



Natural gas: The option for a sustainable development and energy in the state of Amazonas

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ABSTRACT

The historical scenery of the fossil fuels used for power generation in the state of Amazonas (AM), indicates a great economic loss and imposes severe restrictions on the regional development of the region. This urged the necessity of seeking alternative energy sources that are cleaner, safer and less expensive. In this way, the province of Urucu's natural gas, in Coari—city of the state of Amazonas (AM), presents itself as the best short term option to substitute the petroleum derived liquid fuels by the natural gas for operating thermoelectric power plants not only in the city of Manaus—capital of the state of Amazonas, but also in the other seven cities in the state along the main trajectory of the Coari–Manaus pipeline. Additionally, natural gas can be considered as a viable option for the implantation of the natural gas based chemical pole in the state. In a manner the natural gas will be used for the implantation of many gas based projects highly sustainable and will certainly result in numerous improvements in the state of Amazonas from the social, economic and ambient points of view.

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1. Introduction

Energy policy in today's world is governed essentially by three main objectives: security of supply, efficiency of supply, and social and environmental sustainability. Obviously the specific characteristics of the societies involved, dictates the emphasis and set up the basic priorities in a particular region, which may be quite different from one region to another (Mocarquer et al., 2009).

Energy supply for isolated communities in the Amazon, and particularly, in the state of Amazonas, is dramatically critical, with characteristics that are completely different from other Brazilian regions integrated to the interlinked electrical energy supply system. For example the costs of electric power production are way superior to the ones practised in the interlinked electric systems that serve most of the Brazilian population. This is mainly due to the high prices of the petroleum derived fuels used in electric power generation by the isolated thermal power plants attending the consumers in the state. Nevertheless, the state of Amazonas has great natural and environmental renewable and non-renewable resources of energy and raw material available, crowning the Amazon with strong competitive advantages. These resources rank up the state as being the greatest natural gas producers and the third biggest Brazilian oil producer in land. In other words, having the management of the electrical energy

semipublic corporation Manaus Energia S/A—MESA (MESA, 2009a), and with this energy scenery it is possible to identify the numerous benefits that natural gas in the region can offer to the isolated electric systems in the state of Amazonas. Actually 85% of the state energy matrix is from petroleum derived liquid fuels used for electric power generation and will be substituted in the near future by natural gas due to its economic and environmental positive impacts.

In this way, the natural gas project in the state of Amazonas inserts itself in an important governmental effort to redesign energy and environmental strategies feasible to the Amazon's sustainable development. The long distances, the low demographic density and the regional ecosystems define a set of difficulties that require a specific treatment in order to guarantee the supply of electric energy to attend the necessities of its population. This specific electric demand represents, at the moment, the main market for the use of Urucu's natural gas, in the city of Coari (AM). Adequate electrical energy public services in the state of Amazonas, which fulfils the regularity, continuity, efficiency, security, and less expensive taxes, are among the fundamental issues to comply with the constitutional objectives of reducing the regional inequality, and eliminating the imminent risk of transforming electric energy supply into an inhibitive factor for regional developments as well as economical, social and cultural non-integration.

This federal state is different from the other regions in the country for having many isolated electrical systems, most of them are of low capacity, low reliability, poor service qualities and of

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high cost, according to the Amazonas semipublic energy corporation—CEAM (CEAM, 2008a). This is due to using diesel units for electricity generation, which was responsible for a fuel expenditure of approximately US\$ 1 billion in 2008s fiscal year. This huge electric bill was paid by funds resources transferred from the Fossil Fuels Consuming Account—CCC. This specific account is sustained by a type of tax included in the electric energy consumption bills of all consumers, except those living in this part of the Amazon and attended by the isolated electric systems (MESA, 2009a).

This paper analyses the project of natural gas from the Solimões Basin, in the city of Coari (AM) and the benefits of its inclusion in the energy matrix of the state of Amazonas'. Also the paper discusses the concept of using the natural gas as a raw material in the regional pole dedicated to the gas based chemical industry as proposed by the local and federal governments and considered by both as a new vector for the economic development of the Amazon region, (ANP, 2008).

2. Overview of Amazon's isolated electric systems

The Brazilian energy sector, after the laws, decrees and resolutions, which succeeded the 1988s Federal Constitution, is experimenting a structural change, by introducing new concepts and policies that promote more private capital entry, expressive financial participation into the sector and guarantee the expansion of the electric energy offer necessary to improve the market's service, of approximately 5% per annum for the next decade (EPE, 2008; BEB/MME, 2008).

Nevertheless, there is one part of this sector, that is, isolated electrical systems, which requires urgent definition and implementation of new policies for the expansion of electric energy offer for these regions. The electric energy market for these isolated systems showed historically an increase of 7% per annum, higher than the 5% national growth average. These isolated systems, mainly thermal, 250 altogether (GTON/Eletróbrás, 2009), are located in the capital cities of the country's northern region and in the region countryside localities composed of 1230 generation units essentially small diesel generation groups creating great logistic difficulties, (GTON/Eletróbrás, 2009). Despite serving only 3% of the Brazilian's electrical energy global market, they comprehend approximately 45% of the national territory and a population of 7.5 million (4% of the Brazilian population). However, they have a strategic geopolitical role in the Amazon, contributing to the settlement of the population in the countryside, generating welfare and providing minimal infrastructure conditions to reduce the countryside-capital exodus, considered as a determinant factor for the preservation of the Brazilian sovereignty in the Amazon region and also the social inclusion of the Amazonian citizens.

However, the lack of economic scale for the electric energy generation and exploration by isolated systems, especially those localized in the states' countryside, reduces dramatically the financial resources, resulting in extremely high energy bills, which strongly penalises the consumers in the region. This situation is aggravated by the absence or shortage of adequate and reliable motorways and railways having the rivers or chartered planes as the only ways of possible transport of diesel fuel. This clearly increases excessively their operation and maintenance costs. Nevertheless, these adverse regional conditions should not by any means impede the supply of electric energy to these consumers, a service which is crucial for their regional survival and maintaining the minimum quality of living standards, regional development, as well as the geopolitical aspect of Brazilian Amazon's preservation.

Consequently, Amazon's isolated electric systems have particularities that make them significantly different from the Brazilian national interlinked electric systems. The national interlinked system is composed approximately by 85% from hydraulic resources and the rest from other sources, such as thermal, wind and biomass, among others. Another very important particularity is the fact that in the isolated systems the energy is supplied continuously from petroleum derived products, whereas in the interlinked system the thermal stand-by systems enter in operation only during the peaks of consumption, and eventually, in situations of critically wet or dry conditions.

3. The state of Amazonas' isolated electrical systems

The state of Amazonas has an extensively large territory of approximately 1.6 million square kilometres and 3.8 million inhabitants, two millions reside in the capital city Manaus and 1.8 million spread out over the other 61 cities that form part of the countryside of the state, with different levels of economic and social inequality, caused mainly by the lack of strategic solutions for electric energy supply all over the state. Indeed this represents a big challenge for promoting a local economic and sustainable development project, which harmonises the economic and environmental issues, by adopting programmes that encourage integrated and sustainable development of the local communities.

Nowadays, to attend the electric energy demands for a total of 658,600 consumers in the state of Amazonas, 437,800 of them in the capital city Manaus and 220,800 consumers in other cities of the state, some 102 isolated electric systems are used to cope with this demand. One electric system to attend the capital city Manaus and the other 101 to attend all the other 61 cities and 44 isolated communities distributed in the state's countryside (MESA, 2009b). All these systems are under the responsibility of the semi-public electrical energy corporation Manaus Energia S/A—MESA. Fig. 1 shows all the communities supplied with electric energy in the state of Amazonas.

The electric system that serves the city of Manaus is the biggest of the Brazilian isolated systems, and contemplates electric energy generation, transmission, distribution and trade, besides supplying four places in the countryside: Presidente Figueiredo, Rio Preto da Eva, Iranduba and Puraquequara (Frota and Rocha, 2009). The electric energy supply to the other countryside isolated systems is realized by 97 diesel thermal plants (CEAM, 2008a). The profile and composition of electric energy consumption in Manaus is utterly different from the other capital cities not served by the isolated electric systems. Their industrial sectors represent an expressive part of the electric energy demands (43%), whereas in the countryside the biggest consumption is due to the domestic sector (43.6%). This consumption scenery in Manaus is the result of Manaus Industrial Pole—PIM, which represents 98% of the state's economy, composed by more than 500 industries, producing mainly televisions, monitors, DVDs, CDs, mobile phones, refrigerators, computers, motorcycles, bicycles, chemical products, food and beverage and employing more than 100,000 workers. This industrial pole registered an annual billing superior to US\$ 30 billion in 2008 (SUFRAMA, 2009).

In order to attend the electric energy needs in the capital city, the public corporation, Manaus Energia S/A has an effective generation capacity of 1431.9 MW (GTON/Eletróbrás, 2009), as shown in Table 1. Part of this total capacity is hydraulic, 250 MW, and the rest of about 1181.9 MW, is generated by thermal power plants run on petroleum derived fuels.

As for the countryside demand, the corporation has a generation park, which sums up to an installed effective capacity

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