

## A COMPARATIVE ANALYSIS OF THE JAPANESE AND BRAZILIAN CASES OF ENERGY PLANNING AND TRENDS

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### **I - Introduction**

Brazilian and Japanese energy planning have different approaches and aims owing to differences in natural resources, geographical position, energy uses, available technology, energy policies, environmental and socioeconomic situations and other aspects.

Brazil has a large area endowed with substantial natural resources, excluding fossil fuels. It has a enormous hydroelectric potential, much of which is still undeveloped. Its rivers contain more than a fifth of the world's freshwater that make the hydroelectricity one of its main sources of energy. The abundance of native and planted forest vegetation, and lack of environmental control, has made wood products a traditional and cheap residential use fuel, and more recently its industrial use has grown considerably. The land available for agriculture and a government policy of incentives to try to reduce the fossil fuels imports dependency, after the big 1973 oil crisis, has made sugarcane and other biomass energy plantations a important source of primary energy. A euphoria that cooled in the last years as the oil prices have dropped, but with great potential for further growth in the future. However, the economic crisis and disorganization that has affected the country in the last twenty years has made energy planning a very difficult task, and in most of the cases lead to wrong and unexpected results (Carvalho, 1987).

On the opposite side of the Earth, and almost in opposite energy planning situation, there is Japan. This country has almost no native energy resources, it imports large fraction of its energy, especially fossil fuels, but its well organized economy makes its energy planning quite successful.

One way to interpret these differences in degree of success is that the definition of the conditions on which the planners base their assumptions for planning are much more stable in Japan, making the future generated scenarios more likely to happening.

Here, the energy situation of this two countries will try to be better analyzed by disaggregating the energy sources and the consumption sectors and look at each of their trends separately, and after, in the end, try to aggregate them by sources to define a future scenario.

### **II - Energy Planning Methodology Based on Scenario Evaluations**

The scenario method is a procedure that simulates, coherently, a sequence of events that could lead a system to a future situation and presents the possible future "scenario" of this situation as a whole.

It can be mentioned the following kinds of scenario evaluations (Carvalho, 1987):

- 1) **EXPLANATORY SCENARIO**: It describes, from the present situation and dominant trends, a series of events that lead to a possible future situation through logical thought.
- 2) **ANTICIPATION SCENARIO**: The starting point is not the present situation, but an image of a possible and desirable future situation that is described by a set of objectives to be reached.
- 3) **TENDENTIOUS SCENARIO**: Try to describe future situations that would be reached if the dominant trends, observed in the present, were reproduced in identical behavior.
- 4) **NORMATIVE SCENARIO**: The objective is to delineate the space of the future situations through a convenient adjust in the dominant trends. In this case, it is tried to eliminate the trends that could lead to undesirable future situations.

The tendentious scenario is applied in order to see the dominant trends in the cases of the Brazilian and Japanese energy situations. A System Dynamics simulation program (Ithink, version 2.01 for Macintosh) is used to perform the mathematical tasks, once it can show in a more comprehensible form all energy system.

The energy system of each country is divided in energy subsectors, according to consumption sectors and kinds of energy groups, concerning secondary energy. The present trend in each kind of energy group in each sector is calculated, and the value of the future situations calculated as the present trends had identical behavior in the future. Then the secondary energy are summed according to the kinds, and at the end the primary energy necessary to generate this secondary energy is calculated.

The following assumptions are made to define our scenario:

E1- The Tendentious Scenario Method is used for each subsector.

E2- The aggregation and disaggregation of the different kinds of energy is kept constant in the future, according to the year based on.

E3- The technology and natural conditions to develop every energy would be available at the time needed.

E4 - The international energy market would not have any crisis and could supply the amount of primary energy need without big changes in the same prices .

### III - The System Structure Definition

The division of the energy system in each country were made according to national energetic balance of each country (Ministério das Minas e Energia, 1993 and Shigen, 1993) and in a way that the division could be adapted for the model desired. The divisions are the following:

#### Brazil

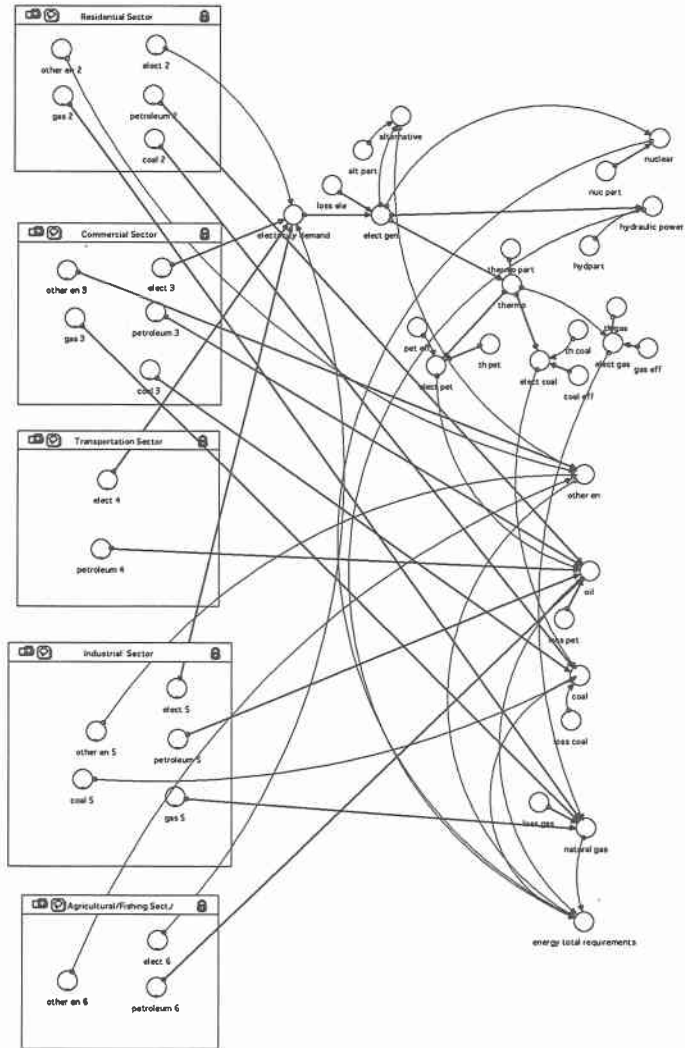
- Consumption Sectors: Energetic, Residential, Commercial and Public, Transportation, Industrial and Agricultural.
- Kind of Secondary/End-Use Energy: Sugarcane Products, Electricity, Petroleum, Coking Coal Products, Steam Coal Products, Wood Products, Natural Gas Products and Others.
- Kind of Primary Energy: Sugarcane, Oil, Coking Coal , Steam Coal , Wood , Natural Gas, Nuclear, Hydraulic and Others.

#### Japan

- Consumption Sectors: Residential, Commercial, Transportation, Industrial and Agricultural.
- Kind of Secondary/End-Use Energy: Electricity, Petroleum, Coal Products, Natural Gas Products and Others.
- Kind of Primary Energy: Oil, Coal, Natural Gas, Nuclear, Hydraulic and Others.

The value of the consumption for each energy subsector is gathered from 1977 until 1991 (Ministério das Minas e Energia, 1993 and Shigen, 1993), and the present trend of each subsector is made based upon the present value of the subsector, its first order exponential average and the exponential averaging time, which in this case is 5 years (High Performance, 1991, Trend Function, p. 283). For the aggregation or the desaggregation of the subsystems, for example electricity, it is use the balance of the year 1991 as reference. The simulation systems for Brazil and Japan are shown on figures 1 and 2 respectively.





*Figure 2.- Japan Energy System*

#### IV - Results

The obtained trends from 1991 until 2020 of some Brazilian and Japanese energy sources are showed in figures 3 and 4 , respectively.

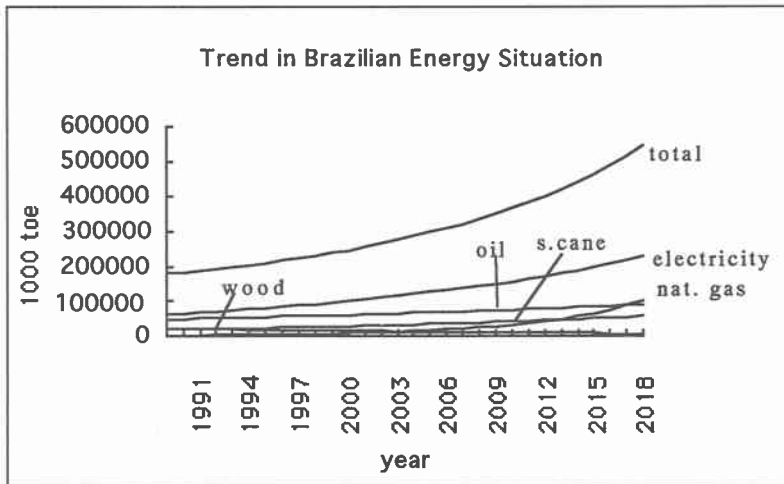


Figure 3 - Some trends in Brazilian energy situation

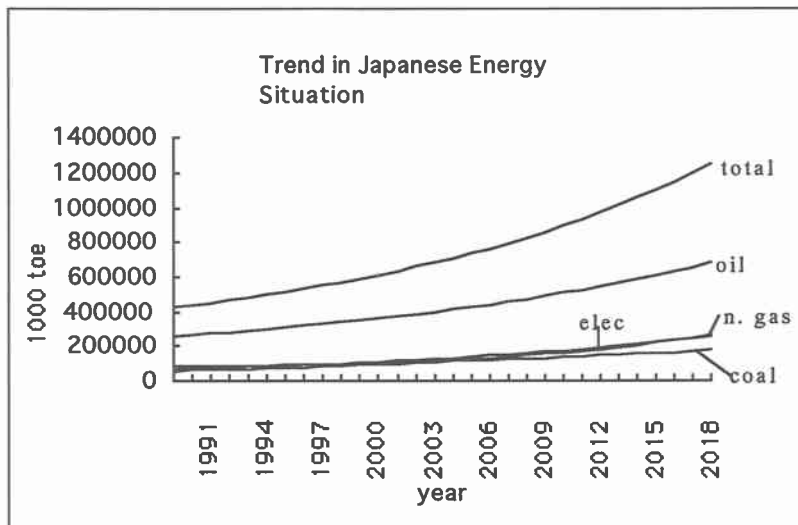


Figure 4 - Some trends in the Japanese energy situation

## V - Conclusions

Brazilian and Japanese energy data are available in different forms of sector aggregation and energy kinds. The agencies responsible for energy planning in these countries have different approaches and ways to work on and organize the data. That is because many factors differ between these countries energy planning situation, such as energy uses, economic situation, natural resources and methodology of planning. But it doesn't impede that one can try to understand the energy systems and organize them in similar form to use the same energy planning methodology.

The Tendentious Scenario methodology was used in this case, showing results that can express some possible future energy situation, if the conditions showed happened (E1 to E4). The probability that these conditions happen can be evaluated, and other conditions can be proposed and analyzed generating different scenarios.

When more information and detailed conditions are involved, the resulted scenario is more likely to happen, but they can make the system much more complex and difficult to simulate.

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