

MINISTRY  

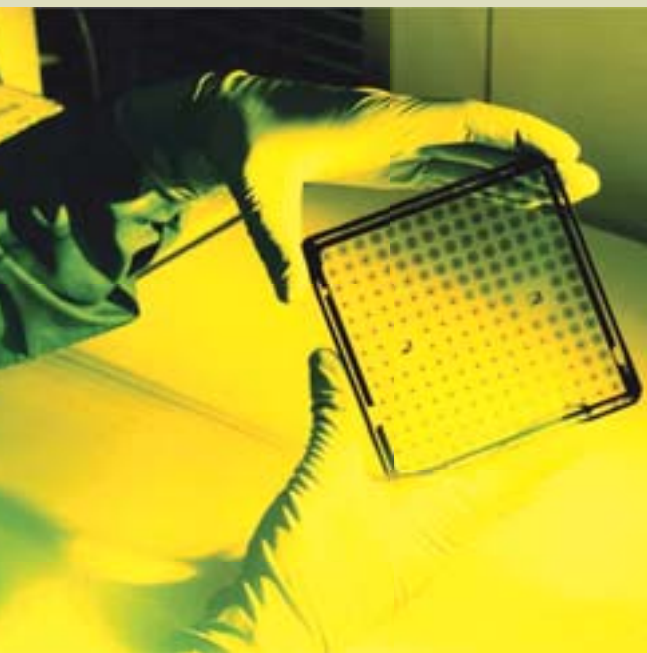
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OF SCIENCE AND  

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TECHNOLOGY  

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Science, Technology and Innovation  
for National Development

Action Plan 2007-2010

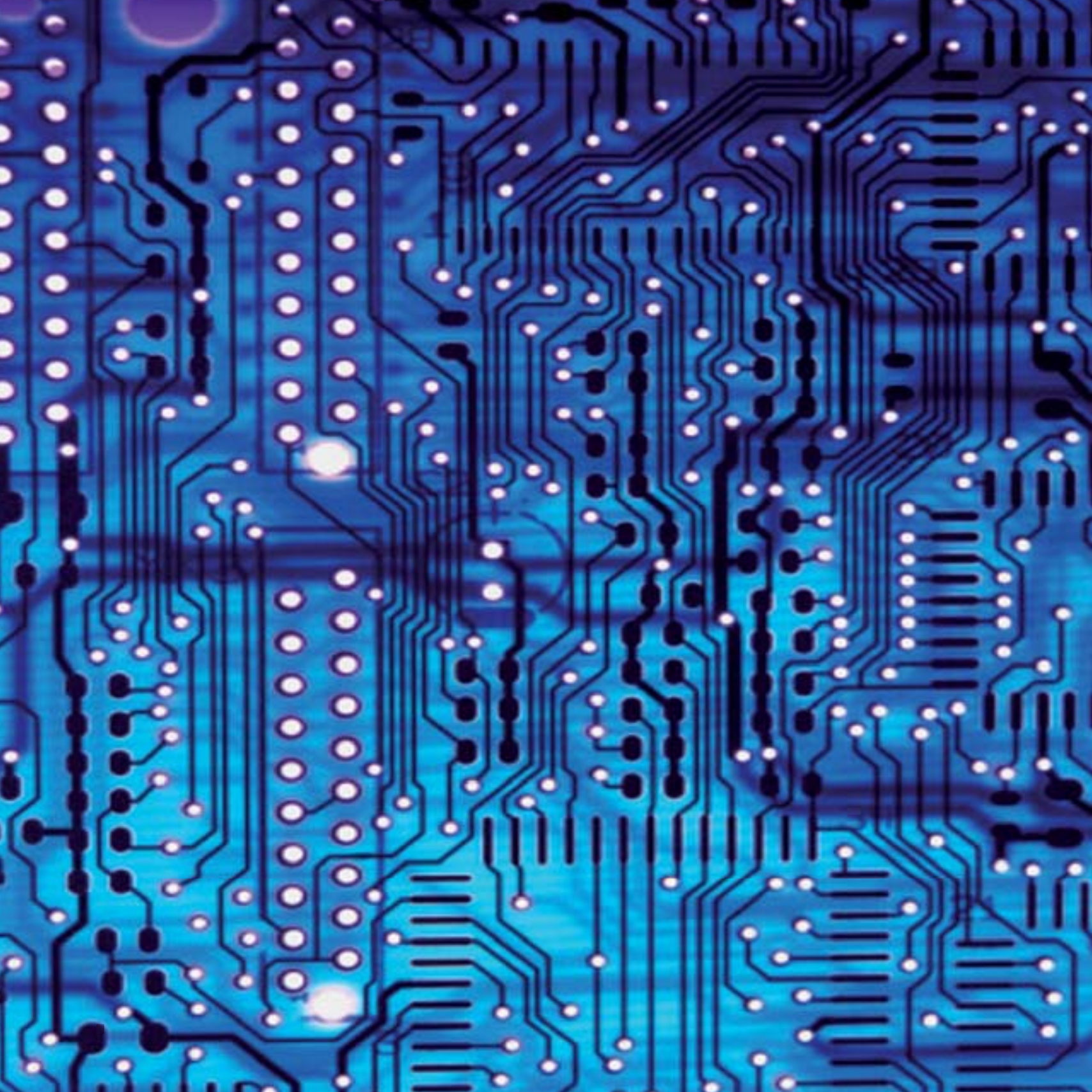
Summary Document



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# 1. Introduction

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The Action Plan for Science, Technology and Innovation (PACTI 2007-2010) that was launched in November, 2007 forms part of the set of plans developed for the second term of the government of President Luiz Inácio Lula da Silva.

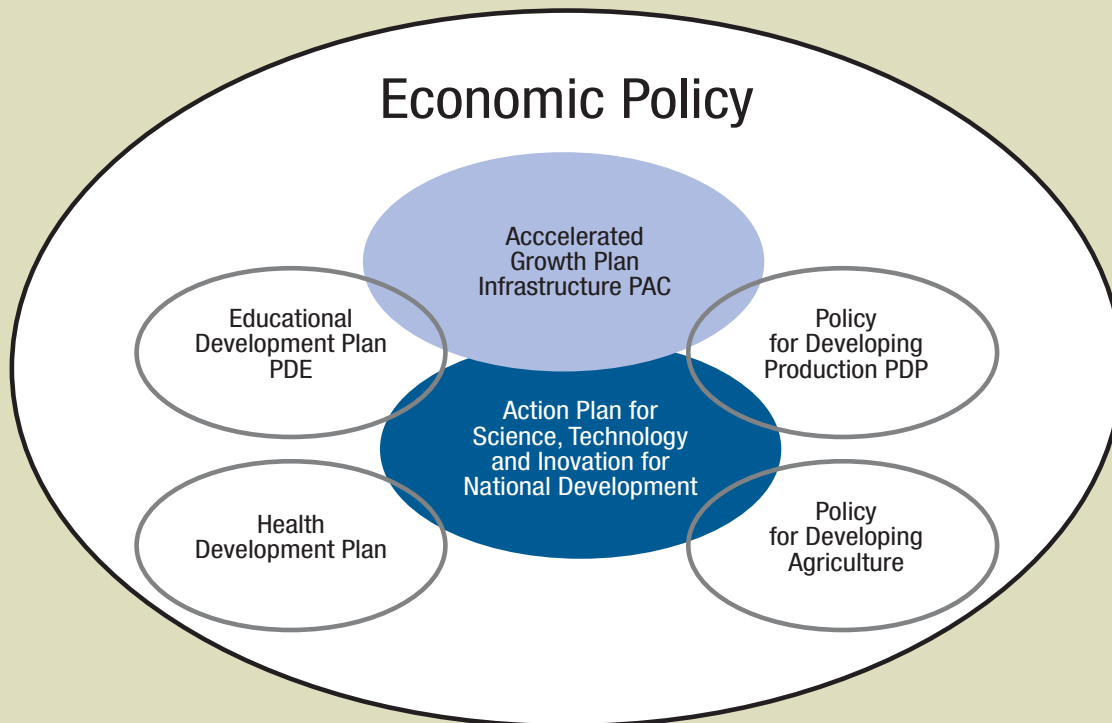
The first of these, presented in January, 2007, was the Accelerated Growth Programme (*Programa de Aceleração do Crescimento - PAC*). This aimed to implement a large number of projects and at the same time generate and encourage investment in the infrastructure of transport, energy, housing and health in order to give Brazil the opportunity to broaden and sustain rates of economic growth and social development in the medium and long terms.

PACTI 2007-2010 was planned as a major element in the initiatives comprising the Government Programme, mobilising and linking skills and actions across the spectrum of the Federal Government in cooperation with state and municipal governments. With the use of this instrument, it is hoped to provide greater control and coordination for actions needed to develop and strengthen science, technology and innovation in Brazil. It is connected to other action plans since all of them share the task of creating, including and using scientific and technological knowledge in order to be carried out.

The aim of these plans is to organise, structure and give visibility to the Federal Government's actions, the success of which depends on the contribution of other areas of public power, state and municipal governments, as well as sectors of civil society, especially the business sector.

The background to the viability of all the action plans is the success of the Federal Government's successful policy of economic stability by means of controlling inflation, a balanced budget and public debt, as well as creating significant international reserves and the economic growth arising from strengthening the domestic market. The integrated pattern of the various plans is illustrated graphically in Figure 1:

Figure 1: Integrated Pattern of the Action Plans





## 2. Integrated Plans

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In line with the Federal Government's decision to coordinate initiatives involving organs of all government areas, many ministries presented plans consolidating the actions to be implemented by 2010.

This is the case, of the Ministry of Education (MEC), which announced in April, 2007 its Educational Development Plan (*Plano de Desenvolvimento da Educação - PDE*), that involves a systemic approach to education. It focuses on involving the Union, Federal District, states and municipalities in carrying out programmes to maintain and develop education, without prejudicing the autonomy of each of those units of the Federation. Education is dealt with in its entirety, from infant school to postgraduate level, with Federal Government initiatives for each stage in the educational cycle.

One of the commitments of the Educational Development Plan is to give more value to teachers and improve and expand the training of these professional staff. This focus reinforces the links between the actions of MEC and the Ministry of Science

and Technology (*Ministério da Ciência e Tecnologia – MCT*), especially in terms of training qualified personnel for scientific and technological production.

Another initiative which has as its main premise the link between government bodies, is the Ministry of Health's "More Health: the Right of Everybody" Programme (*Programa Mais Saúde: Direito de Todos*). Launched at the end of 2007, this includes actions aimed at building a universal health system that concentrates on the citizen's quality of life. In the context of this integrated planning, the Ministry of Science and Technology and the Ministry of Health are partners in building research networks to respond to the needs of the SUS – *Sistema Único de Saúde* – the Brazilian public health system] and in creating national toxicology centres.

This set of plans links up with actions instituted by ministries in the area of the economy and infrastructure and all are monitored directly by the Executive Office of the President of the Republic.

The MCT has been taking an active part in formulating and carrying out the Productive Development Policy (*Política de Desenvolvimento Produtivo - PDP*), led by the Ministry of Development, Industry and Foreign Trade (*Ministério do Desenvolvimento, Indústria e Comércio Exterior - MDIC*), in those aspects concerning technological innovation in business. This represents a significant step in the direction of the necessary link between scientific and technological policy and other strategic sectoral policies such as those concerning industry, education, health, agriculture, energy, among others.

We must emphasise the strong connection between MCT and the Ministry of Agriculture, Stockbreeding and Supply, which is responsible for carrying out policies for developing agribusiness. This is a sector which depends increasingly on science, technology and innovation, which are vital in increasing the productivity and competitiveness required by the global market. As is well known, Brazil is very competent in this area, thanks above all to the system operated by the Brazilian Agricultural Research Corporation (*Empresa Brasileira de Pesquisa Agropecuária - Embrapa*), an internationally recognized centre of excellence in agricultural research. It is already operating outside Brazil by





means of virtual laboratories and business offices, as well as through technical aid programmes.

The Embrapa system has been responsible for developing technologies that have made the *cerrado* into one of the great global agricultural frontiers and is today responsible for almost half Brazil's production of grain, especially soya. This is possibly the most visible example, among many others, of Embrapa's work. The organisation is preparing to adopt a new institutional model that will allow it to be more flexible in the way it operates by operating with business partners in strategic and frontier areas, as is the case with bioenergy projects. PACTI 2007-2010 includes agribusiness among its strategic areas and plans to carry out actions in partnership with Embrapa to strengthen the National System of Agricultural Research (Sistema Nacional de Pesquisa Agropecuária), which includes the State Organisations for Agricultural Research (*Organizações Estaduais de Pesquisa Agropecuária - OEPAs*), and to support the setting up of Embrapa Agroenergy.

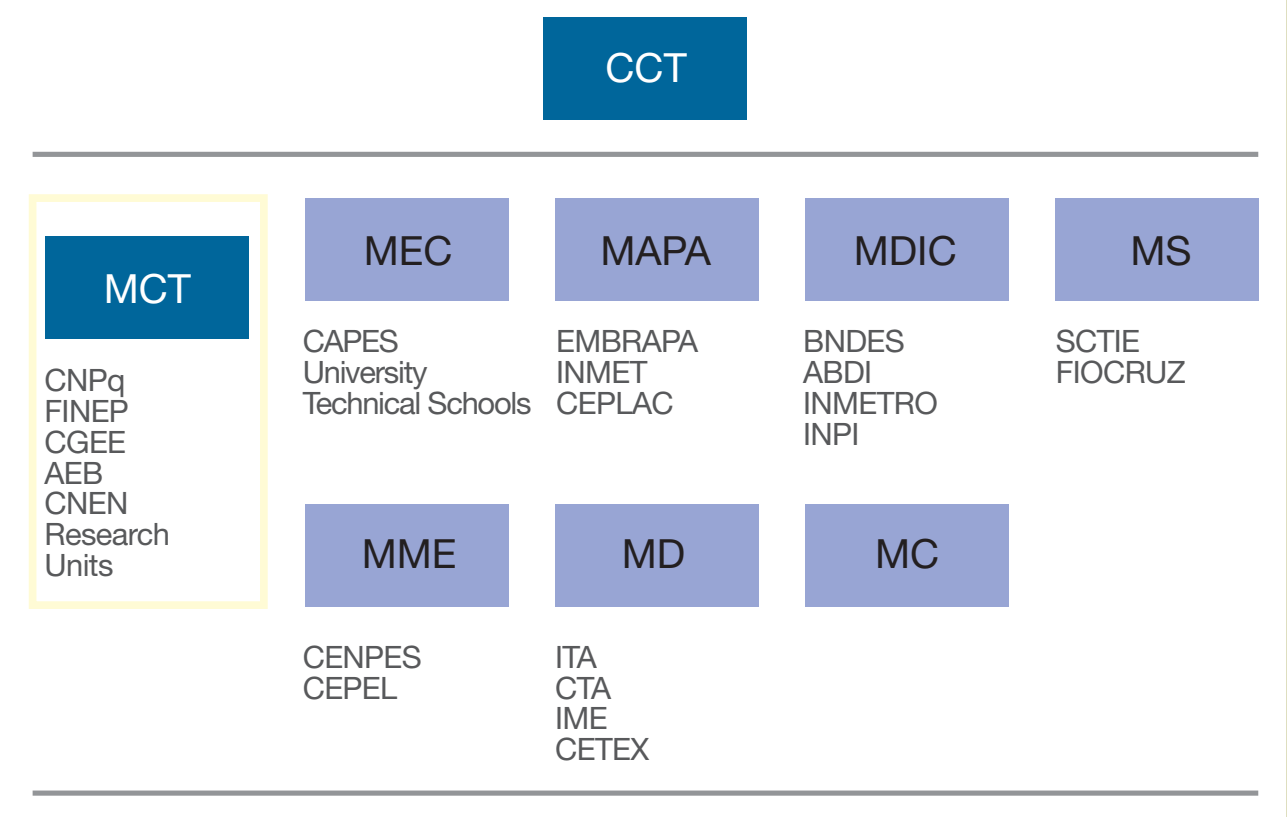
Together with the other plans, PACTI 2007-2010 is in complete harmony with the Federal Government's aims as set out in the

2008-2011 Long-term Plan (*Plano Plurianual – PPA 2008-2011*), which are:

1. promoting social inclusion and reducing inequalities;
2. promoting sustainable growth, job creation and income distribution;
3. providing the Brazilian population with access to education and knowledge at various levels and of different kinds, observing the requirements of equity and quality;
4. strengthening democracy and citizenship with a guarantee of human rights;
5. setting up an efficient and integrating infrastructure within Brazil;
6. reducing regional inequality based on local potential within the national territory;
7. strengthening the projection of national sovereignty on the international stage and South American integration;
8. raising the systemic competitiveness of the economy through technological innovation;
9. promoting a peaceful social environment and guaranteeing the safety of citizens;
10. providing quality access to social services and benefits within an environment of universal equity and guaranteeing its democratic and decentralised nature.

For their part, the main Federal bodies operating in the areas of science, technology and innovation also interact within a systemic network, as illustrated in Figure 2.

Figure 2: Main Federal Government Bodies Operating in the Areas of Science and Technology



### 3. The Principles of PACTI 2007-2010

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At the modern global level, science, technology and innovation are vital elements for development, economic growth, job and income creation and the democratisation of opportunity. The work of specialists, scientists, researchers and academics and the involvement of business are the decisive factors in consolidating a sustainable development model that can meet the reasonable social demands of the Brazilian people and permanently strengthen national sovereignty. This is a question of state which goes beyond government action.

In the last 30 years the global economy has gone through a period of intense technological activity and greatly increased competition. Technical progress and international competition mean that, without investment in science, technology and innovation (STI), it will be difficult for a country to reach the stage of virtuous development in which competitiveness does not depend on the predatory exploitation of natural or human resources. We must continue to invest in training high-level human resources and in accumulating intangible capital - the incorporation of knowledge into Brazilian society. It is therefore necessary to integrate STI policy with industrial policy so that companies may be encouraged to include innovation in their production processes, which is the only way of increasing their global competitiveness.

Well-known studies containing basic analyses of the role of science, technology and innovation in the development of various countries have led to the formulation of four principles for PACTI 2007-2010:



**Principle 1: There is a strong correlation between the level of a country's development and its strength in STI, which is shown in investment in research and development (R&D) and by the size of its research community.**

Indeed, there is a clear correlation between the wealth of countries and investment in research and development (R&D), as is shown in Figure 3, which presents investment in R&D as a percentage of GDP and per capita income for 35 selected countries.

The ability to carry out research, development and innovation depends

directly on the work of specialists, scientists and engineers. For this reason there is a strict correlation between the number of researchers and the wealth of nations, as is clearly shown in Figure 4, which only shows countries having more than 30 million inhabitants, which markedly reduces the variation in data.

Figure 3: Investment in R&D and wealth of selected countries

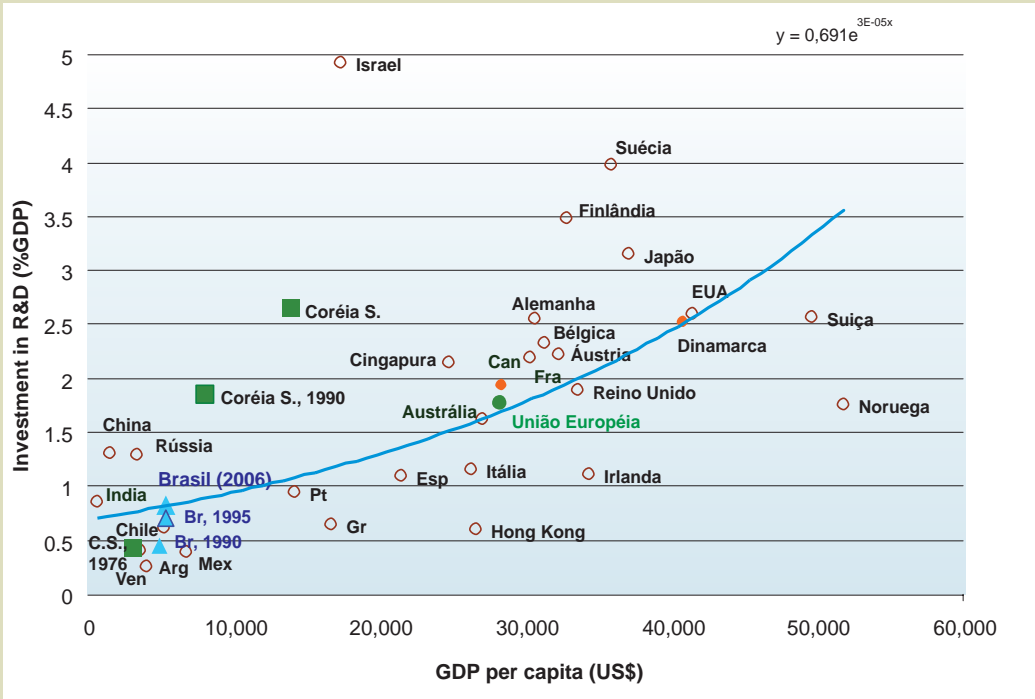
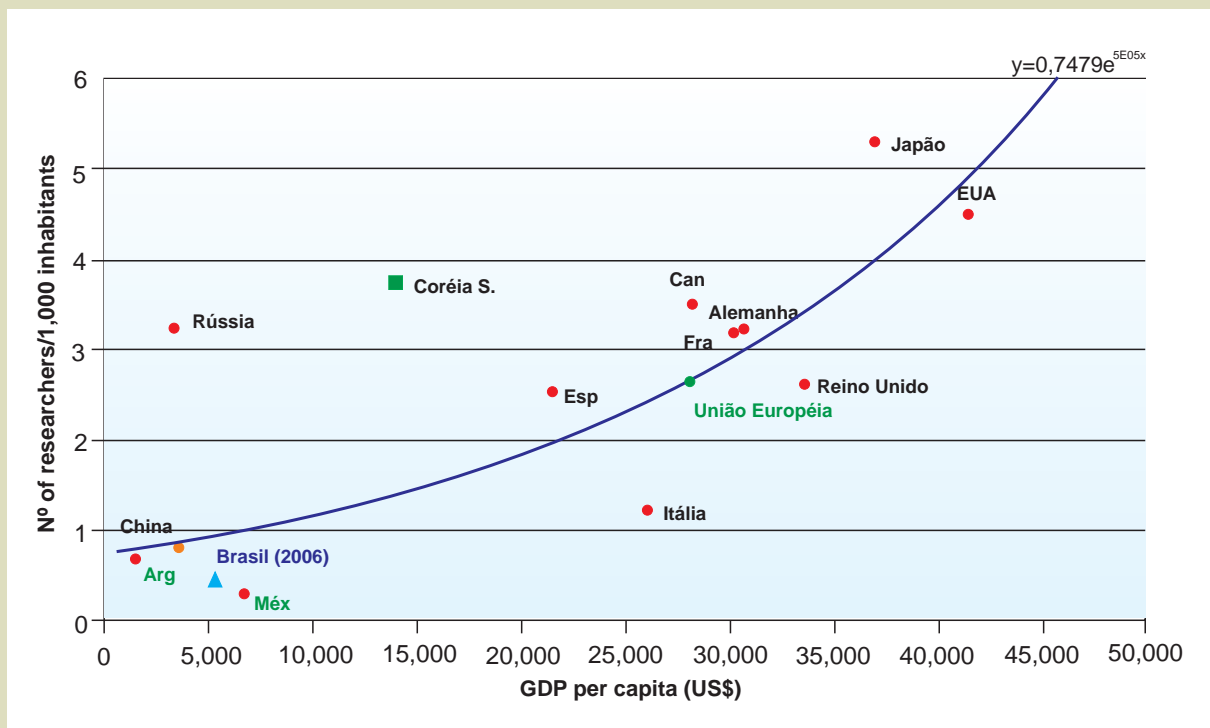




Figure 4: Number of researchers in relation to population and wealth of selected countries with more than 30 million inhabitants



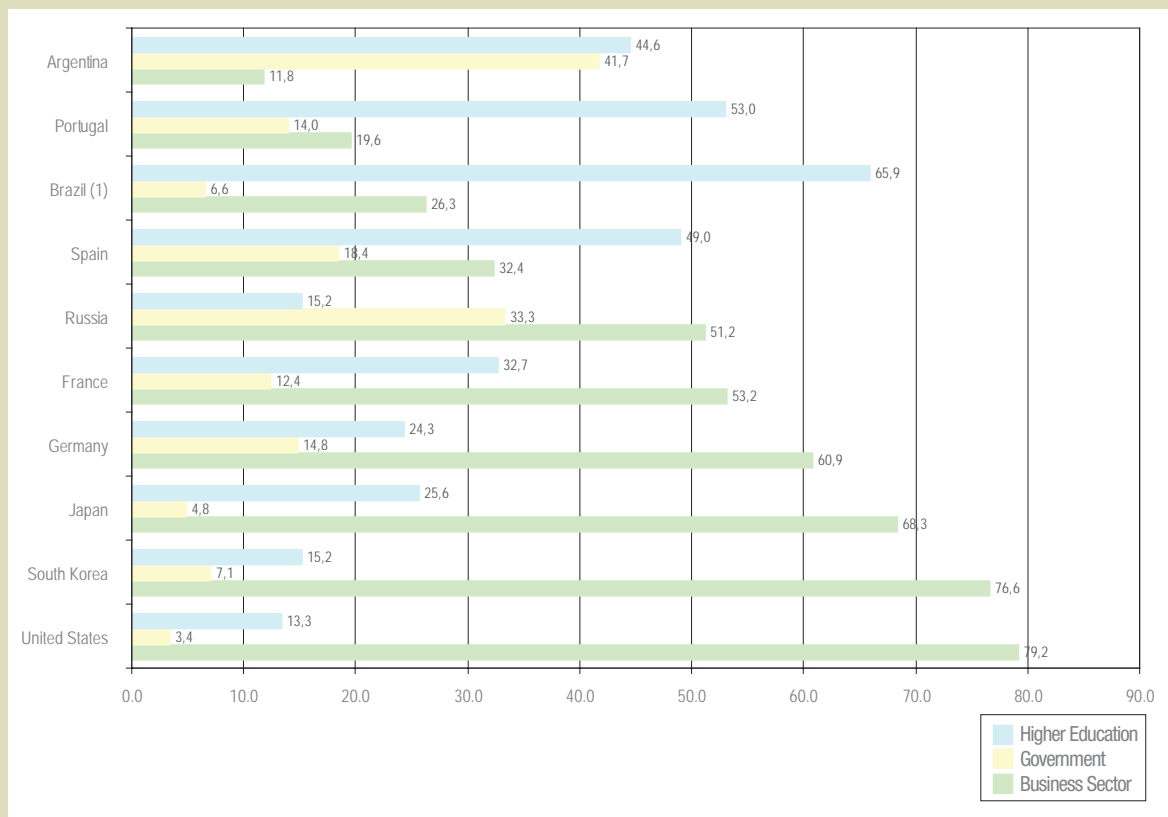
**Principle 2: Countries with developed economies have strong patterns of activity in research, development and innovation in self-financed businesses and in those financed by government.**

In Brazil, in contrast to what happens in developed economies, business invests only a small proportion of Gross Domestic Product (0.51% in 2005) in R&D activities - less than their counterparts in more advanced countries (Japan, 2.62%; USA, 1.84%;

Germany, 1.77%; France, 1.34%) but relatively more than countries like Portugal (0.35%), Mexico (0.25%) and Argentina (0.15%) . Thus, they employ comparatively fewer researchers, as may be seen in Figure 5.

<sup>1</sup>Source for Brazil: ASCAV/SEXEC/MCT: (<http://www.mct.gov.br/index.php/content/view/29144.html>) accessed 25/08/2008  
Source for other countries: Main Science and Technology Indicators – OECD, April, 2008.

Figure 5: Percentage distribution by sector of full-time equivalent researchers in research and development (R&D), 2005



Research on Technological Innovation (*Pesquisa de Inovação Tecnológica - PINTEC*) by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística - IBGE*) confirms these assertions as it shows that Brazilian manufacturing companies are relatively non-innovatory; they concentrate their efforts on process innovation; their innovation costs are mainly related to the purchasing of machinery and equipment and, to a lesser extent, to other innovative activities such as, for example R&D. Also, they do not, as happens in other countries, make more intensive use of public financing to carry out these activities. In Brazil, industrial firms that have developed innovative activities invested about 0.7% of their net income in R&D activities in 2005, far less than the amount invested in countries like Germany, France and Holland, where the proportion varies between 2.2% and 2.7%, but more than the figures relating for example to Argentina and Portugal, where rates were in the region of 0.3% to 0.4%.



Another indicator of this situation is the position in the world occupied by Brazil in terms of patent grants. In 2005, Brazil was in 13th position among countries applying for patents, behind the China in 3rd place, Korea in 4th and India in 11th, to name just some of the important emerging countries. In the same year, the number of patents requested in Brazil relative to the previous year fell by 13.8% while in China there was a growth of 32.9%, in Korea 14.8% and in India 1.3%. These three countries increased their requests for patents abroad at a rate of 27.9%, 27.3% and 23.6% respectively, in an attempt to protect their inventions, while Brazil only increased overseas patent requests by 4.0%. As for the total number of patents granted to residents and non-residents by the respective national organs for industrial property in 2005, data from the World Intellectual Property Organization (WIPO) show that in Brazil, 2,439 patents were granted, more than in India, which had 1,840 patents, but far fewer than the 53,300 patents in China and the 74,500 in Korea.

The low level of R&D investment by Brazilian companies is also reflected in the pattern of exports, as shown in Table 1. In 2005, high and medium-high technologically intensive sectors accounted for about 32% of the total added value in Brazilian industry. Although the relative amount of these products is lower than in more industrialised countries, there has been a year-on-year increase in this area of exports, as shown in Figure 6. We see that the average annual rate increased by 11.5%

between 1997 and 2007, resulting in a real increase in the trend of including technological content in Brazilian exports.

Table 1: Percentage of value of exports of industrial sectors according to technological level – 2005

	Brazil	Russia	China <sup>1</sup>	China	Mexico	Spain	EUA	Japan	Korea
Industrial Products	79.4	51.8	97.7	97.7	83.5	93.4	94.4	99.8	99.7
High and Medium-high technology	31.8	10.7	54.6	54.6	61.7	52.5	70.3	81.2	69.5
High technology	7.4	1.5	34.7	34.7	23.3	10.5	32.3	26.4	34.6
Medium-high technology	24.4	9.2	19.9	19.9	38.4	42.0	38.0	54.8	34.9
Medium-low technology	19.2	36.3	13.8	13.8	9.9	20.8	11.4	15.0	22.8
Low technology	28.4	4.8	29.3	29.3	11.9	20.1	12.7	3.6	7.4
Non-industrial Products	20.5	48.2	2.3	2.3	16.5	6.6	5.6	0.2	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

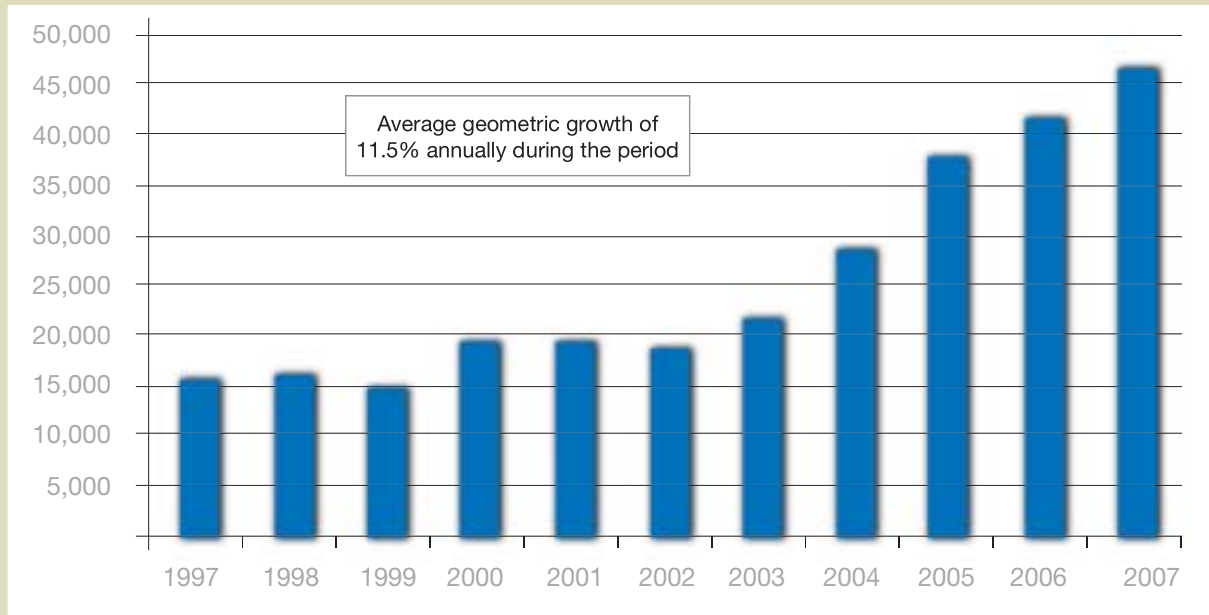
Source: OCDE; Secretariat for Overseas Trade (*Secretaria de Comércio Exterior - SECEX/MDIC*).

Note: (1) Data for China include exports to Hong Kong.

Graph Developed by: *Coordenação-Geral de Indicadores/ASCAV/SEXEC/MCT*.



Figure 6: Development of exports by Brazilian industries involved in high and medium-high technology between 1997 e 2007 (In US\$ millions FOB)



Source: Secretaria de Comércio Exterior - SECEX/MDIC

Graphic by: Coordenação-Geral de Indicadores/ASCAV/SEXEC/MCT

### Principle 3: Some countries have radically changed their pattern of economic development by linking industrial policies to STI policies.

The Republic of Korea (South Korea) is a classic example of how support for R&D activities and incentives for technology-intensive sectors can advance a country's economy. This is the case, for example, with the stimulus given by the Korean government to forming *chaebols*, groups of family-based companies, a policy that has produced large-scale exporters of products that are notable for their aggressive presence in the globalised market.

Korean industry is one of the most aggressive and competitive in the world market. Among the reasons for its success are the support given to R&D activities and the encouragement of technology-intensive sectors of industry. Korean industry absorbs almost 90% of the scientists available in the labour market and 11,000 companies - more than 10% of the total - have their own research and development centres. This figure is even more surprising when we

realise that until 1979 there were not even 50 such companies. However, the strong state presence in generating these activities is reflected today in the performance of the economy of Korea, the GDP of which increased on average by 6% between 1980 and 2005, while Brazilian GDP remained at an average of 2.5% during the same period. In the World Cup economic Forum's index of world competitiveness for 2006/2007, Korea was 21st out of 125 countries, leaving Brazil in a modest 66th place.

**Principle 4: Brazil is in an “intermediate” position in the world in terms of productive and academic capacity, but has the “critical mass” necessary to gradually draw closer to the technological levels of developed economies.**

In fact, in historical terms Brazil has built remarkably quickly a complex and diversified industrial structure which is an important basis for its future development. Equally, over the last 40 years it has developed a complex system of science and technology which contains today 85,000 high-level scientists and engineers who are carrying out scientific and technological research of international importance. However, at the same time as knowledge has increased in teaching and research centres, the ability of business to produce technological innovation has not progressed at the same pace. There has not been sufficient technological development to satisfy either internal requirements or those related to the country's overseas competitiveness.

Today Brazil is a country that is emerging on the international scene, both in science and production, it is still a long way behind developed countries, but ahead of countries with a corresponding level of development. Total national development in R&D is still low (1.02% of GDP) when compared to the investments of industrialised countries, as is shown in Table 2.

Indicators of recent development show that the national academic base has been growing significantly. Between 1981 and 2006, there was an increase of 8.9% per year in the numbers of scientific articles published in international journals, while the annual increase at a global level was 2.0%, as shown in Figure 7. The accumulated increase in Brazil was approximately 232%, while the figure for the rest of the world during the same period was only 73%.

Table 2: Investments in R&D relative to GDP for selected countries in 2006

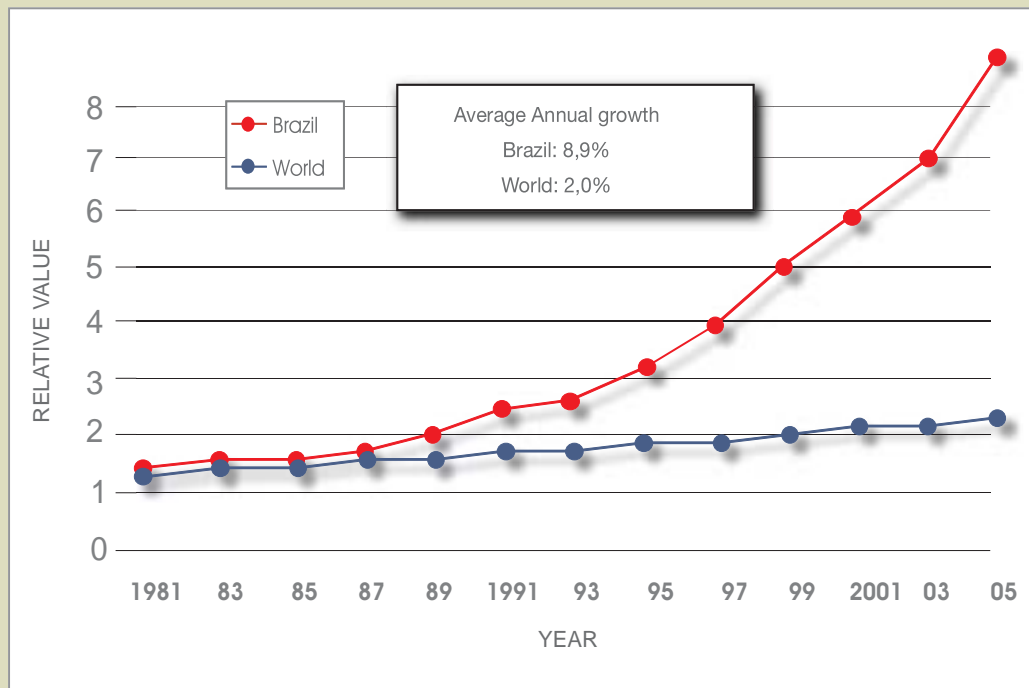
Sweden	3.73	Italy <sup>1</sup>	1.09
Finland	3.45	Russia	1.08
Japan	3.39	Brazil	1.02
South Korea	3.23	Hungary	1.00
United States	2.62	South Africa <sup>1</sup>	0.92
Taiwan	2.58	India <sup>5</sup>	0.85
Germany	2.53	Portugal	0.83
Singapore	2.31	Turkey	0.76
France	2.11	Malaysia <sup>4</sup>	0.69
Canada	1.94	Chile <sup>2</sup>	0.68
UK	1.78	Poland	0.56
Netherlands	1.67	Mexico <sup>1</sup>	0.50
China	1.42	Argentina	0.49
Spain	1.20	Ecuador <sup>3</sup>	0.07

Source: Main Science and Technology Indicators - MSTI 2008/1. OCDE; World Development Indicators - WDI - 2007. World Bank (India and Malaysia); Rede Iberoamericana de Indicadores de C&T - RICYT (Chile and Equador); and *Sistema Integrado de Administração Financeira do Governo Federal - Siafi e Pesquisa Industrial de Inovação Tecnológica - Pintec/IBGE (Brasil)*.

Notes: (1) 2005; (2) 2004; (3) 2003; (4) 2002; and (5) 2000.

Table prepared by: ASCAV/SEEXEC/MCT.

Figure 7: Increase in the number of scientific publications in Brazil and in the world, compared to 1981

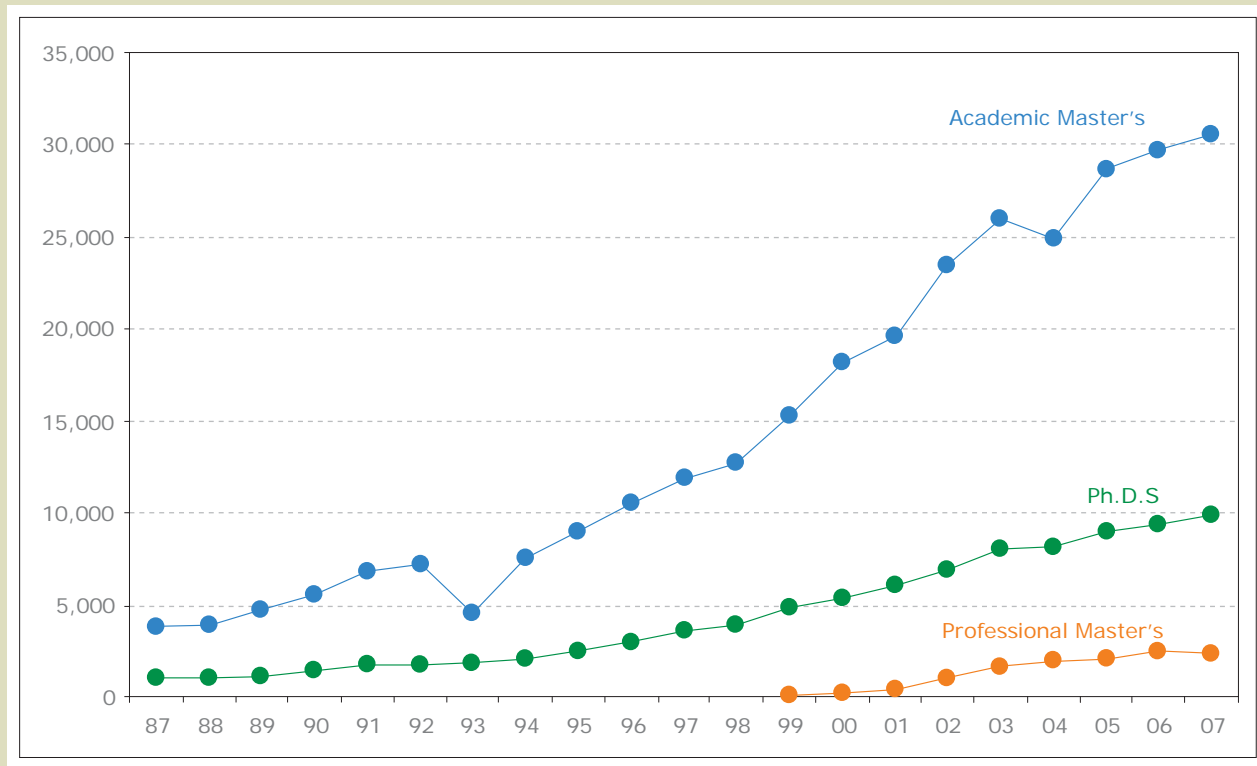


Source: ISI

At the same time, there has been very rapid growth in the supply of qualified human resources. During the last ten years, for example, the number of Brazilians receiving master's and doctoral degrees has grown at a rate of about 12% per year. In 2007, doctoral degrees were granted to 10,000 people, as shown in Figure 8, and the aim is to have reached the figure of 16,000 doctoral degrees by 2010.



Figure 8: Master's and doctoral degrees granted annually in Brazil



Source: <http://ged.capes.gov.br/AgDw/Silverstream/pages/frPesquisaColeta.html>.  
Graph by: ASCAV/SEXEC/MCT.

By pointing out Brazil's disadvantageous position when compared to more advanced countries in four aspects connected to its scientific and technological development, these principles are the basis for and justify the existence of the components of the Plan related to these sectors.



## 4. Aims, Strategic Priorities and Targets of PACTI

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The Action Plan is based on the fundamental principle that, as with investments in tangible goods, those concerning intangible investments such as research and development (R&D), training, education and acquisition of technologies, are also of vital importance for social and economic development.

Its main aim is to create conditions for Brazilian businesses to significantly speed up the creation and adoption of technological innovation so that they can add value to their production and increase competitiveness. To this end, it focuses on increasing interaction between those working in the system, aiming both to broaden the national scientific base in terms of consolidating excellence in various areas of knowledge, as well as increasing the technological capacity of Brazilian firms to create, acquire and turn knowledge into innovations leading to increased value added to their products and their entry into domestic and international markets.

### 4.1. Main General Aims

- Improving the institutions, management and control of STI policies;
- expanding and consolidating Brazil's capacity for scientific and technological research, substantially increasing financial support for science and technology in general, and the training and placing of human resources, giving priority to engineering and areas related to the Productive Development Policy (*Política de Desenvolvimento Produtivo - PDP*);
- broadening support for innovation and technological development in companies, speeding up the development of advanced technologies and those operating in sectors developing future trends, technological extension and training programmes, with an emphasis on micro, small and medium-sized businesses;
- reinforcing R&D activities and innovation in areas strategically linked to Brazil's growth and development, with emphasis on Information and Communication Technologies, Health



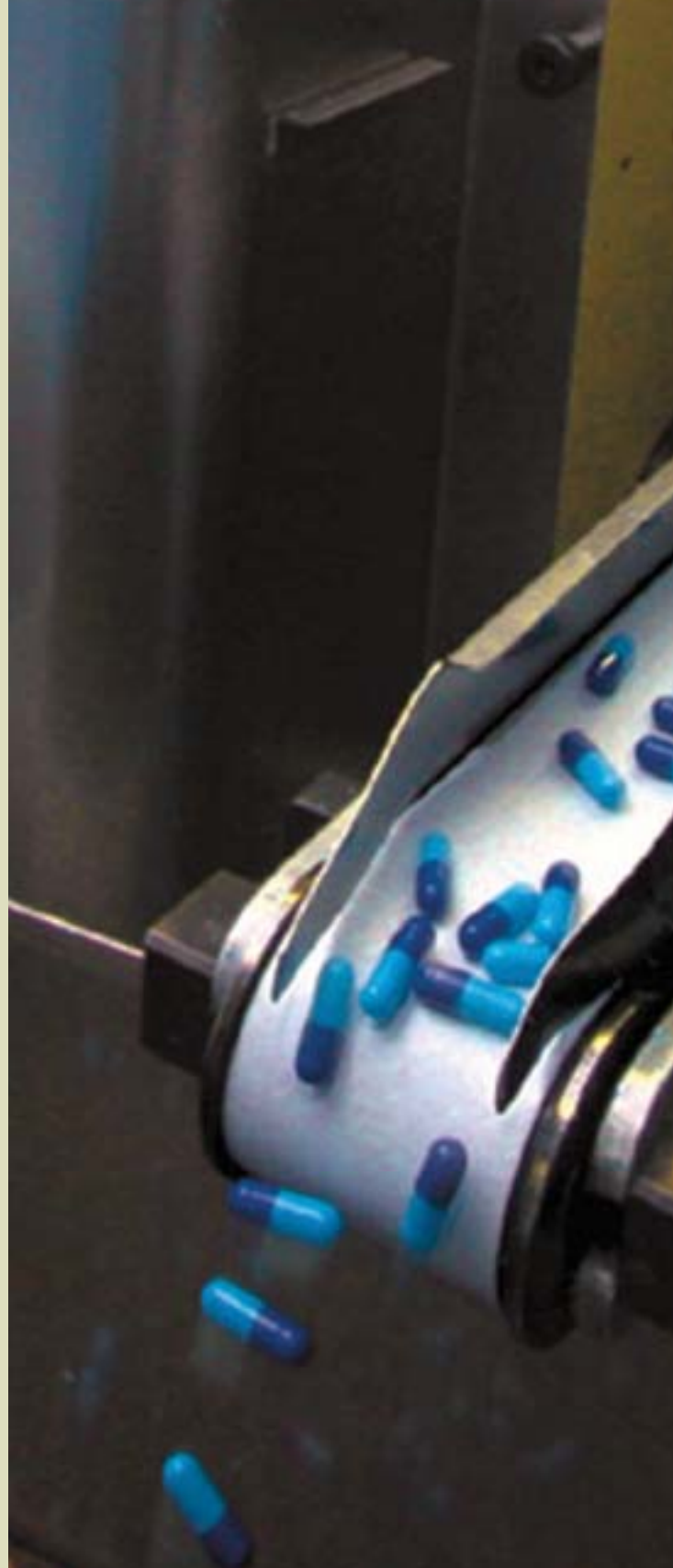
Products, Biofuels, Agribusiness and the Nuclear Programme;

- contributing to regional and social development and equality, especially in the Mid-Western, North-eastern and Northern regions, and
- popularising science and promoting the creation, spread and use of knowledge to improve the living conditions of the population.

## 4.2. Strategic Priorities

Characteristic elements of the Action Plan in STI are:

- the integrated participation of various ministries and federal bodies, coordinating their activities with individual states;
- the expansion and guarantee of increased resources from the National Fund for Scientific and Technological Development (*Fundo Nacional de Desenvolvimento Científico e Tecnológico - FNDCT*)/Sectoral Funds and improving its management model;
- improving legal and regulatory systems such as the Law on Information Technology and Innovation and the *Lei do Bem*, [“the Good Law” - it introduced tax incentives for companies carrying out research and incorporating technological innovation];
- broadening the scope of mechanisms and instruments to support innovation in businesses;
- the centralisation of actions and initiatives specific to regional and social development.





PACTI prioritises the consolidation of the National System of STI and increased innovation in business. It consists of four priorities covering 21 lines of action producing 87 programmes (with more than 200 sub-programmes to assist in its management).

This section presents a summary of the lines of action.

**Priority I. Expansion and Consolidation of the National STI System: expanding, integrating, modernising and consolidating the National System of Science, Technology and Innovation.**

Line of Action 1: Institutional Consolidation of the National STI System
Aim
To finish building the legal and regulatory systems of the National System of STI by passing and implementing the Law of Regulation of the FNDCT; to set up and consolidate forums to integrate the policies and initiatives of those working in STI, with an emphasis on revitalising and animating the National Council of Science and Technology (Conselho Nacional de C&T - CCT) in its role as a senior advisory body to the Federal Government, and on structuring the system linked to the business sector; also
improving management and financial support instruments, creating stronger partnerships with states and municipalities by broadening joint actions aimed at improving their STI systems and promoting the integration of the latter with the National System, and revitalising and consolidating international cooperation, with emphasis on areas considered to be strategic in terms of national development.

In recent years, Brazil has been putting together a complex legal and institutional framework to consolidate and expand its national scientific base, to encourage and promote expansion of activities in Research, Development and Innovation (RDI) in business and paying greater heed to the requirements of the current stage of development of the National System of Science, Technology and Innovation (*Sistema Nacional de Ciência, Tecnologia e Inovação - SNCTI*). A systemic advance has been noted as a result of adopting a consistent policy in STI.

The Sectoral Funds have become increasingly important in financing RDI activities. The ability of the National Fund for Scientific and Technological Development (*Fundo Nacional de Desenvolvimento Científico e Tecnológico - FNDCT*) to finance projects has been recovered. The historic peak of resources in the 1970s has been surpassed, its 2006 investments reaching a record sum. The management model of the Sectoral Funds has also been improved so that resources of several Funds with common interests - the so-called transverse demands - may now be used.

We must recognize the need for improving the legal situation and safety in applying these instruments and for making an even greater effort to consolidate and improve STI policy with the participation of the whole of the Federal Government and the active involvement of society in general, and of the productive sector in particular. This effort will be directed towards:

- raising the level of coordination and synergy between programmes, institutions and policy instruments;
- advancing the process of improving the legal situation of the policy;
- making possible the efficient use of all the innovatory mechanisms created by the Innovation Law and the Lei do Bem and improving the instruments contained within the Information Technology Law;
- encouraging and strengthening cooperation and coordination between Federal, State, municipal and regional institutions with a view to increasing the policy's efficacy and bringing the whole of the country into the process of developing STI;
- improving the management of the Sectoral Funds and strategic or priority projects, which FNDCT regulation will do much to achieve;
- improving the management of Ministry of Science and Technology's agencies aimed at encouraging related activities – FINEP (Studies and Projects Financing Agency) and CNPq (National Research Council) - in order to increase the efficiency, efficacy and speed of its operations.



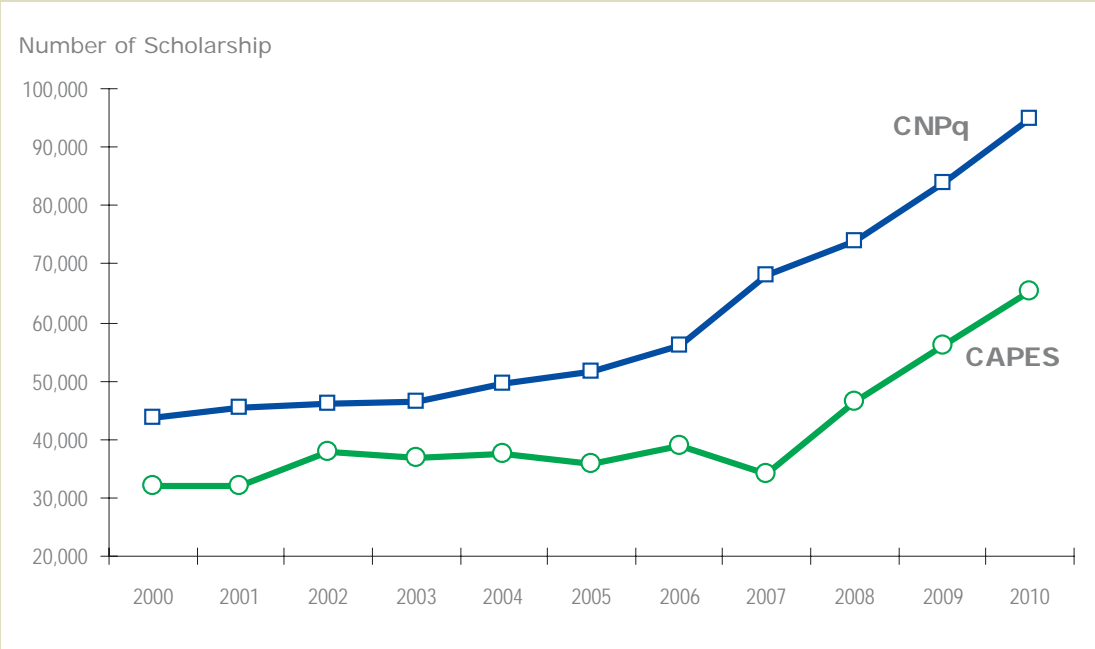
Line of Action 2: Training Qualification and Placing of Human Resources for STI
Aim
Increasing the number of scholarships for training, research and extension courses granted by CNPq, with an emphasis on engineering and priority areas for the Policy for Productive Development (Política de Desenvolvimento Produtivo - PDP) and in sectors of strategic importance for national development;
helping to employ research staff - engineers and PhDs - in companies as a means of encouraging the birth of structures for business RDI, and
encouraging the expansion and qualification of a group of professionals involved in research, development and innovation activities in Science and Technology Institutions (STIs), following directives giving preference to efforts aimed at overcoming regional inequalities.

The Federal Government will continue its policy of consolidating and broadening support for scientific and technological training in Brazil. Its aim is to balance and link support for teaching and research institutions with technological and innovative training in the business sector. These efforts aimed at increasing companies' ability to innovate will not be carried out in such a way as to compromise existing infrastructure and research support actions. On the contrary, they will be implemented based on the understanding that strengthening teaching and research institutions and their interaction with other elements is essential to create, acquire and spread knowledge within the country, especially in terms of the frontiers of knowledge.

The increase in scientific production and consolidation and opening up of new lines of research and new postgraduate courses, as well as exploring new and diversified sources of advanced training in Brazil and in its best academic centres, will be vital paths for strengthening STI. The training of qualified human resources was and will continue to be one of the main elements sustaining STI policy. In the last four years there has been a marked increase in the number of scholarships granted by CNPq and Capes in all disciplines, as shown in Figure 9. Complementary

initiatives have been undertaken in conjunction with the Ministry of Education to broaden the base of the labour market for those with master's and doctoral degrees. Among these, it is important to mention the increase in the federal university system by the creation of new campuses in the interior of the country and new federal universities as well as the implementation of that part of the Lei do Bem that creates mechanisms for encouraging companies to employ research staff.

Figure 9: Total Number of scholarships per year granted by CNPq and Capes, in Brazil and abroad (1998-2006 and targets for 2007-2010)



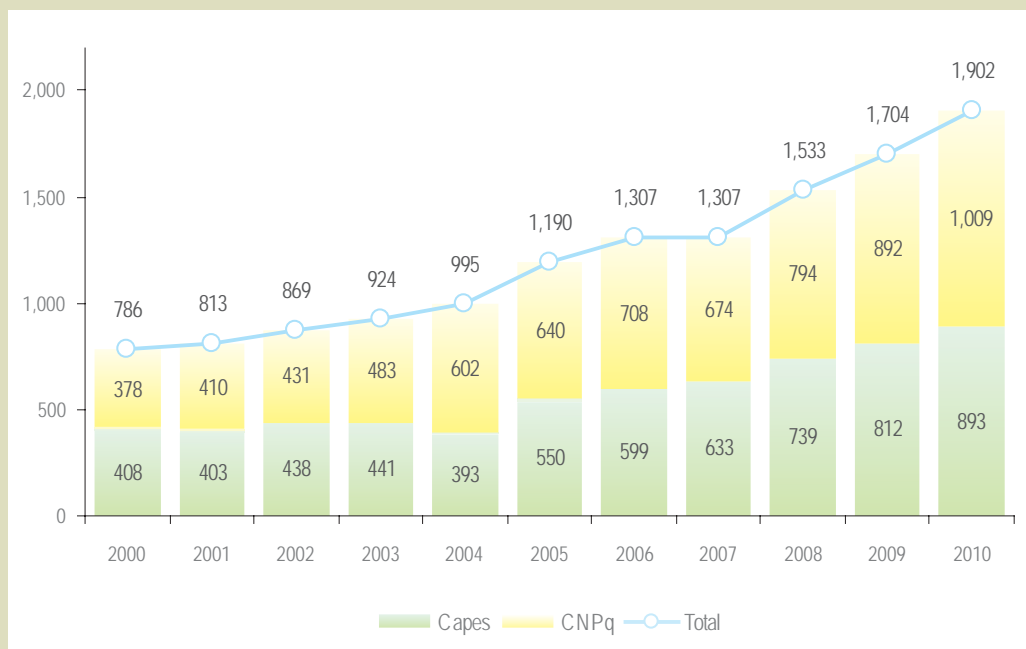
Source: National Council for Scientific and technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq*) and The Coordinating Body for Further Training of High-level Personnel (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Capes*)  
Graph developed by: ASCAV/SEXEC/MCT.

The aim is to broaden and improve the possibilities for people to gain master's and doctoral degrees. To this end, there is a growing and stimulating participation of state foundations in hosting research. In 2007, Brazil achieved the historic landmark of granting about 10,000 doctorates. However, this number is still insufficient for the country's developmental needs. Proportionally, it

is a smaller than figures for more developed countries and has shortfalls in certain scientific and technological areas. For this reason efforts are being intensified to train more people at the master's and doctoral levels, especially in order to increase numbers of those trained to meet the country's needs, with a particular emphasis on strategic sectors such as engineering and areas developing future trends.

The targets of qualifying 16,000 people at Ph.D. level and 45,000 with master's degrees by 2010, laid down in the National Postgraduate Plan 2005-2010 (*Plano Nacional de Pós-Graduação 2005-2010 - PNPG*), will be achieved by means of resources dedicated to increasing the number of scholarships and other forms of postgraduate assistance, estimates of which are shown in Figure 10. These efforts will be made along with seeking a substantial rise in patterns of quality and efficiency in university-level training of R&D and innovation staff specialising in business needs.

Figure 10: Total resources in scholarships per year granted by CNPq and Capes, in Brazil and abroad (1998-2006 and targets for 2007-2010) in R\$ millions at current levels



Source: Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Capes  
Graph prepared by: ASCAV/SEXEC/MCT.

### **Line of Action 3: Infrastructure and Encouragement of Scientific and Technological Research**

#### **Aim**

Consolidating the infrastructure of scientific and technological research in Brazil by means of encouraging individual and group projects, including networks formed by universities, research centres and technological institutes;

improving mechanisms and instruments to encourage STI development by broadening the range of resources for current programmes and creating new programmes aimed at satisfying the growing demand for research and development in different areas of knowledge;

expanding the National Network for Teaching and Research (Rede Nacional de Ensino e Pesquisa - RNP), to create a high-speed link between bodies belonging to the National System of Education, Science, Technology and Innovation; consolidating the research units of the Ministry of Science and Technology in terms of national laboratories or nuclei coordinating topic-related networks in strategic areas for Brazil's independent development, encouraging the association of these bodies with state or the municipal institutions in order to develop RDI activities.

One of the most important aims of PACTI is the improvement and consolidation of Ministry of Science and Technology incentive schemes through programmes and instruments operated by CNPq and FINEP. These should form a co-ordinated and integrated set of programmes and means of support to guarantee conditions for expanding and improving quality in the national system of Science, Technology and Innovation, as well as improving their geographical distribution within the country. Improving incentive programmes demands a variety of initiatives and actions that must be widely discussed within the scientific community.

The main aims to be followed are those of scientific and technological excellence at international level, vigorous integration of the Science and Technology system with the business system, the improvement of science education, and a more balanced participation of the various regions of Brazil in the effort to produce a knowledge base.

The organisation of the National System for Science and Technology, the subject of reflection and discussion while the National Plan for Science, Technology and Innovation was being drawn up, should be based on: sets of research groups in all areas of knowledge spread throughout Brazil; institutions made up of groups with greater experience and scientific competence, mainly in public federal and state universities, and non-university scientific and/or technological research institutions linked to the Federal Government or to state governments, as well as private institutions. This science and technology system is mainly financed by federal and state public funds; these funds coming mainly from CNPq, FINEP, CAPES, Petrobras, BNDES, the Ministry of Health and state research foundations, among others.

In addition, a special effort will be made in the area of the qualification, strengthening and modernisation of scientific and research units in the Ministry of Science and Technology with a view to raising the level of their contribution to the aims of national policy in STI. Special attention will also be given to the strengthening and qualification of technological research institutes that exist in other ministries, in individual states and those in private hands. These bodies must be effectively integrated into the policy in a coordinated and complementary fashion, giving full value to their role as relevant sources of technological training and of providing services to business and society. The setting up of networks for research and technical assistants linked to the aims of policy and the needs of sectors, regions and types of business or users, will be stimulated.

The process of implementing the National Network for Teaching and Research (*Rede Nacional de Ensino e Pesquisa – RNP*) will be continued and broadened, connecting all public universities and research centres, together with federal technical and agricultural schools, by means of a nationwide high-capacity fibre optic network, thus internalising access to its decentralised units in order to support distance education (the Brazilian Open University – UAB, *Universidade Aberta Brasileira*) and advanced research applications (e-science). This initiative will be carried out in partnership with state governments and other government bodies involved in projects linked to the information highway.

## **Priority II. Promoting technological innovation in business.**

Increasing actions to encourage the creation of a favourable environment for innovation in business and for the strengthening of the Productive Development Policy (Política de Desenvolvimento Produtivo - PDP); encouraging the adoption of a research and innovation culture in private firms, public service and society in general, as well as the wide dissemination of information and evaluations concerning the results of public policies and social progress within companies.

### **The Legal Position**

The Innovation Law (Law N° 10,973, dated 02/12/2004) established several mechanisms to promote innovation in Brazil. It created the conditions for setting up strategic and cooperative partnerships between universities, public research institutes and businesses aimed at increasing Research, Development and Innovation (RDI) activities and generating innovation. It also allowed the Federal Government to have minority participation in capitalising private companies with the specific aim of them developing innovations. It also allowed the financial resources to be granted in the form of economic subsidy, financing or shareholding in order to develop innovative products and processes, as well as making it possible to develop technological responses to solving problems concerning objectives of public interest.

The *Lei do Bem* (Law N° 11,196, dated 21/11/2005) provided a set of fiscal incentives to promote RDI activities in businesses. The main fiscal incentives are significant reductions in Income Tax and Social Security Contributions based on Net Profits in relation to investments made in RDI activities by companies operating within the system of assessment of actual profit. The law also authorises Science and Technology incentive agencies to subsidise the salary costs of research staff with master's or doctoral degrees employed in technological innovation activities in companies based within Brazil.

The Information Technology Law (Law N° 8,248, dated 23/10/1991, modified by Law N° 11,077, dated 30/12/2004) is another important instrument for industrial and technological policy within the context of digital connection. It is the result of large-scale negotiations concerning the provision of tax and fiscal measures which extends the scope of the 2009 incentives to 2019,



also to the Industrial Zone of Manaus. The concession of the incentives set out in the law establishes the requirement of reciprocal contribution in R&D investment on the part of Information and Communication Technology companies (*Tecnologias da Informação e Comunicação - TICs*), encouraging partnerships between the business sector and teaching and research institutions in carrying out R&D projects in promoting the use of knowledge created in those centres, including the Northern, Midwest and Northeastern regions.

More recently, Law N° 11,484 dated 31/05/2007, concerns incentives for industries producing digital TV equipment and electronic semiconductor components, and also protection for intellectual property in integrated circuit topography, creating the Support Programme for Technological Development in the Semiconductor Industry (*Programa de Apoio ao Desenvolvimento Tecnológico da Indústria de Semicondutores - PADIS*) and the Support Programme for Technological Development in the Digital TV Equipment Industry (*Programa de Apoio ao Desenvolvimento Tecnológico da Indústria de Equipamentos para a TV Digital - PATVD*). The aim of these programmes is to encourage the setting up of companies with corresponding investment in R&D in Brazil, as well as carrying out activities in development and production. PADIS is aimed at companies working on the conception, development, design and production of electronic semiconductor equipment and of displays. PATVD is concerned with companies



working on the development and production of equipment transmitting signals by radio frequencies for digital television.

Outside the management framework of the Ministry of Science and Technology, other organs are bringing innovation into their agendas. The National Bank for Economic and Social development (*Banco Nacional de Desenvolvimento Econômico e Social - BNDES*) has opened the lines of credit for R&D and innovation; the National Institute for Metrology, Normalisation and Industrial Quality (*Instituto Nacional de Metrologia, Normalização e Qualidade Industrial - Inmetro*) has received a significant amount of investment for laboratories and increased staff in order to deal with the new demands coming from society. The strengthened National Institute for Intellectual Property (*Instituto Nacional de Propriedade Industrial - INPI*) will be able to respond quickly and efficiently to the requirements of protecting intellectual property in Brazil.

Line of Action 4: Support for Technological Innovation in Business
Aim
To contribute to the construction of the favourable environment for motivating activities related to the process of innovation in the business sector by increasing the presence of researchers in the productive sector, encouraging co-operation between companies and Science and Technology Institutions, spreading a culture of absorbing technical and scientific knowledge and training human resources for innovation and supporting the implementation of Centres for Research, Development and Innovation in Business with a view to expanding employment, income and the value added at various stages of production.

Putting this Line of Action into practice will provide a foundation for the following institutional and financial instruments which will be made available to companies:

- **Financing with reduced real interest**  
Greatly increased resources aimed at supporting innovation in business, managed by FINEP (Sectoral Funds, FAT (Worker Support Fund), etc.), and in partnerships with public financial bodies (*Banco do Brasil, Caixa Econômica Federal, Banco do Nordeste, Banco da Amazônia*), as well as using the Constitutional Funds dedicated to regional

development) and private bodies; increasing and consolidating the participation of the BNDES in financing R&D and innovation in business, as well as in the capitalisation of technology-based businesses.

- **Tax incentives**

Increased use of tax incentives to promote R&D and innovation by means of consolidating the use of opportunities created by the new legal situation in the area of science and technology.

- **Economic subsidies**

The mechanism for providing economic subsidies was instituted by law in 2004 and has since been improved by successive legal instruments. Funds destined for economic subsidies are applied to the costs of technological research and development activities of innovative products and processes in Brazilian companies, and are aimed at meeting the aims and priorities of the Industrial, Technological, and Foreign Trade Policies. More recently, the law has been modified and has increased the scope of economic subsidies, now also subsidising the salary costs of research staff with master's or doctoral degrees employed in technological innovation activities in companies based in Brazil. For legal entities with headquarters in the former Sudene (*Superintendência do Desenvolvimento do Nordeste*) and Sudam (*Superintendência do Desenvolvimento da Amazônia*) areas, the value of the subsidy is as much as 60%, and 40% in other regions.

The focus of the instruments and programmes for supporting innovation resulting from linking STI policy with industrial policy will encourage firms to strengthen their R&D centres and increase the amount of external R&D they hire in. Taken together, these factors constitute a safe form of support to enable Brazil to achieve its target of applying 0.65% of GDP to business investments in 2010. Thus, total investments in R&D by the public sector and private industry should reach 1.5% of GDP in 2010.

The ever-increasing demand on the part of the business sector for qualified personnel and the expansion of nationally-based higher education have caused a significant increase in the number of scholarships granted by CNPq and CAPES to the level of 79%, rising from 95,000 in 2006 to 170,000 in 2010, with a greater emphasis on engineering and in the areas of knowledge

relevant to the PDP. It is intended that the greater supply of human resources, combined with the incentives of the Innovation Law and of the Lei do Bem will increase R&D activity in companies and the absorption of those with master's and doctoral degrees, and will cause the proportion of research staff in companies to grow from the present 26.3% to 33.5% of the 120,000 research staff it is estimated will be working in Brazil by 2010.

Line of Action 5: Technology for Innovation in Business
Aim
To structure the Brazilian Technology System ( <i>Sistema Brasileiro de Tecnologia - SIBRATEC</i> ) which is made up of a group of bodies working to promote innovation and the execution of technological services for businesses and which are spread throughout the country, organised in networks set up according to their major activities and fields of operation.
The initiative of the network of technological institutions, designed to establish the policy for productive development (PDP), aims to support the development of businesses by offering technological services, namely those focusing on Basic Industrial Technology ( <i>Tecnologia Industrial Básica (TIB)</i> ), working in the areas of RDI, extension, assistance and technology transfer to increase business competitiveness, giving support to small and medium-sized companies, strengthening Local Productivity Arrangements ( <i>Arranjos Produtivos Locais - APLs</i> ), this support is for activities Brazil considers to be strategic to its interests.
This line of action has been formulated using an intelligent combination of available instruments and mechanisms, its organisation and its implementation based upon the strong links between and integration of several already existing initiatives involving support networks for business development which may be led by different government bodies and the private sector.

The technological development of industrial companies and services will benefit from a new arrangement: the Brazilian Technology System (*Sistema Brasileiro de Tecnologia - SIBRATEC*), which has been organised and given official status by the Ministry of Science and Technology to implement R&D and innovation activities, the provision of technological services, technological extension services, assistance and technology transfer. Made up of technological research institutes and federal, state and private university bodies that are competent to work with industry, SIBRATEC

will be organised in networks according to sector, theme and strategies of three kinds: (i) innovation centres whose focus is on turning knowledge into commercially viable prototypes, whether to support the emergence of new, technologically-based companies or to enable the development of new products or innovations to help existing companies grow; (ii) technological service institutions to provide services such as the measurement, testing and evaluation of product conformity, and (iii) technological extension focused on stimulating and satisfying the demand for specialised assistance in the innovation process.

Activities in the fields of technological cooperation and extension can contribute significantly to raising the technological capacity of businesses, especially at the micro and small levels, which together can make a direct contribution in forming an important part of the systemic productivity and competitiveness of the national economy. In the same way, increased use by business of basic tools to ensure quality such as the metrology, normalisation and evaluation of product conformity is vital to increasing their competitiveness and entry into new markets.

The technological institution networks will support the development and provision of services and specialist consultancies aimed at improving and increasing the efficiency of the productive process, improvement of quality and innovation of products in economic sectors, production chains and local production arrangements. Special attention will be given to intellectual property and technology transfer so that added technological value will result in an increased number of Brazilian patents.

This mobilisation of businesses and technological institutions aimed at forming problem-solving networks and technological training in business, in all parts of the country, will definitely encourage the establishment of an environment propitious to innovation in companies, especially small ones.

## Line of Action 6: Incentive for the Creation and Consolidation of Technology-intensive Businesses

### Aim

To increase and guarantee resources to support business incubator bodies, technology parks and the RDI activities of companies located in them to help increase their turnover and exports, in order to create and consolidate innovating companies that can manage themselves, especially in terms of the creation and diffusion of innovation;

- stimulating the creation and broadening of instruments using venture capital, increasing number and scope of investment funds and making use of the buying power of the State to stimulate Brazilian technology companies so that they may contribute to technical and innovative development and the increased presence of these companies in internal and external markets.

Among the economic and financial instruments providing specific help for new technology-intensive companies, the following stand out:

- **Economic subsidies**

Although explicitly linked to the programmes of Line of Action 4, this may also be used to facilitate the programmes of Line 6. It aims to promote a significant increase in innovative activities and greater competitiveness of firms in the national economy. It can also provide resources for the latest programme aimed at new companies: the First Innovative Company Programme (*Programa Primeira Empresa Inovadora - PRIME*).

- **Venture Capital**

Arising from a significant increase in sources of special capital funds (private equity, venture capital, seed capital and business angels) dedicated to innovation through the work of FINEP and of the BNDES (by means of the CRIATEC line especially meant for emerging innovating businesses), as well as from using investment bank funds, pension funds and national and overseas insurers, which will increase their presence after the recent privatisation of reinsurance companies.



- **Public sector buying power**

This instrument will be used to promote the technological development of Brazilian businesses both through the direct purchase of innovative products and processes (as allowed by the Innovation Law), and by establishing partnerships for accessing technology through government acquisition overseas of significant amounts of products or services. Some areas are preferential, for example the pharmaceutical products industry, because of the considerable quantity of public purchase of these products in the home market and their importance for public health, and also the fact that this sector has been included in the PDP priority areas.

Non-financial mechanisms can be encouraged, such as those supporting the creation and consolidation of technology-intensive business incubators, technology parks, RDI centres in businesses and RDI programmes in selected sectors by means of public-private partnerships. At the same time, institutional and financial instruments to develop sectoral and local innovation systems will be activated to support the internationalisation strategies of Brazilian companies and incentives for mergers or cooperation on the part of technology-based businesses.



### **Priority III. RDI in strategic areas: reinforcing research and innovation activities Brazil's strategic areas.**

Opportunities for scientific and technological development are unequally distributed between the areas of knowledge and sectors of activity. Advanced technology sectors, firmly based in scientific knowledge, are usually fertile areas generating opportunities to innovate, grow quickly, create high-quality jobs and have a positive effect on other sectors of the economy, so they are essential for economic growth and development.

The control of strategic technologies in the period covered by the Plan represents in many cases an equally ambitious target. Several programmes have been planned with the main focus on these challenges and two may be used to illustrate present priorities: the ethylic route for transesterification in biodiesel production and enzymatic hydrolysis in ethanol production.

The strategic areas selected as lines of action for this PACTI priority are:

- Areas of future importance: Biotechnology and Nanotechnology
- Information and Communication Technologies
- Health Supplies
- Biofuels
- Electrical Power, Hydrogen and Renewable Energy Sources
- Oil, Gas and Coal
- Agribusiness
- Biodiversity and Natural Resources
- The Amazon and the Semi-arid Region
- The Weather and Climate Change
- The Space Programme
- National Defence and Public Safety.

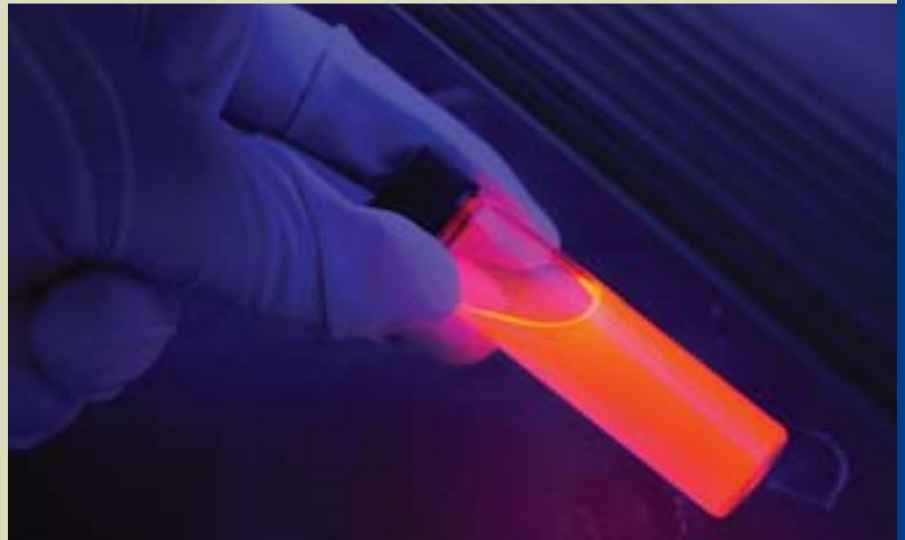
In this plan, special attention is paid to certain technology-intensive areas. These are areas that have sectoral crossover, are multi-disciplinary in the technical and scientific fields and are potentially very innovative and energising in economic terms and which, together with their significant import for the balance of payments, justify their selection.

In areas that are most sensitive in terms of national sovereignty and security, RDI is also vitally important for the country's development. For this reason the development and broadening of scientific and technological knowledge in these areas are necessary conditions for Brazil to control specific and potential interests, a key means for ensuring the nation's sovereignty and development.

Within this group, sensitive areas in terms of international relations are also considered,

given the geopolitical dimension of questions such as mastery of the technology for launching rockets and satellites and enriching uranium, as well as national control of the biodiversity of the Amazon and of the long-term preservation and use of water stocks and their aquifers. Brazil has huge stocks of natural resources and is host to the greatest biodiversity on the planet, as well as the greatest stock of freshwater and expanse of forest in the world, not to mention a vast sea area for its exclusive use. Efficient administration of the potential and the use of these natural resources give Brazil definite advantages if it develops a virtuous cycle of development bringing together economic growth, reduction of poverty and protection of the quality of the environment.

The sustainable development of Brazil and its regions will have to be accompanied by a clear policy of supporting technological



training in regional businesses and the growth of its technological base. The Plan involves strengthening initiatives to explore closer links between the capacity of the technical-scientific base and the needs of the productive sector. Sustainable development in the Amazon in particular depends on the ability to give economic value to the rainforest and this depends basically on developing technologies capable of using, and at the same time preserving, the huge potential of its biodiversity. This is one of the reasons why biotechnology has been emphasised as one of the strategic sectors of the Plan.

To deal with the strategic areas described above, and taking into account the initial considerations, the lines of action are now described that will meet the aims of each of these areas.

Line of Action 7: Areas of future importance - Biotechnology and Nanotechnology
Aim
To strengthen the management and planning of government activities in the areas of biotechnology, nanosciences and nanotechnology in order to better identify the great challenges and opportunities facing Brazil;
establishing priorities and creating conditions in institutional, material and human resources terms for increasing the stimulus for innovation by speeding up the process of knowledge transfer to create products and processes using biotechnology and nanotechnology;
helping to increase competitiveness in Brazilian businesses as set out in the Productive Development Policy ( <i>Política de Desenvolvimento Produtivo – PDP</i> ) by incorporating biotechnology and nanotechnology in developing new products and processes.

## Line of Action 8: Information and Communication Technologies

### Aim

To promote and support training and qualification of human resources in information and communication technologies (*Tecnologias da Informação e Comunicação - TICs*), encouraging RDI and production activities by cooperation between Science and Technology Institutions and businesses, and actions to install and enlarge manufacturing and service businesses in Brazil. The programmes will include the following areas and segments:

*i.* the electronic and semiconductor industry;

*ii.* software and services;

*iii.* digital technologies for communication, media and networks, including digital TV, wireless communication, broadband networks and telecommunications in general, characterised by the convergence of communication technologies and services, and information processing.

Among the main actions to be carried out are the reinforcing and enlarging of the CI-Brasil Project, a network of integrated-circuit design houses, the implementation of CEITEC, encouraging the development of new technologies in semiconductors and other materials for electronics, supporting the implementation of the Centre for Research and Development in Digital Technologies for Information and Communication, and the improvement of the Information Technology Law's management instruments and other legal elements, and the creation of programmes to increase the competitiveness of Brazilian information and communication technologies companies.

## Line of Action 9: Health Supplies

### Aim

To stimulate the development of products and processes in strategic areas for the Ministry of Health in order to increase the activities of Brazilian industry, creating greater competition, more participation in international trade, speeding up economic growth and creating more jobs.

To encourage:

the modernisation of the industrial base by defining regulatory standards, lines of credit and stimulation compatible with the incorporation and development of production processes and the creation of adequate fiscal and tax incentives to suit the situation of the health supplies industry;

creating innovation systems, strengthening the infrastructure needed for developing technological platforms and service chains linked to developing products production processes;

training human resources for RDI business management in the health supplies sector, encouraging the training of entrepreneurs in the sector.







### Line of Action 10: Biofuels

#### Aim

Encouraging the Research and Development of renewable energy sources and clean and efficient energy technologies, with an emphasis on biodiesel and ethanol, by working through the Brazilian Network for Biodiesel Technology (*Rede Brasileira de Tecnologia de Biodiesel – RBTB*) and setting up a centre for bioethanol technologies of international standard to increase production, the development and use of new technological directions, and of co-products and technologies for the sustainable production of energy.

## Line of Action 11: Electrical Power, Hydrogen and Renewable Energy Sources

### Aim

To encourage integrated and cooperative actions to develop science, technology and innovation in the areas of electrical energy, hydrogen and renewable energies by implementing and expanding the RDI infrastructure with a view to developing new technologies for the generating, transmission, distribution and final use of electrical energy; the consolidation of the CTI programme for the hydrogen economy in order to enable Brazil to achieve its commercial use as a fuel during the next 20 years, and also the implementation of the CTI programme for renewable energies focusing on resources with the greatest potential for Brazil (hydroelectric, biomass, biogas, wind and solar), taking in those areas not covered by the biodiesel and ethanol programmes.





## Line of Action 12: Oil, Gas and Coal

### Aim

To support and promote:

integrated and cooperative actions to develop science, technology and innovation in the areas of oil, natural gas and coal, by implementing, expanding and modernising the RDI infrastructure;

support for technological research and development activities in the exploration for, production and transport of oil and natural gas, as well as oil-refining activities;

implementing actions related to sustainable development in the areas of oil and natural gas, and

developing an RDI programme for the production and clean use of coal.

### Line of Action 13: Agribusiness

#### Aim

To increase the scientific and technological knowledge base necessary for innovation, as well as maintaining and developing the competitive capacity of Brazilian agribusiness, bearing in mind its technical and economic dimensions and emphasising those dimensions related to dietary and nutritional safety.

To give attention to the new frontiers opened by food technology such as quality foods, nutraceuticals and functional foods;

developing methodologies, equipment and systems to increase automation in agriculture with an emphasis on small-scale businesses;

supporting RDI for innovative production systems;

increasing international links for the progress of RDI related to agribusiness; and

giving new emphasis to the State Organisations for Agricultural Research (*Organizações Estaduais de Pesquisa Agropecuárias - OEPAS*) in order to strengthen the National System for Agricultural Research.



Foto: Gazeta Santa Cruz



#### **Line of Action 14: Biodiversity and Natural Resources**

##### **Aim**

To create and improve the mechanisms and instruments for protecting biodiversity at national level and the knowledge it produces; developing and refining products, processes and services aimed at adding value to everything produced from Brazil's biodiversity and at developing efficacious management practices leading to the production of goods and services that will maintain and give value to environmentally friendly processes;

developing RDI to extend and efficiently manage the knowledge base concerning Brazilian biodiversity for the exploration for, use and management of maritime, mineral and freshwater resources by means of building themed research networks that will receive significant amounts of investment, and consolidating the research programme in the Antarctica.





## Line of Action 15: The Amazon and the Semi-arid Region

### Aim

To enlarge and consolidate the RDI system in the Amazon and Semi-arid regions in order to provide the institutions already there with the proper conditions to respond suitably to present and future challenges. Taking into account regional cultures while promoting the sustainable use of natural resources with consequent harmonious socio-economic and cultural development, by means of:

enlarging and modernising research infrastructure;

training and placing qualified personnel and supporting interaction between businesses;

extending research networks and their structure in theme-related institutions;

implementing the RDI Management Forum, and

promoting and creating the Advisory Centre for Political and Socio-economic Sciences for Amazonia.

For the Semi-arid region programme, the strategy is:

promoting sustainable development in the region by making the scientific and technological contribution necessary for modifying present and future patterns of organising production and quality of life, encouraging programmes for the training and placing of human resources;

the diffusion of technologies and development and the consolidation of theme-related research networks, also using new networks and consolidating the local RDI infrastructure (RNP, INSA, CETENE, RENORBIO and the new university centres in the region).



## Line of Action 16: The Weather and Climate Change

### Aim

To reinforce Brazil's activities in the face of global climate change. Encouraging studies and research about climate change with a view to disseminating scientific and technological information and helping construct public policies for reducing greenhouse effect gas emissions. Extending and integrating Brazil's capacity in terms of weather forecasting, climate and air quality, paying special attention to the areas of agriculture, water resources, energy, transport, civil defence, health, tourism and leisure. In this context, implementing and consolidating a programme to monitor and forecast the weather with the help of the state research network in this field; implementing the Brazilian Research Network for Global Climate Change (*Rede Brasileira de Pesquisas sobre Mudanças Climáticas Globais - REDE-CLIMA*), to carry out studies and research on the causes and effects of global climate change in order to spread knowledge that will enable Brazil to respond to the challenges of these changes, mainly in those aspects linked to national development; promoting the development of technologies leading to lower antropoc liquid emissions (movement emission reduction) of greenhouse effect gases.



## Line of Action 17: Space Programme

### Aim

To enable the country to develop and use space technologies for the benefit Brazilian society, including questions associated with monitoring the environment and global climate change, surveillance of national territory and the study of natural resources, air traffic control and government publications. Establishing the space infrastructure consisting of a launch centre, launch vehicles and satellites as a fundamental action for achieving the nation's long-term strategic vision.





## Line of Action 18: The Nuclear Programme

### Aim

To implement the actions included in the proposal for the new Brazilian Nuclear Programme (Programa Nuclear Brasileiro - PNB), the institutional reinforcements to the National Committee for Nuclear Energy (*Comissão Nacional de Energia Nuclear - CNEN*) and:

completing the first phase of the INB Uranium Enrichment Plant in Resende (state of Rio de Janeiro) and installation of the UF6 pilot production (gas conversion) plant in Aramar;

promoting increased production of ore and re-initiating uranium prospecting in Brazil;

supporting the recovery of NUCLEP, enabling it to make components for new nuclear power stations;

carrying out a national policy for waste treatment by creating the Brazilian Company for Managing Radioactive Waste (*Empresa Brasileira de Gerência de Rejeitos Radioativos*), to construct permanent deposits for medium- and low-level radioactive waste and providing initial deposits for used combustion elements; carrying out a national policy for waste treatment by creating the Brazilian Company for Managing Radioactive Waste (*Empresa Brasileira de Gerência de Rejeitos Radioativos*), to construct permanent deposits for medium- and low-level radioactive waste and providing initial deposits for used combustion elements;

creating and implementing the Brazilian Radiopharmaceuticals Company and planning a multipurpose research reactor;

developing the means and instruments to reinitiate activities in the area of research, development and innovation, as well as creating and developing the necessary ability to carry out the activities required by the PNB.

## Line of Action 19: National Defence and Public Safety

### Aim

To encourage the research and development of technologies focused on the priorities of the National Defence Policy and concerning public safety by supporting research infrastructure in scientific and technological institutions (STIs) in these areas; the qualification of human resources, and innovation in national businesses.

Support will also be given to partnerships between STIs and public bodies towards formulating, implementing and evaluating policies for public safety and fighting crime.



## **Priority IV. Science and Technology for social development: promoting the popularisation and improvement of science teaching in schools as well as broadening the spread of technologies for inclusion and social development.**

The creation of a wide base in society suitable for creating and using scientific and technological knowledge is essential for the success of the Plan's objectives as a whole and in particular, the target of using Science and Technology to improve the quality of life of the Brazilian people. It is necessary to spread and consolidate within Brazilian society a culture of respect for science, technology and innovation by mobilising individuals, businesses and institutions.

It is also necessary to mention the concern with raising interest in science on the part of children and young people, the future scientists and innovating businessmen and women (the target for increasing participation in the Brazilian State Schools Mathematics Olympics is 40%, while it is aimed to increase the number of municipalities holding events in the National Science and Technology Week by 90%), and with increasing access to information and qualification to take advantage of opportunities for generating income (telecentres, Vocational Technological Centres (*Centros Vocacionais Tecnológicos* - CVTs) and technology extension programmes).

In terms of resources, the change in emphasis of the present government has accompanied increased funding for establishing a new legal and regulatory system, giving special priority to the least-favoured regions in Brazil.

Part of the effort to advance the construction of stronger regional technical and scientific bases involves an element of inter-regional technical and scientific cooperation in research and in training human resources. Exchanges between regional institutions need to be increased, with support given to cooperative projects involving groups from those regions and mechanisms provided to encourage those with doctoral degrees to be placed in the Northern, Northeast and Midwest regions.

Special attention will be given to formal education, to improving teacher training, to providing equipment and using information and communication technologies in teaching, giving access to knowledge, digital inclusion and the development of the abilities and skills that contribute to

## Line of Action 20: the Popularisation of Science and Technology and Improving Science Teaching

### Aim

Contributing to social development in Brazil, promoting the popularisation of CTI and working together to improve scientific, technological and innovation education by means of:

support for programmes, projects and events aimed at publicising science, technology and innovation; organising the annual National Science and Technology Week and increasing the number of cities where this is held;

establishing international agreements to hold events on education in and popularisation of science, technology and innovation;

creating and developing science centres and museums;

developing programmes in science, technology and innovation education, in collaboration with the Ministry of Education, such as Mathematics and Science Olympics, science fairs, producing innovative teaching material with digital content on the Internet to help teachers and students and to give wider publicity to science, technology and innovation.





improving the conditions and quality of life, as well as to sustainable development in Brazil. In this context, it is worth pointing out those activities that give value to and enrich the traditional knowledge of population groups, giving them a new sense of more positive inclusion in the country's social and economic life. These policies will maintain the efforts being made in science education and the popularisation of science and technology, the scope and potential of which have been shown in the huge success of the Mathematics Olympics.

### **Line of Action 21: Technologies for Social Development**

#### **Aim**

To link, encourage and promote actions for the production, spread, requisition and application of knowledge concerning science, technology and innovation as an instrument of social, economic and regional development in Brazil, as well as mechanisms for digital inclusion by means of RDI aimed at social and inclusion technologies through participatory methodological processes.

Actions aimed at the development of socially useful technologies will also be developed in cooperation with other public institutions, especially in areas such as housing, health, basic sanitation, family agriculture and people's cooperatives in order to create jobs and income, as well as protecting the citizen and the consumer.





## 5. Main Targets for 2010

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The priority targets for the contribution of RDI to social and economic development are highlighted below:

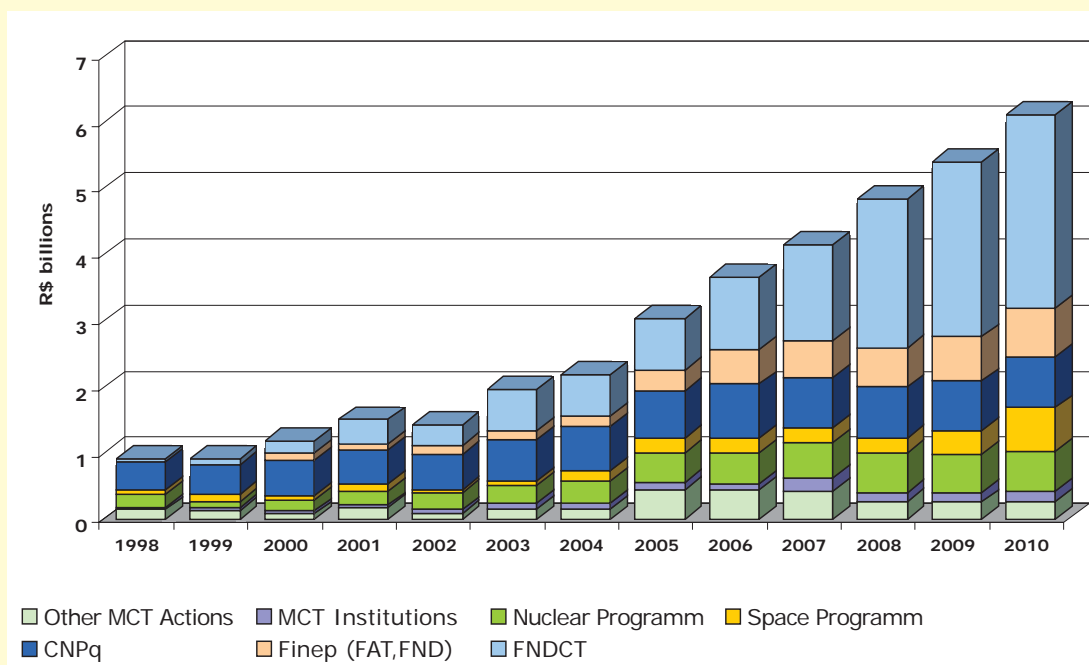
- investment in R&D: increasing overall investments in internal R&D from 1.02% of GDP in 2006 to 1.5%;
- innovation in business: increasing private enterprise participation from 0.51% in 2006 to 0.65% of GDP, in terms of total investments R&D;
- training human resources: increasing the number of scholarships granted by CNPq and CAPES from 100,000 in 2007 to 150,000 by 2010, with an emphasis on engineering and areas related to the PDP, as shown in Figure 9 (p. 28);
- Science and Technology for Social development:
  - establishing 400 technology vocational centres,
  - establishing 600 new telecentres, and
  - enlarging the Mathematics Olympics by 2010 and with the participation of 21 million pupils and granting 10,000 scholarships for secondary education.



## 6. Financial Resources for Scientific Research and Technological Development

The funds given to developing science and technology in general, and in particular to supporting innovation in business, will be substantially increased in the period 2007-2010, so that the efforts made in R&D and in other forms of intangible investments will be doubled in the very near future. As well as the expansion envisaged in the Ministry of Science and Technology's funds, as shown in Figure 11, it is also planned to increase the amount of other public funds to complement these.

Figure 11. Budget for Other Funding and Capital of the Ministry of Science and Technology (MST) Executed (1998-2006) and Planned (2007-2010), in billions of reais at current value



Note 1: does not include financial and obligatory expenses, personnel and charges; includes only costs of Other Funding and Capital and funds controlled by the FNDCT.

Note 2: in order to include the years 1998 and 1999, the financial bodies AEB, CNEN, INB and Nuclep have been included, which at that time were not part of the MST but belonged to the Extraordinary Ministry for Special Projects.

Source: SIAFI, SigMCT and PPA.

Graph developed by: ASCAV/SEXEC/MCT.



As well as the increase in availability of current sources of investment in the Ministry of Science and Technology's actions and programmes - especially those concerning the FNDCT/Sectoral Funds shown in Figure 12 - it is planned to create new Sectoral Funds and to introduce new sources of finance for RDI activities, which will greatly increase the development of these activities in business, in an integrated action involving federal bodies and private institutions.

The possibility of financing technological development in business, combining reimbursable and non-reimbursable resources, provides a strong inducement to initiating activities aimed at innovation. The target is to raise the proportion, within the GDP, of the turnover of companies dedicated to R&D, which was about 0.8% in 2005, to a proportion in the region of 1.0% in 2010.

Public support for RDI activities in business is common in developed countries, as the World Trade Organisation notes. In Europe, for example, between 2002 and 2004, an average of 35% of innovating industrial companies received public money to develop innovative activities. In Brazil, the proportion of industrial companies with industrial activities financed by the government is notably small (19% between 2003 and 2005). The significance of this difference is greatly increased when we consider that Brazilian firms have traditionally suffered relatively disadvantageous conditions in terms of the availability and cost of credit. However, in recent years innovation policy has been notable for the creation of instruments providing a greater supply of funding. In the case of finance for business, there already exist many methods of funding aimed at meeting the variety of demand and handling projects of different kinds and at various stages of innovation. In the next few years existing mechanisms, especially those created by new legal provisions, will be consolidated and complemented.

The targets set out for 2010 are ambitious, but the strong connections between ministries, science and technology secretariats in individual states, and foundations to foster research, on the government side, together with scientific institutions and associations on the academic side, companies and class associations on the private enterprise side, and with extension institutions in the third sector, mean these targets will definitely be reached. This combination of efforts will depend on the growth of federal investment in R&D (from 0.36% to 0.64% of GDP), especially through the National Fund for Scientific and Technological Development (*Fundo Nacional de Desenvolvimento Científico e Tecnológico - FNDCT*) and partnerships between ministries, and will bring about an increase of investment by individual states from 0.15% of GDP to 0.21%.

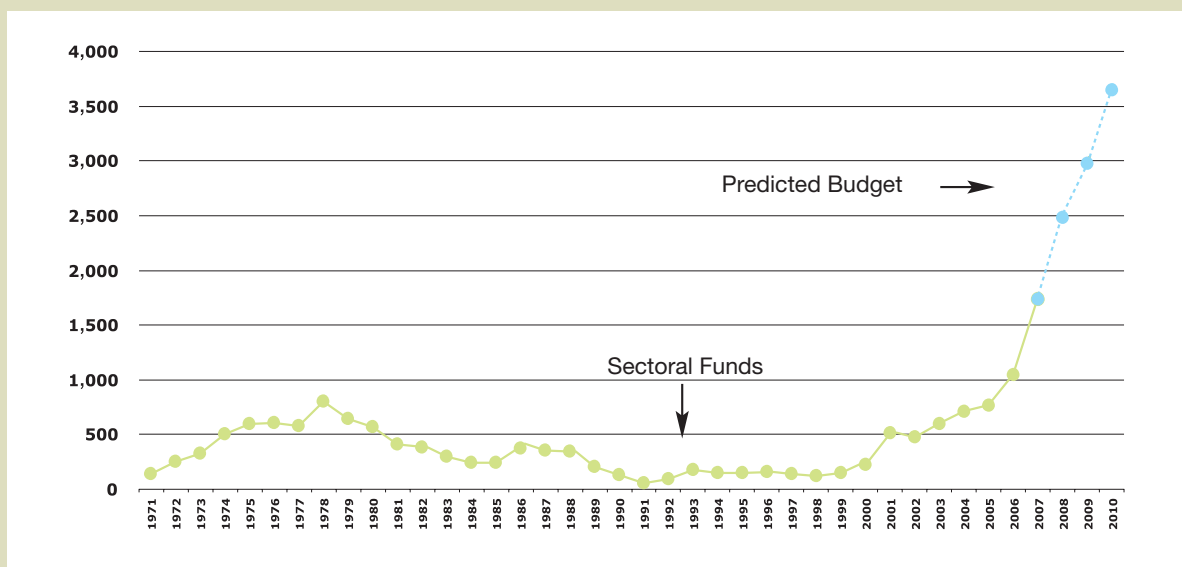


Set up in 1969, the FNDCT was reshaped in November, 2007 when it was sanctioned by Law No. 11,540. This law consolidates the model adopted by the Ministry of Science and Technology which, since 2005 had been working on integrating sectoral funding by transverse actions. Previously, operations were separated and could not promote development. The FNDCT budget is made up of resources from the Sectoral Funds, a means of encouraging the strengthening of the system of science, technology and innovation in the country. Another innovation introduced by the law regulating the Fund was the creation of a Council of Directors made up of representatives of the government, the business sector and workers' representatives. This group gives society the right to express its opinion on the priorities for funding and to monitor the application of resources and results achieved.

To achieve the targets and meet the objectives it was planned for, the Plan receives federal funds in the order of a billion reais from partner ministries and state companies, a clear demonstration of the importance given to the role of science, technology and innovation in national development, as shown in Figures 12 to 14.



Figure 12: FNDCT – Financial Operations from 1971 to 2006 (in millions of constant-value reais, IPCA; annual average/Dec. 2006) and budgetary targets for 2007-2010 (in millions of reais at current value)

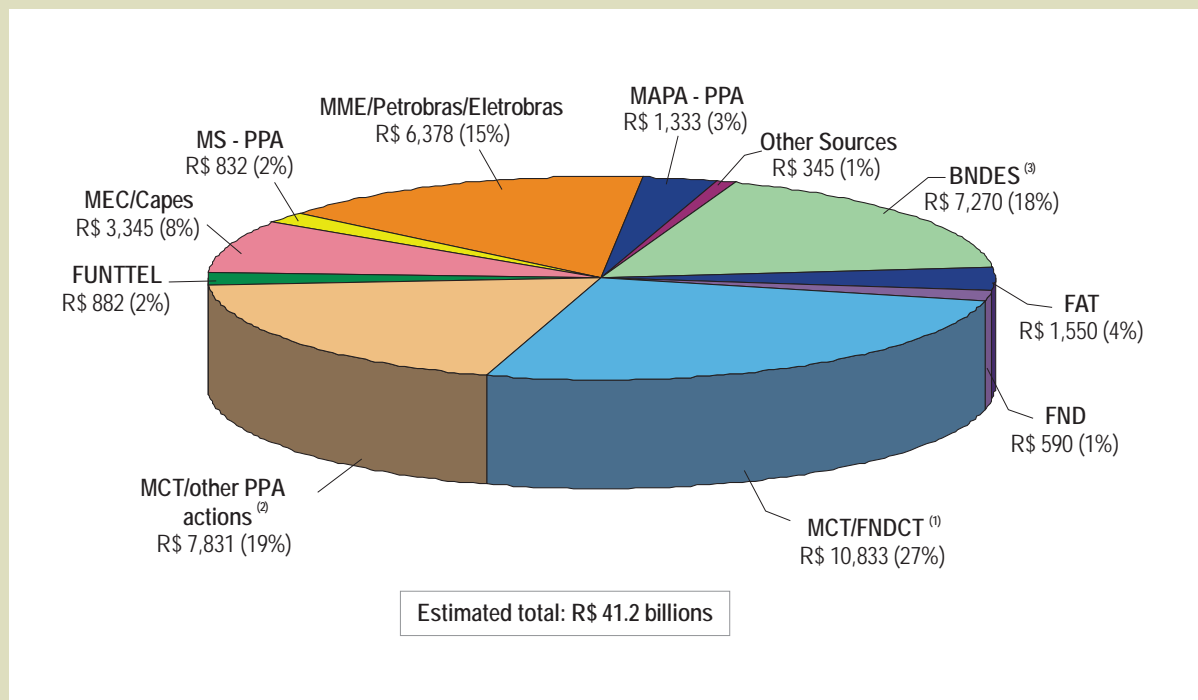


Source: FINEP.

Development of graph: ASCAV/SEEXEC/MCT.

Note: Law + Credits in 2006 and 2007 and PPA for 2008 to 2010.

Figure 13: Resources from the Ministry of Science and Technology and other federal sources, 2007 to 2010



Source: LOA 2007, PLOA 2008 and PPA 2008-2011

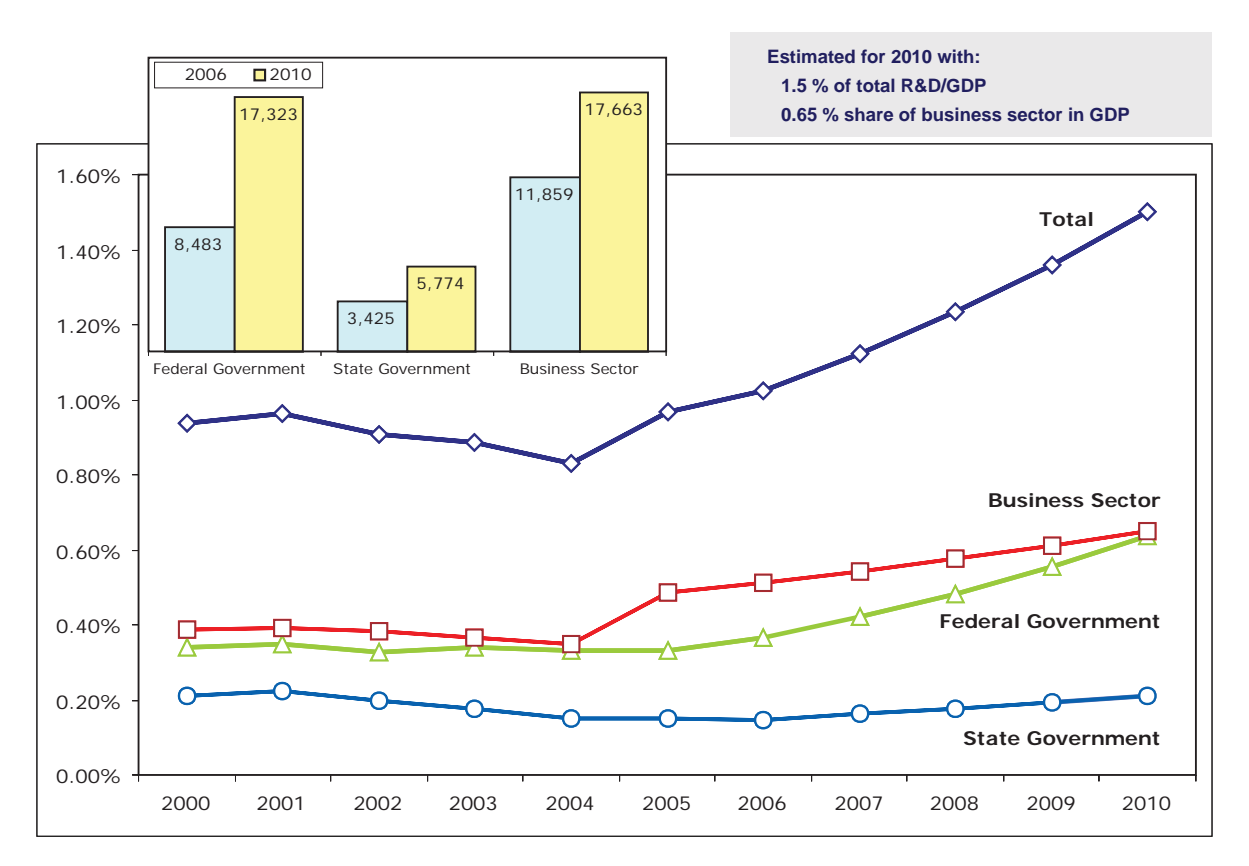
Graph developed by: ASCAV/MCT.

Notes: (1) includes resources controlled by the FNDCT;

(2) does not include personnel, social costs and financial and compulsory expenses; and

(3) BNDES estimates, subject to annual modification.

Figure 14: Brazil: Investments in R&D in percentages of GDP, by financing sector, 2000-2010



Source: SIAFI/SERPRO/PINTEC-IBGE.  
Graph developed by: Coordenação-Geral de Indicadores/ASCAV/SEXEC/MCT.

# 7. Index of the Complete Document

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## **Strategic Priorities, Lines of Action and Programmes for 2007 – 2010**

### **I - Expansion and Consolidation of the National RDI System**

- 1 - Institutional consolidation of the National RDI System
  - 1.1. Institutional consolidation of the National RDI System
  - 1.2. Extension and consolidation of international cooperation
- 2 - Training Human Resources for RDI
  - 2.1. Training, qualifications and placement of human resources for RDI
- 3 - Infrastructure and Encouragement of Scientific and Technological Research
  - 3.1. Support for the infrastructure of scientific and technological institutions (STIs) and technological research institutions (TRIs)
  - 3.2. Encouragement for scientific, technological and innovation development
  - 3.3. New RNP Programme – advanced Internet for education and research
  - 3.4. Scientific and Technological Research Units of the Ministry of Science and Technology

### **II - The Promotion of Technological Innovation in Business**

- 4 - Support for Technological Innovation in Business
  - 4.1. Financial support for RDI activities and for incorporating researchers into companies
  - 4.2. Support for cooperation between companies and STIs
  - 4.3. The National initiative for innovation
  - 4.4. Qualification of human resources for innovation
  - 4.5. Implementation of entrepreneurial RDI centres
- 5 - Technology for Innovation in Business
  - 5.1. The Brazilian Technology System (*Sistema Brasileiro de Tecnologia – SIBRATEC*)
- 6 - Incentive for the Creation Consolidation of Technology-intensive Businesses
  - 6.1. The National Support Programme for Incubator Bodies and Technology Parks (PNI)
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#### **7 - Areas Developing Future Trends: Biotechnology and Nanotechnology**

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#### **8 - Information and Communication Technologies**

- 8.1. Support for technological development in the electronic and semiconductor industries
- 8.2. Programme for stimulating the software and services sector
- 8.3. Digital technologies for communication, media and networks

#### **9 – Health supplies**

- 9.1. Pharmaceuticals and medicines
- 9.2. Medical and biomaterial products
- 9.3. Diagnostic kits
- 9.4. Hemoderivatives
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#### **10 - Biofuels**

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- 10.2. STI programme for ethanol

#### **11 - Electrical Energy, Hydrogen and Renewable Energy Sources**

- 11.1. Setting up infrastructure in national teaching and research institutions in the area of generating, transmitting and distributing and final use of electrical energy
- 11.2. Expansion, modernisation, maintenance and infrastructure for technological research and development in the generating, transmitting and distributing, and final use of electrical energy
- 11.3. STI programme for transmitting electrical energy, especially over long distances
- 11.4. STI programme for optimising assets in the electrical system
- 11.5. STI programme in planning and operational methods in the electrical energy system
- 11.6. STI programme for increasing the quality and efficiency of energy
- 11.7. STI programme for the hydrogen economy
- 11.8. STI programme for renewable energy sources

#### **12 - Oil, Gas and Coal**

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- 12.2. The expansion, modernisation, maintenance and infrastructure of technological research and development in the areas of oil, natural gas and biofuels
- 12.3. Technological research and development programme for refinery processes
- 12.4. Technological research and development programme for activities involving exploring for oil and natural gas
- 12.5. Technological research and development programme for technological research and development in activities involving producing oil and natural gas
- 12.6. Technological research and development programme for activities involving the transport of oil and natural gas



- 12.7. Technological research and development programme for activities involving natural gas
- 12.8. Technological research and development programme for the activities involving sustainable development in the area of oil and natural gas
- 12.9. STI programme for the production and clean use of coal – *ProCarvão*
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  - 13.2. Agricultural automation with an emphasis on small-scale enterprises
  - 13.3. Research, development and innovation in innovative agricultural production systems
  - 13.4. International links for advancing STI in agriculture
  - 13.5. Reviving the State Organisations for Agricultural Research (*Organizações Estaduais de Pesquisa Agropecuária - OEPAS*) to strengthen the National System for Agricultural Research
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  - 14.2. STI for exploring maritime resources
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  - 15.1. Integrated STI programme for conservation and sustainable development in the Amazon region
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- 16 - The Weather and Climate Change
  - 16.1. National climate change programme
  - 16.2. Weather and climate forecasting
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  - 17.1. The Alcântara Space Centre (*Centro Espacial de Alcântara - CEA*) programme
  - 17.2. The Satellite Launching Vehicle (*Veículo Lançador de Satélites - VLS*) programme
  - 17.3. The PMM Programme – Earth observation satellites based on the Multi-Mission Platform (Plataforma Multi-Missão – PMM)
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  - 18.2. Increasing the cycle of nuclear fuel in the Brazilian Nuclear Industry
  - 18.3. Finishing the pilot plant for producing UF6 (conversion) at Aramar
  - 18.4. Technological preparation and enablement of NUCLEP for making components for new nuclear energy plants
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  - 18.6. The Brazilian Radiopharmaceuticals Company (*Empresa Brasileira de Radiofármacos – EBR*)

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  - 19.2. STI for public safety

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  - 20.2. Support for the creation and development of science and technology centres and museums
  - 20.3. The Brazilian Mathematics Olympics in State Schools (*Olimpíada Brasileira de Matemática das Escolas Públicas - OBMEP*)
  - 20.4. Digital multimedia content for science teaching and popularising STI on the Internet
- 21 - Technologies for Social Development
  - 21.1. Setting up and modernising Technological Vocational Centres (*Centros Vocacionais Tecnológicos*)
  - 21.2. The National programme for digital inclusion
  - 21.3. Support for research, innovation and technological extension for social development
  - 21.4. Community Programme for Technology and Citizenship
  - 21.5. Science and Technology for regional development with a focus on local development (APLs)
  - 21.6. Support for research and development applied to dietary and nutritional safety
  - 21.7. Agricultural and agribusiness research and development for social inclusion
  - 21.8. Qualification in STI for social development

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