of IUMRS)

The excellent growing conditions in Brazil provides ample opportunity for producing “second generation” cellulosic ethanol, using the stalks and leaves of plants. This is a step beyond the fermentation of sugar-

cane using established technology. Is Brazil developing the science and engineering base needed to exploit this new technology?

The conditions for growing sugarcane in Brazil are so favorable and the production of ethanol from sugarcane is so efficient that probably we will always use the conventional technology to produce ethanol. However, it is estimated that the conversion efficiency can be increased by about 30% with improvements in the fermentation technology and also with the use of the stalks and leaves of the plants to produce cellulosic ethanol.

In recent years, it became clear that in order to maintain the lead in ethanol production, Brazil needed to dominate the technology of cellulosic ethanol. So in 2006, we created a national network to promote basic and applied research in this area involving dozens of universities and research centers. And in 2009, we established a new center with the mission of conducting R&D in all areas related to bioethanol, the National Center of Science and Technology of Bioethanol—CTBE. Besides conducting research, CTBE is building a pilot-scale ethanol plant to test conversion technologies. Petrobras also has been developing research in this area and has a pilot plant at the laboratory scale.

How important is nuclear-generated electricity likely to become for Brazil?

One of the secrets of secure energy is to diversify sources of energy. The thermonuclear energy is within an energy mix that Brazil has at its disposal.

One of the most important points regarding the nuclear issue is that the supply chain promotes technology development and innovation of high value added in high technology. Such advances will spread in conventional industries and institutions of science and technology. It is also the question of national sovereignty, insofar as in the nuclear industry, there is virtually no technology transfer.

With only 30% of its territory prospected, Brazil has the sixth largest world reserve of uranium mineral, and some



Guillermo Solórzano (left) and Sérgio Rezende

estimates indicate it may have the first or second largest. In relation to the cycle of production and disposal of nuclear fuel, Brazil has self-sufficiency in the exploration, mining, processing, and production of uranium oxide (yellowcake); the production of powder and tablets; and the fabrication of fuel elements.

We still depend on uranium enrichment abroad but, thanks to a program designed during President Luiz Inácio Lula da Silva’s term [2003–2010], we should reach self-sufficiency in enrichment by 2015.

Brazil has the opportunity to become an exporter of energy. What is the impact of this opportunity on the economy of Brazil?

Historically, Brazil has been an importer of energy, petroleum imported from Venezuela, Africa, and from the Middle East; electricity imports from Paraguay; and gas from Bolivia. The total domestic energy consumption in 2008 was about 250 MTEP, of which 8% was imported.

In a few years, when the new offshore fields are in production, Brazil will no longer need to import gas and oil, and it will become an exporter of oil and biofuels.

A bill which was just [recently] passed in Congress [created] a fund from the future oil revenues to support programs in education, health, and science and technology.

Sérgio Rezende responded to a written interview by *MRS Bulletin* representative

Guillermo Solórzano.