

The energetic revolution of the 21st Century

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The beginning of the century coincides with the beginning of yet another energetic revolution stirred up by the raise in oil prices and conditioned to three factors:

- The proximity of “oil peak,” that some geologists are announcing for the next decade, and that is translated by the unevenness between the volume of its production and that of the recently discovered reserves. According to Colin J. Campbell (2006), from 1981 on the world began to use more oil than it discovered. In 2005, for every five barrels consumed, only one was found,¹ thence the tendency of raising prices of the black gold.

As I am writing this article, the barrel of oil is sold between US\$ 50 and 60, having reached US\$ 75 already. Many observers forecast that in the next few years it might reach US\$ 100 or more. The competitiveness level of Brazilian sugar cane ethanol that benefited from thirty years of improvement and from the drop in price of its production is at US\$ 35 per barrel of oil, while biodiesel becomes competitive in the US\$ 50 to US\$ 60 range, with great possibilities of further cost reduction in the future.

- The late realization that, regardless of the economic costs, the international community must promote with maximum urgency an obstinate and rigorous policy to reduce the consumption of fossil energy sources to avoid harmful and irreversible climatic changes, caused by the excessive emission of greenhouse effect gases. The Kyoto Protocol is an extremely timid and totally insufficient step in that direction. According to the scientists, there should be at least a 50% cut in emissions by 2050, and by a factor of four in the industrialized countries.²

Among the followers of “deep ecology”, some people believe that the point of no return has already been surpassed, and that the inadequate use of technology has hopelessly harmed the Earth’s self-regulation of the system. Instead of claiming for sustainable development, we shall, at best, discuss the sustainable withdrawal, with a drastic limitation of both consumption levels and world population.³

- Finally, the growing uncertainties and threat to peace that derives from the explosive geopolitics of oil, illustrated by the invasion of Irak.⁴ Even in the United States, an ever more influent current of public opinion favors the substitution of imported oil, instead of keep wasting hundreds of billions of dollars to keep the Middle-Eastern supply lines.

Actually, there is no immediate threat of an oil shortage, since high prices will stimulate, on the one hand, the exploration of the heavy oils of both Orinoco Bay and Canada Bay and, on the other hand, the transformation of abundant coal into gas and liquid fuels.⁵ As Henri Prévot (2007, p.8) says very well

the danger that threatens humanity is not the absence of fossil energy; quite the opposite, it derives from its overabundance. Its economy resembles that of drugs: an abundance that destroys health and leads to death upon the absence of the desire to abstain from that dangerous product.⁶

In a certain sense, the raise in oil price may be considered as a gift from Heaven, because it turns the exit from the petroleum era less difficult to face the threat of climatic change with its social and economic outcomes. According to Nicholas Stern (2006), they would represent a commotion comparable to that of the big 1929 crisis to the world economy, with a GDP loss of at least 5% per year and forever, without excluding the possibility of a cut of at least 20% in GDP.⁷

Any way, none of the past energetic transitions happened due to the physical depletion of an energy source. The history of humanity can be synthesized as the history of production and of the economic surplus allocation, paced by successive energetic revolutions. They all took place due to the identification of a new energy source with both superior qualities and inferior costs. That happened in the transition from biomass energy to coal and from that to oil and natural gas.

Even today, our energetic matrix gathers all those energy sources, even though the 150 years of resplendent influence of oil have radically transformed the life and consumption styles, inculcating wicked features upon our civilization that are characterized by a huge energy waste, especially in transportation, but in residential heating and cooling as well. King automobile, the giant trucks and the airplanes are its central pieces.

The car became the most covetable positional good to distinguish oneself from the neighbor, in a society that took social inequalities to the extremes⁸ and generated trade flows that benefit from the abyssal wage disparities.

The energy wasted to move a vehicle that weighs more than a ton and often transports a single passenger is phenomenal. What, then, can we say of the long distance touristic trips? Every Brazilian middle-class child dreams

about spending a weekend at Orlando's Disneyland. And how about the thousands of kilometers traveled by commodities?

The low transportation cost together with the wage difference, allow Chinese strawberries and roses from Ecuador to arrive in Paris by plane. Without reaching such extremes, New York gets most of its fruits and vegetables supply from Florida and from California, and all the capitals of the Brazilian Northeast receive lettuce from Ceasa, located in São Paulo. The "Cornucopia Project" of Rodale Institute, in Pennsylvania, tried to show the under-used potential of the periphery of the East Coast cities of the United States concerning food production. Similarly, there are reasons to stimulate green belts around Northeastern cities.

Energy waste is absurd in the Persian Gulf. To attract tourists, an artificial skiing track was built in the desert in Dubai. If they want, they can stay at the first underwater hotel in the world.

What distinguishes the current energetic revolution is that none of the alternative energy sources offer, at least until now, clear economic advantages as compared to oil and its by-products. At the same time, the ecological imperative will, as everything seems to indicate, act with a growing force, as the crisis that the climatic changes stirs up becomes clearer. However, we must take into account that, once again quoting Nicholas Stern (2006), climatic change is the greatest market mistake ever seen. In other words, it is yet another confirmation that the markets are short-sighted and insensitive to the social and environmental dimensions.

The deviser of the Davos World Economic Forum himself, Klaus Schwab, recently stated that "we are living in a schizophrenic world".⁹ In the last meeting in Davos, much was said about climatic changes and, at the same time, about an optimistic prognosis for the future of world economy, but there was no convergence of both debates. Therefore, it is impossible to mend the current situation based exclusively on the market forces.

The second-rate results of the practical application of the resolutions agreed upon in the Earth Summit, that took place in Rio de Janeiro in 1992, must be mostly attributed to the fact that the environmentally sustainable and socially including development that it called for¹⁰ is on the opposite direction of the neoliberal counterreformation that dominated the last quarter of the 20th Century. The world emerged from World War II with three central ideas: the need to ensure full employment, to create the Welfare States and to plan to avoid waste. Both the Western and the Soviet block shared those ideas. The divergences had to do with how to put them into practice. The years 1945-1975 were the golden age of the reformed capitalism that had to face, in the social realm, the competition from real socialism. Things changed in the 1970's. The invasion of Czechoslovakia in 1968 indicates the beginning of the real socialism agony that culminated with the fall of the Berlin Wall.

The neoliberal counterreformation took control of the Western block, which caused the immoderation of an asymmetrical globalization, driven by the market forces and characterized by the excessive opening of the economies, with the resulting selectiveness loss in their foreign relations.

Moreover, it seems to us that in the current debate on the climatic changes there is an excessive emphasis on the search for market solutions and on the incorporation of environmental costs into prices. The “polluter- payer” principle doesn’t make any distinction between paying a fine, compensation to pollution victims or the restructuring of the productive apparatus to avoid future pollutions. The carbon credits market is criticized by environmental movements that challenge the possibility given to the Northern industrialized countries to omit themselves from having to reduce greenhouse effect gas emissions when they support projects that are sometimes debatable, financed in the Southern countries, through the Clean Production Mechanism.¹¹ Strangely, the preference for the economic instruments has not resulted in the universal adoption of taxes on carbon, even though they would have an undeniable effect on the consumption level of fossil energy sources, but they can’t be considered as a panacea.¹² The consumers eventually get used to the new price level, especially when it deals with products considered to be indispensable. The future policies shall reserve a much more important place to the administrative and legal measures.¹³

As we have pointed out before, from the point of view that concerns us, the raising price of oil may have wicked effects, such as the exploration of heavy oils and bituminous schists. What will the oil firms do with the extraordinary profits obtained with the recent raise in oil prices? Some of them, such as Petrobrás or BP (that from British Petroleum became Beyond Petroleum), are diversifying towards biofuels and solar and aeolic energy, while Total decided to invest in nuclear energy.

In the same way, we must ask ourselves about how the producing countries will use the profitable petroleum royalties. Unfortunately, the almost general rule is that they succumb to the so-called “Dutch disease”. The abundant foreign exchange credits allow for unlimited imports with which the local producers, harmed by the valuation of the local currency, can’t compete. Besides, easy money from oil favors corruption.¹⁴ It would be desirable that the recently created Unctad Biofuel Initiative¹⁵ includes in the agenda of the debate on an orderly transition from the petroleum to the post-petroleum era the issue of the partial utilization of the petroleum royalties to finance the renewable energy sources and sustainable development. The author proposed that in 1972 to the Peruvian government which, at the time, believed it had found an important oil field in the Amazon region.

When the thesis by H. Prévot is accepted, according to which our problem is the excessive abundance of the fossil energy sources, the solutions shall be found going against the market dynamics.

Therefore, the features of the energetic revolution currently underway will depend on the capacity of the national states and of the United Nations Organization to define public policies that are both national and international in scope with the triple goal of reducing the profile of energetic demand, of increasing efficiency both in production and in the final use of the energy sources and of substituting the fossil energy sources for renewable ones, without getting rid of the “clean” use of the abundant fossil energy sources such as coal, through the sequestration of the greenhouse gases.

Obviously, the solutions will vary from country to country and the future energetic matrix will remain multiple, with variable proportions of the several energy sources.

Sobriety, efficiency and substitution

The less polluting and often the cheapest energy is the one that is not produced due to the adoption of a more sober profile of the energetic demand and to greater efficiency in the final use of the produced energies. The substitution of the fossil energy sources for bio-energies and for all other renewable energy sources is only in the third place.

According to the correct statement by Bernard Laponche (2007, p. 71-83), sustainable development is not compatible with the current energetic paradigm. Besides, in the search for solutions, we should keep in mind that the most serious energetic crisis is that of firewood, because it affects the two billion poorer inhabitants of the planet, who have no other source to cook and to keep warm. Therefore, energy conservation must be considered as an imperative (Dessus, 2007, p. 79-81). As a proof of that, according to Amory Lovins (s.d., p. 115), the generalized use of the most effective technologies currently known would allow the United States to reduce by half the consumed oil by GDP dollar at an average cost of US\$12 per barrel of oil saved.

The search for the sober energetic profile takes us back to such issues as life styles, consumption patterns, organization of the space and of the productive device, re-structuring of urban spaces¹⁶, selectiveness in trade relations, product durability (opposite to the current civilization of short-lived products) and better maintenance of the infra-structure patrimony, of the buildings, and of the equipment and vehicles used to reduce demand for replacement capital.

Ecologists emphasize the need to reduce the amount of material consumption. However, the main obstacle is the abyssal social inequalities. We can't forget that the building of a civilization of being can't do without the fair partition of having, according to Joseph Lebet's beautiful formula.

Upon recommending the gathering of the local economies and the resulting decrease of long-term trade, the book by Nicholas Hulot (2006) quoted above introduces the “circular economy” concept that fosters synergies between companies that are close to one another and encourages recycling.¹⁷ It also defends a “functionality economy”, based on the substitution of the selling of equipments for its leasing with the resulting extension of its life time.

The reduction of the energetic profile also includes the production of more efficient equipment, starting with ultralight vehicles. According to Lovins, quoted above, it is possible to cut by half the consumption of gasoline in the automobiles that are built with carbon fibers and other ultralight materials instead of metals. The flex engine (that accepts the mixture of gasoline and ethanol in variable proportions) is a step ahead which is compatible with the search for smaller and cheaper car models, while the cost of the hybrid car (two engines that accept both gasoline and electricity as fuel) is much higher.¹⁸

In the same way, ongoing researches indicate that the airplane fuselage made of carbon fiber and other composite materials would provide a one-third reduction on energy consumption. (L'expansion, 2007).

The efficiency gains in other domestic appliances may also have a significant impact. There is a huge potential to reduce energy waste at home. In France, a house built before 1970 may consume as much as 500 kWh per square meter per year with heating, hot water and lighting. The new ones consume between 170 and 250 kWh per square meter per year on average. According to the Law of July 13th, 2005, in 2050 a new house shall consume no more than 50 to 70 kWh per square meter per year (Rey-Lefebvre, 2007).

However, we can't forget that the introduction of new technologies requires some time. Kalecki (1993) introduced the retooling period concept. The same author showed, in his growth theory, that an economy's growth rate is influenced by two parameters that are very closely related to our theme:

- The “a” parameter denotes real depreciation (not an accounting one) of the equipments. The lower is “a”, the greater will be the durability of the existing production device and, therefore, the lower will be the demand for replacement capital; parameter “a” depends on the maintenance of the existing patrimony; the more elaborate it is, the lower “a” will be.
- The “u” parameter denotes the best use of the existing production device. Recycling and the reutilization of the residues have a positive impact on “u”.¹⁹

Most of the times, the businessmen treat the measures that the environmentalists proclaim as a cost. But in many cases they become a profit opportunity. Some companies are starting to understand that (see Marcovitch, 2006; Esty & Winston, 2006).

As far as the substitution of the fossil energy sources for renewable ones is concerned, the scope of the theme goes beyond the limits of a single essay, even if it is restricted to the Brazilian case. Obviously, there are several solutions, with different proportions attributed to the several energy sources, due to the configurations of availability of natural resources, of climate and of the technical progress pace which is, by definition, unpredictable.

Therefore, for example, solar energy perspectives will depend on technical progress in the production of solar cells. The first cells produced commercially appeared in the 1950's and had only a 2% solar to electric energy conversion ratio. With that ratio, one square meter of solar cell produces 20 watts. In the year 2000 it reached 33% (330 watts per square meter). The new superefficient cell developed in the United States reaches a ratio of more than 40%. In a few years electricity from solar energy might compete with the one produced in thermal power plants (*Veja*, 01.24.2007).

On a recent essay, Hermann Scheer (2007), who is the President of the World Council for Renewable Energy, made an optimistic account of the impacts of the German law on renewable energy sources. Since its implementation, in the beginning of the year 2000, more than 18 thousand megawatts of electricity produced from renewable sources were installed in Germany. For the investments to be profitable, all the producers have access to the network with guaranteed rate for twenty years. The extra cost is divided by all consumers and is no greater than 5 Euros per person per year. The new industrial sector has already created 170 thousand jobs. No other political program to support the industry was so cheap and had such a positive result. In six years, the investment costs became less than 40% due to serial construction, and carbonic-acid gas emissions became less than 7 million tons per year. Scheer (2007) emphasizes that the law as an instrument of environmental policy was far more efficient than the carbon credits' market and concludes that, if development is kept at the same pace, the entire electricity production from fossil or nuclear origins will be completely substituted.

Next, we will concentrate on the controversy that surrounds the perspectives of biofuels, but before that we will disclose our opinion regarding nuclear energy.

The advocates of nuclear energy, mainly in France, where there is a powerful lobby for it, present it as a clean alternative to fossil fuels and, therefore, as a priority in the development strategies for the transition to the post-petroleum world. The doubts about it have to do with its safety. However undermost is the probability of a grave accident caused by natural forces (earthquake) or by deliberate acts (terrorism), its consequences could be so disastrous that it's not worth the risk. Besides, there are heavy doubts concerning the destiny of the nuclear residues and how to neutralize the

power plants when they are not in use anymore. Some people fear that the need to protect the nuclear power plants may favor authoritarian regimes. Besides requiring heavy investments, nuclear energy production is highly centralized, which elevates transmission costs and losses in the network. Due to its moral and political implications, decision on the subject may not be left to scientists alone. Instead, it requires the debate and the widespread participation of all citizens.

Biofuels: are they green gold?

Brazil and the United States emerge as the two main global players in the new ethanol world market and might also play an important role in the biodiesel market.

It took a long time for the American government to wake up for the problem of the substitution of oil by-products for biofuels. However, in his speech about the State of the Union on January 2007, President Bush established, for the great joy of the subsidized corn producers' lobby, the goal of 130.25 billion liters of ethanol for 2017, as compared to 18.75 billion liters produced in 2006 (a level which is close to the production of ethanol in Brazil forecasted for the 2006/2007 harvest), and a final goal of 225 billion liters by 2030. Some people doubt the capacity to reach that level, which will depend on the large scale entrance of cellulosic ethanol and, even so, it won't significantly reduce the dependence of the United States on imported oil (Samuelson, 2007).

The national agro-energy plan of the Brazilian Ministry of Agriculture also forecasts a quick expansion of ethanol production and a slower pace for biodiesel. BNDES estimates that one hundred new power plants shall be built only by 2010, adding to the 248 that already exist in the Center-south region and 88 in the Northeast (Folha de São Paulo, 02.07.2007).

The plan claims that the goals should be reached without risking nourishment safety, agricultural exports, and without resorting to deforestation to create new cultivation areas.

That last issue is specially delicate due to Brazil's second-rate performance concerning the protection of native forests and to the controversial issue of the expansion of soybean growing within the Legal Amazon.²⁰ As Sérgio Teixeira Jr. observed, "Brazil is experiencing the ambiguous situation of being the country of both the hydroelectric power plants and of ethanol, but it is also seen as the villain of the Amazon region's deforestation."²¹

Although the substitution of oil by-products for biofuels contributes in principle for the reduction of the greenhouse gases emissions, one must pay attention to the conditions of its production. They may have such a negative impact on the environment that the result of the operation may be

negative. That's what happened with the palm oil production in Indonesia and Malaysia, which the Netherlands import as fuel. Recent studies detected a real environmental disaster, caused by fire destruction of native forests and the drainage of the swampy soils covered with turf, with the consequent carbon emission. According to Friends of the Earth, the establishment of new palm oil plantations is responsible for 87% of the deforestation that took place in Malaysia between 1985 and 2000. The forest fires in Indonesia throw into the air 1.4 billion tons of carbon per year, while the drainage of turf soils throws other 600 million.

However, it is absurd to blame biofuel for that. The environmental impact of the biofuels production will depend on the cultures that are chosen and on how they are cultivated and processed. The result may both be a 90% reduction of the greenhouse gases emissions and a 20% raise, according to the European Environmental Agency of Copenhagen (see Rosenthal, 2007).

As for the competition for the biofuels' agricultural soils with food production, considered to be a matter of concern by several environmentalists, Lester Brown points to the danger of biofuels displacing the food production that is necessary to fight famine, which is still present in the world. Brown discusses the clash between 800 million car owners and 2 billion people whose fate is to starve (Fortune, 08.21.2006). The argument is somewhat demagogical, since the reason they starve is not the lack of food, but their low purchasing power. However, that does not exclude from the agenda a more important theme: how far can we advance in the biofuel production?

It seems to us that many agronomists underestimate our margins of freedom because they reason from the juxtaposition of cultures point of view, instead of thinking in integrated systems of food and energy production adapted to the different biomes. A good example of that is the integration between biodiesel and cattle raising. The oil extraction residues are used as cattle feed. If it is stabled or semi-stabled, with the liberation of some of the pasture for feeding cultures, the manure that is processed in the bio-digesters will produce fertilizers and energy that can be used at the biodiesel power plant. Not to mention that a Brazilian industrial group already began to produce biodiesel from ox grease.²²

Besides, there is not enough attention paid to the production of fuel oils in the degraded areas that are useless for feeding purposes. Thus, for example, purging nut may be cultivated in degraded and semi-deserted lands with an estimated yield in India of two tons of biodiesel per hectare/year. The many kinds of degraded lands in that country are likely to add up to 50 to 130 million hectares. Another advantage of the purging nut is that the extraction of its oil uses simple presses that any village blacksmith can produce. According to Indian authors, the cultivation of purging nut would generate one job per

hectare. Taking for granted the provision of 10 million hectares of *wasteland* for the cultivation of purging nut and a low yield of 1.5 ton per hectare, the 6 million tons of biodiesel produced would substitute one-tenth of the Indian demand for petroleum, generating 10 million jobs and, moreover, 11 million pies that can be used as manure and 400 thousand tons of glicerol.²³

By far the most important issue concerns the transition from the first to the second generation of ethanol. There are reasons to believe that the emergence of cellulosic ethanol will drastically change the picture, since absolutely any biomass – straws, leaves, forest residues, and wood – may be used as raw material. The United States are waging high in this alternative, and the Bio association, that includes 1,100 companies, academic institutions and public organs, both in the United States and in 31 other countries, support the construction of cellulose biorefineries (cf. Biotechnology..., 2006; Caldwell, 2007). They won't be limited to biofuels production suggesting an ever wider range of green chemistry products, a step towards the modern biomass civilization (cf. Sachs, 2005, p.195-211).

By the way, Brazil may quickly lose the huge competitive advantage that its sugar cane ethanol enjoys today due to the advance of cellulosic ethanol that will have an extremely abundant and cheap raw material base (Gazzoni, 2007).

That's why it is important to deploy an ambitious research program about the several aspects of agro-energy. In due time, Embrapa created a unit that will take care of that matter, although with extremely limited resources when compared to the scope and the importance of the theme and the resources that the Department of Agriculture of the United States invests in agro-energetic research.²⁴

The suggested solutions shall be informed according to the concept of evergreen revolution, as Indian scientist M. S. Swaminathan calls it, seeking solutions that are both knowledge and labor intensive, that save natural resources (soils and water) and capital, proposing integrated systems of food and energy production accessible to the small farmers.

According to his assessment, besides the traditional cost /benefit ratio, there must be the use of environmental and social criteria, especially energy in/energy out, carbon sequestration, yield per hectare, demand for water, on the one hand and social criteria with special highlight to the generation of decent job opportunities in the biomass production, in its processing, in the follow-up and transportation services, in the utilization of the byproducts, on the other hand.

Agrosilviculture and the thickening of native forests with useful species emerge as a great promise, mainly in Brazil, which can increase by ten times areas of joined economic reforestation for several purposes: energy (charcoal, cellulosic ethanol, co-generation of electric energy and heat), paper and cellulose, construction materials, raw material for the wood byproduct industry

and for green chemistry. We have just begun to identify useful species through the systematic study of biodiversity.²⁵

We believe that the time has come to produce Floram II at IEA.²⁶

Towards a new cycle of rural development?

Considering what has been said, there is no doubt that bioenergies have a brilliant future ahead of them, economically speaking, and will play an important role to try to stop the negative impacts of climatic change, especially in Brazil. Its social impact, however, is undefined.

Since the United Nations Conference on the environment, which took place in Stockholm in 1972, the debate on ecological development, currently called sustainable development, favored a symmetric treatment of the social and environmental dimensions. That's what we must do when we examine the perspectives of the energetic revolution of the 21st Century since, along with the environmental crisis, we are facing an extremely serious social crisis, represented by the chronic and growing deficit of "decent job" opportunities.²⁷

Although urbanization is still considered as a symbol of progress, the rural exodus that the industrialized countries experienced in the 19th and 20th Centuries can't be repeated on a global scale. The European countries were able to send tens of millions peasants to the Americas. Other tens of millions died in both World Wars. Besides, the industries needed abundant labor. That is not the case anymore. We also don't know how to organize migration flows for hundreds of millions of urbanization candidates. Finally, let's hope that the solution for underemployment and unemployment hidden in the countryside does not include a devastating world conflict or an endemic disease.

If we want to avoid the urban explosion that will eventually turn the world into a "planet of slum" (cf. Davis, 2006),²⁸ we can't omit ourselves from seeking ways to generate job and self-job opportunities in the countryside, despite the difficulties to undertake this task. While the poorer peasants continue to work with primitive technologies that allow them to cultivate no more than one hectare and to produce one ton of grains per year, the farmers equipped with modern machines and using a large amount of manure can cultivate one hundred hectares or more with a productivity of ten tons per hectare. In other words, we must manage productivity differences ranging from one to one thousand or more (cf. Mazoyer & Roudart, 1998).

The fundamental debate on the social model in which the bioenergies expansion will take place is located in this context. Soybeans generate no more than one direct job for every one or two hundred hectares; palm oil, one job for every five to ten hectares. Sugar cane is historically associated in Brazil to great plantations. Can that be changed? Can we combine sugar cane and other cultures (in the reform lands)? Can we provide at least to sugar cane cutters installments for the integrated and sustainable agro-ecological production (Pais) for their own consumption and to sell? Can we complement sugar cane

with manioc stem supplied by small manioc farmers to continue to produce ethanol between one harvest and the next?²⁹

There are similar issues concerning the production of wood. Instead of being produced in large monoculture plantations that belong to the processing industries, it can be supplied by small farmers according to a system of fomentation contracts. For their turn, they could be used as leverage for an integrated rural development.³⁰

Conclusion

The energetic revolution of the 21st Century has just begun. What we can say for sure is that the transition from the petroleum to the post-petroleum era will be long and that it is hard to forecast its path. That's why many questions arise from these preliminary thoughts.

To what extent are the governments able to design and to implement long term national strategies? The parliamentary system pushes towards immediatism (short termism, according to Indian economist Deepak Nayyar). Besides, how will the UN system evolve and how influent will it be? To what extent will Unctad be successful in the organization of the emerging ethanol and biodiesel markets and of the orderly transition from the petroleum to the post-petroleum era?

The projection of the fossil energy consumption trends to the year 2050, observed in the last fifty years, clearly indicates a rupture. It may happen through adaptation or through the "revenge of Gaia", that is, a natural catastrophe of unknown proportions. Thence the importance of obtaining at the same time the drastic decrease in the energetic demand profile, the significant substitution of fossil energies for non-pollutant energies (including the "clean" burning of coal) and, finally, the sequestration of a significant part of the greenhouse gases. The challenge calls for carefully planned actions by the Nation-States and an actual international agreement.

The countries that still have an agricultural frontier and specially those that enjoy the advantages of tropical and subtropical climates will be able to choose an adaptation strategy with emphasis on the promotion of the bioenergies and on the indirect substitution of the fossil energies for bioproducts. As we have seen before, this is particularly true in Brazil.

The condition for them to succeed in that venture is not to rely only on the natural comparative advantages (climates that favor biomass productivity, soils that can be used for agriculture and abundant hydric resources), but potentialize them by means of comparative advantages developed through research. It must have abundant human and financial resources which must be directed towards clearly established goals from the point of view of the biomass modern civilization, with special distinction to the ability to adequate integrated energy and food production systems adapted to the different

biomes. Brazil presents objective conditions to lead this process and to make, by the way, an extra step ahead of the currently more industrialized countries.

The environmental threat currently polarizes all the attention. For how long will we continue to underestimate the crisis represented by the chronic and growing deficit of the decent job opportunities, by the abyssal and also growing social inequalities due to the exclusion from the civilization emoluments a significant portion of world population? The situation gets worse from one year to the next in the “planet of slum”, with hundreds of millions of refugees from the countryside that are candidates to an urbanization that hardly will take place.

Therefore, we can't omit ourselves from the debate about a new cycle of rural development that generates decent job opportunities. At the same time, all efforts must be made for the countryside to become urban, in the sense of conditions and amenities of life and of access to education and protection of health and culture.

It would be vain to expect that this process happens through the unrestricted market forces. When we enter the phase of the intensive promotion of the biofuels we must design, as soon as possible, public policies that take advantage of the existent margins of freedom to direct agro-energy and the biofuels industry in the path indicated above. The bioenergy projects must be selected according to environmental and social criteria that transcend the traditional cost/benefit.

A *sine qua non* condition to succeed in this venture is the redefinition of the models of mixed public-private economy, with markets regulated by a meager development State, despite being active and able to protect us from the “market failures”.

Notes

- 1 Campbell is the President of the Association for the Study of Peak Oil & Gas. For a deeper debate on the theme, see Wingert (2005).
- 2 See the most recent report of the International Group of Experts on the Climate (GIEC) presented at the meeting that took place in Paris on 1.30.2007.
- 3 That's the stance assumed by James Lovelock (2006) in his most recent book: *The Revenge of Gaia*. The author even suggests that the world population is stabilized between half and one billion people, without, however, showing us how to achieve it. Curiously enough, Lovelock (2006, p.24) sees the use of nuclear energy and the promotion of synthetic food as a last salvation board, which would allow for the shrinking of agriculture, since “the natural ecosystems of the Earth don't exist to be turned into agricultural land, but to conserve the climate and the chemistry of the planet”. The advocates of the *décroissance* don't go as far as this leader of deep ecology.

- 4 See the report *Winning the Oil Endgame, Innovation for Profits, Jobs, and Security*, prepared by Amory Lovins and by collaborators at the Rocky Mountain Institute and with preface by a former Republican Minister, George P. Shultz. Even more significant is the fact that this study was partially funded by the Pentagon.
- 5 Driven by a pragmatic approach, GEF (Global Environment Fund), created with the goal to promote clean energy sources, has just funded for the first time a project to make the electric power plants in India less pollutant (*Folha de S.Paulo*, 1.24.2007). At the Davos World Economic Forum, an executive from the French company Alstom announced that, near 2012, it expects to be ready with big technologies for the sequestration and the underground or oceanic storage of carbon (*International Herald Tribune*, 1.24.2007).
- 6 President Georges Bush himself used the expression “oil addiction” in one of his speeches.
- 7 According to Stern (2006), reasonably efficient measures to stop greenhouse gases emissions wouldn’t cost more than 1% of the GDP per year. His economic estimates are open to debate, although they have the merit of showing that the cost of the reduction of the greenhouse gases emissions is much lower than that of not taking any action.
- 8 About the positional good concept, see Hirsch (1976). The United Nations correctly consider social inequalities to be an obstacle to development (see United Nations, 2005). The main author of that report was Brazilian social scientist Roberto Guimaraes. See also a recent pamphlet in Kempf (2007). The author considers that the necessary production to meet the concrete needs of existence can be easily reached. From that point on, the increase in production is motivated by the desire to demonstrate wealth to distinguish oneself from the other.
- 9 Quoted by Kanth (2007).
- 10 About those concepts, see Sachs (2004). For an analysis of the Earth Summit, see Sachs (1993).
- 11 For a bitter review, see “Carbon Trading: A Critical Conversation on Climate Change, Privatization and Power”, *Development Dialogue*, n.48, Sept. 2006 (the magazine is published by the Dag Hammarskjold Foundation, in Sweden).
- 12 In his proposal of an ecological pact submitted to all the candidates to the Presidential election in France, Nicolas Hulot (2006) seems to overestimate the role of the carbon taxes. Jean-Charles Hourcade is correct when he suggests that the institution of the tax on carbon happens along with a corresponding reduction of the burdens on labor. Thus it would have two effects: reducing the consumption of the fossil energy sources and promoting the job (see Hourcade & Ghersi, 2007, p.68).
- 13 In the United States, pragmatism overcomes the ideological preference for the market economy *in many states and cities of that country*. 45% of the American states approved energetic efficiency norms for civil construction, more than twenty incentives for ethanol and renewable energy, more than ten incentives for energetically efficient cars, ten limits for greenhouse gases emissions by cars and by the industries. Almost four hundred cities have plans to limit and to reduce

the emissions (see “The greening of America”, *The Economist*, 1.27.2007). Indeed, although they advocate free market economy, the United States practice Keynesianism (see Villemeur, 2007).

- 14 Thus, for example, Angola, which is about to produce two million barrels/day of oil didn't do anything to reduce the unemployment rate that affects 50% of its active population, while infant mortality kills one child out of four (see “Angola – oil boom in the time of cholera”, *The Africa Report*, Jan. 2007). The issue of *National Geographic France*, dated February 2007, published a large story on Nigeria with the significant title of “La malédiction de l'or noir. Espoir et trahison dans le delta du Niger” (p.66-91).
- 15 Available at: <<http://www.unctad.org/biofuels>>.
- 16 Retrospectively, the Athens Charter is used to justify a diffuse urbanism, as exemplified by Brasília regarding the automobile. The counter-example is the city of Louvain La Neuve, near Brussels, where the French-speaking part of the Catholic University of Leuven was transferred. It recreates a dense medieval city, in which only pedestrians e bicycles can circulate. Cars only enter a central garage located under the flagstone, on top of which it was erected.
- 17 On this respect, see the initiative of the United Nations University, in Tokyo, that promotes researches aiming at the zero emissions, known by the acronym Zeri (UNU/Zero Emissions Forum: <http://www;ias.unu.edu/ecology/g_economy/unu_zef.htm>).
- 18 See “Interview with Ghosn”, president of Renault and Nissan, *Veja*, 1.10.2007.
- 19 Kalecki's growth equation is as follows:
$$r = \frac{i}{k} - a + u$$

“r” represents the growth rate, “i” is the rate of investments on GDP and “k” is the capital/product ratio. When we act upon “a” and “u” (reducing the former and increasing the latter), we are promoting growth without new investments.
- 20 According to the latest IBGE data, deforestation already reaches 3.3% of the Legal Amazon area or 666 thousand square kilometers. However, in 2005 there was a 31% fall in the deforestation pace. The rate of 18.8 thousand square kilometers is the lowest since 2001 (*Folha de S.Paulo*, 1.26.2007). The McDonald's fast-food chain in Europe decided not to buy the chicken fed with soybean planted on deforested area of the Amazon forest. Members of its Board of Directors visited Brazil a short time ago for an inspection of the region guided by Greenpeace (*O Eco*, 2.5.2007).
- 21 In the year 2000 deforestation represented 18.2% of total carbon dioxide emission as compared to 24.5% for electricity, 13.8% for the industry, 13.5% for agriculture and 13.5% for transportation (see “Global heating, a new climate for business”, *Veja*, 12.20.2006, p.23).
- 22 Biodiesel has been produced in handicraft scale from pork fat at Pork Terra Farm, which self-supplies itself with biodiesel produced through the biodigestion of 15 thousand liters of effluents per day (*Globo Rural*, Dec. 2006).

- 23 See *Hope in Jatropha*. Available at: <<http://www.ecoworld.com>>. The Brazilian agronomists from Embrapa consider that for the time being, there is no proven scientific data regarding purging nut. They recommend an urgent study about it, reminding that, since it is a perennial plant that only starts to produce after the fourth year, they will need many years to have more concrete information about it (“Technical recommendation on purging nut planting in Brazil”, article distributed on 1.26.2007 by the Ministry for Agrarian Development).
- 24 Embrapa will hire twenty researchers with post—doctorate degree and will invest fifty million reais in the next five years, expecting that the volume doubles with the participation of the private initiative, while the American Department of Agriculture will invest 1.6 billion dollars in agro-energy research (*O Estado de S.Paulo*, 2.5.2007).
- 25 As an example, according to a recent study, one can expect a yield of almost twenty thousand liters of oil from pupunha palm tree (*bactris pasipaes*) (*Bulletin from Fapesp Agency*, 1.10.2007). There are reasons to believe that certain four-carbon bamboo species might be well-used for energetic purposes.
- 26 The first Floram Project was published in 1990 and had a wide and deserved repercussion as a pioneering effort to try to protect the native forests of the Amazon region through planting productive forests outside it (see “Floram Project: strategies and action plan” (Antonio S. Rensi Coelho; Azis Ab’Sáber; Geraldo Forbes; Jacques Marcovitch; James Wright; José Goldemberg; Leopold Rodés; Luiz G. Barrichelo; Mauro Antonio de Morais Victor; Nelson Barbosa; Werner Zulauf), *Advanced Studies*, v.4, n.9, May-August, 1990).
- 27 The International Labor Organization defines decent work according to three criteria: wage, work conditions and work relations.
- 28 The original title of the book is *Planet of Slums*.
- 29 Apparently a power plant of the Toledo group from Alagoas successfully tested that technology (Sebrae’s insert *Rural Money*, n.26, 2006).
- 30 Taking the interview by Horácio Lafer Piva, President of Bracelpa, as a pattern, the industries congregated under that entity are opening to the partnerships with the small farmers and the social movements (*Rural Money*, 12.26.2006).

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