From a petrol-based to a new green civilization

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NOT LONG AGO, the International Energy Agency based in Paris, a branch of the OECD, organized an international seminar on biofuel options, together with the United Nations Foundation and the Brazilian government. Brazil was represented by a strong delegation led by Minister Rodrigues. In a sense, this seminar was a coming-of-age for biofuels, or at least heralded a new situation, as explained by a conjunction of three factors:

1. A great number of geologists believe that oil output will peak in the next ten to twenty years. This does not mean that there will be no more oil, but simply that the new reserves apparently do not compensate the extraction. We are entering a period of depleting oil reserves that could last a century. However, this is not important in itself, what matters is that we find ourselves in a time of permanently high prices caused by diminishing supply and still growing demand. This is the first factor, oil prices have hit sixty dollars a barrel, already way above the margin that starts to make biofuels competitive. If this proves a relatively long-term phenomenon, we could say that we have entered a new age.
2. The second reason is geopolitical, in other words, the mounting costs that the United States and its allies have to shoulder in order to maintain the supply-lines through the Middle East. More and more North-American specialists are starting to think that it would be more worthwhile to invest in alternatives than to continue trying to administrate this situation.
3. The third factor, which I consider as very important, though I do not believe it has led to the new situation, is the environmental problem. It is already clear that, even if the Kyoto Protocol were implemented fully, it would still be far too little in terms of cutting greenhouse gas emissions.

The combination of these three factors recently led the eminent North-American energy specialist, Amory Lovins, to publish a new book. In the

* Transcription of a lecture delivered (and revised) by the author at the Institute of Advanced Studies of the University of São Paulo

1970s Lovins wrote *The Soft Energy Paths*, and later co-authored a work much discussed by environmentalists entitled *Factor Four*, in which he postulated doubling world GNP while halving resource use, especially in energy. His new book carries a very telling title, *Winning the Oil Endgame*, the final phase of petrol-based liquid fuels, not because we are going to run out of oil, but because none of the energy revolutions of the past was motivated by resource exhaustion, and because of the emergence of a cheaper, more efficient alternative.

It is interesting that Lovins' report was co-financed by the Pentagon and prefaced by George Schultz, one of the great Republican ministers of the Reagan era.

Almost simultaneously, the US Departments of Agriculture and Energy published a joint report in which they claimed that the USA could put an end to their dependence on oil within the next 25 years through a massive biofuel production program requiring only a billion dry tons of biomass per year.

Lovins' argument, which follows similar lines, basically rests upon a technological fix, a new generation of ultra-light vehicles that will weigh much less than present-day cars and use under half the amount of fuel. This will enable a 50% cut in the dependence on oil imports, a further 25% will come from the biomass program and the remaining quarter from a more efficient use of gas and the application of gas surpluses in hydrogen production. This, in a nutshell, is the Lovins Proposal.

The proposal laid out by the US Departments of Agriculture and Energy for meeting 25% of this demand for liquid biofuels is based on another important technological innovation, one well-known to Brazil, albeit not yet in practice, I believe, which is the production of cellulosic ethanol, that is, the production of ethanol from cellulose. This allows us to consider a whole new base of raw-materials to that currently in use, as all agricultural residues can serve as feedstock for cellulosic ethanol. In fact, in the North-American study, corn, today the main base for alcohol production in the United States, would account for a mere 5 or 6% of that base, with over half of the feedstock coming from agricultural residues.

We therefore have two technological innovations in the pipeline: a new generation of ultra-light vehicles and a new type of fuel, namely cellulosic ethanol. The company Dedini took out a patent on a method of producing ethanol from bagasse, which would be exactly this new type of fuel. According to the published data on cane-based alcohol production, this would enable us to practically double alcohol outputs, thus reaching around 90%.

This is the international outlook. Obviously, within this panorama there is special interest in Brazil as a pioneer in the field, with over thirty years experience through its Proalcool Program. In fact, the interest is two-fold: first of all, there is the wish to better understand the Brazilian experiment, which was very well presented by the Brazilian delegation in the figure of Dr. Gylvan;

and secondly, as Brazil is so competitive in ethanol, why not start thinking about a new global market, with ethanol as a commodity? Shall we buy cheap ethanol from the southern cone to drive our northern cars? This would explain why the oil companies were joined at the table by two of the world's leading car manufacturers, Peugeot and Toyota, which co-financed the event.

Two observations are fundamental at this point. The first warns against reducing the end of the petrol-based civilization exclusively to the technological problems of modifications in car manufacturing or the production of a new type of fuel. Obviously, the problem must be framed within the broader context of an energy strategy in which the main variable is a non-pollutant and often cheaper fuel, in other words, it is about the fuel type whose consumption has been foregone. It is important to address energy conservation and the redefining of the profile of energy demand from the angle of lifestyle choices, the role of transport and the substitution of individual modes of transport, etc. The whole discussion on the shape that our cities will take pertains to a wider problem of which the construction of more efficient vehicles and biofuel production is an important element, but not the end-solution.

The second and more important observation is that, rather than treating biofuels as a commodity-based market supplied by monoculture activities and designed for economic efficiency, I would prefer to place biofuels within the broader context of what I call the modern biomass-based civilization.

If we really are nearing the end of oil domination – should we say a centuries-long interlude of domination first by coal and then by oil – we are therefore, in a certain sense, returning to solar power captured by biomass, though this is by no means a step backwards, but rather a return at an infinitely higher level of the spiral of knowledge. The biomass-based civilization not only allows us to produce food, but also animal feeds, building materials, green fertilizers, biofuels, industrial feedstocks (fibres, plastics, etc.), pharmaceuticals and cosmetics. The range of products derived from biomass is enormous and can be further boosted through the use of biotechnologies at either end of the process: to increase biomass yields and broaden the spectrum of biomass-derivatives. The key question is how much cropland we actually have at our disposal, and on this matter opinions diverge wildly. On one hand, the camp of environmentalists, represented by Lester Brown, claims that we will face a shortage of arable land on which to produce food. On the other, the FAO's position is diametrically opposed to the Malthusian thinking of Lester Brown and company. I recently examined an FAO forecast study that found that Africa and Latin America are using only 20% of available cropland. I do not want to go too deeply into an analysis of this subject, essential to a discussion on the perspectives of a biomass-based civilization, but suffice it to say that this theme should not be approached in terms of juxtaposed

monocultures, but rather as a wider context of integrated systems for the production of foodstuffs and energy.

It was a program I directed at the United Nations University some fifteen years ago, entitled "The Food-Energy Nexus", that made me think deeply about the way different forms of production interlink within integrated systems. Of course, this debate must consider what the French agronomists call the doubly-green revolution, or what the world-renowned Indian agronomist MS Swaminathan calls the "Evergreen revolution", in other words, a second generation of green revolution that surpasses the first (which was essentially productivist in scope) and proposes an agriculture that seeks reasonable yields, but in harmony with nature, and which is, moreover, oriented toward small farmers.

In fact, the debate on the biomass-based civilization allows us to address one of the greatest problems of the century, if not the greatest and most difficult; the social problem *par excellence*, namely the employment issue, the provision of decent work for all; and part of this issue is the kind of future that lies in store for the world's two billion small farming families. It is utterly absurd to attempt to envisage the rest of this century without recognizing rural development as an abiding and crucial problem. We can't simply sweep all these people into shantytowns, and if they do end up there, we will have a catastrophe of untold proportions on our hands.

Alongside this first problem, the social problem, comes the environmental one. We have to stop emitting greenhouse gases as soon as possible; we simply have to abandon fossil fuels. The third problem, which I have already mentioned, is geopolitical. As long as we continue with the current oil-based geopolitics, we risk shuttling from one war to another, facing the uncertainties and enormous costs generated by competition for oil sources among the industrial powers.

The problematic I am discussing here resides where these three dimensions intersect. The crux is to understand all the possible ramifications of soil use. If I start producing ethanol feedstock from agricultural residues, I am not going to have to set aside hectares in order to do it. If, to take the example of a project I visited in the south of Bahia in April, I can produce animal protein by farming fish kept in cages and fed exclusively with banana and cassava leaves, this protein is not going to compete for the hectares I need on which to raise beef stock. The shift from free-range cattle to semi-confined and confined cattle-raising is another variable in this debate on land availability.

And so, not to prejudge which countries have the capacity for a 100% switch from petrol to biofuels, or which countries will have surpluses to plough into this new commodity market, I think we should analyze each case individually, country by country, and on this note I now turn to Brazil.

If there is one nation for which the end of the petrol-based civilization is a real possibility, not tomorrow, but in the next twenty to thirty years, that

Photo Tengku Bahar/Agência France Presse 11.9.2005

Chimney stack at the petrochemical complex in Paka, Terengganu State, Malaysia.

country is Brazil. If there is one nation that can really think about building a modern biomass-based civilization, it is Brazil. It has the world's largest reserve of biodiversity, an enormous stock of cropland at its disposal without needing to fell a single Amazonian tree, various climates, a good to excellent endowment of water resources in most of its territories and, another important factor, an agronomical and biological research corps of international quality and an industrial sector capable of providing the equipment for the production of ethanol and biodiesel. All the elements are in place for Brazil to proceed in this direction.

The fact that Brazil has practically reached self-sufficiency in oil does not mean it should refrain from pushing ahead with the substitution of oil whenever possible, as the oil it chooses not to use can be sold as a commodity on the international market. The transition from petrol-based to biomass-based civilization will take decades to complete, so in the meantime Brazil will be able to continue prospecting and selling its oil at most likely very high prices, as alcohol will be extremely competitive in relation to petrol with oil at fifty dollars a barrel. Naturally, it makes much more sense to sell oil at fifty dollars a barrel and run the cars at home on alcohol, which costs much less. And as Brazil has the recent innovation of flexi-engines, there is absolutely nothing to prevent it from steaming ahead in the area of ethanol.

Things become much more complicated in the area of biodiesel, as we do not have the same experience to draw from. Last year saw the creation of the Esalq Biodiesel Refinery, but there have been no definitive results so far, as the plant is working with thirteen or fourteen different oils. Of course, the country will need different biomass strategies, as it is one thing in the wet tropics, another in the semi-arid, and different still in the scrubland. Oil palm seems to be a promising prospect in the wet tropics, firstly, because there is a successful foreign precedent in Malaysia for the large-scale production of oil palm as a foodstuff and, secondly, because we have been working for some decades now toward a model of land reform for the Amazon based on the idea of a cooperative of 500 small farmers, each of which would receive ten hectares of land on which to grow oil palm and another ten for agro-forest and farming activities for their own subsistence. For each five thousand-hectare area producing oil palm, Agropalma, a national company with international-class technology in this field, has agreed to build a processing plant, on the following four conditions:

1. that it provides the saplings;
2. that it also provides the technical assistance;
3. that it has exclusive right-to-buy;
4. that it buys at a price calculated as a percentage of the global palm oil price.

These strike me as very reasonable proposals. A study conducted by three well-known specialists, Professor Kageyama, on the staff of both the

Ministry of the Environment and Esalq, Professor Ademar Romeiro, from Unicamp, and Dr. Kitamura, director of Embrapa Meio Ambiente, showed that these ten hectares of oil palm (being a continuous production process) can keep one man in work for an entire year, while the other ten hectares effectively generate employment for one to two members of that farmer's family. Five hundred such families taken together comprise an agro-industrial village in which further job creation through the provision of related transport, technical, social and commercial services would generate very favorable employment prospects for these families.

Though this proposal was enthusiastically received by the government of Amapá State four or five years ago, it never left square one; but this is the type of proposal that can be made.

However, in semi-arid regions, the options should be rather different. In much of the Northeast, the choice will probably fall on castor oil, as Brazil has experience in this crop, which was used as industrial feedstock for many years. The latest fiscal incentive law is worth mentioning here for its interesting composition, which sees the incentives doubly-qualified per region and size of producer, with large fiscal incentives for the small farmer in the Northeast, smaller incentives for large producers in the Northeast, smaller still for small producers in the South and practically no incentives for large producers in the South.

I think we have enough elements to start drawing up an agro-energy map of Brazil. Minister Rodrigues is interested in creating a network of Brazilian institutions that work with agro-energy and I think that among the projects under appraisal is the creation of an Agro-energy Institute and an Agro-energy Station at Embrapa, though still at a very embryonic stage.

I would like to further stress the fact that what biofuels present us is a golden opportunity for rethinking rural development, not just for meeting the fuel demands of cars. Therein lies the crux of the matter: how does one insert this perspective within a more integrated vision of rural development? How do we mobilize this enormous contingent of small farmers who are out there and who need support, assistance and guidance toward a less precarious situation? How can we integrate the production of biofuels with other forms of production, agrarian and non-agrarian? Because not everything rural is simply agrarian. How do we integrate this with the question of forest management and forest plantations, bearing in mind that, from an environmental perspective, it is always more interesting to go for perennial rather than annual species, and that by planting trees we are generating carbon sinks that could, in some cases, entitle the grower to carbon credit, although I would not make this the key objective. The key objective should be to define a rural development strategy that is compatible with modern conditions. With the new generation of communication technologies we can now consider the decentralization of a series of non-

agricultural activities in rural areas, thus heightening the plurifunctionality of traditionally farming families. In short, we have a host of issues that should be integrated.

Add to this the learning curve of technological innovation. Where are the technological innovations? What pace of productivity increase can we expect? Why does biotechnology come into the question at either end? It comes in at one end in order to boost baseline productivity, although as a tropical country we already enjoy a permanent competitive edge. Brazil's tropical nature, long viewed as an obstacle, is now seen as the opposite, as a value-added factor, though we must not forget that the control of endemic diseases should rank among the aspects most in need of examination. At the other end of the equation, biotechnology will also expand the range of biomass by-products.

So where are the opportunities? Where should we look for technological innovations? At what point does cellulosic ethanol emerge as a competitive alternative to cane-based ethanol? Today, according to *The Economist*, Brazil is unbeatable: one liter of Brazilian ethanol costs twenty euro-cent compared with thirty euro-cent in the United States and fifty euro-cent in Europe. But that is ethanol from sugar cane, when will cellulosic ethanol become competitive?

The member of the Dutch government responsible for funding research in this area says that new possibilities are opening up for cellulosic ethanol, as they are now working on an interesting enzyme extracted from elephant dung. So Brazil might want to start thinking about breeding elephants, not to mention the fact that my scenario for the next global economic crisis goes as follows: phase one – all cars start running on ethanol; phase two - due to excessive zeal on the part of tourist agencies, African safaris end up wiping out the elephants; phase 3 - the last elephant dies and the global economy grinds to a halt.

Going back to our main theme, I think we need to analyze the potential technological innovations. As already mentioned, we need to have territorially distinct prospects for biomass production, at least in the tropical, semi-arid and scrubland biomes. Brazil has a series of possible exit signs to follow in the construction of a gradual farewell to the petrol-based civilization. Of course this analysis must encompass an analysis of soil use, water availability, and so forth.

This is just to say that the time has come to conduct such an analysis. The IEA is ideally suited to the task, to seeing how we organize the knowledge we already have, how to identify gaps in that knowledge and how to start a debate that is not exclusively Brazilian, but international, not exclusively about switching from petrol to biofuels, but about how to organize a strategy for the transition to a truly sustainable, truly inclusive society, playing all the cards I have outlined in this text.

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Ricardo Abramovay – I have an observation to make on the exposition delivered by Ignacy Sachs, but first I would like to ask two questions that I imagine must be important to everyone working with or thinking about this subject.

The first is as follows: I noted that, even before beginning his exposition on the importance, viability and urgency of the transition he is announcing, Sachs makes it clear that the problem to which the end of the petrol-based civilization is pointing should not eclipse the broader question to our civilization, which concerns, in the last analysis, our consumer behavior. This is a theme that has been under discussion both within the environmental movements and increasingly in companies, like DNA Brasil, under the auspices of social responsibility. I don't know if you may recall, but last year there was a meeting held in Campos de Jordão at which fifty Brazilians, mobilized by Ricardo Semler and others dedicated to thinking Brazil, came together in the most unusual format. There were no roundtables, instead, people just strolled about Campos de Jordão in twos and threes discussing Brazilian themes. This initiative is going to be repeated and one of the themes will be sustainable consumption.

So, since the Bruntland Report, in your opinion, in what respects has the discussion on changes in consumer behavior advanced?

The customary position of the economists is that changes in consumer behavior will follow the cues issued to economic agents and players by the pricing system. Of course, we all know that if this is how things work, it works very badly. So what are the tools, what progress has been made on this matter?

The second question is that the scenario you develop in relation to the petrol-based civilization leads to an issue that you did not address in your talk, but which is clearly present in your thoughts, namely the question of power in the field of energy. After all, if there is one facet of our society in which there is a fantastic concentration of power, this is it. What does the end of the petrol-based civilization have in store for us in relation to this?

This brings me to the reflection I would like to make on the exposition made by Sachs, which is as follows: for people who do not work directly with rural development themes, the connection Sachs makes between a change in the pattern of energy consumption, an increase in biomass production and the fight against poverty by strengthening small landholders may come as something of a shock. Why? Because we, as citizens, university people, non-specialists, have incorporated a point of view that is consensus among the majority of economists, namely that the production of the means by which to effect the transition from the petrol-based civilization to biomass civilization should be entrusted to the most efficient possible forms, namely – and this is the crucial point – competitive units that produce and function on such

a large-scale that they leave no room for any possible competition from smallholders, especially not from units composed by people now living in a state of poverty.

I would like to make two observations in relation to this. Firstly, while I recognize, and in this I am an admirer and disciple of Ignacy Sachs, that the undoubtedly voluntarist perspective can indeed make economic life a means of combating poverty, this voluntarist perspective would be entirely vain and neutered without a solid technical, economic and sociological basis. Well, it rests, first and foremost, and in at least two key respects, on what can be called the specificity of agriculture. If someone were to say 'come on-board this plane, which is the product of family-based manufacture', I am sure you would probably prefer to take a Boeing or an Airbus. Agriculture, in this sense, is a sector that has a technical particularity, the world over, in that family-based productive units do tend to be competitive. We cannot consider economies of scale in agriculture in the same way we do in industry. There are various international studies that show that this is precisely why agriculture is, worldwide, with the exception of some service sectors and the informal economy, the most family-based sector there is, both in its current composition, predominantly family-based throughout the world, and in terms of its succession. The vast majority of farmers are sons of farmers. So this is an important element.

But this technical aspect is perhaps not the most important one, though it does provide an objective base for what is being proposed. The most important point may be that we are at the threshold of the construction of a new market, for which we have two possibilities. One is to take the line that markets are objective realities that correspond to points of balance between supply and demand as established by impersonal and autonomous mechanisms – prices. This is a view concerned with what markets are. The second is a position of contemporary economic sociology that markets are social structures based on reasonably stable and time-honored rules, as well as patterns of interaction among economic agents.

What Professor Sachs is telling us is that if society organizes itself – that is, if the government, private agents, social organizations, public and private innovators and associative innovators organize themselves – to occupy important places in this market, there is no reason to think that they would be excluded from it. History is full of instances in which family smallholders organized themselves to establish relationships with dynamic markets, competitive markets, and succeeded in gaining a foothold. Of course, such cases are a minority, precisely in function of a correlation of forces, rather than a technical question concerning such an abstract notion as efficiency.

And so, I think that what Prof. Sachs is proposing is a research agenda, but, at the same time, an agenda of political propositions as to how this market

should be organized and whether the different social forces should have representation; or to put it more clearly, whether they should be present within this market.

Luiz Gylvan Meira Filho - As Professor Sachs and most of those gathered here will know, I have been dedicating myself, here at the Institute, to one aspect of the problem, the third one mentioned by Prof. Sachs, which is the problem of climate change.

Yesterday we had a visit from a scientific advisor to Prime Minister Tony Blair, Sir David King. He was here in Brazil to talk to people whose heads of State and governments have been invited to a meeting in Scotland next month, an expanded meeting of the G-8.

Tony Blair invited Brazil, China, India, South Africa, South Korea and Mexico to join the G-7, plus Russia, in other words, the G-8, for a debate on two themes: development, or poverty, depending on which way you look at it, and climate change. In general, the theme is seen worldwide as rather opportune, as the Kyoto Protocol came into vigor with the Russian ratification. The United States and Australia opted out. Inevitably, no sooner had the protocol come into effect than the international debate shifted to what the next step should be, the second tier to the Kyoto Protocol, or the New Regime, Post-2012 or Post-Kyoto, whatever you want to call it, but clearly something has to be done.

Everyone concerned with the theme has found Tony Blair's initiative extremely interesting, as it is one of the few fora in which the theme has been placed on the table by the head of State, in this case the United Kingdom, where no-one can avoid it; and at that table there'll be the United States, who chose not to ratify the Kyoto Protocol, as well as developing countries like Brazil, China, India and South Africa. These are countries that may be poor in terms of per capita incomes, but there are many ways to define 'poor' or 'developing'; I prefer to define them as countries in which there is still a percentage of the population that has yet to be included in the modern economy. These are new countries. Brazil only started to industrialize after the Second World War, the percentages, or fractions, in this bracket in China and India are far bigger than in Brazil. This means that, as they still have much to implement in terms of energy infrastructure, transport, and so on, they are very important countries in this discussion. In this context, I agree with Professor Sachs' assessment. It is noteworthy that it was in the OECD building, in fact in the offices of the International Energy Agency, which, it is important to remember, is a branch of the OECD created in response to the formation of the oil cartel, a rational response on behalf of those who said: if the producers can form a cartel, then I'm going to organize myself so that I can react in conjunction too, increasing my bargaining power. So, the soul of the International Energy Agency is this, and it is noteworthy that it was there, at a venue like this, that a meeting on biofuel options was held.

I think, but of course this is clearly my own professional bias, that the problem of climate change will swiftly become an extremely important factor in this equation. And the reason for this is physical. In his lecture, Prof. David King said that greenhouse gas emissions need to be reduced by roughly 60% by 2050, more or less, worldwide. Considering that we have to respect those swathes of the population that remain excluded, or have yet to be included, a good portion of which are in Brazil, a little more again in China, another slice in India, entire nations in Africa, in other words, if we have to create space for these countries to gain access to energy, etc., then the industrialized nations will have to cut emissions by more than 60%. Maybe 70 or 80%. Last night, at the British Council, he was talking in terms of 80%. It's a figure that is not calculated, it's higher than 60% but less than 100%, because you can't just shut down whole countries. On another occasion, not here in Brazil, he used the expression 'a new industrial revolution'. We created the industrial revolution, so now we have to set ourselves the task of creating another one, and this has to be done. All of this is in full agreement with what Prof. Sachs has been saying; what we need – calmly, you can't do it all of a sudden – is a very serious change of paradigm.

So I would like to pose two questions to Professor Sachs. One is that, when we think about liquid fuel, to run our cars and trucks on, here in Brazil we have the ethanol program, but if we look through the lens of climate change, an equally serious problem is coal, and this was aggravated by the fact that, back in the 70s, with the oil crisis and the formation of Opec, the political agendas of all the nations of the world quite rightly started prioritizing assured supply. Brazil was intelligent or lucky enough to mix both, and in so doing jumped in the right direction. Greenhouse effect had not emerged back then, and there was no Kyoto Protocol. Brazil opted for alcohol. The United States jumped the wrong way, I mean; the problem was framed more or less like this: how do I manage to reduce my dependence on external energy sources? They opted for coal, because coal was abundant there. They invested heavily in the sector, etc., and this still hasn't been amortized. However, and I mention the coal problem because, in fact, from the perspective of climate change, and greenhouse gas emissions are the key issue here, we have to take coal into account and recognize certain nuances or differences. For example, the production of alcohol from corn in the United States consumes lots of energy, fertilizer, etc. So when we look at it through this lens, the alcohol produced from sugar cane here in Brazil is much better in terms of cutting greenhouse gas emissions than the alcohol from the US. Some biologist friends of mine tell me that it is not a foregone conclusion that cane-based alcohol produced elsewhere, even in the tropics, from different soils, would have the same effect as that produced here. So if what I say is true, despite my bias, that climate change will prove an important factor, then we will have to face things, approach things from the perspective of

these emissions, we'll have to start looking at coal, we'll have to start looking at other forms of energy. Cement production is extremely energy-intensive; aluminum, then, is pure energy, in the basic production of aluminum, and the production of iron and steel too, we use coal here, in Minas Gerais. Coke is used in the thermo-reduction anodes, I mean, in addition to reducing the mineral oxides, latent energy is also being released there. In other words, professor, if this trend sticks, if, in the short haul, whether through the conversations of Tony Blair or if another large iceberg collapses in the Antarctic, if everyone takes a huge fright, five, ten years from now, what is your opinion on the role of renewable fuel sources in the broader global energy context, not just oil?

I have friends who say things like, hey look, Brazil has so much space, why don't we just clear away the Amazon and plant a whole heap of stuff to supply China. Futuristic things like that, but not all that futuristic. So I would like to coax you into a little speculation, if you don't mind, as to what you think the pressures will be if and when the climate problem turns ugly.

My second question, Prof. Sachs, has more to do with the economy. Once, some years ago, Professor Bresser Pereira became Minister for Science and Technology and I was responsible for briefing him, to explain all about climate change. I thought to myself: it's going to be hard, he's an economist. So I invented things like the marginal cost of reducing emissions, got my courage up and explained. He studied the thing long and hard and said – Gylvan, there's no way. There's no solution to this problem you've brought to me, the laws of economics don't permit it. Then he explained to me in simple language that this market-thing can't solve the problem on its own, we would have to somehow send signals to the market, in the form of subsidies or fines, etc., before things would start to edge in the right direction. So I ask you, professor, what do you think can be done to induce such a movement?

Ignacy Sachs - First, Ricardo's question about the problem of the structure of consumption. It's a decision tree. It's the juggling act of harmonizing economic, social and environmental goals. The social goals are primordial, development is, before all, the problem of social inclusion and decent work for all; not just any work, decent work. The economy plays a merely instrumental role. However important that might be, it is not the end in itself. Now, obviously the most difficult variable to adjust, and the most essential, is that which changes demand, not that which adjusts supply to meet demand. And that means discussing lifestyles, transport habits and time use; for example, the difference it makes to energy consumption whether we cityfolk go home for lunch or not, etc.

We have been trying to pose this question since the Stockholm Conference in 1972. In 1974 we had a seminar whose recommendations I recently re-read. The Cocoyoc Declaration of 1974 probably contains

everything that has been said about these problems ever since, and in a very impactful manner. It was an absolutely extraordinary seminar because we had Barbara Ward as president and lightning-conductor in chief. Also present were various United Nations directors and renowned intellectuals. The Mexican President made a point of attending the closing session as a way of endorsing its conclusions. We drew attention to the hyper-consumption of the rich and the under-consumption of the poor. A few days later, a gentleman well-known to us all, Henry Kissinger, sent his messengers to the UN threatening that the United States would have to reconsider their stance on the United Nations Environment Program.

In other words, our discussions on the issue were locked up for a few years. We rebuilt the theme through a series of regional seminars on styles of development and the environment, of which the most memorable was perhaps the Santiago Seminar, organized by Oswaldo Sunkel, which gave rise to two important volumes published in Mexico. We held another seminar in Africa, which was not very good, and another in Bangkok on Asia, followed by another one in Europe, as we thought the problem of lifestyles in the industrialized world was the most important aspect of the whole problematic.

And what happened? The environmental advisors on the United Nations Commission for Europe said that we were straying from the environmental theme and the whole thing died right there. It is obvious that it is a fundamental theme. How much is enough? – it's a Gandhian question, it's at the core of Gandhian thought. We introduced it to a public debate with the Swedish public opinion in a report widely circulated at the time, entitled *"What now?"* and published in 1975. We asked four questions, three of which I remember: would it be a good idea to limit meat consumption, not to save the children of Bangladesh, but to protect people's health? How many square meters of living space are enough? What's better, having a private car or a good public transport system and a rental service for when you need a car to go somewhere out of town? The debate was on TV and radio and we got it in the neck. The majority of the Swedish thought that we shouldn't limit cars or meat. And we said nothing about drink. You are absolutely right, this is a crucial issue.

The question of power, of the seven sisters. Naturally this is an essential element of the whole game, but it is interesting how the big oil companies are trying to transform themselves into energy companies. It's as if they know times are changing and they want to save their skin.

The third question you raised, concerning efficient production. Indeed, this is one of the most treacherous words in the vocabulary of economics. Efficiency of what? Efficiency in relation to costs? Efficiency in relation to social goals? Efficiency in relation to environmental goals? Our whole struggle since the 70s, as we are outsiders in relation to the economic orthodoxy, has been to show that we have to introduce criteria that are not merely economic,

but social and environmental as well. This brings me to another of your questions, though not in the order they were put, which is your last question. It is obvious that this cannot happen within a market economy.

In fact, it is interesting to recall that at Rio-92 – I was advisor to the Secretary General of the Earth Summit - we circulated two documents which clearly stated that sustainable development was incompatible with a pure market economy. One of these, published by the World Bank and UNESCO, was a collection of articles by eminent economists, two of whom were Nobel laureates. They all said more or less the following: we need a mixed economy in which the market has an important role to play, but a regulated market, a market that is not the end all and be all. John Robinson used to say that the market is short-sighted and socially insensitive. So if we want social sensitivity and long-term vision we need something more than just the market.

This is the key institutional question of our century. What should we build out of the ruins of the paradigms inherited from the last century? Why did what happened last century actually happen?

We had real socialism, which died with the fall of the Berlin wall. I'm not going to go into the matter. We had the Washington Consensus model, which, for me, from an intellectual point of view, died with the tragedy in Argentina. We had thirty years of reformed capitalism, 1945-75, which was contested by the neoliberal backlash. But as this neoliberal reaction led to the Washington Consensus, I think we have to reactivate the reformed capitalism of 1945-75. I'm not saying we should return to it, but we have to reactivate it. It is worth remembering the three key words of reformed capitalism, which surged as a response to the catastrophe of 1929, to which there were three reactions: fascism, real socialism and Roosevelt's New Deal. Those three mottos were: full employment as the social goal; a protective State as a complement; and planning. When van Hayek penned his famous pamphlet in 1944 against planning, he was a dissident, everyone else around him was planning.

I think we have to return to these ideas, the importance of full employment, of a protective state, and, more than ever, of planning – not planning in the Soviet sense, I don't have time to go into the differences, but some form of planning.

We had another very important paradigm in the Brazilian debate, which was the model of rapid growth and rapid modernization by tensioning social inequalities; the Brazilian miracle model. Extremely high growth rates, modernization and industrialization, everything we wanted, but with yawning social inequality. This is the model of China today, this is also largely the model of present-day India. The Brazilian example shows that this model has limits; that it runs out of steam, to say nothing of the damning legacy it leaves in social terms. So we need to invent new forms of organizing the Economy, but within these parameters.

Returning to Ricardo's question, this is connected with Bagnasco's idea

– *la construzione sociale del mercato* – in other words, the market is a social construction and we have to build a market from within a wider vision that is subordinated to these goals.

Now, on the observations made by Prof. Gylvan, I would like to start by getting back to an idea that was discussed at length last week in Paris. The enormous potential for South-South cooperation in the construction of a new post-petrol civilization and how the Brazilian experience can serve as a model for others. This was underscored by the FAO representative, the World Bank representative, who said that he was unfortunately in the minority at the Bank. It goes with the territory. I am very glad you have brought these numbers to the discussion – 60% to 80% reductions for the industrialized world – as this, seen from another angle, shows that Kyoto, even 100% implemented, is still only $^{1}/_{10}$ of what the industrialized nations should be doing.

First of all, I must confess that although I have not discussed coal, I should have done, as this is a great asset of Poland. There are modern coal-burning technologies that greatly reduce environmental impact, such as fluidized bed combustion, for those who are interested. That said, it is clear that coal is the number-one problem, especially in China. China is a terribly polluted country because of excessive coal-burning. However, we clearly need to work with all the technological alternatives at hand. For example, it is often said that solar energy has no future because it requires too much space. I don't see space being an obstacle to building large solar plants in the Northeast. Now, I would not suggest doing the same in the middle of São Paulo. We have to know how to contextualize the proposals.

The great debate is nuclear energy, which neither you nor I mentioned, although returning from Paris I can say that all of the proposed solutions are coming through the nuclear door; France, for example, is convinced that the future is nuclear. In the nuclear debate we still have the question of fission. Is it a real alternative or is it not?

Fifty years ago they used to say that we'd have fission in the next half-century. Today, we're still saying that we'll have fission in the next half-century. Will we? I don't know, I don't have the answer.

Is nuclear energy dangerous? Is it not? How dangerous is it? It's a debate we can't avoid. In the early 70s a group of French NGOs asked me to represent them at an energy debate in Brussels. I worked the miracle of managing to upset everybody by saying that nuclear energy should be considered, at least, as a transitional energy strategy for countries, like France, that had no other available energy source. Obviously, the establishment in France and Brussels didn't like that, while the NGOs were furious because, as far as they were concerned, I should have said I was against nuclear energy on religious grounds, period, with none of this transitional business. Later, the French Socialist Party, still in opposition at the time, created a working group on energy, presided by Alain Touraine, whom many of you know. We produced

a report in which we proposed that we stop and launch a major social debate, not one to be decided by scientists, but a political debate par excellence: do we want to run the risks posed by nuclear energy? The risk of a nuclear accident is minimal, but the consequences of a large leak can be catastrophic. On the other hand, we still don't know what to do with the spent reactors, there's a series of problems which I won't go into here. I don't have a clear answer to these questions, only my gut-feeling. They can't be buried over the way they are being buried over today, this has to be a big social debate, because then there will be no scientific proof to override the political and ethical solutions to be taken.

This is why I believe we have to put the future of humanity's energy supply at the center of a genuine political debate. This is not a matter for specialists, this is a matter for citizens. And I don't mean it should be solved by referendum – are you for or against nuclear energy? It's an issue that requires lengthy social pedagogy, as does the issue of climate change. We are seriously low on genuine information on world public opinion concerning what the key challenges are, what the problems are, where the big decisions need to be made, and this, in reality, goes back to a subject we didn't discuss: how should we define that word so often cited and yet so vague: democracy?

ABSTRACT - PEAK oil, the tapering of petroleum production, is drawing nearer. The resulting steep rise in oil prices will enhance the price competitiveness of biofuels – ethanol as additive or replacement for gasoline, and biodiesel as additive or replacement for diesel oil. Brazil meets all the requirements to become a large producer and, in time, an exporter of biofuels – reducing the emission of greenhouse gases, generating numerous decent job opportunities for family farmers, and becoming less dependent on the geopolitics of petroleum. The substitution of biofuels for petroleum-based products is only part of an energy strategy in which efficiency and conservation must have an overriding role. On the other hand, the production of biofuels should be seen within the larger setting of the construction of a modern biomass civilization, for which the tropical countries have highly advantageous conditions and which would be an essential contribution to sustainable and encompassing development.

KEYWORDS - Oil, Biofuels, Ethanol, Biodiesel, Climate Changes.

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