ENERGY BALANCE OF STATE AS AN INSTRUMENT FOR BUILDING SUSTAINABLE PUBLIC POLICIES: THE CASE OF TOCANTINS

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ABSTRACT

The Energy Balance of State (BEE) allows the user either technical, scientific, deciding parties or merely the studious a rapid overview of the dynamics and transformations which the Energetic Framework has gone through these past years. To draw up an BEE one needs a survey of the principal data regarding production, import and export and .the final consumption of different forms of energy consumption of society's various segments. This paper purports to show the importance of this data for the construction of sustainable public policies. When drafting the Energy Accounts of Tocantins State one notices the degree of exploitation of the local energy sources and their sustainability. The use of Wood as the main energy source demonstrates the issue of the fragile sustainability of the Legal Amazon and the difficulty in preserving its natural resources. However this issue is linked to the lack of availability of other energy sources for industry and the development of technologies adapted to the region.

Key Words: *State Energy Accounts, Tocantins, Sustainability Energy*

Introduction

This article's objective is to demonstrate the importance of drawing-up State Energy Accounts (SEA) or Energy Balance of State (BEE) as an instrument to support economic, environmental and social planning for the states that belong to the Legal Amazon region. The SEA is a general diagnosis comprising the primary and secondary energy sources available internally and externally of the State, and correlates this to the actual energy consumption of the various sectors. When drafting the Energy Accounts one notices the degree of exploitation of the local energy sources and their sustainability. The use of Wood as the main energy source demonstrates the issue of the fragile sustainability of the Legal Amazon and the difficulty in preserving its natural resources. However this issue is linked to the lack of availability of other energy sources for industry and the development of technologies adapted to the region.

Literature Review

Meaning of the Term "Legal Amazon"

The Legal Amazon concept was instituted by the Federal Government to unite the States that belong to the Amazon Basin and consequently have parts of the Amazon forest located within their territories. These regions have similar economic, political and social problems. Nine States comprise the Legal Amazon: Acre, Amapá, Amazonas, Mato Grosso, Pará, Rondônia, Roraima and Tocantins and part of Maranhão State (east of the 44th meridian of the western longitude), an area of approximately 5.217.423 km² corresponding to almost 61% of the total Brazilian landmass.

We shall use the State of Tocantins' energy consumption and supply data and their general characteristics under the light of economic and social sustainability to better understand the problem presented (BURANI, 2007). As the principal bibliographic source for consulting the energy data will be used the first Energetic Accounts and a Perspective until 2030, which was carried-out by the team of the Energy and Electro Technical Institute (IEE) of the University of São Paulo (USP), in collaboration with the Federal University of Tocantins (UFT) and the State Planning Department (SEPLAN-TO)

Evolution of Methods to Establish the Energy Balance

One of the first and most well-known methods to draw-up an Energy Matrix was the technical-economic model known as EDEM (Energy Demand Evaluation Model). This model was thought out by a French organization (IEPE/Grenoble) and after having been adapted to the Brazilian conditions has been the standard applied in almost all the world (GODET, 2007; PUISEUX, 1972).This same method has been augmented with up-to-date techniques, highlighted by the LEAP model (Long-range Energy Alternatives Planning System) developed by the Boston Centre of the Stockholm Environment Institute with the support of the Bariloche Foundation in Argentina (IDEE/FB) and ENDA-TM in Senegal. This model enables an interface for demand, besides allowing for an integrated vision with the supply and the environmental impacts. The crucial point of its focus is the disaggregated form of evaluating the future energy demand, based on the technique of technical-economic scenarios (PRADO, 1987). When analysing demand the analytical instruments utilized takes into consideration the end-use of energy and the yield of the equipment and the consequent transformation. The advantage of these procedures is to put the issue of supply and end use of energy on an unbundled and transparent approach. These procedures allowed the actors involved in the various areas of the energy sector (electricity, gas, alcohol, oil) or related (users of energy, civil society representatives, government entities), the beginning of a dialogue aimed at defining policies or guidelines that enables society a rational growth, minimizing waste and environmental impacts.

Items used to relate energy and socioeconomics are:

1. GDP by sector
2. Final Energy Consumption by Sector
3. Energy intensity by sector (energy consumption / GDP sectoral)
4. Energy Supply / GDP / Population
5. Energy Supply by Area / GDP
6. Residential Sector - Energy / Population
7. Transportation Sector - Energy / Value Added
8. Energy / Physical Production - energy intensive sectors
9. Expenditures with Currencies Oil Imports and derivatives

Research Methodology

For the development of BEE to State of Tocantins used the LEAP model. This programme can be freely accessed on the Internet and is used by planners in the energy sector. This model is based on an analysis of the impact of trends through the following steps 1) Collect time series data; 2) Generate a preliminary extrapolation; 3) establish probabilities of events that occur over time; 4) Modify the extrapolation; 5) Write scenarios.

The approach used for to build the Energetic Matrix Projection for Tocantins up to 2030 was performed based on a complex set of relationships between factors economic, political, technological, social, and environmental resources and evolved according to the steps cited in HUSS (1988): 1) Analyze decisions and strategic concerns; 2) identify key decision factors; 3) Identify the main environmental forces; 4) Analyze environmental forces; 5) Define the logic of the scenarios; 6) draw up the scenarios; 7) Analyze implications for key decision factors; and 8)-Analyze implications for decision-making strategies.

Research Results

State of Tocantins

The State of Tocantins has an area of 277.620 km2, representing almost 3.3% of the national territory and 7.2% of the Northern Region and 5.4% of the Legal Amazon. The conservation areas or with a high natural limitation for land use in the State comprises a total of 59.516,2 km2 which corresponds to 21.3% of it's territory, 2.5% are areas with an ecological evaluation, 1.6% ecological corridor, 1.9% potential area for conservation, 7.2% Indian reservation, 0.9% State Park, 0.1% national monuments, 2.3 % ecological station, 2.4% State

Park, 9.0% environmentally protected area and 0.003 extraction reserves, this data is from 2005 (SEPLAN-TO). It has two large rivers the "Araguaia" and "Tocantins", which cuts the state from north to south. .

The installed energy generating capacity of the State is 1.468.4MW, the three hydroelectric power stations installed on the Tocantins River answer for 1.430MW. Besides these, there are 8 stations under construction at the moment on the same river and its tributaries totalling a capacity of 766.210 kW. (ANEEL 2007)

Table 1: Electricity consumption per sector

Sectors	2004 MW h	2005 MW h	2006 MW h
Residential	322604,70	344367,29	356838,10
Commercial	181985,58	197099,21	203692,50
Public	72169,52	80409,72	87594,67
Street lighting	87901,24	88321,75	90786,37
Public Services	37680,99	39292,44	39738,27
Rural	65173,52	70109,78	78558,11
Own Consumption	4159,86	4113,10	2898,56
Industrial	111022,18	108263,45	104366,78
Total	882697,60	931976,74	964473,35

Source: CELTINS (2007), Local Electricity Distributor.

Table 1 shows the State's electricity consumption until 2006. This consumption tends to grow for all local sectors, since the State of Tocantins is only 17 years-old; it is the last state of the Union created by the division of the state of Goiás in 1988. The region is in full development and needs investments in housing, infrastructure, healthcare, and for the creation of new jobs in many areas still to be discovered and developed. The population is estimated at 1.243.627 by the last census of the Brazilian Geographic and Statistics Institute (IBGE). Every year the State attracts migrants seeking improvement in their living conditions and they are determined to obtain their place in the sun on a sustainable basis. The Tocantins' economy is based on agriculture and cattle raising, and the Federal University is only 5 years old, and still many more Federal and State Institutions to be created in the future, commerce and industry are beginning to develop. For all these reasons electricity consumption and that of other fuels will tend to grow in the coming years until the State reaches stability or maturity.

The States of the Legal Amazon produce a large part of the electricity consumed and distributed in the whole country. Nevertheless, many communities in the region do not have access to electricity. Some hydroelectric stations are built only to generate electricity for energy intensive industries which convert local minerals and send them on to be processed abroad. Others are built to supply energy for the large commercial and industrial centres in the country. Therefore the majority of the Legal Amazon States do not benefit from the energy generation in their territories.

The case of Tocantins is no different, the greater part of the power stations built in the State are for companies manufacturing cement, steel, aluminium, and others which are located outside the State, and another part is sold at auctions and accounted for by the Electricity Sales Chamber (CCEE). According to the new rules set forth by ANEEL the local energy distributors can only purchase their energy through these auctions which are held on a national level. This norm has the producing States not benefiting from the energy generation in their territories. At present the most utilized energy sources in the State are: electricity, biomass (wood, rice husks, alcohol, charcoal, forest residues) and oil products.

According to Table 2, the sector that most uses oil is transport, seen that the North-South railway is not yet operational and travel between towns and States is done by road or air, this also holds true for cargo.

Table 2: Oil consumption in % per Sector in Tocantins

Sectors	2003	2004	2005	2006
Energy	0,0	0,0	0,0	0,0
Residential	9,2	8,5	8	8,2
Commercial	0,1	0,1	0,1	0,1
Public	0,2	0,2	0,2	0,2
Agribusiness	8,4	10	12,3	10,2
Transport	78,3	74,7	73,8	76,5
Industrial	0,1	0,1	0,2	0,3
Non energy End User	3,7	6,4	5,4	4,5
Total %	100,0	100,0	100,0	100,0

Source: BEE – TO – (2007)

Diesel is also used in hospital and factory generators when the local electricity company has problems in supplying or at times when electricity has a higher cost.

Table 3: Residential energy consumption in Tocantins per energy source (%)

Energy Source	2003	2004	2005	2006
Natural gas	0,0	0,0	0,0	0,0
Wood	7,0	5,2	5,9	5,7
LPG	52,5	52,9	50,0	50,1
Kerosene	1,1	0,9	1,0	0,7
Electricity	32,9	34,2	36,3	36,5
Charcoal	6,5	6,8	6,9	7,0
Total	100,0	100,0	100,0	100,0

Source: BEE – TO – (2007)

In Table 3 one can see that LPG is used for cooking and 97.04% of the low-income population in the urban areas has a gas cooking range. Nevertheless, it is certain and even though difficult to count, the majority of the rural low-income homes besides having a gas stove (87.61%), also have a wood or charcoal burning furnace.

Wood is used in great quantities in industry and commerce and for food production (Table 4). This fact has incalculable consequences for the environment, since a greater part of this fuel

is the result of irregular deforestation. Meatpacking, ceramics, grain processors, dairies use wood or charcoal as energy to produce. Besides, there are many illegal charcoal producers who sell their product to smelters in other states such as Pará, Maranhão and Minas Gerais. Government authorizations for deforestation for energy production amounted to 9.574ha in 2001 and grew to 76.093ha in 2006. The official licences to produce charcoal went from nil to: 1.020.892 wpmc (wood per metres charcoal) and the authorizations for cutting trees grew from 29.957m3 in 2001 to 248.511m3 in 2006. For cutting wood to burn authorizations went from: 3.975m3st in 2001 to 3.289.047m3 st. One can see from these numbers how wood consumption grew for the various sectors.

Table 4: Composition per sector, biomass energy consumption in Tocantins (%)

Sectors	2003	2004	2005	2006
Energy	2,30	2,10	1,90	1,60
Residential	5,00	4,10	3,90	3,40
Commercial	3,70	3,90	3,90	3,70
Agribusiness	5,20	5,10	5,40	4,30
Transport	9,50	10,00	9,00	8,00
Industrial	74,20	74,60	75,60	77,20

Source: BEE – TO – (2007)

The ceramics industries (bricks, roofing tiles) use wood in their ovens, but have lately also taken up rice husks. This is because the region is a rice producer and the publicizing of a manufacturer who changed over from wood burning to rice husks and thereby signed a Carbon Credit Contract in which he sells a ton of avoided carbon for US$ 5.00 (one share). Even though the calories produced by rice husks are less than wood (Kcal/kg 2300 against 3200) needing more rice husks (450kg/t) to produce the same amount of energy than wood (370kg/t), the exchange is still advantageous. That is because wood prices have risen significantly and there are no more guarantees that it can be obtained illegally. Rice husks are abundantly available in the region and the brick factory that changed-over informed that before he used to buy 1.445m3 of wood per month which cost him R$ 24.225.00 and which allowed him to produce 900 thousand units/month. When he changed he needed about 240t/month of rice husks costing R$ 8.500,00 and managed to produce 850 thousand bricks per month. Another alternative using risk husk together with wood is being used by other companies in their manufacturing processes.

Discussions

It is the national consensus that in the long term new environmental, social and economic policies need to be developed which has to result in the diversification of the energy matrix (BURANI, 2007). Its purpose is to make the production, transmission and energy distribution environmentally and socially less aggressive and at the same time to develop more efficient final user technologies. This idea serves not only to find substitutes for oil; freeing one from dependence on it, but also to increase the use of more sustainable energy sources such as biomass, solar or wind energy. The significant energy production from these sources still faces economic feasibility obstacles, technological restrictions or access to it

which still have to be overcome.

Nowadays for an energy source to become feasible it is necessary that it be sustainable environmentally, technologically, socially and economically. In the past if it was economically viable it would have already been approved because the technology would be developed soon after or adapted for its' exploitation; environmental and social issues were considered secondary. Since the orthodox development paradigms believed that the market would resolve these questions in the best possible manner.

The Energy Accounts for Tocantins demonstrate the choices made in the past, but through the energy matrix one can implement systems and make choices for the future of energy in Tocantins, and thereby creating a better world for future generations (BURANI, 2007).

For Tocantins as well as the other States of the Legal Amazon, sustainability means respecting nature's limits and at the same time using it to create better life-conditions for the local population. One of the possibilities for the isolated communities to produce their energy with the production of vegetable oils and at the same time using the residues or parts of the palm or the non-utilized fruit to produce food, construction materials and marginal products which could produce income. The principal vegetable oils available in the region either by extraction or cultivation are: Babassu. Brazil nuts, Castor bean, Soya, Palm-oil, Cashew nuts, Pinion, Jojoba seed and others.

However for this utilization to be sustainable it needs to be used in a controlled manner because the greater part of these belongs to a fragile ecosystem. Some of them when exploited commercially, without any controls, can harm the flora and fauna and the possibility of the land being transformed into sand.

An example of this kind of sustainable endeavour was implemented in the State of Rondônia in an isolated community which had no access to electricity in the "Ouro Preto" River Reserve (RESEX RIO OURO PRETO) carried-out by the Renewable Energy Research Group (GPERS) of the Federal University of Rondônia (UNIR) which together with other federal institutions developed the generating potential of fuel oils for the production of electricity using the Babassu (LIMA et al, 2006). The results of this project are manifold: the trunk was used to build houses, the leaves served as roofing, and to make domestic utensils and as fuel for burning. The palm-heart (the fruit of the tree) is used as food and for processing, from which starch, oil, and protein flour from the kernel can be extracted and also energy from the endocarp, using it directly as burning fuel or to produce vegetal charcoal and the oil from the nut to generate energy (heat, mass, power, electricity)

Solar energy is another source of sustainable energy which can be used in the homes, hotels and shops in general, and is already being used by many of these sectors in the city of Palmas (capital of the State) and other towns. However, those that have adopted it use it for specific purposes, such as lighting and other uses. Solar energy is also used to power pumps used in irrigation and other applications.

According to the data observed during four years (2002-2006) at the Automatic Meteorology Station of the Federal University of Tocantins (Network Data SONDA - INPE/CCST), the average sun radiation accumulated monthly in cal/m2 was 217.2 in 2002 and 2003 it fell to 214.0, in 2004 the average was even lower 209.8, in 2005 it equalled 219.8 and in 2006 it increased to 236.3. The months with the highest radiation are from July to November. In these months radiation can vary from 224.4 – 251.6 cal/m2. Among the data collected the most outstanding month with the greatest variation was April and May 2006 with 256.4 and 292.9 cal/m2 respectively.

Another point to be noted as far as the environmental and economic sustainability of the State is concerned would be the substitution of imported diesel by building a refinery to produce fuel oils, using agricultural residues, cattle fat, saturated oils collected from homes, restaurants and bars and other raw materials abundantly available in the State. Its purpose would be to substitute diesel for a cleaner fuel and thereby reducing oil imports, helping to improve the country's trade balance.

For the industries to substitute wood and rice husks for a more efficient and cleaner fuel, natural gas would have to be made available for them. This could be transported on the North-South railway to the principal towns in the State, sold and distributed according to everyone's needs. Thereby less efficient fuels could be rapidly substituted, which could also lower the electricity consumption in the State.

Conclusions

The Legal Amazons sustainability is going through changes with regard to the population's vision of its resources. For the majority of the population the use of its' resources is to fulfil their basic needs and are not seen as harmful. The greater part of the harm done to the environment begins when one exceeds the extraction and exploitation limits allowed for the local ecosystem. The Energy Accounts is a photograph of past and present consumption patterns of all the types of energy for a certain region, State or country. That is why it is an essential instrument to project and plan for the sector. For the diversification of the energy matrix to become possible; there has to be political will, the availability of other energy sources and making society aware with regard to its benefits and consequences. The States that comprise the Legal Amazon are for the greater part being built and they need statistical and scientific instruments which show them where they are going and the same time orients the federal government actions. This region is special and its own dynamics have to be respected, and not as colonizers. This brings us the possibility of contributing on sustainable basis. All rich or poor countries are interconnected and the world is the home of all human beings and just this is sufficient reason in wanting to protect it.

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