

## ENERGY AND DEVELOPMENT: PERSPECTIVES FOR A SUSTAINABLE FUTURE

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***Abstract.** Energy is a basic input for the development and an important component of competitiveness for any country. The impacts verified by the emission of gases produced by the burning of fossil fuels suggest that the future will be negative in case the humanity will continue to degrade the environment. In function of all these current environmental problems caused by the economical practices, it will surely bring implications on the society in medium and long periods, in view of the natural resources consume and the environmental degradation, added to the population growth, a search of a new development type becomes necessary. The adoption of the sustainable development indicates a new route to the society, capable to guarantee its survival and the nature as well, and energy is an essential factor in global efforts to reach a sustainable future. In this article, analysis between the use of energy and the current development, its implications on the sustainable development and the applicable solutions will be performed in order to state that the wished development is really possible.*

***Keywords:** sustainable development, energy, environmental impacts and energy solutions.*

### 1. INTRODUCTION

According to the expectation that the population will be doubled by the middle of the XXI century and the present model of effective economical growth keeps going on, it is expected that the global demand of energy increases in the primary sector from 1.5 to 3 times, also increasing the impacts on the environment, since the use of primary resources is the main source of pollutant emissions (Dincer, 2000). If the developing countries base themselves on the unsustainable consumption patterns from the countries named Annex I, which are responsible for the consumption of 75% of the energy resources, the future tends to be negative. This is one of the reasons why energy has now been one of the main dilemmas: Such as how to combine economical development with an inhabitable atmosphere in a world that is suffering fast changes as a result of the population growth and the applied economical development model?

Perhaps the sustainable development is the answer, since it focuses to the role and use of science supporting the careful atmosphere administration for the survival and development for the mankind's future. It has been kept in the center of the recent policies and in the planning of many countries and there is no doubt regarding the connection between energy consumption and the reduction of the atmosphere capacity. By the social aspects of the future economical development, it is the maximal interest for a modern society to implement policy to seek the development in all where the use of renewable energies becomes necessary to possibility the development for the future generations.

The society is developing and, appropriating the nature, largely, in a disoriented way and in a very high speed, leaving concrete marks in the space. The complexity of all this evolution can be analyzed throughout the indicators and energy sceneries seeking a better way to take decision and definition of which route the society will trace, an enormous economical growth without thinking about the environmental subject or about how that development will be seen in the multidisciplinary form where all economic, environmental and social factors are important.

The article intends to perform analysis between the use of energy and the current development, its main impacts on the environment and which are the necessary policies to reach a sustainable development capable to minimize the social injustices and the environmental degradation.

### 2. ENERGY AND DEVELOPMENT

After the Second World War (1939-1945), the participation of petroleum, electricity and of the natural gas determined the dynamics of the world economy on the second half of the XX Century (Dias, 2003). With the crisis of 1973, there was a strategic change, mainly by the countries members of Organization for Economic Co-operation and Development (OECD), to reduce the dependence of the exports by the Organization of the Petroleum Exporting (OPEC). In front of such perspective, that affected not only the countries members of OECD, but also those in phase of

economic development, the concern in relation to the finite of petroleum supply resource came out and, therefore, a development of a plan based essentially on its available capacity which would have a great possibility to enter in a collapse.

Economic growth and energy growth were influenced; however, the two shocks of the petroleum have showed that the correlation between both doesn't necessarily develop in a positive way. According to Reis et al. (2005), the developed countries based their growth on a very high consumption of energy, however, when they saw themselves in shortage of it, they set up strategies maintaining and even elevating their growth rates, without great increases in the consumption of energy; in other words, in this period, they got to reduce their energy intensities, which is the relationship between the total consumption of primary energy and the income, measured by the Gross Domestic Product (GDP).

The energy is a basic input for the development and an important component for in the economy of any country. It is known that the consumption of energy is dependent on two main parameters, the amount of energy consumed per capita and the population growth. The study of convictions of the contemporary history showed that the natural resources are economically necessary and continue to grow with the passage of time and the resources shortage opposes to the economic growth (Afegean *et al.*, 1998).

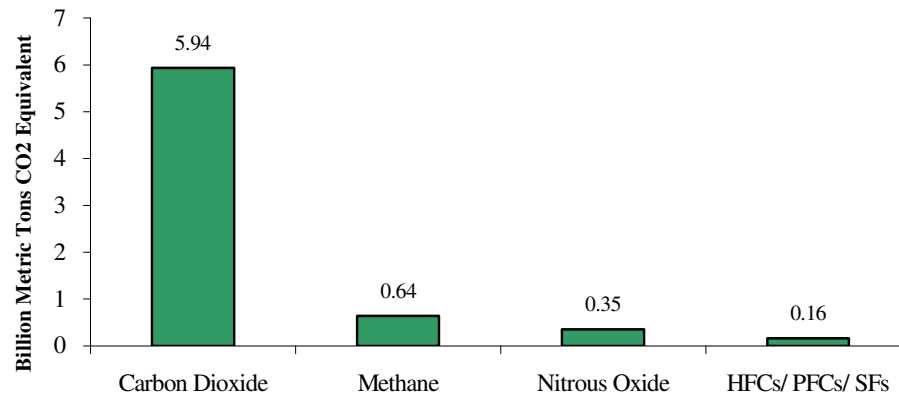
According to Hughes and Johnston (2005), an inflationary growth of about 2-3% a year is necessary in countries of OECD to maintain high levels of employment. To enable a significant convergence with the developed countries, most of the countries in development will need to sustain GDP growth of 6-8% a year for the next 3-4 decades. China has succeeded on the since 1990, and India is following its route. However, in agreement with Yao *et al.* (2005), this growth had enormous implications for energy consumption and an impact into the atmosphere. One of the environmental problems associated to the energy consumption is the CO<sub>2</sub> emission, 75% of the Chine pollution is due to the burning coal, the main energy source of the country.

According to Saha (2003), it is expected that the energy demand continues growing up in high rates in this century, frequently to a larger rate than the economic growth, being necessary to the evaluation, the planning and the definition of energy policy for the development. With strategies taking on the efficient use of energy, it is possible to promote the development with economic growth and poverty eradication, guaranteeing the energy provisioning for the future generations, providing the sustainable the development.

### 3. ENVIRONMENTAL IMPACTS

Along the history, the mankind has ever used the processes of burning to release the necessary energy for its activities, consequently, emitting CO<sub>2</sub>. However, with the coming of the industrial revolution that process of burning increased in a high scale, starting to send CO<sub>2</sub> into the atmosphere in a superior rate than it can be assimilated in its natural cycle. Such unbalance has ever been intensifying the called "greenhouse effect", and consequently a progressive increase of global temperature.

The Fig. 1 displays the pollutant emitted in the year 2004 by the USA. The pollution of the urban air is one of the most visible current problems. Great part of that pollution is due to the transport and the industrial production, and it is widely linked to the use of energy. The production of electricity, starting from fossil fuels is also a source of the air pollution, once it produces sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), monoxide carbon (CO) and suspended particles. The amount of those produced gases depends on the specific characteristics of each plant and the type of used fuel (natural gas, coal, oil and wood). There are also pollution problems in the interior due to emissions of CO by the domestic activities using certain energy sources, mainly in rural areas.



Source: Energy Information Administration (EIA, 2005)

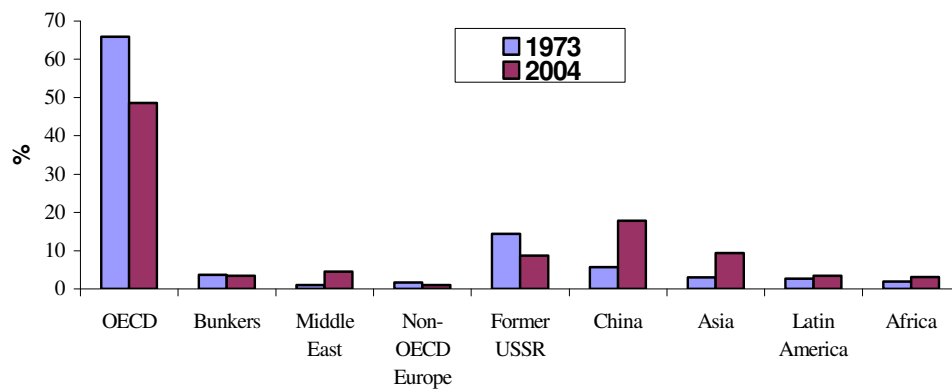
Figure 1. Emission of gases of the effect stews in the year of 2004 in the USA

The discharge concentration of those gases in the atmosphere generates a larger retention of the solar radiation contemplated by the earth, and consequently elevation of the global medium temperature besides the normal levels, tends as consequences:

- Climatic Changes as overheat of the equatorial area. Being able to spark desertification;
- Climatic Changes, as overflow and droughts;
- Melting the glacier layers in the polar areas, what causes the increase of the ocean levels (foreseen increase is up to 88 cm, in 2100). If that continues to happen, in short gap of time, aerial coasts of low altitude densely populated and islands will completely engulfed by the sea.

According to Dincer (1999), over the last two decades these risks and the reality of the environmental degradation have been more visible. The environmental problems indicate a continually growing range of dangerous pollutant and the ecosystems degradation in a world proportion. These subjects should be simultaneously taken in account if the humanity wants to reach a sustainable future with minimum impacts. The verified environmental impacts suggest that the future will be negative if the humanity continues to degrade the environment.

Figure 2 displays the CO<sub>2</sub> emissions in some areas and countries of the world. Here can be observed that the OECD countries are great originators of this type of pollutant. This can be explained due to the fact that the base of the energetic matrix of these countries is compounded by the non-renewable energy.

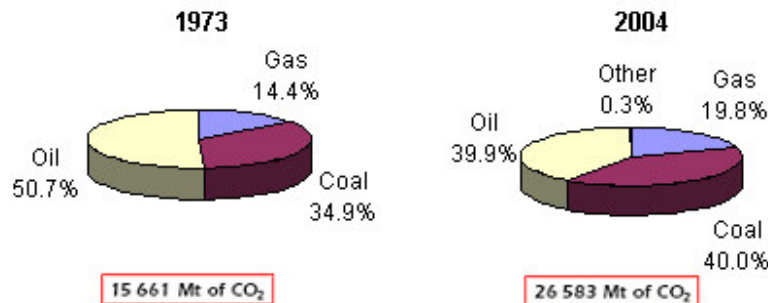


Source: International Energy Agency (IEA, 2006)

Figure 2. Emission of CO<sub>2</sub> in some areas and countries of the world

India is a country in high development, its future economic development route is probable to result in an accelerated growth in demand for energy, with current shortage of it and problems. It is probable that the growing energy consume leads to growing emissions of gases, while composing the pollution problems in local and world level leading up to the emission of gases which end up in the greenhouse effects (Gosh *et al.*, 2002). Added to the development of China that led to an increase in the CO<sub>2</sub> emissions in 12% from 1973 to 2004 -what indicates that, if the developing countries intend to maintain the type of development like the richest countries, the results on the environment can happen to be catastrophic.

Figure 3 reinforces the statement that the responsible for the atmospheric pollution are the fossil fuels. The provided emissions due to the burning of the fossil fuel associated to the burned ones as forests spark the environmental damages like the ones that have already been occurring.



Source: IEA (2006)

Figure 3. Evolution of the emissions of CO<sub>2</sub> in agreement with the fuel used in the world

Two billion people still suffer from significant problems of health due to the use of fossil fuels, especially by the burning of traditional biomass in limited spaces and the burning of mineral coal, without correspondent consideration to the health and environmental impacts. The consumption of non-renewable energy corresponds to about 80% of the energy consumption energy what indicates that the world has not been seeking a route to develop sustainable energy yet (Jefferson, 2006).

According to the report of Intergovernmental Panel on Climate Change (IPCC, 2007), it is possible to affirm with at least 90% of certainty that the climatic changes over the last decades are consequence of the carbon dioxide emissions and other human activities. The text underlines that the concentration of carbonic gas - the most important gas of the greenhouse effects - in the atmosphere has increased from 280 to 379 ppm (parts for million) up from the industrial revolution. The main reasons for such increase are the burning of fossil fuels and changes in the use of the soil, as the progress of the agriculture and deforestation.

#### 4. SUSTAINABLE DEVELOPMENT

According to Clark and Lund (2007) the sustainability concept falls back upon the Report of Brundtland 1987, and the most used definition is: "development that satisfies the needs of the present without affecting the abilities of the future generations to satisfy their ones".

The aware of sustainable development has been used as a milestone of a new project for the society, capable to guarantee, in the present and in the future, the survival of the social groups and the nature. It has as fundamental premises the recognition of the unsustainability or economic inadequacy, social and environmental of development pattern for the contemporary societies. This aware is born from the understanding of the compliance of the natural resources and social injustices sparked by the effective development model in the most of the countries (Almeida, 2002).

The concept of sustainability can be extended to the energy use and it bases on enough growth of energy types to satisfy the human needs; efficiency of energy and conservation to minimize waste of primary resources; use of renewable energy resources with improvement of the life quality; protection of the biosphere and prevention in most located ways of pollution.

No development can be considered sustainable progress if the relief of the poverty associated to the economic development has not been included (Spreng, 2005). The implantation of a development strategy, based on the sustainability should consider a paradigm that includes political, economic, social, technological dimensions and adapted to serve as base for the search of solutions in a broaden character for the world populations development. Great part of these dimensions is contained in the concept of justice that is inseparable of the development model.

The present world scenery comes up full of challenges to implant a sustainable model of development, embracing not only the complexity involved on its application, but also in the disparity among the situations of the several countries, mainly the ones related to the capacity to brake it and to revert the current development model and the process of imposing the same. The consumption of energy can be used as a disparity example in the distribution of income and quality of world life, if one sees that approximately two billion people don't have any access to the electricity, and great part of them are in Africa.

According to Vera and Langlois (2006), the energy is an essential factor in global efforts to be reached by the sustainable development. However, many of the current patterns of energy provision and its use are unsustainable ones. In many areas of the world there is no provision of energy or effective infrastructure for its economic development, while in other areas the environmental degradation by the use of energy chose to inhibit its sustainable development. Taking as the first example case the African continent, with larger resources of renewable energy, but without enough infra-structure nor financial capital to grow; China and India represent the second case, countries in franc development that have to use fossil fuels as its main energy resources responsible for the atmospheric pollution.

In function of all current environmental problems due to the economic practices and that will certainly bring implications to the society in medium and long periods, the consume of natural resources and the widespread degradation with loss of the environmental quality of life, becomes urgent the physical planning under the economic, social and environmental perspectives (Rampazzo, 2002).

One of the methods for analysis and decision make up is the use of energy indicators. That not only is statistical data, but even more, they are to promote a deeper understanding of the causal relationships in the connection among energy - environment - economy, that cannot be evident in simple statistics. The energy indicators relate energy consumption to the other important variables of a process or system and can be used to monitor and to evaluate the evolution of this process or system related to the energy use. By determining the indicators that can be measured over the range of subjects related to energy and development, the index of the countries actions, like Human Development Index (HDI), an index that establishes the relationship among the use of energy, economic growth and social growth and it is also used as comparison to the countries regarding to social and economic areas (Dias *et al.*, 2006).

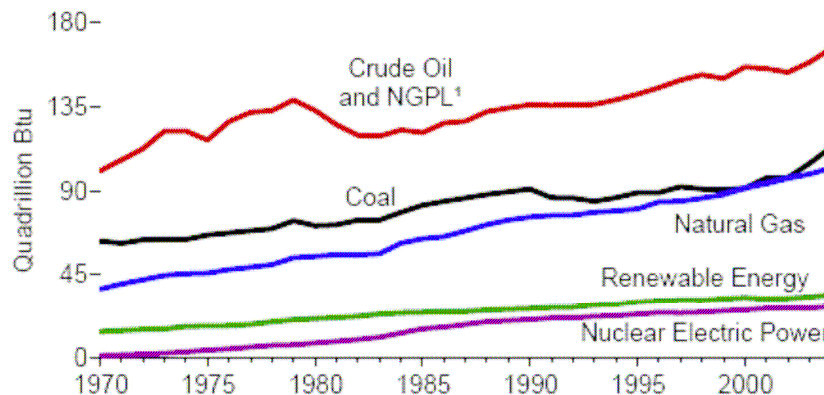
According to Goldemberg (1998), the need to look for a development balance to be developed considering the environmental aspects exists, including reduction of the energy intensity in the productive processes, reduction of the energy demand rate in the countries in general, developed or not, promotion of strong policy to search energy efficiency and the use of renewable energy sources. That is why it is necessary to compare the indicators in the later situations

with future sceneries in order to have finally a process of development for the country and the best policy to manage in a sustainable way.

## 5. ENERGY SCENERIES

As a tool to plan a sustainable development, the present sceneries must be used providing to state options for evaluation of the possible problems and which the best strategies are to reach such development. Therefore, it is important to mention and to evaluate data and results of studies in global level.

Figure 4 shows evolution of the provision of world energy, taking as analysis the period from 1970 to 2003, over 33 years long, and an increase of the provision of world primary energy in approximately 93%. This one compared the rate of world growth in the order of 2,1% a year with increase of the population in about 1% a year. Although OECD is still the largest user of energy, its provision of total primary energy has reduced from 61% in 1971 to 50% in 2003. This can be explained due to the great economic development in Asia, that obtained an increase of 12% in the same period (EIA, 2005).



<sup>1</sup> Natural gas plant liquids

Source: EIA (2005)

Figure 4. Evolution from 1970 to 2004 of the production of total primary energy world

There is a great disparity related to the amount of energy used by person per capita in several parts of the world, the patterns of per capita consumption of North America (6,41toe) and the rest of the world (1,51 toe), brings up the subject of which pattern should be adopted as a worldwide reference keeping the certainty that an energy globalization, based on the pattern of North America, if it were possible it would simply accelerate the degradation and the unsustainability of this development type (Reis *et al.*, 2002).

Indications suggested that a global pattern similar to the European one could possibly be adopted, but, even that development type, would demand great efforts and changes, since the developing countries are relatively below of it. Then, a global population at the current size cannot adopt European and American lifestyles without destroying the environmental systems of the planet.

Regarding to the future, several world energy sceneries have been built for periods that go to 2100, trying not only to esteem the demand for energy in the next century, but as well as to verify the forms that it can be supplied. Taking as base the analysis developed by World Energy Council (WEC) with multiple sceneries. The main analysis collects the period from 2020 to 2100 and it describes three alternative cases of future energy sceneries that are subdivided in 6 different sceneries with implications on the 11 main world areas.

Table 1 displays the hypotheses of mentioned sceneries for the WEC periods studied. The A scenery describes a "high world growth" as a consequence of the economic growth, increase of the energy consumption and improvement in the energy efficiency. The B scenery was a "reference" (in the half of the way), describes a less ambitious future. Finally the C scenery was ecologically addressed; with policy, such as manufacturers and govern who promote energy efficiency, technological innovation and substitutions of fuels for the ones which have not fossil origin and elimination of institutional barriers. The scenery C had a low consumption of energy as well as low emissions of greenhouse effect gases what is different from the previous three cases.

Comparing the results between the two antagonistic sceneries, A and C can be observed that the energy demand varies among 25 Gtoe in the scenery of high growth and 14 Gtoe for the one ecologically addressed, year 2050. This happens due to the improvement in the energy intensity and a smaller world economic growth. Greater demand increasing in the developing countries is expected, where great populations have no appropriated accesses to the energy and other services yet. The process of economic development and the supply of those services will imply significant

increase of the demand and an appropriate supply administration and the use will allow a quantitative and qualitative improvement in the energy sector over those countries (Reis *et al.*, 2002).

The WEC sceneries have two important characteristics based on the current reality and they have future possibilities. In spite of the discussion regarding to the restriction to the fossil fuels stock, the reality is that the technological progresses are allowing to explore these fuels more and more, but if the tendency of consume is kept on, it is probably expected that the emissions of greenhouse effect gasses related to the energy grow slowly, due to the gradual tendency of the carbonizing relief from the energy supply.

Table 1. Hypotheses of pointed sceneries for WEC

	YEAR	Scenario "A" High growth	Scenario "B" Middle growth	Scenario "C" Ecologically driven
World population growth (10 <sup>9</sup> )	1990	5,3	5,3	5,3
	2050	10.1	10.1	10,1
	2100	11.7	11.7	11,7
World economic growth 1990 – 2050		2.7 % p.a	2.2 % p.a	2.2 % p.a
World energy intensity improvement		Medium	Low	High
1990 - 2050		0.9 % p.a	0.8 % p.a	1.4 % p.a
2050 - 2100		1.0 % p.a	0.8 % p.a	1.4 % p.a
Primary energy demand. (Gtoe)	1990	9	9	9
	2050	25	20	14
	2100	45	35	21
Primary energy consumption. EJ	1990	379	379	379
	2050	1041	837	601
	2100	1859	1464	880
<b>Resource availability</b>				
Fossil		High	Medium	Low
Non-fossil		High	Medium	High
<b>Custos tecnológicos</b>				
Fossil		Low	Medium	High
Non-fossil		Low	Medium	Low
<b>Technological costs</b>				
Fossil		High	Medium	Medium
Non-fossil		High	Medium	Low
CO <sub>2</sub> emission constraint		No	No	Yes
Net CO <sub>2</sub> emission (GtC)	1990	6	6	6
	2050	9 - 15	10	5
	2100	6 - 20	11	2
CO <sub>2</sub> accumulated emissions (GtC) 1990 - 2100		910 -1450	1000	540
Environmental tax		No	No	Yes

Source: <http://www.worldenergy.org> 2006/11/20

## 6. SOLUTIONS RELATED TO THE USE OF ENERGY FOR A SUSTAINABLE DEVELOPMENT

In order to make the sustainable development happen, energy solutions are necessary to allow reaching such development. The following main solutions related to the use of energy in a sustainable way will be discussed.

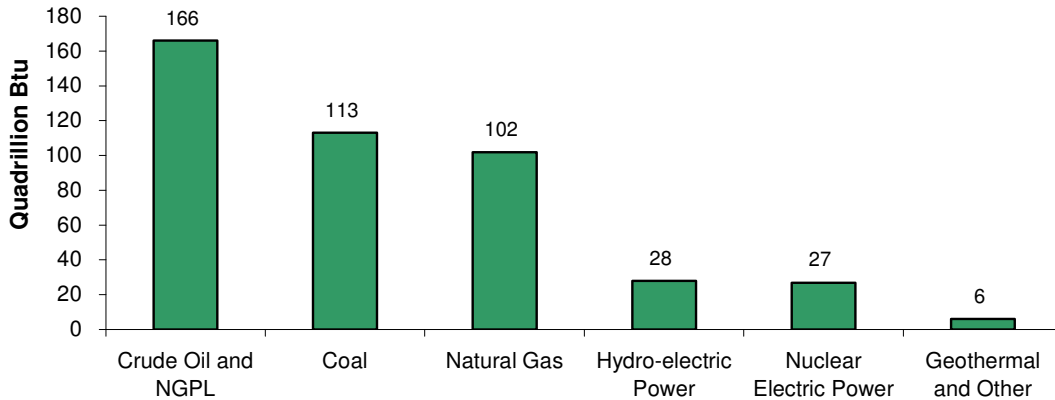
### 6.1 Renewable energy

An important action to be taken in view of a sustainable development model, the implement of renewable sources of energy use is increasing. Inserted in this group: solar energy, hydro, geothermic, biomass, wind and photovoltaic.

The renewable ones prevent the environmental impacts previously mentioned, due to cause less pollution in emissions. In addition, one of the most outstanding advantages of the renewable energy is the improvement of creating a job market, coming up to help solving problems when implanting this type of energy. Although, at the present, it represents a small contribution to the system of energy in worldwide, the use of the renewable ones is growing up

quickly, at a rate of 3.5% a year, in contrast to 2% a year by the primary energy over the period of 1990-2001, with the contribution projection from 6.7% to 12.9% of total energy consumption before the 2020 (Goldemberg, 2006).

Figure 5 displays the world primary energy production in the year 2004. Over that year, the fossil fuels represented 75% of all energy produced in the world, the renewable ones 8% and the nuclear energy 5%. Some researchers brought up questions about the expansion of the nuclear energy use, because it solves the problem of energy, but it presents another one, the deposition of its rejects.



Source: EIA (2005)

Figure 5. Production of the world primary energy in 2004

The provision of renewable energy is not larger in countries belonging to OECD. In 2004, the renewable energy contributed with a production of 40% in Brazil, 39% in India, 17% in China, 11% in South Africa and 3% in the Russian Federation, signaling an increase of the renewable head office in the long term and the decrease of the use of fossil fuels. It is believed that development degrees comparable to the reached until the present moment, it has been possible without a similar increase in the use of energy as it was verified in the process of previous development. This means that with an efficient use of the renewable energy sources, it is possible to the countries to continue developing without putting high pressures on the ecosystem.

## 6.2 Conservation of energy and energy efficiency

The conservation of energy can be understood as the use of a smaller amount of energy to obtain the same product or service by the decrease of waste, by the use of efficient equipments and improvement of productive processes. As consequence of the conservation and rational use of energy, there will be a reduction of environmental impacts, social benefits and global reduction of costs and more investments to the country.

The energy efficiency comes as one of the central topics for the energy conservation, being constituted in a variable resultant of several economic, political and social interaction factors. That is why it is directly influenced by structural changes in the economy, characterized by alterations in the technological patterns and in the energy content of the whole productive system. In addition, factors as the rational use of energy, consumption habits and the standard of the population lives also produce changes in the levels of energy efficiency (Reis et al, 2002).

As one of the effective methods of conservation there is cogeneration that can be applied when economically justified. The term cogeneration is usually used to designate the simultaneous generation of heat and power (mechanics or electric) in industrial facilities, tertiary sectors. In conventional thermoelectric plants, usually electric or mechanics is produced with a global efficiency (proportion between useful energy produced and the energy supplied in fuel) in the range of 34% to 50%. A fact that contributes to that is the great amount of heat released to the atmosphere, through cooling towers and lakes or rivers. Differently, in cogeneration plants, useful heat and electric power or mechanics are produced by burning only fuel, recovering part of the released heat. This way, the global efficiency of this plant modality reaches values between 50% and 90%, depending on the technology used, as well as the application (Balestieri, 2002).

## 6.3 Energy policies

A sustainable energy strategy implies, necessarily, the effective State targets policy to establish and to apply the necessary administrative instruments for it. The market rules by itself to have no conditions to implement the basic guidelines of sustainability as the social justice in the distribution of resources and to adapt to the production and the consumption in agreement with the capacity to support the nature. However, it is possible to the State guarantee its

capacity of performance by the legislative and fiscal mechanisms (establishment of norms and patterns, creating incentives to the production and more efficient consumption). As example of government action is in the African continent the Document of South Africa Energy Policies that seeks to reach 15% of renewable energy contributions, mainly solar energy; in Egypt the program of Authority of New and Renewable Energy, with development and amplification of the solar energy use, wind and biomass; in Mali the encouragement of private enterprises exists for the commercialization of the renewable energy (Bucaje, 2006).

A factor of great influence in the sceneries of energy policy is the controls and actions implementation stated in the Convention of the Climate. In negotiations in the Kyoto Protocol, in 1997, goals of emissions of greenhouse effects control by the year 2020 were established. In the protocol the most direct responsibility for these actions is the developed countries that at the present are the largest originators. However, a growing participation of the countries is expected in development, in the sense of addressing the development way to minimize their own emissions, which tend to increase in case of nothing be made to restrict the progress in the use of fuels fossil, CO<sub>2</sub> main source.

According to Dias et al. (2006), to reach these demands of energy it is not only important to intensify the development of advanced technologies and sources of fuel, but as well as the establishment of environmental policy and understand the importance of the society behavior in the pattern of economic development, being this understanding process questionable. The implantation of energy policies should be defined in a way to favor the formation of markets for the environmentally beneficial technologies and to charge environmental costs of non-sustainable alternatives, being necessary a strategic planning and administration of the energy sector, seeking the enlargement of the access to the energy services to the poorer population in a rational way (Saha, 2003).

#### **6.4 Research and Development (R&D)**

A radical change in the system of world current energy is requested if the sustainability is defined as priority and incorporated in the political decisions and future technological choices. Developing countries, in matter of are facing additional and significant challenges to continue their economic development and the need to increase the access and the level of energy services to the population. More efficient and clean technologies and economic strategies for trading can help so much in the solution of these subjects by the developed countries as by the ones in development (Jannuzzi, 2005).

The technological development of the energy sector is essential to grow environmentally beneficial alternatives. The investment in research and development seems to be a solution to the countries while trying to promote the energy efficiency and, relative to the renewable energy, it is possible the amplification of this type of energy by the development of new technologies.

According to Jannuzzi (2005), developing countries have a little tradition in the R&D investment, representing a small portion of GDP in the developing countries. India and Brazil, for instance, only 0.5% of GDP for this activity type, less than South Korea that invests 5%. The introduction of reforms in the energy sector has immediate implications in the support for R&D and in the energy efficiency, in several developing countries the public agencies and research institutions are the main agents to look for the development of efficient technologies with low environmental impact, social and efficient use.

One of the promising markets now to the countries in development is the Clean Development Mechanism (CDM). By this mechanism, the developed countries (Annex I) can invest in projects in developing countries, that prevent or reduce the emission of the greenhouse effect gases, or that remove CO<sub>2</sub> from the atmosphere. This generates advantages for both sides, because the reduction of emissions or capture of CO<sub>2</sub> included in those projects, they would be eligible for credits that would help the countries investors to reach their reduction goal, while the developing countries (which haven't reduction goals yet) to receive those investments would have to be following the goals of sustainable growth. For so much, the investment in the human capital is essential for R&D, being necessary the investment in education for the enrichment of skills and improvement in the quality of the people's life. A country that wants to become more competitive in the world scenery has to have as strategy the investment in education, formation, R&D form adapting to the new reality of a globalized world (Hughes and Johnston, 2005).

#### **7. COMMENTS AND CONCLUSIONS**

According to the exposed it is possible to conclude that the economic development model of the developed countries and the lifestyles of their society cannot state as an example to the developing countries due to the impacts generated by the consumption of non-renewable energies. With the forecast of the energy demand at a high rate in this century, becomes necessary the planning and the definition of energy policy to make the development happen without great implications on the environment, and an appropriate political formulation is a pre-requirement for a paradigm change for the future of sustainable energy.

Due to the availability of fossil resources and its reserves, as well as the potential of use of the renewable ones, it is not probable that there are difficulties to supply energy in long term. In view of this, it becomes necessary to insert the developing countries and the poor countries in a development model that prioritizes the environmental sustainability, with developed policy in worldwide scale, as the Kyoto Protocol. No development can be considered sustainable if do



not include the progress for the relief of the poverty, where a development strategy claims to be in the sustainability it should be considered as in a multidisciplinary form, including the political dimensions, economic, energetic, social, educational, technological and environmental.

## 8. ACKNOWLEDGEMENTS

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