

Energy in Brazil: Toward sustainable development?

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Abstract

The objective of this study is to analyze the evolution of the Brazilian energy sector with reference to the results of the business-as-usual scenario of the National Energy Outlook 2030 studies. The analysis was made with, as a starting point, energy indicators for sustainable development, which take into account social, economic and environmental aspects. The study demonstrates that the country has great availability of energy resources and that renewable sources can contribute to maintain a big participation in the production and use of energy, giving the country considerable advantages in economic and environmental terms. As regards the social aspect, on the other hand, the unequal distribution of income continues to be the country's principal weak point in achieving sustainable development. © 2007 Elsevier Ltd. All rights reserved.

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1. Introduction

Brazil has been prominent in the international media due to the strong presence of renewable sources within its energy sector. Data in the National Energy Balance (BRASIL/MME/EPE, 2006a) show that such sources represented 44% of the country's domestic energy supply in 2004, whereas the world average was 13% and that of OCDE countries 6%. A great part of this percentage is due to the strong participation of ethanol in the transport sector, and of the hydroelectric stations, which represented 83% of electricity production in 2004.

On the other hand, the growth of energy demand will require that the country seizes upon all disposable sources to guarantee supply for the population. To this end, in a long-term perspective, various ways are open given the availability of the country's resources. If Brazil desires to maintain high hydroelectric participation in the electricity sector, it will need to expand the use of resources in the Northern region, where the potential is significant, although environmental factors are quite appreciable. If it

decides to expand the use of fossil fuel sources, it will need to make big investments in the exploration of natural gas and/or coal. In this case the country will lose the great comparative advantage of possessing a clean energy sector. There is, furthermore, the possibility of increasing the nuclear program, which also demands great investments both in R&D and in infrastructure for the exploration and processing of uranium and the construction of power stations. Brazil can also invest more in renewable sources, which also are of high availability in the country, though, in some cases, technologies are not as mature as those previously cited.

All the options mentioned are viable and the use of one does not make the use of another unviable. The question that the present study aims to discuss is: what paths should the country follow to ensure that its energy development is sustainable? This question will be analyzed on the basis of energy indicators for sustainable development.

The indicators referred to were applied to the results of the business-as-usual (BAU) scenario of the National Energy Outlook 2030 developed recently by the Energy Research Enterprise (Empresa de Pesquisa Energética—EPE), a state company linked to the Ministry of Mines and Energy (MME), whose main results was published by Tolmasquim et al. (2007). The study considered the

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development of macroeconomic scenarios that provided the framework for simulations of the evolution of the consumption and production of energy within a timeframe of 25 years. However, only the BAU scenario for the energy supply sector was built. The idea is that the analysis of these indicators will give support to the alternative scenarios, one of them following the path of the sustainable development.

2. Energy indicators for sustainable development

Energy is one of the principal driving forces in the economical development of a country. It is the fundamental input for the production of goods and services, apart from increasing the well-being of the population, through the provision of thermal comfort, light and leisure, among other benefits.

These benefits, however, are accompanied by high economic and environmental costs. The construction of great hydroelectric dams, the exploration and processing of oil, and nuclear power generation are examples of projects that demand high investments and that can cause important environmental impacts. It is therefore necessary to have a planning process that, on the one hand, makes possible a supply of energy that guarantees security of supply at minimum cost and that minimizes environmental damage, and, on the other hand, manages consumption so that it takes place in an efficient way. In other words, it is necessary that energy planning be made in a sustainable way. This demands the drawing up of indicators to serve as tools to assist the decision makers in the evaluation of the energy system with regard to its economic, social and environmental aspects.

In accordance with Vera and Langlois (2007), the need for the use of indicators to assist with decisions leading to sustainable development was recognized at the 1992 Rio Earth Summit with the adoption of Agenda 21. Such indicators show the relationship between energy, economy and environment and highlight the connections among these variables, which, when combined, give an overall view of the energy system, as well as the relationships and trade-offs among the various dimensions of sustainable development. The variation in time of the values of these indicators shows progress or lack of progress in the direction of sustainable development. In this way, the decision takers can use such tools to measure or to analyze whether their country is on the way to sustainable development and what measures need be taken to continue on this road.

In response to Agenda 21, the Department of Economic and Social Affairs of the UN (UNDESA) began to produce a group of indicators for sustainable development (ISD). That work resulted in a set of 58 indicators, of which only three were for energy. To complement that work, the International Atomic Energy Agency (IAEA) began a long-term program for the elaboration of Indicators for Sustainable Energy Development in 1999,

in cooperation with several international organizations and some IAEA member states. This work had two main objectives: to complement the UN's ISDs and to motivate the technical training in energy and the necessary statistical support inducive to energy sustainability. The project was presented at the ninth session of the Commission for Sustainable Development, in April 2001. The commission reaffirmed the relevance of the indicators presented in the project and it also identified the need to include important energy subjects such as accessibility, energy efficiency, renewable energy, advanced fossil and nuclear fuel technologies and energy consumption in the transport sector. The subject returned to be discussed the following year at the World Summit on Sustainable Development (WSSD), which took place in Johannesburg. Accessibility to energy was confirmed as an important condition for reaching the Millennium Development Goal of reducing by half the proportion of people living in poverty by 2015. The Johannesburg Plan of Implementation, which resulted from WSSD, recommends that all nations, groups and institutions take immediate steps to reach the objectives of sustainable development, launched at Agenda 21 (Toth and Moreira, 2006).

In 2005, IAEA, in cooperation with UNDESA, the International Energy Agency (IEA), the European Community's Institute of Statistics (Eurostat) and the European Environment Agency drew up a new series of indicators, this time called Energy Indicators for Sustainable Development (EISD), in a publication where 30 EISDs are identified and described, presenting a methodology and a guide for the elaboration of the indicators (IAEA, 2005). Table 1 lists all the EISDs, classified in accordance with the areas of sustainable development: social, economic and environmental. The indicators are further classified by theme and sub-theme.

The EISDs have already been applied in the Brazilian energy sector. The study, which took 2000 as the base year, drew the profile of the country and projections in terms of sustainable energy development (IAEA, 2006). Cima (2006) also makes an analysis of the Brazilian energy sector, starting from energy indicators, using a similar methodology. In the present study, the EISDs will be applied to the 2030 National Energy Outlook BAU scenario to analyze whether the country is on the road to sustainable energy development and to help in the formulation of policies that will guarantee such an objective.

3. The National Energy Outlook for 2030

Four growth scenarios for the Brazilian economy were considered in the 2030 National Energy Outlook study (Matriz Energética Nacional 2030—MEN 2030). They are based on future projections arising out of considerations about the world economy and forming three world scenarios. The quantification of the economic scenarios in the timeframe under study is based on a model of macroeconomic consistency (Giambiagi and Pastoriza, 1997).

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