A STATE POLICY FOR SCIENCE, TECHNOLOGY AND INNOVATION

ABC'S CONTRIBUTIONS TO CANDIDATES FOR THE PRESIDENCY OF BRAZIL

2006

PRESENTATION

The Brazilian Academy of Sciences which was founded 90 years ago, celebrates the date by elaborating a proposal to incorporate, as a State Policy, science, technology and innovation into the sustainable and socially just development of Brazil. In this century, it is essentially impossible to create jobs, to combat poverty and to strengthen democratic governance without the intensive use of science, without applying the most efficient technology based on location, without introducing the concept of innovation within the entire society and improving education.

Brazil gathers unique conditions to efficiently utilize the triad science, technology and innovation in a daring and transforming development project. A project that contributes towards reducing inequalities, improving the quality of life of the population and placing the country in a spot of highlight in the international scenario. The already installed scientific competency, the complex and mature research support structure consolidated throughout the years, the continental dimensions, the population and the diversity of Brazilian ecosystems, all contribute towards this.

The energy and environmental crises which affect the planet today present new opportunities for resizing Brazil´s role. Our country can become a key element in facing these crises, contributing towards the construction of a new energy matrix, towards the decrease of global warming and towards the maintenance of the hydrographic basins, a crucial element in the water crises that is foreseen.

Yet, the full use of these favorable conditions requires that we establish priorities which allow us to eliminate important obstacles for national development. These obstacles include the precarious level of education of the Brazilians, the low investments in infrastructure, particularly in governmental resources which are insufficient to support research an innovation, as well as the low investments in research and development of businesses located in Brazil.

We intend, with this proposal which includes suggestions made in the last years by several segments of the scientific and technological community, to offer a contribution so that in this moment of Presidential elections, we undergo serious and consequent reflections on the routes of our country.

In the world today, an economy based on knowledge is viewed as a natural substitute of industrialized economies. This is the path of the new trend of world development, of which countries like China and India enthusiastically participate. The decisions made by the following government will influence the rank occupied by Brazil in the International scenario.

Rio de Janeiro, August 8, 2006

Eduardo M. Krieger
President of the Brazilian Academy of Sciences

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SUMMARY OF PROPOSALS

SCIENCE AND TECHNOLOGY POLICY

1. **The role of the National Council of Science and Technology needs to be strengthened as a support agency to the presidency who proposes the country's Science and Technology policies as a source and integral part of the national policy for development.**

2. **The sector funds need to be increased and its resources need to be fully used. The funds need to support important efforts in the area of education, including science education, and innovative courses in the area of engineering.**

3. **A wide range of financing should be made available, including networks of research, individual support and small group support, long term programs for consolidated groups, programs for emerging groups and the institutional support to universities and research institutions. In particular, the support to spontaneous demand by CNPq should be substantially strengthened and for such, should count on resources from Sector Funds.**

4. **International cooperation in Science and Technology should be a part of a State Strategy. The relationship with countries under development, deserve special (yet no exclusive) attention, especially India, China, South Africa and the countries in South America and the Caribbean.**

QUALIFICATION OF HUMAN RESOURCES

5. **an action plan needs to be put into effect urgently, coordinated between Federal Government, States and Municipalities, to revert the state of bankruptcy of elementary and high schools in Brazil – Comprising the following issues:**

    a. **the valuing of elementary and high school teachers, with salary increases associated to**

recycling activities and continued education.

b. Improvement of the alphabetizing methods with the recycling of the professionals involved.

c. Turning public schools mandatorily into full-time schools, with sport activities and programs which stimulate social interaction, self-esteem and creativity of students, in addition to tutoring for students with learning difficulties.

d. Increase the role of higher level public institutions with regards to qualifying and improving well qualified teachers for elementary and high school (allied to the valuing program of these professionals); involvement of these institutions in activities which re-enforce elementary and high school education, with scholarships for students who get involved in these activities.

e. Re-enforcement of technological and professionalizing education, simultaneously to high school.

6. Higher education needs to be strengthened through the qualified expansion and diversification of the public sector, including two to three year courses, professionalizing schools and institutions of general qualification.

7. The imperative need for enhancement of the quality of higher education requires that a consequent evaluation mechanism be established in public and private institutions, with a reflex on financing and accreditation: an evaluation agency independent from the evaluated institutions, should be created – a CAPES for the graduate courses.

8. A long term scientific Alphabetizing program should be created for the Brazilian population.

9. **The GDP percentage invested in education should be increased, in order to achieve a level of a minimum of 5% by the end of the next presidential mandate, and a minimum of 6% by the end of the following one.**

10. **The scholarship programs for post graduation and research to which CAPES and CNPq contribute to, has had an essential role with regards to research and with regards to qualifying new talents. This should be increased and strengthened. In particular, one should observe that the values of post graduation scholarships need to be substantially revised.**

11. **Differentiated mechanism to attract and fixate new groups and researchers need to be created, especially in the North, Northeast and Mid-west regions.**

TECHNOLOGICAL AND INDUSTRIAL RESEARCH AND INTERACTION AMONG INDUSTRIES AND UNIVERSITIES

12. **A state's purchasing power should be used to encourage the development of new industries with innovative profiles, encouraging a collaboration among them and with research institutes and universities.**

13. **New research institutes should be created, linked to the ministry of Science and Technology, or to other ministries as a way of making use of local potentialities and contribute towards decreasing regional inequalities in the country.**

14. **Research, Development and innovation in businesses need to be strengthened, through the diversification of instruments, the effective implementation of an industrial technological and foreign exchange policy and through the innovation law.**

15. **Public policies should contemplate the promotion of activities which explore the differential advantages of Brazil, such as the sustainable utilization of Brazilian bio-diversity and the development of renewable energy sources. They should improve the instruments which promote the R&D in businesses and promote the use of qualified personnel.**

1. COMPETENCE INSTALLED IN BRAZIL

Worldwide development is transitioning from industrialized economies to economies based on knowledge.

The transition from the standard worldwide development of industrialized economies to economies based on knowledge is becoming more and more evident and highlighted. In the statistics on science technology and industries supplied by OCDE, one already utilizes the concept of “investing in knowledge” (higher education, research and development, and computers), and based on this concept organizes the most prosperous countries and those with better conditions to confront the challenges of the future. Brazil occupies a relatively good position among the countries which are not part of the OCDE. The gross absolute sums of the expenditure on research and development (GERD) reveal the quantitative gap which separates Brazil from the developed countries. Recent data from UNESCO (UNESCO Science Report, 2005) shows that the Global GERD was of US$2.8 trillion in 2002. Out of this total North America is responsible for 37%, Europe 27.3%, Asia 31.5%, leaving only 2% to Latin America.

Brazil holds today a renown competence in S&T, conquered after decades of investments

The post graduation expansion policy, involved a parallel increase of the country´s scientific foundation. With a relative concentration in the Central-South Region, the post graduation programs, and associated to that the scientific foundation, spread throughout the country, with clear gaps in the Amazonian region. Nevertheless, the investments in Science, once you deduct the sums destined towards scholarships, did not follow that made on the expansion of post graduation or the increase which resulted from scientific production. The number of people with Masters and PhDs and the number of scientific publication increased more than twice than that of the previous decade.

The imbalance between the expansion of research and financing is most evident in the States of the Federation where the State Research Support Foundations were not physically implemented. It is totally unnecessary to perform any analysis to demonstrate that the acquired level will not be sustained if the current volume of investments at the base of research is maintained. This scientific foundation which resulted from the implementation of post graduation, can and should be enhanced, but we need to indicate a few conditions for this to be kept and suggest concrete actions to enhance its foundation.

It is also necessary to, even if in a generalized way, define the outline of the scientific foundation obtained in Brazil. The distribution of Brazilian Scientific production per area of knowledge is comparable to that of a developed world. Thus, today, there are no scientific areas in which Brazilian scientists are absent from. The building of this foundation represents a unique asset, comparable to very few other countries under development. Undoubtedly this foundation would be enhanced, above all to cover the Brazilian continent. Yet, the impact of this production is not comparable to that of a developed world. The impact of Brazilian Scientific production is, in several areas, a fraction of what is expected based on the volume of production. Clearly Brazil should face the challenge of striving for excellence, while maintaining and enhancing the current conquests. This is the only way the country will be able to solidify the acquired foundation and, at the same time, construct actions in the areas of science and technology which will impact socially and economically.

In this precise context, and within the indicated limitations, one can state that Brazil possesses Scientific competence. This competence can and should be utilized to encompass a national development project which aims towards improving Brazil´s ranking to a new standard, within worldwide development, but with a differentiated profile. The project of S&T is the direct function of a daring development project, and not that in the lines of shy policies, resigned to the obstacles of the moment and focused on maintaining the existent levels and linear distribution.

Access to knowledge is capital to businesses, which need to seek a space in the market in a competitive scenario, enlarged by globalization. In this context, qualified personnel and access to technologically modern equipment and services is essential. They are also capital for education, because placement in the workforce will require, more and more, personnel capable of facing technological advances.

The national system of S&T is today complex and mature

The complexity is due to the diversity of agents and interests involved – besides the "traditional" agents, linked to education a research (universities, research institutions, more dynamic segments of the productive sector, governmental promoting agents and financers). The system today also involves a bigger quantity (and one expects – a growing quantity) of the states and of the organized civil society working to influence in the definition and in the implementation of a S&T policy.

The maturity of the system depends on the training of its agents. The half-century of continued effort in the organization of the system and in the strengthening of its agents, in which we must point out the institutional financing of FINEP in the decades from the 70s to the 90s and our excellent post graduation program, resulted in a high level human resources, unique among developing countries. This training is represented by the quantity of PhDs granted each year in the country (10 thousand in 2005); by the Brazilian participation in international scientific publications and by the worldwide acknowledgement of national S&T, manifested by several renowned international institutions.

Despite the installed competence, we have still not managed to make the link with technology and especially with industrial research.

On the other hand, Brazil´s presence in the international scenario of science and technology has been greatly strengthened in recent years. In

particular, Brazilian scientists have earned high distictions abroad and have occupied key positions in relevant international institutions in this area. International cooperation, especially with countries under development, is vital and strategic for our development and our insertion within the world.

Innovative ways of supporting initiatives in S&T were created in the last five years

These new forms were directed at facing the risks of the activities of R&D and at decreasing the costs of these activities (Sector funds, Centers of Excellence programs, Innovation Law, Provisional Measures, etc.) Allied to traditional financing instruments (scholarship systems and institutional funding), the instruments available today cover almost all the financing needs of all the relevant agencies for the S&T policy, in any place in the Country.

The institutions that operate these instruments are experienced at national and international levels, and are capable of dialoguing with other agencies. At a state level, we have agents with distinct experiences working, but the organization of state forums on S&T has improved general maturing. New agents have been created to work on the identified gaps – specifically CGEE and the ABDI, which work on the production of studies and comprehensive diagnosis, to promote articulated initiatives which support the several stages of the policy of S&T.

The total resources in S&T are now coming from a larger diversity of agents. Although federal funds are still prevalent, the participation of state and businesses funds are increasing.

Other ministries have a considerable participation in the resources and in the policy of S&T aside from the Ministry of Science and Technology: notably the ministries of Agriculture, of Education and of Health. Despite the policy of S&T being of the responsibility of the Ministry of S&T, this ministry accounts for less than 40% of the federal resources allocated to S&T.

2. CURRENT OBSTACLES OF SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

The biggest obstacles faced by the S&T system could be avoided with relevant public policies committed to a more advantageous position for Brazil within the world.

The existent system, with its highly qualified human resources and its research infrastructure, demands for a continuous upgrade and expansion, O sistema existente, com seus recursos humanos altamente qualificados e sua infra-estrutura de pesquisa, demanda contínua atualização e ampliação, to the extent that knowledge and its applications expand in the world.

From the 1980´s, and for a long time, the formulation of an industrial policy to leverage national productive competence was abolished. Both the industry as well as the generating of new jobs entered a period of great difficulties and the political guidelines which were enunciated signaled programs which spared labor and prioritized the import of machinery and technologies. As a result, after 20 years, we have an economy more identified with commodities and dependant on imports, aggravating the conditions of competition of Brazilian products in the international markets. This component generates an inevitable pressure on exportation.

In the absence of a policy that would draw the best out of Brazilian training in S&T, with regards to resources, the area also faces serious difficulties for over 20 years. This is overshadowed however by the disregard for the current laws represented by allocating significant resources to the Sector Funds of Science and Technology to the Contingency Reserve. By the year of 2006, practically 5 billion Reais, raised specifically for projects of S&T of specific sectors, will have been allocated to the Contingency Reserve.

The precarious state of education constitutes a serious obstacle for a national project of scientific and technological development

It is evident that social conditions in Brazil are wicked and that the concentration of income and knowledge are parallel. In an economy that incorporates knowledge as a value, the lack of education condemns an increasing part of the Brazilian population to an eternal socio-economic marginality. The universalization of primary education is a development that is, at the same time, revolutionary, late and insufficient. Revolutionary, because the country made a strategic central effort. Late, because many countries in comparable states of development had already attained the universalization of primary education well before Brazil. Insufficient because, being of questionable quality, it is separated by an enormous distance between levels, depths and breadths of the teaching in developed continents.

The average schooling of the population aged 15 or more, according to IBGE, is of only 4.9 years, contrasting with the 7.2 years of Mexico, the 8.8 years of Argentina, and the 10.8 years of Korea. Moreover, the quality of education is poor, with 83.8% of the students in the public elementary school in the South and 80.6% in the Northeast region, attending school for an average of less than 4 hours a day. According to the National Indicator of Functional Literacy, evaluated by the Paulo Montenegro Institute, a nongovernmental organization affiliated to IBOPE, only 26% of the Brazilians between the ages of 16 and 64 have full ability to read. In addition, only about 10% of the people between the ages of 18 and 24 are enrolled in institutions of higher education, in a scenario largely dominated by private institutions of very low levels. As a result of this realm of private institutions of higher education, 69% of the enrollments of higher education are in the areas of Human and Social Sciences, versus 11% in Engineering and Technological Sciences, and 2% in Agricultural Sciences. In the OCDE countries, the percentage of enrollment in the human and social sciences is of about 30%.

The process of devaluation of primary and secondary level teachers, which occurred in the last decades, is closely linked to the aggravation of this situation: according to the document *Education at a glance,* from OCDE, the salaries of these professionals are amongst the lowest in the world.

3. FOR AN ECONOMY BASED ON KNOWLEDGE: OPPORTUNITIES, PERSPECTIVES AND PROPOSALS

Brazil has the capacity of repositioning itself in the international scenario, for it presents the conditions to face the global crises which threaten the future of the planet.

A recognized set of global crises, threatens the future of the planet. The energy crisis, characterized today by the price of petroleum, comes from a fact that has nothing to do with the political components that aggravates it: the era of increase of petroleum reserves shall end in the next decade. The environmental crises, and its impact on health, degradation of the ecosystems, global warming, is essentially anthropogenic and is characterized by a model of development which is in the long run, unsustainable. Associated with the above, there is also the crisis of drinking water which threatens a large part of humanity.

Brazil possesses the capacity to replace itself in the international scenario, for here are the conditions to face, at least partially, all the three global crisis described. Brazilian agriculture, if it incorporates science, technology and innovation, can contribute towards the construction of a new energy matrix: that of biomass. In this direction, it is essential to consider that this global contribution needs to take into consideration the social inequalities in Brazil, and generate science, technology and innovation focused on social inclusion and respecting the environment. The sustainable development of the Amazon region can, at the same time, articulate a national contribution towards the decreasing of global warming and the maintenance of our

The sustainable development of the Amazon region can, at the same time, articulate a national contribution towards the decreasing of global warming and the maintenance of our basins, crucial elements for the water crisis which is foreshadowed.

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None of these opportunities can be seized without the development of science, technology and innovation, involving a national coordination between government, businesses and education institutions.

The strengthening of the support infrastructure, with a full use of the sector funds and the strengthening of the National Council of Science and Technology (CCT) are important steps in this direction.

3.1. SCIENCE AND TECHNOLOGY POLICIES

The role of the National Council of Science and Technology needs to be strengthened as a support agency to the presidency which proposes the country's Science and Technology policies, as a source and integral part of the national policy for development

This is the role of the CCT, instituted by Law No. 9257, of 1996. This body should have an important role in the formulation of a development policy based on knowledge, for it has among its members, Ministers of States and business representatives and representatives of the scientific and technological community. In particular, it should be responsible for proposing initiatives focused on mobilizing the industry and the scientific competence installed in the country towards projects of national interest.

The sector funds need to be increased and its resources need to be fully used

The structure of sector funds, as conceived in Brazil, is unique in the whole world, and can be an important instrument for the scientific, technological and industrial development of the country. Yet, in order for that to happen, the contingency of resources from these funds cannot be allowed, which often occurs, in defiance of the law, since they were created. New funds should support the important

efforts in the area of education, including education in sciences and in innovative courses in the area of engineering. Transversal actions, bringing together several sector funds, and proposals from the National Council of Science and Technology, can have a decisive role in exploiting the opportunities associated to the global crisis mentioned previously.

A wide range of financing should be made available

This wide range should include networks of research, the support to individuals and small groups, long term programs for consolidated groups, programs for emerging groups and the institutional support to universities and research institutions. The system should provide stability and financing continuity to research.

It should be noted that great progress in science and technology are often works of researchers working individually or in small research groups. Therefore, funding agencies should give high priority towards a stable and adequate support of small groups and individual investigators, working on the frontier of science. The support for the spontaneous demands of CNPq should be substantially strengthened, for which it should rely on resources from sector funds. The scholarship programs for post graduation and research to which CAPES and CNPq contribute to, has had an essential role with regards to research and with regards to qualifying new talents. This should be increased and strengthened. In particular, one should observe that the values of post graduation scholarships need to be substantially revised.

International cooperation in Science and Technology should be a part of a State Strategy

The relationship with other countries should be substantially strengthened in conjunction with the Ministry of Foreign Affairs. On this global agenda, the relationship with countries under development, deserve special

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(yet not exclusive) attention, especially India, China, South Africa and the countries in South America and the Caribbean

3.2. QUALIFICATION OF PERSONNEL

An action plan needs to be put into effect urgently, coordinated between Federal Government, States and Municipalities, to revert the state of bankruptcy of elementary and high schools in Brazil

This action plan, that in order to be effective should involve a long term State project, shall:

- Value the elementary and high school professionals, with salary increases associated to recycling activities and continued education.

- Improvement of the alphabetizing methods with the recycling of the professionals involved.

- Turning public schools mandatorily into full-time schools, with sport activities and programs which stimulate social interaction, self-esteem and creativity of students, in addition to tutoring for students with learning difficulties.

- Increase the role of higher level public institutions with regards to qualifying and improving well qualified teachers for elementary and high school (allied to the valuing program of these professionals); involvement of these institutions in activities which re-enforce elementary and high school education, with scholarships for students who get involved in these activities.

- Re-enforcement of technological and professionalizing education, simultaneously to high school.

Higher education needs to be strengthened through the qualified expansion and diversification of the public sector

The diversification of the public sector, including two to three year courses, professionalizing schools and institutions

Value the elementary and high school professionals, with salary increases associated to recycling activities and continued education**.**

of general qualification, will broaden the spectrum of students served, along the lines of what is done in the United States of America (nearly half of the students in higher education are enrolled in Community Colleges) and in several countries of Europe. It is essential to the technological and industrial development of the country, to encourage technical education at a high school and higher education level.

The imperative need for enhancement of the quality of higher education requires that a consequent evaluation mechanism be established in public and private institutions, with a reflex on financing and accreditation: an evaluation agency independent from the evaluated institutions, should be created – a CAPES for the graduate courses. The distribution of resources for the development of the federal institutions should be based of external evaluations, and done by a National Council of a non endogenous nature.

It is important to grant autonomy to universities, to be authorized based on coverage and quality, with financing dependant on evaluation and attributing the responsibility of conducting the institution, to the teachers. In particular, the excessive legal framework which paralyzes higher education and reduces management autonomy in the universities should be simplified.

A long term scientific Alphabetizing program should be created for the Brazilian population

The importance of a program of this type is not only for its contribution towards the qualification of future scientists and technicians. It is an important part for the democratic participation of the population in debates about important political options which increasingly involve technical and scientific arguments, as is the case of the researches with stem cells, genetic engineering and sources of energy.

The GDP percentage invested in education should be increased, in order to achieve a level of a minimum of 5% by the end of the next presidential mandate, and a minimum of 6% by the end of the following one

Scientific alphabetizing is a key element for the democratic participation of the population in debates about important political options which increasingly involve technical and scientific arguments.

The diversification of the public sector, including two to three year courses, professionalizing schools and institutions of general qualification, will broaden the spectrum of students served, along the lines of what is done in the United States of America and in several countries of Europe

The previous considerations make it evident that it is necessary to invest more resources in education. The comparison of percentages dedicated to this area in several countries should consider that this investment is more important in countries under development who intend to decrease the distance which separate them from the developed countries. South Korea, for example, invested 7% of its GDP in education in 2001.

Differentiated mechanism to attract and fixate new groups and researchers need to be created, especially in the North, Northeast and Mid-west regions

Special support conditions to maintain the infrastructure of active researchers should be offered, so that they can continue their activities, through individual projects or to support emerging groups. It will also be important to incorporate components of S&T in the regional development agencies, such as SUDENE, SUDAM, and BNB, as well as establishing a strong link between the Federal Government and the states, aiming to improve and/or develop the state systems of S&T, supporting the preparation of studies for the definition of local development strategies and funding programs and joint projects under counterpart.

3.3. TECHNOLOGICAL AND INDUSTRIAL RESEARCH AND INTERACTION AMONG INDUSTRIES AND UNIVERSITIES

Mobilizing Projects which stimulate scientific and technological development should be established

This procedure, widely used in other countries (for example, the computer industry and the aviation industry were great

beneficiaries of this approach in the USA) use the purchasing power of the State to encourage the development of new industries with innovative profiles, encouraging the collaboration among them and research institutes and universities. Mobilizing Projects could be implemented in areas such as biogenetics, agriculture, aeronautics and space activities, fuel cells, high-speed optical communication (Terabits per second) and materials, for example. Specific projects for the Amazon region should be contemplated.

New research institutes should be created, linked to the ministry of Science and Technology, or to other ministries as a way of making use of local potentialities and contribute towards decreasing regional inequalities in the country.

The feasibility and the importance of these institutes can be illustrates with two key examples, both from Embrapa: the Research Center of Agriculture of the Cerrado, in Taguatinga – DF, that contributed in a decisive way to create the best technology in the world for the cultivation of soybeans, and enlarged the agricultural frontier of Brazil, and the Research Center of the Semi arid Tropics, in Petrolina – PE, that enabled the region to become an important center for irrigated horticulture. These examples inspire the creation of other institutes, for example, in the area of Forest Technology, in the Amazon, in Water Resources, Oceanography, Earth Sciences, or renewable Energy, in the Northeast

Research, Development and innovation in businesses need to be strengthened, through the diversification of instruments, the effective implementation of an industrial technological and foreign exchange policy and through the innovation law

Brazilian business, despite recent advances, still innovates very little. The Industrial Research of Technological Innovation (Pintec) from IBGE, shows that only 33% of the Brazilian industrial businesses introduced some type of innovation in the period of 2001 -

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2003. In addition, the number of businesses which internally perform activities of R&D and that establish cooperative relationships with other entities is limited. This low level of innovation restricts global competitiveness of the Brazilian businesses and hinders the growth of the country.

Extensive research conducted by Ipea shows however, that firms that innovate and differentiate products, although they only represent 1.7% of the industry, are responsible for 26% of the industry revenues. They are the companies that grow the most, export the most, hire the most, pay the best salaries and present the best working conditions. Moreover the country has proven to be competitive in agricultural goods and in the service sector with high added knowledge, with its world leadership in several fields being notorious, ranging from oil exploration in deep waters and the utilization of biomass to generate energy, to banking automation and electronic voting.

A new development path requires public policies that increase the number of innovative businesses, encourage the internal performance of R&D and the establishment of partnerships with research institutions, increase productive efficiency and broaden the international integration in the segments of greater technological content. More than a specific segment, what needs to be supported is a type of activity and of technology capable of raising competitiveness of the businesses in any sector.

These public policies should contemplate the promotion of activities which explore the differential advantages of Brazil, such as the sustainable utilization of Brazilian bio-diversity and the development of renewable energy sources. They should improve the instruments which promote the R&D in businesses and promote the use of qualified personnel. The close proximity between the institutions linked to science, technology and education, the National Council of Science and Technology and the National Council of Industrial Development represent a key step in the institutional improvement of the State.

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Public policies should contemplate the promotion of activities which explore the differential advantages of Brazil, such as the sustainable utilization of Brazilian bio-diversity and the development of renewable energy sources.