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ENERGY AND SUSTAINABILITY IN THE 21ST CENTURY: THE CASE OF BRAZIL

ABSTRACT

This paper emphasizes that the Brazilian energy policy in the early decades of the century focused excessively on oil is a mistake due to being in a transition of environmental energy paradigm on the base of productive and focused on the global society to build a sustainable energy sources. We need to prioritize and implement the strategic management of the energy matrix, seeking diversification and growing, significantly, the share of renewable energy sources with the directors of the new environmental-energy paradigm. Gradually, it should meet the needs and realities of each context regional and national levels, taking into account the energy base, the universe of natural resources, the production structure, the technological potential available and the needs of growth and development economical.

KEYWORDS: Sustainability; Energy Policy; Oil.

ENERGIA E SUSTENTABILIDADE NO SÉCULO 21: O CASO DO BRASIL

RESUMO

Este trabalho enfatiza que a política energética brasileira nas primeiras décadas do século XXI direcionada de forma excessiva no petróleo é um equívoco em função de estarmos numa transição de paradigmas a nível energético-ambiental sobre a base produtiva e centrados na sociedade global para a construção de uma matriz energética sustentável. É necessário priorizar e implementar a gestão estratégica da matriz energética, buscando sua diversificação e fazendo crescer, de forma significativa, a participação das fontes energéticas renováveis com os energéticos diretores do novo paradigma. De modo gradual, deve-se atender às necessidades e à realidade de cada contexto regional, e também nacional, levando em consideração a base energética, o universo de recursos naturais, a estrutura produtiva, o potencial tecnológico disponível e as necessidades de crescimento e desenvolvimento econômico.

PALAVRAS-CHAVE: Sustentabilidade; Política Energética; Petróleo.

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Manoel Gonçalves Rodrigues
Universidade Federal do Rio de Janeiro, Brasil
http://lattes.cnpq.br/5940113046592928
manoel.rodrigues@terra.com.br

Fernando José Pereira da Costa
Universidade de Santiago de Compostela, Espanha
http://lattes.cnpq.br/0908286687921354
fjpcosta@sapo.pt

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INTRODUCTION

Between the 18th and 19th centuries, the Industrial Revolution in England predominantly established the Fossil Fuels Paradigms domain, first based on coal and lately, mainly after the Second World War, having oil as leading energetic.

This paradigm was based on one high level model of energetic voracity with deep impacts over the environment. The occurrence of the oil shocks in the 70´s decade starts to show weaknesses and the perverse aspects of the model that would characterize the Fossil Fuels Paradigm. From then, it begins a process transition to a new energetic-environmental paradigm, namely: the Renewable Energy Sources Paradigm, which assumes strategic importance the technic-economical-productive base and the construction of a sustainable energetic matrix, which has as background the climate matters and the searching for the configuration of one Global Climate Agreement.

The economic policy should star to interact systematically with the energetic policy and with the environmental policy, through a strategic management of the energetic matrix and the construction of an effective sustainability, acting mutually with all the public policies spheres in one systemic effectively perspective. However, the notion about energetic paradigm shows itself insufficient due to the real dimension of the matter which must be in-depth discussed from the concept of energetic-environmental paradigm, beginning from that is a systemic-interactive relation between energy and environment. Therefore, it makes much more sense to talk about energetic-environmental paradigm than only about energetic paradigm.

THEORETICAL DISCUSSIONS

Sustainable Energetic Matrix

The drawing of a sustainable energetic matrix has as background the impacts resulted from the disproportionate use of the fossil fuels over the environment and climate questions (carbon emissions reduction). Being understood that the climate changings, considering this or that magnitude, have, indeed, one significant anthropogenic component, the implementation of one significantly cleaner energetic matrix reinforces (and is dialectic reinforced) by the configuration of an effective Global Climate Agreement, to be implemented. In this way, a systemic interaction between the distinct public policies (economical, industrial, agricultural, technological, energetic, and environmental) will be founded through a strategic management of the energetic matrix and the construction of a sustainable energetic matrix.

However, according to signaled by Soares and Higuchi (2006, p.574-575), the concentration of Greenhouse Gases in atmosphere intensifies itself due to mankind´s action (anthropic source). In medium range, the human activities launch in atmosphere 25 billion of tons/

of CO_2 until 2050 the planet medium warming will be between 1,5º and 4,5º. However, it is suitable to verify that in terms of CO2 emission, the central countries (denominated industrialized or developed ones) assume 65% of them, remaining the rest with the named developing countries (the countries of the Periphery and Semi-periphery).

From this point that is attempted that the central countries (rich ones), in historical terms, are the major polluting launchers, while the peripheral and semi-peripheral countries need to grow and promote their economies sustained development. This aspect endowed by a crucial importance, not only in terms of historical-energetic passive, but also because the peripheral/semi-peripheral countries have the right to grow, to develop and improve their insertion in the world economy context.

It is obvious that in many chapters the developing nations, highlighting the emergent economies of the Semi-periphery, do not have to step the same way of energetic inefficiency and carelessness/aggressiveness to environment done by the central countries since the English Industrial Revolution (18^{th} and 19^{th} centuries), due to the technician progress, to technics/less energy consumption production processes, to more advanced organizational methods/production management/natural and energetic resources management and the introduction of renewable energetic sources especially biomass.

Anyway, thus the advance registered by China, the major launchers still are the developed countries, owners of capital and technology, what could mean, on one hand, a fundamental element for searching more equal criteria in the trial to solve the energetic-environmental matter. However, on the other hand, this aspect constitutes an enormous compounding (practically an obstacle) for the establishment of one Global Climate Agreement. The own difficulty to plan and implement it, beyond its implementation, appears as effective result of inequality and heterogeneity that mark the configuration of the proper world economy. However, thus this, the public-governmental and strategic-planner initiatives related to the energetic-environmental sphere must have as its objective, the construction of one clean and sustainable energetic matrix.

There are other questions that bring difficulty for reaching one Global Climate Agreement, which, according to alerted by Oliveira and Vecchia (2009, p.957-960), relates to the increasing complexity at the level of the environmental problems, the data/scientific evidences about them and the level of trustiness related to the appropriate information to give support the decision-making process. In fact, there would be a great number of uncertainties (beginning with the scientific one) related to the environmental questions and few would be the critical analyses about uncertainty and its possible impacts over the environment and society.

This aspect would open space for questions about the relation between the scientific component and politics, once the risks and cost-benefit analyses, which appear as support to the decision makers (politics, managers and policy makers), are based in scientific analyses which results are incorporated as absolute truths. This, at first sight, does not cancel the need of structuring a sustainable energetic matrix.

Indeed, the scientific-absolutist point of view presented in the models of support to the processes of decision making only could be softened by the uncertainty incorporation and its implications. In this sense, it is suitable to observe that even the anthropic global warming matter (supported by the scientific analyses) must be relativized by research and respective involved actors´ characterization in this process, as also their interests and relative positions.

In reality, what is considered is that does not exist a scientific controversial matter established about the climate changings and the global warming and many times the political component seems to overtake the scientific argumentation, making use of it when meets their defended interests. The fact is that there is an uncertainty sea and an enormous/diverse number of interests between the global warming alarmism and the position to refuse the association «human action/global warming».

On the other side, the global warming rhetoric would serve as base for the detachment from carbon «production/consumption», conducting to a new productive, energetic, space and social configuration, based on small units, reduced population cores and the rejection of the economic growth, to lead to one equally society (the utopic-ecologist project).

However, the ecologist utopia does not found minimal fundaments in reality. The primordial needs of the countries of the Periphery for overtaking delaying, to eradicate the poverty focal points and embrace the excluded economic-social big mass cause it to be totally unviable in practice and shows a systemic-strategic intervention of energetic-environmental content as the unique possible alternative.

One extremely important aspect on the searching for one diversified and sustainable energetic matrix, instrument of one strategic content of one new energetic mix in the stage of paradigmatic transition and which shows itself coherent with the universe of resources and the technological-energetic-productive *savoir-faire* of the developing emerging countries, mainly the countries of the Humid Tropic and particularly Brazil, it is related to the energetic use of biomass.

However, thus the advances registered in the last four decades, in the Brazilian case, according to Teixeira´s alert (2003, p.11-12), the use of energetic sources originated from biomass (sustainable energetic sources) occur in one marginal way, generally inserted in other specific systems of production. In these ones, the basic raw material births several products.

Therefore, the sugar cane sustains the combined production of alcohol, sugar and electricity. In its turn, biomass use in industry is not linked to social or environmental reasons, but for the fact that shows technical-economical at the level of determined processes. It must be highlighted the use of biomass in co-generation, which is maximized through heat and power generation. In fact, such restrictions tend to constitute strengthens and opportunities for the biomass diffusion at the level of the Brazilian energetic-productive matrix (and other countries of the Humid Tropic).

The relation between the economic politics and the searching for one sustainable energetic matrix is comprehended by the fact that one major variety of such matrix, mainly by autochthone

energetics which base is the biomass, will be expressed by currency savings, creation of employment, regional development, enterprises creation and income generation. However, this relation only makes sense if existing, considered and analyzed under one systemic-integral way, that is, in the ambience of one dynamic-interactive approach in all public policies areas. Therefore, only within a systemic context of the public policy is that the relation «economy/energetic matrix» gains importance, once its diversity/sustainability will have implications not only of economic-financial character but also industrial, technological, energetic, environmental etc. This is notorious in the case of the biomass for the Humid Tropic countries, especially Brazil.

Biomass, and also other renewable energy sources like sun and winds, appears as strategic drawing element for the developing and emerging countries begin not only to take step to more sustainable paths in terms of energetic matrix, reinforcing its position while one new Global Climate Agreement as also giving it the role of smaller levels of energetic dependence and enabling also the result from the breaking with the peripheral condition and overcoming the semi-peripheral-emerging stage through reaching one effective industrial and technological upgrade, enhancing one real process of development.

The energetic use of biomass presents several conditioning aspects. First of all, the concurrence between energy and food must be refereed. This can exist in countries of few agricultural lands and one limited agricultural frontier, what does not impede the development of agro-energy since made the adequate zoning/agricultural planning, where the delimitation of different models of cultures and soil use (food production, cultures for exportation, cattle and agro-energy) is made.

It is necessary to get over uncertainties related to the climate changings, particularly related to the real dimension of their anthropic component. It is also needed to analyze, equally, the data related to agro-energy and its real implications. It is yet determining to consider the technological dynamism as relevant factor for the alternative viability and restrictions and conditions overtaking. Ending, at the level of the developing and emergent countries, only one strategic and systemic view of the productive system dynamics can define one new energetic model based on sustainability, without directing for the fundamentalist ecology or be submitted to a conception based on catastrophism and environmentalist determinism.

The enormous complexity which permeates the debate about ethanol and biodiesel as alternatives to oil do not allow itself to simplification, mystification or occasional rhetoric to the taste of eco fundamentalists. So, it must avoid, on one hand, the adoption of patriotic/triumphalist positions, and, on the other hand, the inconsequent substit (pseudo ideological) . Therefore, when trying to analyze the matter of biofuels (namely: ethanol and biodiesel) and their possible impacts (energetic, environmental, technological, agricultural, economic, social, etc.), making use of the scientific/methodological rigidity and also one strategic-prospective view which overtakes the merely extrapolar optic must be sought.

Considering initially that reality is changeable and technology, if cannot be taken as *Deus ex machina* (technology as panacea), base of the technician view, also cannot be despised since is one element of intervention, modernization and advance for promoting changings. In fact, ethanol, biodiesel and biofuel, beyond technological lecturers and technic progress launchers, are fertile land for technological innovations use, whether agricultural or in the productive-industrial sphere.

Under a correct point of view, in terms of one view marked by the scientific an methodological rigidity, and considering the ethanol case in Brazil, which was implanted in the 70´s, the metallurgical industry was capacitated for producing equipment for the alcohol/sugar alcohol units; it was discovered *vinhoto* as fertilizer; the bagasse began to be used as soil fertilizer and be burnt inside boilers, supplying heat for the process and making possible the electricity energy generation, making viable self-generation and even cogeneration; new technics of intercropped plantations were developed to restitute the nutrients exhausted by sugar cane culture, etc.

Biofuel production brings problems and risks, but, on the other hand, make viable one predominantly green/renewable energetic matrix. On the other hand, the risks presented by biofuels, notoriously in agricultural matter, show themselves as susceptible of being significantly minimized from energetic-environmental, political-government and public-institutional initiatives directed to the agricultural area, namely: the implementation of one effective agricultural zoning; the use of unclaimed or free lands due to the increasing advance of the intensive livestock to the detriment of the extensive livestock and the advance of the plantation and food cultures intercropping.

Appearance of the Energetic-Environmental Paradigm

The environmental question cannot be treated separately from the energetic question. Therefore, it can be considered that today one transition from the Fossil Fuels Paradigm (no-renewable) to the Renewable Energies Paradigm has been lived. The transition is not immediate and yet will take even some decades. However, the alternative energetic sources, along this period, will have its level of participation, in terms of the energetic-productive base, increased, allowed to evoke to determine no-renewable energetic resources, like the natural gas, less pollutant than oil and its derives and processes and technologies improver.

According to Costa and Rodrigues (2011, p.3), the transition of paradigm will be signed by the introduction of new energetic sources, through their living and interaction with the traditional energetic sources and one growing mix of energetic sources. With this, the transition of energetic-environmental will be drawn from the strategic growing interaction between the energetic policy and the environmental policy. In fact, referring only to the energetic paradigm or the environmental

paradigm gives a restricted view of the matter. Therefore, one systemic approach is chosen and the concept of energetic-environmental paradigm is adopted.

On the other hand, making use of the theory contribution of Cazadero (1995, p.16), it is not to be considered only the occurrence of one Industrial Revolution, in England in the 18th and 19th centuries, but of three Industrial Revolutions, along the history. The English Industrial Revolution, according to this approach, would constitute the First Industrial Revolution (FIR). The Second Industrial Revolution (SIR) would happen in the end of the 19th century of the 70´s of the 20th century, being marked by the automobile appearance, the development of new methods in terms of organization/production management and having the Taylorism/Fordism as the regulation system. Concerning the Third Industrial Revolution (TIR) would happen from the 70´s of the 20th century. If considering the argument that all Industrial Revolution is simultaneously one Technological Revolution, the TIR, undoubtedly, the most technological of the Industrial Revolutions. Due to this aspect, that can also be denominated Third Industrial Technological Revolution (TITR).

In each Industrial Revolution, the presence of one or more sources which constituted their respective energetic base was perceived. So, in the FIR, there is coal and already in the end of the 20th century, oil. Beyond oil, the SIR finds energetic support in electricity and thermonuclear energy. Between the end of the SIR and the beginning of the TIR/TITR, the natural gas appears energetic and less polluting than oil and its derives, processes and equipment improver, but equally a fossil fuel. Therefore, what happens is that from the FIR, the Fossil Fuels Paradigm is established, still present along the FIR and great part of the SIR.

The occurrence of oil shocks in the 70´s decade of the 20th century will signal the end of the Fossil Fuels Paradigm. The crisis of this period is not only energetic or economic (stagflation, crisis of the Keynesian State and the emergence of the neoliberal proposals), but before one paradigm that breaks down and dismantles. From that, what is had is a long transition period until the establishment of the new paradigm (the Energy Renewable Sources Paradigm). We live today with this transition, which is long and may endure for more some decades, with the coming up on scene of the renewable sources coexisting with the fossil fuels.

According to mentioned by Costa and Rodrigues (2011, p.10), the FIR had as basic energetic the coal which is consolidated, grows and transits to the SIR with the appearance on the scene of the oil, that, due to a series of favorable aspects liquid fuel of relatively easy handling and reduced trade price) would be converted into the energetic leader of the SIR, bearing one growth consuming model. The Third Industrial Revolution (TIR) that begins in the 70´s, coinciding (and accelerating) with the Welfare State crisis (probably its *débâcle*) and with the hegemony of the neoliberal thesis is characterized by the introduction of one immense source of scientific-technological innovations.

In fact, according to registered by Chiavenato (1993, p.20-21), all this process will be marked by the appearance of genuinely new technologies and not only by the simple existing

technologies unfolding, with the increasing acceleration of the technology transformation in product/service ready disposable for use/consumption.

According to observed by Costa and Rodrigues (2011, p.10), the SIR also marks the establishment of the thermonuclear energy. In the end of the SIR and beginning of the TIR, considered by this work more adequately denominated Third Industrial Technological Revolution (TITR), for being the most technological of the Industrial Revolutions, where the interaction between the scientific-technic and the industrial base reaches one never seen level, the natural gas appears.

This one, also a fossil fuel, no-renewable and pollutant (although less than oil and coal) begins to constitute one innovative process string at level processes, equipment and final uses, with clear consequences in terms of technological advance.

In fact, in the context of one stage of transition between energetic-environmental paradigms (from Fossil Fuels Paradigm to Renewable Sources of Energy), coinciding with outbreak and development of the TIR/TITR, it must be registered that such fact disposes all one source of process technologies, generation and final use for the energy-environmental component. The stage of interparadigmatic stage will be marked by the technological increasing, which will make viable not only the no-conventional sources of energy, but also the coexistence/interaction between them and the conventional energetics.

In this way, petrochemical must not give up places for gas chemistry and alcohol chemistry. The living of the three energy technological concepts will last for much time, being possible even to think about the possibility of interpenetrations of productive and technological content between those concepts.

The same will happen with oil, that can be improved at exploration/production, at refining activity in terms of petrochemical products) and at the final use sphere levels, through technological innovations. The technical progress assured by the TIR/TITR will be also able to dispose new conceptions, concerning process technologies, final use and agricultural production to promote biomass expansion, concerning the advance for one major green energetic matrix. Therefore, the source of technological innovations created in the scope of the TIR/TITR will give base/sustain to the transition process, enabling the desirable energy environmental combinations, making sure, by the way, of the fossil fuels, particularly the natural gas, due to its distinct characteristics concerning oil, and the fact of beginning to constitute the gas chemistry energy technological base.

According to the analysis developed by Costa and Rodrigues (2011, p.11), the period of the paradigmatic transition will be slow (long-term time horizon), with the combined use of fossil fuels and renewable energetics, with their complementarity and that two energy-technological-environmental models interpenetration. The paradigmatic transition phases in energetic-environmental terms already has, as basic element of characterization, the strategic management of the energetic matrix, not only concerning the oil derives participation reduction, but also in terms

of the relative increasing of the renewable energetics and the diminution of the dependence of the external flows of energy supply.

In fact, to Costa and Rodrigues (2011, p.11), the long period of paradigmatic transition in terms of energetics-environmental will be signed by one intense/dynamic action of the binomial «Energy/Technology», with the scientific-technical advances and the technological innovations crating/making possible the use of no-conventional sources of energy. So, the change occurs at the energetic-environmental paradigm level. Therefore, it is within this context that the energy-planner must be considered instrument for study/analysis and for society´s preparation and awareness, especially the generation who will live this process more intensively and presently.

In fact, according to registered by Singer (1998, p.173-174), the occurrence of the TIR/TITR coincides with the appearance on the scene of the neoliberal project (or neoliberal counter-revolution). In other words, the TIR/TITR starts to take their first steps in the midst-70´s of the 20th century. This is the period microcomputers are enhanced, being cheapened and becoming more accessible to businesses and the major part of consumers. From then, there was one expansion/accelerated diffusion of the digital technology for every industrial task, services and agricultural activities, what would provide the obtaining of high and increasing gains in working productivity. Automation, through robots improvement (robotics), gave greater laps, enabling the working labor force substitution even for elemental intelligence activities. So, it would be expectable that the TIR/TITR while infra-structural revolution, would lead to the technological process acceleration.

In fact, according to highlighted by Costa and Rodrigues (2011, p.14), what is configured is that the environmental matter cannot be treated separately from the energetic one. Therefore, it can be considered that today what is being lived is one transition from the Fossil Fuels Paradigm (no-renewable energetics) to the Renewable Energies Paradigm. Transition is not immediate and will take yet some decades. However, the alternative energetic sources, along this period, will have their level of participation increased in terms of energetic-productive base, being able to evoke to interaction and interpenetration of the renewable sources of energy with determined no-renewable energetic resources. So, the paradigmatic transition (from the fossil fuels to the renewable sources of energy) will be marked by the introduction of new energetic sources, their living/combination and interaction with the traditional energetic sources (growing diversity of the energetic matrix) and one growing mix of energetic sources (strategic management of the energetic matrix).

On the other side, according to what Costa and Rodrigues register (2011, p.14-15), and this is more instant in the case of the great metropolis and megalopolis of the Periphery and Semi periphery (São Paulo, Mumbai, Calcutta, Mexico City, etc.), the new energetic environmental paradigm passes through the economical-conservationist (re)use of the urban solid waste from recycling and waters and sewers treatment, which, beyond opposing to the consumption-waster logic and the environmental degradation nuance of the previous paradigm, contributes, significantly, for the energetic-alternative production (especially methanol gas), collaborating so

much for the establishment of auto-sustainable cities/metropolis (one of the pillars of the new energetic-environmental paradigm).

At energetic-environmental transition level, according to observed by Costa and Rodrigues (2011, p.15), the conservation and rational use of water gain fundamental importance. Energy conservation, inclusively, must be considered as energetic resource in the ambience of the new energetic-environmental paradigm, as also in the interparadigmatic transition stage. Energy conservation/rationalization must be seen under two views, namely: energetic sources and consumption segments (COSTA, 1990, p.367). Energy conservation/rationalization articulates besides other aspects with the habits consumption changing, one of the basic points of the new energetic-environmental paradigm, enabled to provide the energetic model overtaking.

Brazil´s Oil Option

The magnitude assumed by the estimative related to the pre-salt oil/gas reserves, would constitute, in one first moment and under quick and less deep appreciation of the fact, in one great weariness motif for those who risk in the viability/construction of one green, renewable and sustainable matrix. And, considering this particular side, it seems to point out, ion terms of the national energetic policy, for the almost entire Brazil attachment to oil dependence.

According to observed by Martins (2010, p.84), the pre-salt layer area comprehends one strip that extends along the 800 km between Espírito Santo and Santa Catarina States, below the sea bed, extents through three sedimentary bases, namely: Espírito Santo, Campos and Santos. The estimative shows that the pre-salt layer may contain the equivalent to about 1,6 trillion of cubic meters of oil and natural gas. The estimative which leads to 2017 overtakes 1,3 million of barrels of oil/day. Once these estimative are confirmed, Brazil will be considered the fourth major world oil, with all the results from then.

However, this event can be analyzed in three distinct manners: namely, immediate state, fundamentalist-ecologist position and strategic intervention.

First of all, concerning the immediate state, oil (and also natural gas) would be now seen as one panacea for Brazil´s maleficence and limits, what would lead to the acceleration of the prospections and production struggles and the growing, probably unlimited, of those two fossil energetics consumption levels, especially oil and derives, where the fossil fuels assuming the leadership within the context of the national energetic matrix, diminishing the renewable energetics participation, what would represent one retrocession in energetic, environmental and technological terms. According to this option, at the world level, Brazil would integrate with one energetic matrix predominantly compounded by fossil fuels, probably in one world turned to the use of renewable sources of energy, predominantly the clean/green ones.

Secondly, due to the fundamentalist-ecologist state, the option would be to reject the fossil fuels from pre-salt and to enhance the use of the clean/renewable energetic sources. However,

this view would represent an unreal approach of the environmental matter. In fact, nowadays is the transition between the Fossil Fuels Paradigm (heritage of the FIR of the 18th and 19th centuries) and the Renewable Sources of Energy Paradigm that has been lived. This passage begins in the 70´s (from the oil shocks). It will be slow (probably lasts more two decades) and will imply in the coexistence/interaction between the fossil fuels and the renewable energetics, inclusively, due to the technological and productive restrictions.

Third, concerning the strategic intervention, the pre-salt oil, its availability, exploration and use, the limitations/restrictions of technologic content must be considered, which oppose itself to the oil substitution (certain segments of the petrochemical industry, for example), being necessary to promote the strategic management and the rational use/parsimonious of the oil/gas reserves of pre-salt layer.

On the other hand, it must be considered that even the privilege of building up one green, renewable and sustainable energetic matrix, it cannot be unconsidered that oil and its derives, as also the natural gas, beyond compounding Brazil energetic base, can also guide to the industrial/technological capacitation at the level of equipment production and services linked to the oil/gas prospection/exploration.

Differently, it is also possible to improve the oil, oil derivate and natural gas exportations, viewing resources which be channeled for the financial support, development and implantation of renewable projects of energy, especially concerning the improving of the struggles of Research and Development (R&D).

In fact, the strategic intervention approach due to the oil/gas resources from the pre-salt layer and its prospection, production and use convenience, not only relates itself with the technological, industrial and energetic content restrictions, but also to the fact that the sources of energy diversity, as also their substitution, are not presented as easy and right solved matters.

This issue assume higher complexity levels, because the option for each energetic implies in one distinct chain (energetic, industrial and technological) with one proper rationale and specific technical-productive trajectories. Therefore, the oil string implies in distinct trajectories of the gas string or even the alcohol one.

According what is signaled by Piquet (2009, p.54) and Júnior (2007, p.7), the diversity of the sources of energy supply assumes a central role, consequently, represent one matter in the planning process in several countries, implying the implementation of distinct domains actions, namely: economic, technological, environmental, geopolitical and social. The strategy of diversity due to the energetic supply was converted into one important item of the energetic policies implemented by several national states. However, seeking for alternative energetic sources is endowed by a significant grade of complexity, once the energetic sector is compounded of several distinct chains. These, in their turn, show well defined frontiers for each one of them, with distinct technical, products and trades bases.

To Vichi and Mansor (2009, p.757), Brazil has all the conditions to be positioned as one of the world leaders at the energetic sector level. Brazil owns one high potential of hydric generation (which only 20%/25% is used) and leans on important initiatives in terms of alternative fuels (ethanol and biofuels). On the other side, the new oil reserves recently discovered in the Brazilian coastal side cannot be despised. However, for the consecution of the energetic leader project, it is necessary to promote the maintenance/modernization and the energetic systems and, especially, improve, significantly, the R&D struggles.

According to Vichi and Mansor (2009, p.758-759), the total value of internal energy supply in Brazil in 2007 was around 240 millions of equivalent tons of oil (Eto), what represents one increasing of 5,5% comparing to 2006, equivalent to 2% of all energy produced in the world. In *per capita* terms, the internal energy supply was of 1,29 Eto/inhabitant, inferior than the world range (1,8 Eto) and about 3,6 times smaller than the range of the countries of the Organization for the Cooperation and Economic Development (OCED), institution that reunites, in its major part, the countries that pertain to the «Central Organic Core» of the world economy. The lack of heating systems in almost all Brazilian houses is a factor which contributes, significantly, for the low energy consumption *per* capita registered in Brazil.

The analysis of the Table below depicts that 46% of the internal energy supply in Brazil are referred to renewable sources, correspondent to biomass (31,1%) and to hydraulic energy (14,9%). Concerning to comparison with the internal energy supply of other globe areas, the levels very under to the registered in the rest of the world and mainly by OCED must be signed. On the other hand, the differences at the level of hydraulic energy are greater, especially in terms of biomass. In fact, these data prove that Brazil, compared with other countries, has one high potential due to the perennial constitution of one energetic, green, clean and sustainable matrix.

Table 01: Comparing Participation of Several Sources of Energy Brazil, OCED and World 2007 (%).

Sources	Brazil	OCED	World
Oil	37,4	40,6	35,0
Biomass	31,1	4,2	10,5
Hydraulic	14,9	2,0	2,2
Mineral Coal	6,0	20,4	25,3
Natural Gas	9,3	21,8	20,7
Uranium	1,4	11,0	6,3
Millions of Eto	226,1	5.506	11.435
Renewables	46,0	6,2	12,7

Source: VICHI and MANSOR (2009).

However, according to Vichi and Mansor (2009, p. 760), on trying to reach the exact value of the recoverable reserves estimative of the natural gas, the consensus is still far. In fact, the information compiled by the World Counsel of Energy present a dispersion of ± 4,5% around the value of 177 trillion of $m^{3.}$ However, according to specialists' opinion, the natural gas not yet discovered is underestimated. In fact, the natural gas exploration is in one less developed stage than oil one, and many lands have not been yet mapped.

On the other side, the new coal-bed methane deposits and another no-conventional sources (for example, the methanol hydrate) are yet less explored. According to the Centro

Internacional de Informações da Indústria do Gás (CEDIGAZ), the present mapped reserves, if consumption is kept in the present levels, is shown insufficient for the next 130 years.

Concerning oil and making use of the analyzes carried out by Vichi and Mansor (2009, p. 760), the detected oil reserves, evaluated by the World Counsel of Energy and the *British Petroleum* (BP), are still sufficient to allow one consumption base for a medium term period. According to the World Counsel Energy data (closely to the BP one), based on the member countries information, the world reserves were, in the end of 2005, of 1.238 billion of barrels (160 billion of tons), about 117 billion above the values of the ending of 2022. Beyond these reserves, some estimative seen as optimists shows the possibility of recuperating 244 billion of added tons, that is, one value 52% superior to the present detected reserves.

However, according to Vichi and Mansor (2009, p.760-761), the expectation lead to one oil consumption increase during the next three decades, which would leap from 85 million of barrels/day in 2006 to 118 million of barrels/day in 2030, that is, around 39% growth. Besides, the oil production peak must occur between 2010 and 2020.

In another words, there is a dangerous combination. Worsening the situation, it must be registered that seven of the ten major oil consumers do not produce enough oil to attend to their demands, fact which makes the alarm of "energetic security" signs. In fact, the oil barrel price leaped from US$ 25,00 in 2000 to US$ 140 on June 2008, right before the crisis of the world financial system. In 15th January, 2009, price would have dropped to US$ 36,22 reflecting the crisis, but it is expected that prices are retaken throughout the crisis overcoming.

As well observed by Vichi and Mansor (2009, p.761), the discovering done by Petrobras, in the last years, in the Santos Basin, are being considered by specialists as the major world oil discovering in recent years. The Tupi land, with reserves of 5 to 8 billion of barrels, was amplified in 60% of the detected reserves of the enterprise. The denominated pre-salt oil is a superior quality oil then the one normally found in Brazil, since its fraction of light compounds is higher, what easies the refining process. The pre-salt discovering will be able to lead to one significant increase of the no-renewable sources of energy at the Brazilian energetic matrix level.

The directed relation between the oil expectations about the pre-salt layer and the oil derives growing in terms of the Brazilian energetic matrix would seem at first sight something inevitable, but the substitution of oil as energy source gains relevance in environmental and technic-industrial terms, once there are fractions of oil of extreme importance as raw material for chemical industry.

In fact, opposed to what happens to the energetic sector, there is not yet alternatives economically viable for the oil substitution while industrial input (except maybe the named "green plastic", obtained from the partnership Braskem/Petrobras). In fact, mentioning only one example, the use of oil by the plastic producer industry does not imply CO2 emission, once carbon remains unchangeable in the final product.

Indeed, according to observed by Vichi and Mansor (2009, p.761), oil is one product of extreme value and should not keep being burned in motors. In this point, the cargo transport matter in Brazil predominantly highways gains relevance, what means avid oil derives consumer. Due to those characteristics continental dimension country that does not present great natural accidents), the best and more rational option for the cargo transports (and passengers too) for Brazil is the railway transport.

So, the reduction of oil derives consumption and the passage for one energetic matrix less energy consumer, more efficient and with one smaller grade of dependence facing the fossil fuels passes through, necessarily, Brazil railway industry, especially concerning the cargo transports. Considering that approximately 95% of fuel for automobile or truck are spent for moving the vehicle and speed retaking, it is notorious the superiority of the railway transport over the highway one. The railway industry assumed while project would appear as a clear example of one interacted, systemic and strategic planning model action, once the strategic management of the energetic matrix would be mixed with the reformulation of the transport structure, the energetic consumption redefinition and one new industrial/technological chain.

Technological Development and Sustainable Society

In the industrial park, the investments in R&D would have to be improved, significantly, especially at the level of process technologies, new and more efficient equipment, production rationalization, wasting reduction, energy conservation, resources and raw materials rational use and one bigger level of energy generation, mainly electricity, improving the self-cogeneration/cogeneration.

According highlighted by Otaviano (2011, s/p), the 3ª chemistry wave would be already being lived, that is, the green chemistry. The two first chemistry waves would have occurred, respectively, in the 19th and 20th centuries, having as basic energetic coil and oil afterwards. Making use of Vichi and Mansor´s contribution (2009, p.758), there must be considered that the green chemistry consists of products/chemical processes projected to reduce/eliminate the negative environmental impacts. The use/production of these products must embrace the reduction of residues generation, the use of no-toxicant components and one increase of global efficiency.

The approach is very effective, because applies innovative scientific solutions to real situations. In the green chemistry context, the investment in Brazilian biodiversity potential is inserted, more specifically the oil-chemistry/ethanol-chemistry, aiming to reach one more rentable energetic matrix, what implies going much further than simply substituting fossil fuels for biofuels.

The green chemistry would be able to soften the environmental impacts, beyond promoting the substitution of oil and derives within the most distinct chemical processes (chemical-industrial and energy-chemical), promoting the intensification of the renewable fuels use (obtained from biomass), which are shown as less harmful to environment than the oil derives. In Brazil case,

there must be highlighted the position assumed by ethyl alcohol (ethanol) obtained from sugar cane, as main option in terms of renewable fuels, although this can be obtained from primary sources (cassava and sweet sorghum, for example).

On the other hand, according to Otaviano (2011, s/p), the ethanol derived from sugar cane can be used as raw material (renewable) in polymer production, mainly plastic, the named “green plastic”, obtained from the partnership Braskem/Petrobrás and commercialized from since 2009, making use of technology developed by the Brazilian State oil plant since the ending of the 70´s of the 20th century, which enables the obtaining of ethylene from the sugar cane ethanol, what constitutes itself in one relevant innovation, whether at the level of energy production or under the energetic-environmental point of view.

In fact, according to registered by Otaviano (2011, s/p), in chemical terms, the green and the naphta made polyethylene are identical. However, they cause distinct impacts. The polyethylene obtained from that oil derive leads to the pollutant and greenhouse effect gases emission. On the other side, the polyethylene derived from ethanol withdraws carbonic gas from atmosphere. When the fossil fuels are used, an input is withdrawn from the earth surface, used and discharged in atmosphere. Concerning the ethanol burning, part of carbonic gas is reabsorbed during sugar cane growth. Therefore, making use of oil and derives, an environmental unbalance is created, because CO2 is launched to atmosphere without one counterpart in terms of its capturers processes. So, in Brazil case, ethanol ensures one highlighted place when referring to the green chemistry.

According to what is signaled by Otaviano (2011, s/p), thus the world energetic matrix is yet much based on oil and derives, it presents one tendency to growing bioenergy participation, that is, energy derived from biomass. In fact, according to data launched by the Ministry of Mines and Energy (MME), in 2006, 87,1% of the whole world energy consumption was originated from no-renewable fuels, while 12,9% corresponded to renewable fuels. In 2008, in Brazil, 45,4% of the total energy consumption was renewable and 54,6% no-renewable. The ethanol derived from sugar cane elaborated/used in Brazil, shows itself, according to several students’, researchers´ and analysts´ opinion, .the best option in terms of bioenergy, provided with significant energetic efficiency and one high level of competitiveness concerning the world scale.

In the period 2006/2018, according to observed by Nassar (2008, p.22-24), the Brazilian cattle would need to embrace only more than 5 million of adding ha. Considering the hypothesis that the Brazilian bovine cattle would increase about 20 million heads, the biggest part of the expansion of Brazilian future available lands for food production, rations and ethanol production will come from the conversion of pastures area into agricultural areas without harming meat and milk production, due to the cattle activity intensification.

In fact, there are other matters much present in several critics that are done concerning the energetic use of sugar cane for ethylic alcohol production and that has to do with soil exhaustion/depletion, needing a strong struggle of irrigation and the high use of oil chemical based

fertilizers. However, those critics, in the major part, do not have fundament in practice, because are seen under one static-catastrophic view due to the political-institutional surround, to the strategic-planner scope and the technological changing.

In the specific case of sugar cane, the need of water can be supplied by efficient irrigation systems, which lead to one major productivity with one relatively less water consumption, while other solutions have been already found in the case of the soil fertilization (legume intercropping, rotation in plantation areas, use of vinasse as fertilizer and use of bagasse as fertilizer), what would avoid the negative balance of sugar cane culture destined to the ethanol production. Indeed, these limitations overcoming imply in the intense struggles made by R&D, in the continuous improvement at the level of process engineering and the consequently growth of the level of the technological capacitation, aspect endowed by vital strategic importance for the development of developing and emerging countries of the Humid Tropic.

However, searching for maintain and stress of the green character of the Brazilian energetic matrix not only means to provide the producer sector with ethanol (and biofuels in general) of one wide technological source, but before turn it into one energy-technological base in excellence. On the other side, the technological research has advanced concerning the agrarian-alcohol part, although the level of technological incorporation must be deepen, promoting one stress increase of productivity, what could conduct to one small quantity of cultivated area per ethanol liters, aspect susceptible to unburden the conflict «energetic cultures X food cultures».

On the other hand, to Costa and Hoeschl (2006, p.30-33), biofuels constitute one of the most efficient forms of diversity of the energetic matrix, once contribute for the GEE emission reduction, constituting one economic development motor (by investments optimization/decentralization) and one social development promoter (employment generation/income in rural environment). For that, it is necessary the establishment of supporter mechanisms to production/trade of biofuels, what can be succeeded, in one wider scope, in the public policies and the institutional base, as also, in more specific terms, through integration/interaction of public organisms, private institutions and small producers.

In Brazil´s specific case, according to attested by Costa and Hoeschl (2006, p.30-33), there must be considered biodiesel case, natural fuel obtained from renewable sources and destined to the cycle-diesel motors. In fact, biodiesel (while biofuel) presents one high potential concerning the social/environmental objectives reaching, once can promote the formation of a class of small/medium agricultural producers, to stimulate the employment creation, to make possible the income generation and to collaborate with the gases emission reduction/minimization which contribute to the global climate changings.

For beyond that, in strategic terms, the biodiesel production aims the diversity of the energetic matrix, especially in the case of the countries which import that mineral diesel. In fact, considering one integral-strategic-interactive approach, biodiesel, on acting with the objective to

promote one major level of diversity of the energetic matrix, making it more sustainable, leads to one higher level of its own sufficiency.

Again evoking Costa and Hoeschl (2006, p.30-33), it is registered in the Brazilian case that the productive capacity of biodiesel is closer to the 143 millions of liters/year. The demand for only the mixture of 2% of biodiesel in the energetic matrix represented 840 million of liters/year and the estimated value (by the Ministry of Mines and Energy) with the mixture of biodiesel at 5% would be of 2 billion of liters/year, that is one almost 140% improvement. However, biodiesel presents another aspect of extreme importance and that takes part of its level of *lato sensu* productive chaining.

Due to the world demand and the importance assumed by the biodiesel chain for Brazil´s development, according to signaled by Costa and Hoeschl (2006, p.30-33), it is needed one knowledge organization and the strategic information production. During the biodiesel chain analysis, it must be considered factors related to the input/raw materials choices for the agricultural production, storage, quality characterization/control, co-production and the proper commercialization and distribution. The knowledge management in the biofuels chain gains importance within this context, where it begins to be considered in a whole the universe of resources related to their production, namely: human, technological and of processes.

It must be registered that biodiesel is constituted in one important element, concerning the sustainability of the energetic matrix. There are several benefits (economic, social and environmental) implicit in the use of biodiesel while fuel, once evoking to biodiesel (like other biofuels), conducts to employment and income generation, promotes GEE reduction, opens space for new productive enterprises, reduces the need of diesel oil importations, diminishing the level of energetic dependence and expenditure of foreign exchange, enables the attendance to the compromises firmed in the Convention - United Nations Framework Convention on climate change (UNFCCC) ambience -, besides opening significant opportunities in terms of international financial support in conditions favored in the trade of carbon credits.

FINAL CONSIDERATIONS

The definition of a society model is founded on one determined energetic base and structured due to one determined economic model. Therefore, each paradigm will imply in the hegemony of one model of energetics, in their interactions and implications over the environment, and in one two-sided-interactive relationship with that which could be named the *lato sensu* social configuration, which shapes it and simultaneously is shaped by it, making perennial one determined social-energetic-productive base and to define social, technological and organizational standards.

The transition of paradigms at energetic-environmental level implies in one strategic position, focused in management and planning expressed by one intervention over the productive

base and the construction of one sustainable energetic matrix. For this, it is necessary to implement the strategic management of the energetic matrix, seeking for its diversification and making grow, significantly, the participation of the renewable energetic sources in one gradual way, attending to each context needs and reality, considering the energetic base, the universe of the natural resources, the productive structure, the technological source and the needs for growth and development.

However, if the Brazilian energetic policy walks strongly connected to oil as it seems to be observed in these first decades of the 21st century, this will be an enormous equivoque. Although it is important to analyze the Brazilian situation, under its energetic matrix point and the perspectives related to the oil and gas reserves related to the pre-salt layer, it must be in mind that the way for sustainability necessarily passes through the adoption of responsible practices of consumption and the drawing in one methodological searching for one appropriate indicator and human happiness level performance measure.

In this context, the construction of one sustainable energetic matrix passes through necessarily the incorporation of clean energies, considering sustainability and social environmental responsibility, respecting the regional features and promoting the research on technological innovation.

REFERENCES

CAZADERO, M.. **Las revoluciones industriales**. Cidade do México: FCE, 1995.

CHIAVENATO, I.. **Introdução à teoria geral da Administração**. São Paulo: Makron Books, 1993.

COSTA, F. C.; HOESCHL, H. C.. Gestão do conhecimento na cadeia produtiva de Biodiesel. In: CONGRESSO DA REDE BRASILEIRA DE TECNOLOGIA DE BIODIESEL, 1. **Anais**. Brasília: MCT/ABIPTI, 2006. p.30-34.

COSTA, F. J. P.. **O papel da conservação nas políticas e programas direcionados ao setor energético**. Dissertação (Mestrado em Planejamento Energético) – COPPE da Universidade Federal do Rio de Janeiro, Rio de Janeiro, 1990.

COSTA, F. J. P.; RODRIGUES, M. G.. Estratégias de desenvolvimento da América Latina e Caribe face à transição de paradigmas energéticos-ambientais e no âmbito da atual configuração da economia mundial. In: CONGRESSO INTERNACIONAL DA FEDERAÇÃO INTERNACIONAL DE ESTUDOS SOBRE AMÉRICA LATINA E CARIBE, 15. **Anais**. Valência: UPV, 2011.

JUNIOR, H. Q. P. et al.. **Economia da energia:** fundamentos econômicos, evolução histórica e organização industrial. Rio de Janeiro: Elsevier, 2007.

MARTINS, E. O.. Amazônia azul, pré-sal, soberania e jurisdição marítima. **Revista CEJ**, Brasília, v.14, n.50, p.83-88, 2010.

NASSAR, A. M.. Disponibilidade de terra para biocombustíveis e alimentos: chegamos ao limite?. **Cadernos FGV Projetos: Biocombustível**, Rio de Janeiro, v.3, n.7, p.22-24, 2008.

OTAVIANO, C.. Mudança de petróleo para biomassa impulsiona a química verde. **ComCiência**, Campinas, 2011.

OLIVEIRA, M. J.; VECCHIA, F.. a controvérsia das mudanças climáticas e do aquecimento global antropogênico: consenso científico ou interesse político?. In: FÓRUM AMBIENTAL DA ALTA PAULISTA, 5. **Anais**. Tupã: ANAP, 2009. p.946-962.

PIQUET, R.. A indústria de gás no Brasil: incertezas, implicações territoriais e perspectivas. **Novos Cadernos NAEA**, Bélem, v.12, n.1, p.51-66, 2009.

SINGER, P.. **Uma utopia militante**: repensando o socialismo. Petrópolis: Vozes, 1998.

SOARES, T. G.; HIGUCHI, N.. A convenção do clima e a legislação brasileira pertinente com ênfase para a legislação ambiental no Amazonas. **Acta Amazônica**, Manaus, v.36, n.4, p.573-580, 2006.

TEIXEIRA, M. A.. **Caracterização energética do babaçú e análise do potencial de cogeração**. Tese (Doutorado em Engenharia Mecânica) – Universidade Estadual de Campinas, Campinas, 2003.

VICHI, F. M.; MANSOR, M. T. C.. Energia, meio ambiente e economia: o Brasil no contexto mundial. **Química Nova**, São Paulo, v.32, n.3, p.757-767, 2009.