December 16, 2010

Approved at the 3,226th Conference of the Executive Yuan

White Paper on Science and Technology

(2011–2014)

National Science Council

Republic of China

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Chapter 1　Introduction

The rapid development of science and technology in recent years, along with the spread of globalization, has unleashed a series of worrisome crises, including the global recession triggered by American subprime loan crisis, the outbreak of new types of flu, environmental changes caused by overdevelopment, exhaustion of resources, and ecological imbalance. All countries must address these issues, and open international models of cooperative innovation will provide a way forward for national development in different countries.

Apart from issues of common international concern, Taiwan also faces its own particular challenges: A lack of natural resources, shortages of habitable land, a fragile natural environment, disputes concerning the precedence of economic development and safe living conditions, the effect of growing cross-Strait relations industrial development structure, the aging of society, and trend toward smaller families. All of these issues may significantly affect Taiwan's long-term development and training of superior human resources. Thanks to continuous study and discussion among industry, government, academia, and the research community, the formulation of relevant policies has been expedited, and is expected that Taiwan can develop new styles of intelligent living. This will initiate the next wave of economic growth, enabling Taiwan to maintain its beneficial niche in global scientific and technological innovation networks.

Restructuring of the government S&T organization, enhancing administrative efficiency

In order to enhance administrative efficiency in response to the growing intensity of competition in the global environment, the government plans to initiate a new administrative organizational system in 2012. The new system will restructure the government's organization in order to achieve thrift, flexibility, and high performance. The government accordingly plans to establish a Ministry of Science and Technology, which will integrate the aspects of "functionality" and "accountability" in the government's S&T organizational system, ensuring that policy and implementation are thoroughly fused. It is hoped that the new organizational system will effectively join up-, mid-, and downstream S&T development activities, give stronger roots to high-tech industries, and boost industry's added value by letting R&D results guide improvements to the industry structure. In the future, the unification of services and powers at the Executive Yuan Science and Technology Meeting, Ministry of Science and Technology, and other relevant agencies will accelerate innovative R&D, enable the effective allocation of S&T resources, and realize the vision of using S&T development to strengthen national competitiveness.

Training superior human resources, emphasizing the quality of academic research

The arrival of the knowledge economy has deepened the linkage between social development, knowledge innovation in universities, and the training of human resources. The government's 2004 Academic Excellence Program and 2006 Development Plan for World Class Universities and Research Centers of Excellence helped universities to improve instructional quality and developed models of outstanding teaching among domestic universities. The policy of opening higher education has caused university enrollment to swell, and more than 1.22 million persons attended university during the 2009 academic year. Persons studying technical subjects comprised the largest group of students, and will serve as a foundation for Taiwan's many high-tech industries. Nationwide R&D manpower exceeded 100,000 persons by 2007, and the number of research personnel per 1000 employment has risen steadily, reaching 10.6 FTE in 2008 and exceeding the target of 9.7 FTE set for 2009. The "Flexible Salary Program to Recruit and Retain Special Outstanding University and College Manpower" proposed in 2010 will improve the salaries of outstanding instructors and research personnel, help Taiwan compete for academic human resources with other countries, and ease the outflow of superior domestic academic personnel.

Continued input of scientific research funding, encouraging innovative R&D activity

In light of the fact that S&T and innovation can have a decisive impact on national competitiveness, the government has guaranteed that there will be steady growth in S&T funding. And in order to support R&D activities and improvement of the research environment, the government will also encourage corporate participation in R&D and strengthen international interchange and collaboration. The government's S&T budget grew at an average annual rate of 6.07% from 2006 to 2010, reaching NT$94.1 billion in the latter year. In addition, nationwide funding for R&D grew at an annual rate of over 6% from 2004 the 2008. R&D funding as a share of GDP has also increased steadily, reaching 2.77% in 2008. It is expected that Taiwan will continue to accumulate scientific and technological R&D capacity, which will be manifested in the form of increased industrial competitiveness.

Development of green energy technology, establishment of a low-carbon living environment

Realizing the importance of energy independence and security, and complying with the worldwide trend toward energy conservation and carbon reduction, starting with the 2009 "National Science Technology Program-Energy," the government has implemented energy technology research projects intended to increase energy independence, reduce greenhouse gas emissions, and establish an energy industry in line with the four major principles of "integrating resources, formulating energy S&T development strategies, selecting key future energy technology R&D areas, and allocating and adjusting the energy S&T budget." We hope that Taiwan will evolve into a sustainable society with sufficient energy, a vibrant economy, and a healthy natural environment. The government has also been vigorously promoting the "Six Major Emerging Industries－Dawning Green Energy Industry Program," which seeks to develop renewable energy and energy conservation technologies and industries. We look forward to the green energy industry giving new life to Taiwan's industrial ecology, lead industry into a low-carbon, high-value era, and establishing Taiwan as an energy technology and production power.

Refining disaster prevention and response technology, enhancing people's residential safety

Due to Taiwan's unique location on the earth, it suffers from frequent natural disasters such as typhoon and earthquakes, and has a high level of natural hazards. In addition, global climate change and the rapid development of society have increased environmental fragility, intensifying disasters and steadily increasing socioeconomic losses. As a consequence, it is urgent that the nation strengthen and effectively implement disaster prevention and response technology in practical applications. Following the conclusion of the 2006 "National Science and Technology Program for Hazards Mitigation," the government followed up with implementation of the "Program for Enhancing Innovation and Implementation of Disaster Reduction," which is continuing to promote disaster prevention and response R&D and technical support capabilities. The systematic integration of R&D results and application to disaster prevention and response work, will improve the environment, strengthen protection of the nation's land, boost society's overall resilience in the face of disasters, minimize losses of life and property from natural disasters, and protect people's lives, property, and residential safety.

Promoting healthy living science and technology, letting people enjoy intelligence new lives

Taiwan's over-65 population exceeded 7% in 1993, and the general fertility rate has fallen steadily in recent years. Because the country is already facing an aging society with small families, the government is actively promoting biotechnology, health insurance, and health care policies as a response to the situation. The implementation of such programs as the "National Research Program for Biopharmaceuticals," "Diamond Action Plan for Biotech Takeoff," and "Healthcare Upgrade Platinum Program" is geared to providing citizens with continuously-improving health care in the future. Furthermore, the "Cultural & Creative Industries Development Plan," "Project Vanguard for Excellence in Tourism," and "Taiwan e-Learning and Digital Archives Program" address citizens' need to combine culture with science and technology, and are using online knowledge platforms to promote the country's rich cultural heritage and creative talent on the international stage.

Taiwan's information and communications industry enjoys a lofty global status, and many of Taiwan's high-tech products are world leaders in terms of market share. Because of this, Taiwan must leverage the strengths of its information and communications technology and ICT industry to establish innovative applications services spanning different industries and develop diversified intelligent industries focusing on such areas as cloud computing, smart electric vehicles, and smart green architecture. Not only will this enable citizens to step up to intelligent living characterized by safety, health, convenience, comfort, energy conservation, and low carbon emissions, but also provide opportunities for renewed industrial development, and therefore yield both economic benefits and a better quality of life.

Chapter 2 The Current State of Science and Technology in Taiwan

2. 1 S&T Development System and Policy Formation Mechanism

Responding to the government's overall organizational re-engineering plan, Taiwan's S&T development operating system, which includes such organizations as the National Science Council, Executive Yuan (NSC) and Science and Technology Advisory Group, Executive Yuan (STAG), will be restructured in order to unify the nation's S&T development functions and powers, integrate S&T resources, and confirm S&T development strategies.

I. The Government's S&T Organizational System

The "National Long-Term Science Development Committee," which was established by the Executive Yuan in 1959, was the predecessor of the NSC, and bore responsibility for promoting scientific development. After numerous instances of reorganization and reform over the course of many years, Taiwan's S&T development system gradually took shape, and S&T policy formation mechanisms became increasingly mature. The announcement of the "Fundamental Science and Technology Act" in 1999 provided a basis for S&T development and confirmed Taiwan's S&T development strategies and principles. Taiwan's S&T development system can be divided into a promoting organization, implementing organization, and assessing organization as follows:

The S&T policy organization consists of the NSC STAG, and other agencies. The NSC's role consists of promoting nationwide S&T development, supporting academic research, and developing science-based industrial parks. STAG's mission consists of providing recommendations concerning national S&T research and development policy and major S&T development programs, holding Science and Technology Advisory Board meetings and Strategy Review Board meetings, and promoting S&T development programs or projects designated by the Executive Yuan. Other promoting organizations include the Ministry of the Interior, Ministry of National Defense, Ministry of Education, Ministry of Economic Affairs, Ministry of Transportation and Communications, Department of Health (DOH), Executive Yuan, Environmental Protection Administration, Executive Yuan (EPA), Atomic Energy Council, Executive Yuan (AEC), Council of Agriculture, Executive Yuan (COA), Council of Labor Affairs, Executive Yuan (CLA), and National Communications Commission. The compilation and implementation of S&T

budgets at these agencies guide and realize the government's S&T development policies, and the Minister without Portfolio in charge of S&T matters bears responsibility for inter-agency coordination (see Fig. 1).

S&T implementing organizations chiefly consist of units involved in the four aspects of basic research, applied research, S&T development, and commercialization. The chief implementing organizations for basic research and applied research are the Academia Sinica and domestic universities and colleges. The chief implementing organizations for applied research and S&T development are nonprofit research organizations and domestic universities and colleges. Commercialization is chiefly implemented by public and private enterprises.

The S&T assessment system includes the stages of S&T project review, implementation control, and results evaluation. In the S&T review stage, emphasis is placed on the drafting of focal projects, including annual project and mid-/long-term projects. Control and evaluation are performed during project/program implementation; implementation results and review opinions provide a basis for project revision in a feedback process.

In recent years, the formation of S&T policy in Taiwan has generally occurred at several major conferences, including the National Science and Technology Conference, Science and Technology Meeting of the Executive Yuan, Science and Technology Advisory Board Meetings of the Executive Yuan, Executive Yuan Strategy Review Board Meeting on Industry, and NSC council meetings. The consensus reached at these conferences is used as a basis for the formulation of policy directions.

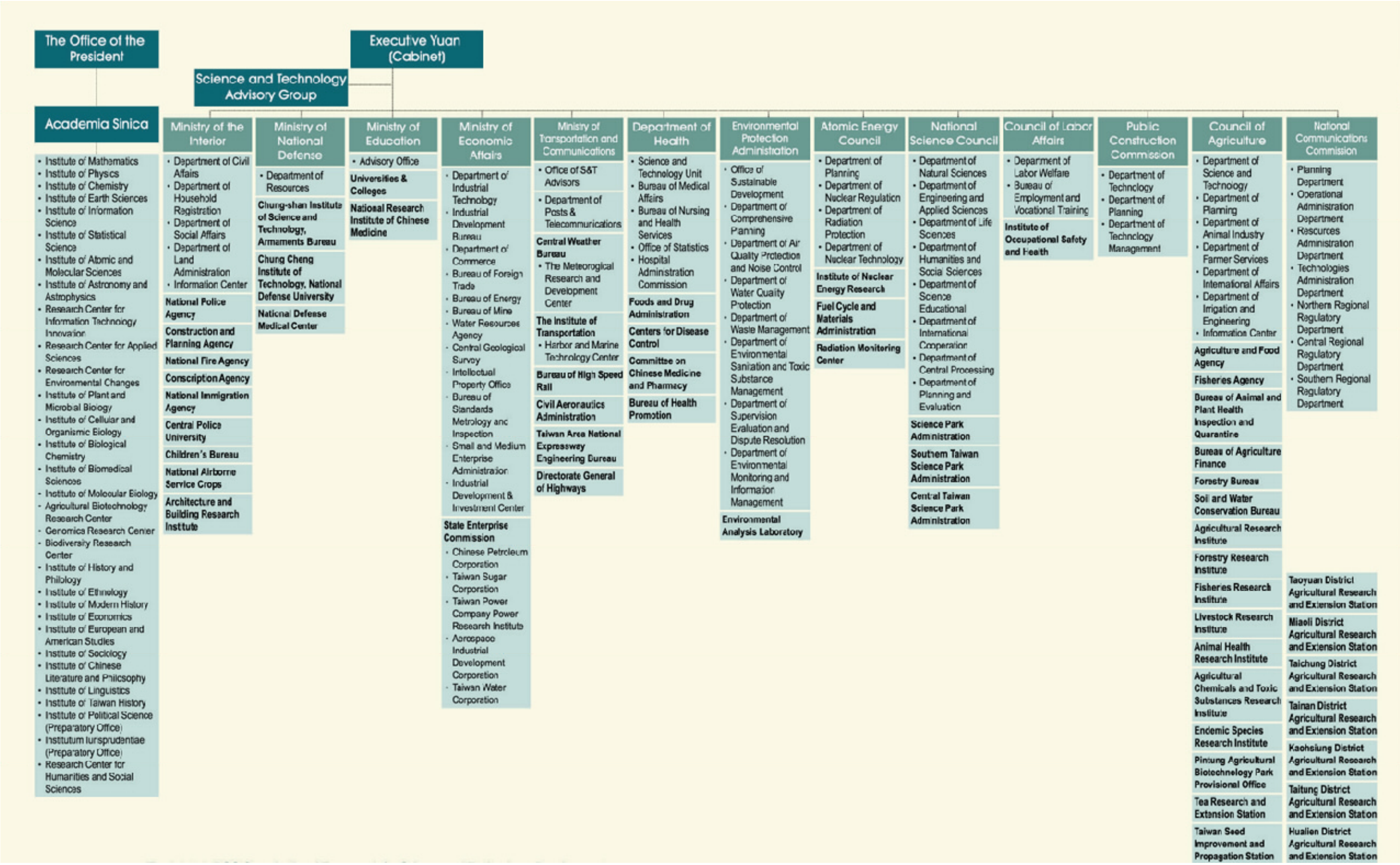

Figure 1 The government's S&T organizational system and research organizations

II. The National S&T Development System after Organizational Restructuring of the Executive Yuan

In order to enhance the efficiency of administrative agencies, the government has embarked on a campaign to restructure the organization of the Executive Yuan in line with the three principles of simplicity, flexibility, and efficiency. On January 12, 2010, the Legislative Yuan passed the Executive Yuan Organizational Restructuring Bill and passed four organizational restructuring acts: the revised Central Administration Organization Basic Law, revised Executive Yuan Organizational Act, Provisional Statute for Adjustment of Executive Yuan Functional Operations and Structure, and Act Governing the Total Number of Civil Servants Employed by Central Government Agencies. In the future, a Ministry of Science and Technology will be established on government's new organizational structure.

In Taiwan's future S&T development system, the Executive Yuan Science and Technology Meeting will serve as a coordinating mechanism at the Executive Yuan level, the Executive Yuan premier will serve as chairman, and the minister without portfolio for science and technology will serve as deputy chairman. Members of the Science and Technology Meeting will include representatives of government agencies, industry, academia, and research organizations. The Meeting's mission includes: (1) making recommendations concerning national S&T development policies, (2) formulation of strategies for allocating the country's S&T resources, (3) review and control of major S&T development programs, (4) coordination and promotion of major S&T development policies, (5) planning and arrangement of major S&T strategy conferences, and (6) other advisory matters concerning S&T development (see Fig. 2).

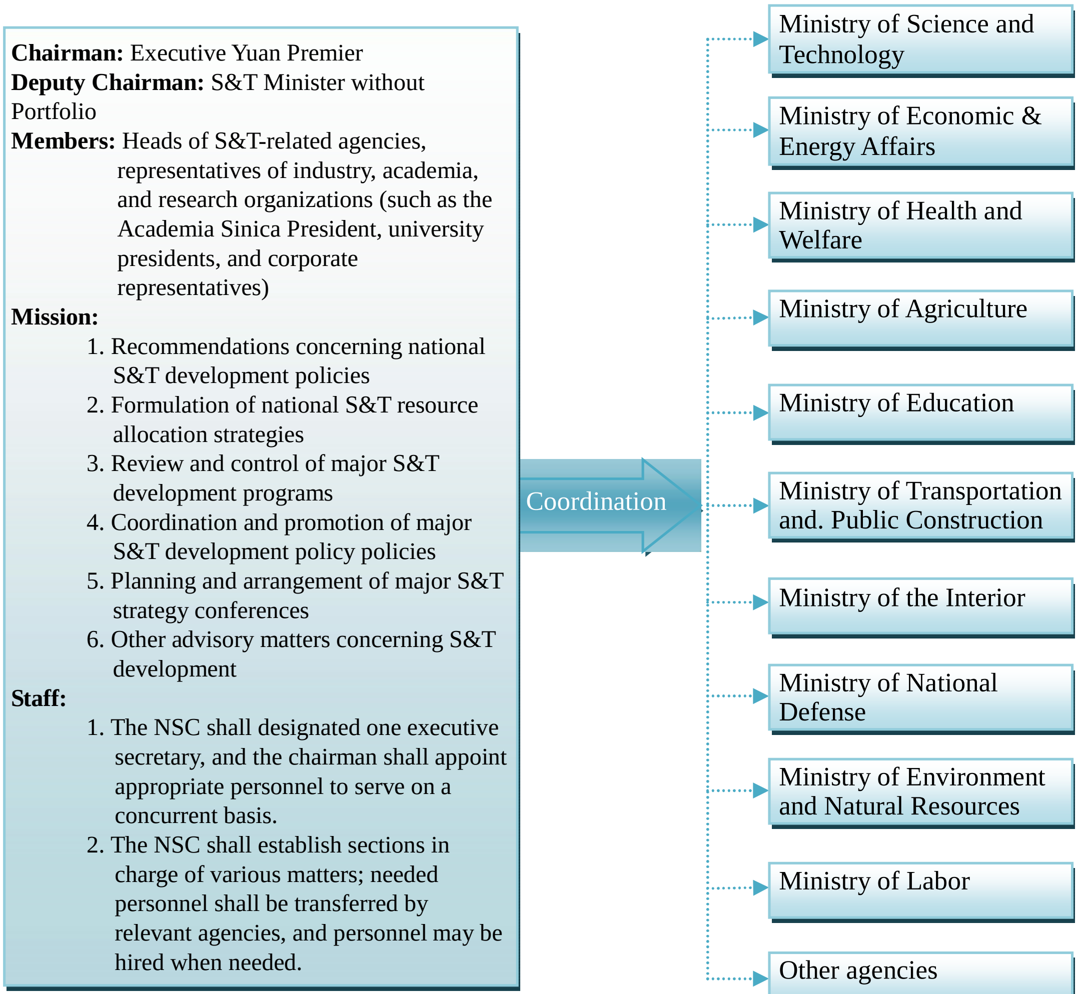

Figure 2 Mission of the Executive Yuan Science and Technology Meeting (draft)

The Ministry of Science and Technology's duties will encompass the drafting of S&T research and development policy, promoting basic and applied S&T research, implementing major S&T R&D programs, supporting academic research, developing science parks, formulating nuclear safety policies and control measures, and managing the Executive Yuan's National Science and Technology Development Fund. The Ministry of Science and Technology's internal units will chiefly consisted eight departments, namely a General Planning Department, Natural Science and Sustainability R&D Department, Engineering Technology R&D Department, Life Science R&D Department, Humanities and Social Sciences R&D Department, Science Education Development and International Cooperation Department, Forward-looking and Applied S&T Department, and Industry-Academic and Science Park Department, as well as four grade three agencies: Office of Nuclear Safety, Northern Taiwan Science Park Administration, Southern Taiwan Science Park Administration, and Central Science Park Administration. All units are responsible for jointly managing their respective duties (see Fig. 3).

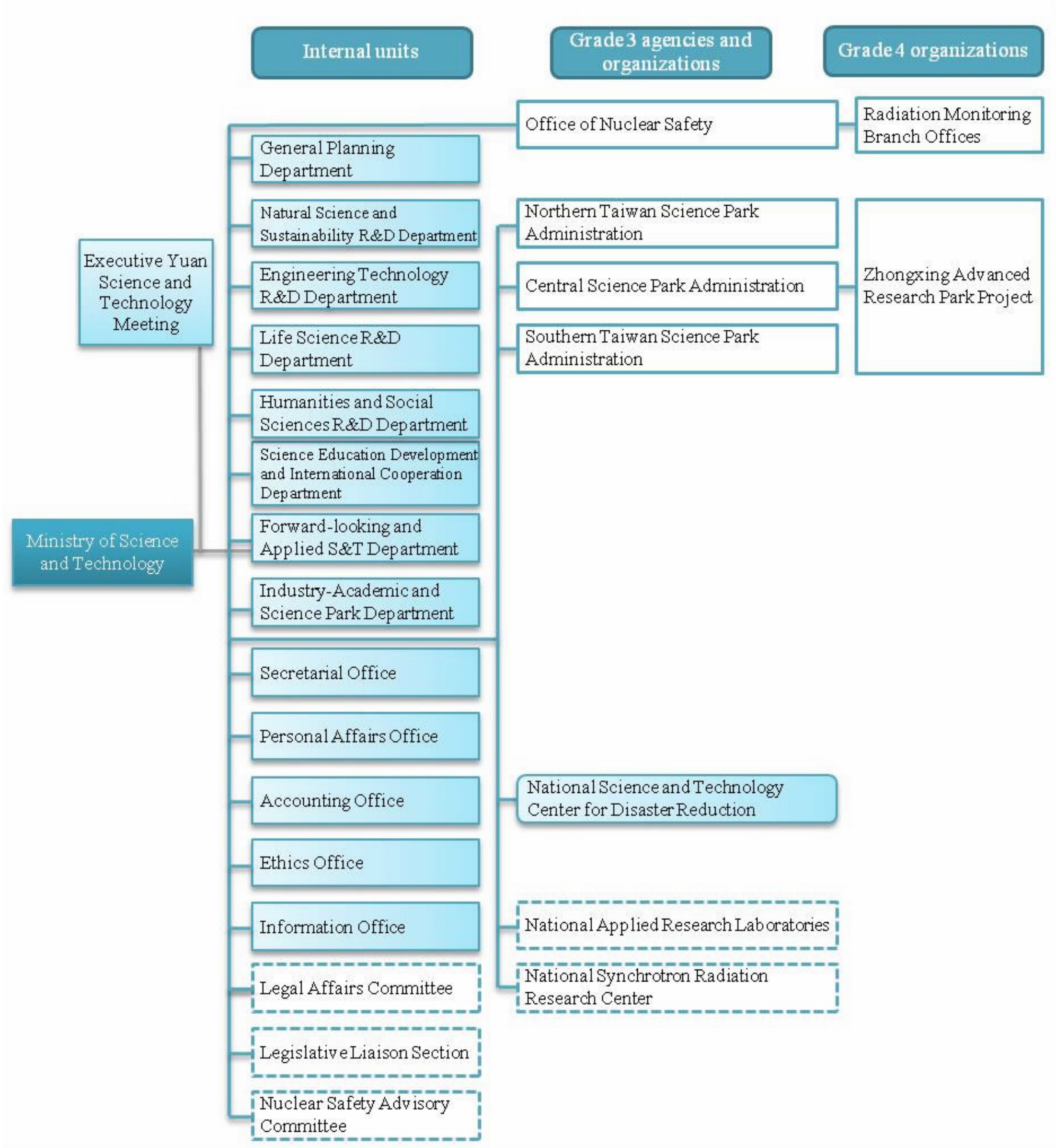

Figure 3　Organizational chart of the Ministry of Science and Technology (draft)

Beyond the original work of the NSC, the organizational framework of the Ministry of Science and Technology will also embody the following principal changes:

A. The Ministry of Science and Technology will build on the NSC's existing Science Park framework by adding innovative R&D services in the area of applied technology, integrating planning of basic research and applied research within the country's S&T research and development infrastructure, and drafting and implementing upstream and midstream S&T development decisions.

B. The Ministry of Science and Technology will take over the Atomic Energy Council's nuclear safety duties, including the Atomic Energy Council's duties and the Institute of Nuclear Energy Research's relevant support for nuclear safety.

C. The Ministry of Science and Technology will be in charge of the country's basic and applied science and technology development work; under the Ministry is National Science and Technology Center for Disaster Reduction, which is responsible for coordinating, planning, and implementation of disaster prevention and response science and technology R&D work, and also assists and supports the implementation and application of disaster prevention S&T research and development.

D. The NSC's original interagency coordination duties, including review of government S&T programs, will be moved to the Ministry.

Future government S&T development funding will generally be classified under the three items as basic scientific research, applied S&T research, and technology development and industrialization; among these items, funding for basic scientific research and applied S&T research will chiefly come from the Ministry of Science and Technology budget, while funding for S&T development and industrialization will chiefly come from other S&T-related agencies. Applicants for S&T funding may include public and private universities and colleges, government-funded research organizations and juristic person organizations, and public or private enterprises. Applications must be made to the agency responsible for the type of funding in question (see Fig. 4).

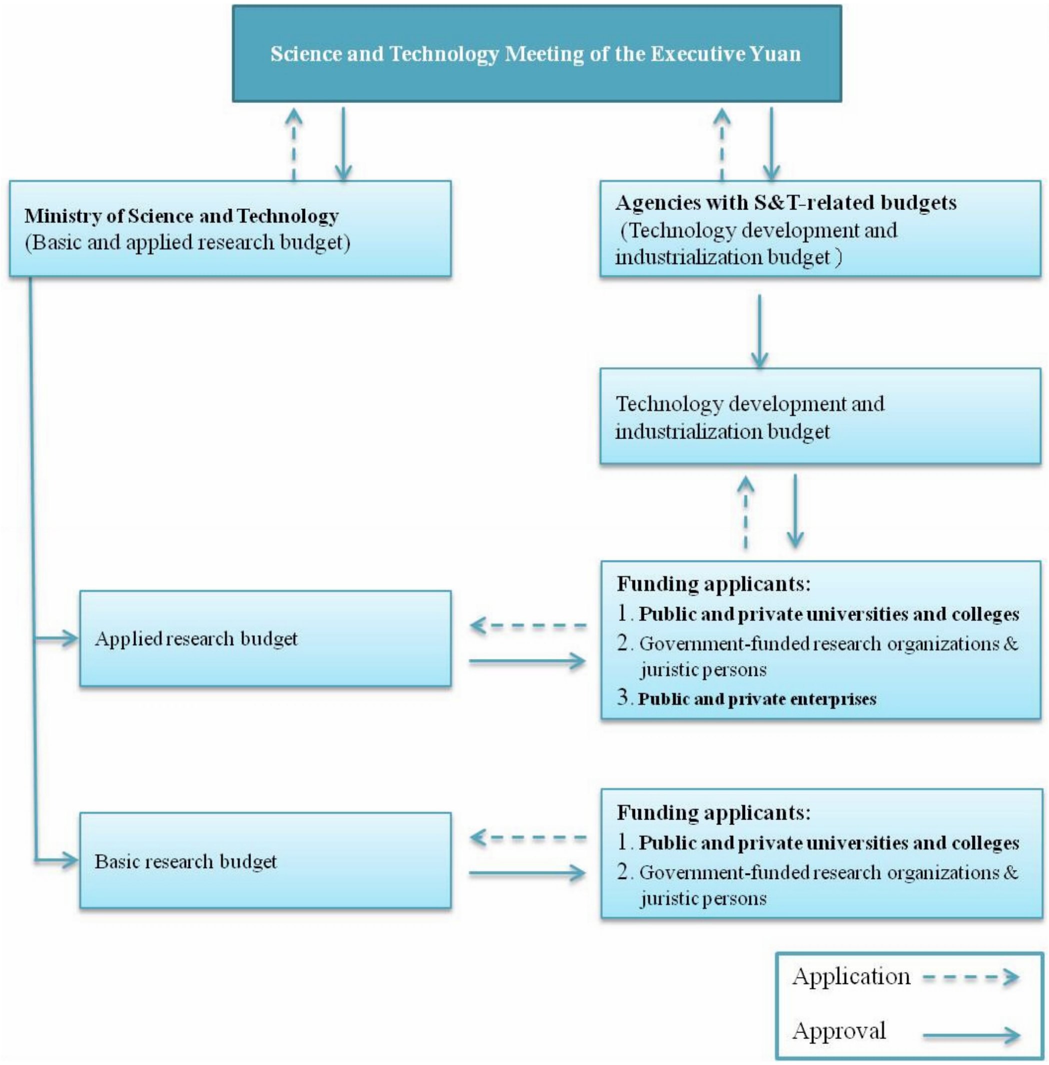

Figure 4 Government S&T funding allocation and procedures

III. Major S&T Conferences in Taiwan

A. National Science and Technology Conference

In 1999, Taiwan publicly announced the Fundamental Science and Technology Act, which calls on the Executive Yuan to hold a National Science and Technology Conference once every four years. The National Science and Technology Conference is an important platform for the drafting and discussion of relevant domestic S&T policies. The National Science and Technology Development Plan is formulated on the basis of the conference's conclusions, and, after approval by the Executive Yuan, serves as the basis for determination of S&T policies implementation of S&T research and development.

The 8th National Science and Technology Conference was held in 2009, and took "Pursuit of technological innovation and value creation; building a superior life and sustainable society" as its theme. This conference discussed the six chief issues of "linking science and technology with the humanities, raising the quality of life," "training S&T manpower, making effecting use of human resources," "updating the legal and regulatory system, integrating S&T resources," "pursuing academic excellence, strengthening social concern," "boosting technological innovation, improving the industry environment," and employing S&T capabilities to promote sustainable development." In addition, to ensure that the conference's conclusions had a positive impact on Taiwan's S&T development, the following five major issues were discussed at the conference: (1) boosting the international competitiveness of Taiwan's academic research and manpower; (2) harnessing the resources of industry, academia, and research organizations resources to develop high-level research parks; (3) establishing multi-stage mechanisms for the integration and utilization of the research results obtained by industry, academia, and research organizations; (4) environmental changes, hazardous mitigation, and sustainable land development; and (5) employing the recession as an opportunity to gather strength for the next surge of industrial development.

The NSC and other relevant agencies drafted the National Science and Technology Development Plan (2009-2012) containing 144 measures on the basis of the 8th National Science and Technology Conference's conclusions and consensus; after approval by the Executive Yuan in July 2009, the Plan has been implemented by relevant agencies.

B. Science and Technology Advisory Board Meetings of the Executive Yuan

Science and Technology Advisory Board Meetings of the Executive Yuan ("S&T Advisory Board Meetings") have been held once annually since 1980. These meetings provide a forum for discussion of Taiwan's mid- and long-term S&T development policy, allowing S&T advisors to submit their impressions and recommendations, which may be included in national S&T administrative focal points after being heard by the Executive Yuan premier.

1. The 2007 27th S&T Advisory Board Meeting

This meeting took the "refinement of Taiwan's S&T development system" as its theme, and proposed the "Basic Framework for S&T Development" and "S&T Development System Refinement Program." The Basic Framework for S&T Development consists of top-down policy promotion functions, and calls for interdisciplinary, interagency integration to promote the development of new technologies and new industries. The Basic Framework for S&T Development is implemented on a four-year cycle, with periodic assessments conducted once every two years; assessment results are used as a basis for the next Basic Framework. The current Basic Framework is being implemented from 2008 to 2011.

2. The 2008 28th S&T Advisory Board Meeting

At this meeting, which took "intelligent Taiwan" as its topic, domestic and foreign S&T advisors and experts and scholars affiliated with industry, government, academia, and the research community discussed the aspects of science and technology, the humanities, industry, life, and innovation, and drafted concrete objectives and strategies with different time frames for the four issues of a "culturally creative society," "intelligent environment," "superior life," and "diversified manpower."

3. The 2009 29th S&T Advisory Board Meeting

At this meeting, which had the topic of "promoting the Six Major Emerging Industries, revitalizing industrial development," participants reviewed the results of promotion of the Six Major Emerging Industries, discussed relevant strategies and measures, suggested challenges, and formulated innovative methods for the future. In addition, the meeting also discussed the use of information and communications technology (ICT) to boost development of the Six Major Emerging Industries and create new "blue sea" opportunities for the ICT industry.

4. The 2010 30th S&T Advisory Board Meeting

This meeting, which had the topic suggested by President Ma of "making Taiwan an innovation powerhouse, achieving a golden decade for industry" and a vision of "transforming Taiwan into a global innovation center," discussed the three issues of "promoting reform of intellectual property, building a foundation for Taiwan's industrial competitiveness," "creativity and innovation," and "industrial foresight and innovation strategies."

C. Executive Yuan Strategy Review Board Meeting on Industry

In order to accelerate the development of Taiwan's electronics, information, and biotechnology industries, the Executive Yuan has held 11 Electronics, Information, and Telecommunications Industry Strategy Review Board meetings since 1992 and five Biotechnology Industry Strategy Review Board meeting since 1997. These strategy review board meetings have sought to harmonize government policies with industry recommendations, and have provided an important basis for the promotion of industrial technology policy. The two strategy review boards were integrated as the Executive Yuan Strategy Review Board Meeting on Industry in 2002. It is felt that by discussing industrial technology issues in different areas, while examining the current state of industrial development, the meetings can yield conclusions able to guide S&T research and development. The main issues covered by Strategy Review Board Meetings from 2007 to 2010 are as shown in Table 1.

Table 1 Main topics of the Strategy Review Board Meeting on Industry, 2006-2009

Year	Issues
2007	Energy conservation technology, renewable energy technology (photovoltaic power technology, biomass energy technology, wind power generation technology), forward-looking energy technology (carbon dioxide reduction technology, marine energy technology, and fuel cell and hydrogen energy technology)
2008	"Transformation and a great leap — Using value-added applied technology and innovation to revitalize conventional industries": Use of ICT to promote value-added strategies for conventional industries, use of ICT to promote value-added strategies for conventional manufacturing, use of ICT to promote value-added strategies in agriculture, and use of ICT promote value-added strategies for SMEs.
2009	"Molding an information security culture, boosting information security output value" Strategy Review Board Meeting on Industry: Creation of a secure and trustworthy information and communications environment, maintaining public privacy, safeguarding online applications, and building an information security industry development environment
2010	Forward-Looking Agriculture Strategy Review Board Meeting: In conjunction with industrial development, building agricultural innovation and R&D capacity, establishing agricultural technology commercialization and industrialization mechanisms, promoting the development of innovative agricultural enterprises

D. Executive Yuan Bio-Technology Committee (BTC) meetings

In order to further plan a development blueprint for the biotechnology industry, while strengthening policy and resource integration, the Executive Yuan established the national policy-level Bio-Technology Committee (BTC) on the basis of the conclusions of the 2004 Strategy Review Board Meeting on Industry. The BTC met for the first time in 2005, and has met annually, when felt necessary, since that time. The conclusions of BTC meetings serve to guide national biotechnology industry policies and development patients, while providing relevant recommendations. BTC meetings also assess and make recommendations concerning key developmental directions appropriate for Taiwan, and review and make suggestions concerning relevant biotechnology investment strategies and their relative priority. The conclusions of BTC meetings ultimately provide a key for the implementation of biotech industry policy by relevant agencies.

1. The two BTC meetings in 2005 and 2006 proposed the following industrial development strategies in key areas of the medical and pharmaceutical industries:

(1) Biotech pharmaceuticals: Emphasis in the R&D value chain should be placed on finding candidate drugs shown to have value in clinical trials, and promoting such drugs to phase II trials. The planning of a brand new incubation model and organization of centralized operating and technical support teams will accelerate new drug R&D and boost the creation of pharmaceutical R&D value.

(2) Medical equipment: Focusing on the development of high-end (Class II and Class III) medical equipment, firms with existing advantages should be encouraged to participate in the development of equipment for the health care industry, promoting the integration of different industries and application of technology.

(3) Agricultural biotechnology: First priority should be placed on the development of aquaculture, aquaculture organism larvae and flower seedlings, breeder poultry and livestock, safe agriculture, and molecular farming. While making the best use of geographical resources, testing industry commercialization platforms and production-marketing systems should be integrated, and one or two export products strongly promoted until they have established leading positions in international markets.

2. 2008 BTC meeting

Building on the main themes of the 2005 and 2006 BTC meetings, the 2008 BTC meeting selected the two areas of biotech pharmaceuticals and therapeutic equipment for promotion, investigated key problems faced by industrial development through discussion of the topics "planning the development of Taiwan's biotech pharmaceuticals industry" and "drafting a blueprint for the development of Taiwan's medical materials industry," and formulated strategic directions and action plans needed for the development of these industries.

3. 2009 BTC meeting

In accordance with the recommendations of BTC members and industry experts, this BTC meeting focused on the topic of "revitalizing the biotechnology industry and establishing a superior industrial development environment," and discussed the three major issues of "promoting effective industrialization," "promoting inter-regional biomedical industry cooperation—Example of cross-Strait interchange in the Chinese herbal medicine industry," and "drug review procedures encouraging development of the industry." This meaning addressed key problems faced by the biomedical industry in Taiwan, and formulated strategic directions and action plans needed to promote the industry's development.

4. 2010 BTC summit conference

With a theme of "Taiwan Diamond Action Plan for Biotech Takeoff," this conference discussed the four major issues of "promoted integrated incubation mechanisms," "strengthening industrialization R&D capabilities, accelerating industry development," "establishing a biotechnology start-up fund, attracting private investment," and "creating an internationally-linked legal and regulatory environment, assisting the development of the biomedical industry." The four main agencies responsible for the Diamond Action Plan and domestic and foreign experts jointly explored key problems and formulated strategies and action plans needed for the industry's development.

E. National Human Resources Development Conference

The Executive Yuan held the National Human Resources Development Conference in 2010 in order to confirm the direction of Taiwan's human resources development policy and reform strategies. This conference formulated a holistic human resources development policy and specific plans based on the consensus prevailing in government and society and the need to train, maintain, and use human resources. At the same time, in order to achieve the nation's S&T and industrial development goals, the conference also drafted specific measures in the areas of "training sufficient highly-skilled manpower," "development of human resources for emerging and key industries," "improvement of public affairs talent," "strengthening of linkage between education and industry," and "global deployment, enhancement of international competitiveness."

F. National Conference on Education

In the wake of the 1994 7th National Conference on Education, the 8th National Conference on Education was held in August 2010 for the purpose of achieving "refinement, innovation, justice, and sustainability" in education in line with the vision of a "new century, new education, new commitment." This conference sought to make the most of the soft power of education and boost national competitiveness on a broad base. The conference conclusions and recommendations will be converted to implementation strategies, which will be collected in a future white paper on educational policy.

G. National Energy Conference

Responding to the international energy situation and domestic and foreign environmental protection trends, as well as the need to accommodate economic development, the government has held three National Energy Conferences since 1998, and hopes that this conference will provide a forum for discussion, gather a wide range of views, and seek a consensus between government and the private sector.

The 2009 National Energy Conference focused on the six major principles of sustainable energy development, low-carbon energy development, repositioning of energy security, full-scale improvement of energy efficiency in all sectors, rationalization in energy prices, and development of energy science and technology. The conference also discussed the four core issues of sustainable development and energy security, improvement of energy management and efficiency, energy prices and market opening, and energy technology and industrial development. The conference's conclusions included "reducing greenhouse gas emissions to the 2000 level by 2025," "reducing energy intensity by at least 50% by 2025," and "developing an energy supply system that can sustain a national income of US$30,000 by 2015."

H. National Industrial Development Conference

The government has held a National Industrial Development Conference once every five years since 1986 for the purpose of drafting a comprehensive, forward-looking basis for industrial policies. However, responding to international economic trends and transformation of the country's industry structure, starting in 2001 the conference has been held once every three years in order to better stay abreast of industrial development changes. The 7th National Industrial Development Conference was held in 2010, addressed the central issue of "enhancing industry soft power and optimizing structural innovation mechanisms," and proposed "industry structure adjustment directions and strategies for 2020." Discussion at the conference was conducted in four sections respectively focusing on the issues of "how to boost Taiwan's international competitive advantage in the face of growing economic integration worldwide," "how to promote green industrial development in the face of the energy conservation/carbon reduction trend," "how to transform and strengthen industrial competitive elements, boosting product added value," and "how to adjust industry's human resources structure while boosting employment."

I. National Commerce Development Conference

The government held a first National Commercial Development Conference in 2009 in order to stay abreast of commercial development trends and future directions, and perform a full-scale review of Taiwan's commerce development policies. This conference formulated three major visions concerning the development of commerce in Taiwan: Transforming Taiwan into a "global franchise chain operating headquarters," "an Asia-Pacific operations center for Chinese-language e-commerce," and "an Asia-Pacific logistics value-adding site." The conference also discuss the topics of "environmental improvement: providing an optimal domestic commercial operating environment," "resources systematization: uncovering future opportunities for commercial development," "innovation in services: boosting commercial competitiveness," "globalization of commerce: expanding international perspectives in commerce," and "embracing the new cross-Strait situation and new commercial opportunities for Taiwan in the wake of the financial crisis."

2. 2 S&T Development Resources and Results

Based on its goal of making Taiwan a technologically-advanced nation, the government has actively committed funding to encourage academic research, innovative corporate R&D, and the development of superior human resources, with the ultimate goal of achieving academic excellence and boosting overall national competitiveness. Apart from steadily increasing input of S&T resources and training S&T manpower, which have yielded outstanding results, in recent years the government has also centralized R&D inputs, boosted manpower qualifications, and implemented supporting measures. The following is a detailed explanation:

I. Funding

A. Central government S&T budget

The government's S&T grew from NT$79.74 billion in 2006 to NT$94.19 billion in 2010. The annual growth rate was 1.47% in 2010, but averaged 6.07% over the most recent five years (see Table 2).

Table 2 Central government agency S&T development project budget allocation during the most recent five years

Units: NT$1 m

Agency	2006	2007	2008	2009	2010
National Science Council	33,848	35,007	36,686	39,385	40,494
Ministry of Economic Affairs	25,883	25,509	27,515	29,364	29,033
Academia Sinica	8,531	8,938	9,293	9,858	10,330
Department of Health	4,215	4,396	4,709	5,089	5,160
Council of Agriculture	3,995	4,264	4,033	4,142	4,255
Ministry of Education	839	889	1,535	1,560	1,691
Atomic Energy Council	827	992	1,137	1,292	1,090
Ministry of Transportation and Communications	711	818	841	888	922
Ministry of the Interior	270	373	456	363	347
Council of Labor Affairs	184	217	221	241	255
Ministry of Justice	24	47	81	85	89
Research, Development and Evaluation Commission	94	81	82	107	87
Council for Economic Planning and Development	50	49	54	84	75
Executive Yuan	43	43	45	74	72
Environmental Protection Administration	55	77	67	66	68
Council for Hakka Affairs	—	—	56	50	45
National Palace Museum	105	64	43	42	43
Government Information Office	—	31	36	32	28
Academia Historica	38	11	10	25	24
National Council on Physical Fitness and Sports	—	—	—	—	20
Public Construction Commission	31	25	20	20	18
Council of Indigenous Peoples	—	—	—	20	18
Overseas Chinese Affairs Commission	—	—	—	12	12
Central Personnel Administration	—	—	20	19	11
Council for Cultural Affairs	—	20	5	13	8
Total	79,742	81,853	86,946	92,830	94,193
Annual growth rate	13.24%	2.65%	6.22%	6.77%	1.47%

Source: Government S&T Program Review Working Group, National Science Council, Executive Yuan.

Notes: 1. The government S&T budget refers to the portion of the central government budget reviewed by the NSC.

2. The NSC's 2006, 2008, 2009, and 2010 budgets included supplementary fund of NT$2.138 billion, NT$800 million, NT$1.8 billion, and NT$1.8 billion respectively consisting of cumulative surplus from the National Science and Technology Development Fund.

B. National R&D funding

Taiwan's total national R&D funding grew at a consistent rate of over 6% over the most recent five years. National R&D funding as a share of GDP was 2.77% in 2008, and has also been growing steadily (see Table 3). In comparison with other major countries, Taiwan is on a par with the United States but still behind Japan and South Korea (Fig. 5) in terms of R&D funding as a share of GDP.

As shown in Table 3, the corporate sector contributes the largest share of R&D funding, followed by the government, the higher education sector, and private nonprofit sector. The corporate sector is the mainstay of R&D activity in Taiwan.

Table 3 R&D funding in Taiwan during the most recent five years－By implementing sector

Units: NT$1 m

Item	2004	2005	2006	2007	2008
National R&D funding	263,271	280,980	307,037	331,386	351,405
Growth rate (%)	8.37	6.73	9.27	7.93	6.04
Share of GDP (%)	2.32	2.39	2.51	2.57	2.77
Implementing sector					
Corporate sector	170,293	188,390	207,238	229,126	248,363
Government	61,144	59,143	60,965	60,643	58,928
Higher education sector	30,350	32,092	37,565	40,400	42,905
Private nonprofit sector	1,484	1,355	1,270	1,218	1,209

Source: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

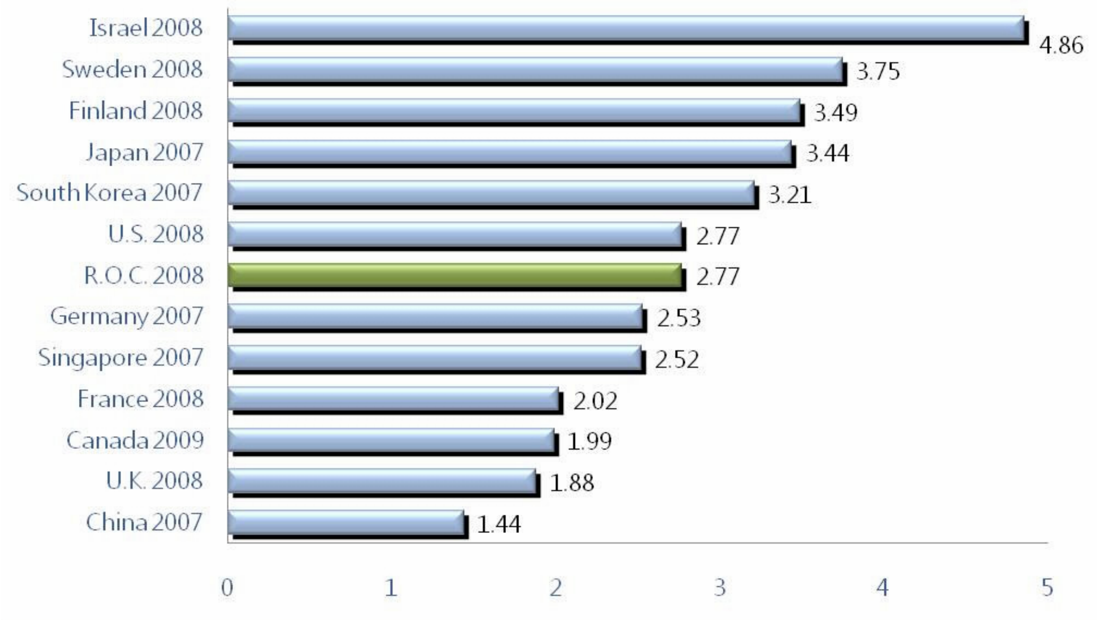

Figure 5　R&D funding as a share of GDP in various countries

Source: 1. ROC: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

2. Other countries: Main Science and Technology Indicators, 2009/2, OECD.

Table 4　R&D funding in Taiwan during the most recent five years－By source

Units: NT$1 m

	2004	2005	2006	2007	2008
Corporate sector	170,469	187,853	206,177	228,074	247,408
(percentage, %)	(64.8)	(66.9)	(67.2)	(68.8)	(70.4)
Government	88,499	88,633	96,443	98,966	99,260
(percentage, %)	(33.6)	(31.5)	(31.4)	(29.9)	(28.2)
Higher education sector	3,130	3,147	3,257	3,158	3,441
(percentage, %)	(1.2)	(1.1)	(1.1)	(1.0)	(1.0)
Private nonprofit sector	1,113	1,204	1,071	1,051	1,144
(percentage, %)	(0.4)	(0.4)	(0.3)	(0.3)	(0.3)
Foreign	60	144	91	137	153
(percentage, %)	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)
National R&D funding	263,271	280,980	307,037	331,386	351,405
Government R&D funding as a share of GDP (%)	0.78	0.75	0.79	0.77	0.78

Source: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

1. Sources of R&D funding: The corporate sector continued to contribute the largest share of R&D funding in Taiwan, and this share has climbed steadily over the most recent five years. The corporate sector's R&D funding accounted for 70.4% of all R&D funding in 2008, and was followed by the government's contribution of 28.2%. The government's relative share of national R&D funding has fallen steadily in recent years. The government's R&D funding as a share of GDP has remained in the range of 0.75%-0.79% during the past five years (Table 4).
2. The technology development has accounted for the share of R&D funding, and constituted 64.31% of all R&D in 2008. During that year, applied research was second with 25.51%, and basic research was last with 10.18%. With regard to implementing sector, corporate sector R&D 7 primarily consisted of technology development, but technology development as a share of total corporate sector R&D funding fell from 81.26% in 2004 to 79.86% in 2008. Government applied research and technology development R&D both accounted for roughly 40% of all government R&D funding; applied research funding was slightly greater than technology development R&D funding in 2008. R&D activity in the higher education sector primarily consisted of basic research; basic research accounted for 49.17% of all higher education R&D funding in 2008 (Table 5).

Table 5 R&D funding in Taiwan during the most recent five years－By R&D category and implementing sector

Units: NT$1 m

Implementing sector	R&D type	2004	2005	2006	2007	2008
Nationwide	Basic research	11.25%	10.31%	10.17%	10.02%	10.18%
	Applied research	25.33%	26.41%	26.47%	25.69%	25.51%
	Technology development	63.41%	63.28%	63.36%	64.30%	64.31%
	Total R&D funding	263,271	280,980	307,037	331,386	351,405
Corporate sector	Basic research	0.66%	0.46%	0.45%	0.42%	0.42%
	Applied research	18.08%	19.79%	20.18%	19.71%	19.71%
	Technology development	81.26%	79.75%	79.37%	79.87%	79.86%
	Total R&D funding	170,293	188,390	207,238	229,126	248,363
Government	Basic research	21.03%	20.48%	20.37%	20.04%	22.90%
	Applied research	37.25%	38.70%	38.72%	39.16%	39.36%
	Technology development	41.72%	40.83%	40.91%	40.80%	37.74%
	Total R&D funding	61,144	59,143	60,965	60,643	58,928
Higher education sector	Basic research	50.72%	49.07%	46.99%	49.38%	49.17%
	Applied research	39.71%	40.74%	39.76%	37.70%	38.44%
	Technology development	9.57%	10.19%	13.26%	12.93%	12.39%
	Total R&D funding	30,350	32,092	37,565	40,400	42,905
Private nonprofit department	Basic research	16.58%	16.75%	17.64%	10.43%	11.66%
	Applied research	72.57%	72.18%	71.50%	81.12%	81.64%
	Technology development	10.85%	11.07%	10.87%	8.37%	6.70%
	Total R&D funding	1,484	1,355	1,270	1,218	1,209

Source: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

3. Corporate sector R&D funding: Taiwan's corporate R&D funding grew

steadily over the most recent five years, and grew at an annual rate of over 10% from 2004 to 2007; this annual growth rate fell to 8.4% in 2008, however. Corporate R&D funding as a share of industrial added value increased from 1.91% in 2004 to 2.51% in 2008. This shows that Taiwan's companies place increasing emphasis on R&D (Table 6).

4. With regard to type of industry, most corporate R&D funding and contributed by manufacturers. Manufacturing accounted for approximately 92.78% of all corporate R&D funding in 2008, while service industries accounted for a mere 6.87%. As shown in Table 6, Taiwan's high-tech industries and ICT industry accounted for steadily rising shares of corporate R&D funding over the most recent five years, and accounted for 72.87% and 73.88% respectively in 2008 (Table 6).

Table 6 Corporate sector R&D funding during the most recent five years

Units: NT$1 m

Item	2004	2005	2006	2007	2008
Corporate sector R&D funding	170,293	188,390	207,238	229,126	248,363
Growth rate	11.58%	10.63%	10.00%	10.56%	8.40%
Share of industry added value	1.91%	2.04%	2.16%	2.26%	2.51%
Manufacturing R&D funding as a share of corporate sector R&D funding	91.59%	92.25%	92.05%	92.95%	92.78%
Service industry R&D funding as a share of corporate sector R&D funding	7.68%	7.16%	7.46%	6.60%	6.87%
High-tech industry R&D funding as a share of corporate sector R&D funding	69.78%	72.17%	70.97%	72.36%	72.87%
Information and communications technology (ICT) industry R&D funding as a share of corporate sector R&D funding	71.60%	73.35%	72.51%	73.50%	73.88%

Source: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

Notes: The scope of high-tech industry ICT industry comply with the OECD's definitions of these industries.

5. Higher education sector R&D funding: Taiwan's higher education sector R&D funding has maintained a growth rate of over 5.1% throughout the most recent five years. The chief funding source for higher education R&D is the government; the amount of such funding derives from corporate sources increased from 5.16% in 2004 to 6.00% in 2008, which shows that industrial/academic research collaboration is gradually growing in importance (Table 7).

Table 7 Higher education sector R&D funding during the most recent five years

Units: NT$1 m

Funding source	2004		2005		2006		2007		2008	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
Corporate sector	1,565	5.16%	1,854	5.78%	2,088	5.56%	2,146	5.31%	2,575	6.00%
Government	25,316	83.41%	26,738	83.32%	31,817	84.70%	34,706	85.91%	36,465	84.99%
Higher education sector	3,068	10.11%	3,103	9.67%	3,228	8.59%	3,133	7.75%	3,412	7.95%
Private nonprofit sector	380	1.25%	379	1.18%	405	1.08%	392	0.97%	389	0.91%
Foreign	20	0.07%	18	0.06%	27	0.07%	23	0.06%	64	0.15%
Total	30,350	100%	32,092	100%	37,565	100%	40,400	100%	42,905	100%
Growth rate	5.05%		5.73%		17.05%		7.55%		6.20%	

Source: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

II. Manpower Resources

A. Higher Education Manpower

In recent years, the number of students at the university level and above has increased rapidly, reaching 1,228,037 persons during the 2009 academic year. Science and technology account for the largest academic programs (Table 8).

Table 8 In-school student categories in Taiwan during the most recent five years

Units: persons

Level	Program category	A.Y. 2005	A.Y. 2006	A.Y. 2007	A.Y. 2008	A.Y. 2009
Ph.D. students	Humanities	14.38%	14.55%	15.15%	15.64%	16.37%
	Social sciences	15.69%	15.69%	15.65%	15.64%	15.27%
	S&T	69.94%	69.75%	69.22%	68.72%	68.36%
	Total persons	27,531	29,839	31,707	32,891	33,751
Master's students	Humanities	23.57%	23.35%	22.98%	22.98%	22.94%
	Social sciences	29.85%	30.40%	30.80%	31.04%	31.23%
	S&T	46.58%	46.24%	46.22%	45.98%	45.82%
	Total persons	149,493	163,585	172,518	180,809	183,401
Undergraduates	Humanities	16.26%	16.13%	16.36%	16.59%	16.98%
	Social sciences	37.35%	37.44%	37.43%	37.82%	38.06%
	S&T	46.40%	46.43%	46.21%	45.59%	44.96%
	Total persons	938,648	966,591	987,914	1,006,102	1,010,885
Total students		1,115,672	1,160,015	1,192,139	1,219,802	1,228,037

Source: MOE.

Notes: 1. The humanities include education, art, humanities, and other (including athletics).

2. The social sciences include economics, sociology, psychology, business management, law, tourist services, mass communications, and home economics (excluding food & nutrition).

3. S&T includes the natural sciences, mathematics, computer science, pharmaceuticals & health, industrial arts, engineering, architecture, urban planning, agriculture, forestry, fishing, animal husbandry, transportation, communications, and food and nutrition.

The number of higher education graduates rose from 252,707 persons in the 2004 academic year to 289,148 in the 2008 academic year (see Table 9). Since the number of persons receiving Bachelor's degrees decreased during the 2008 academic year, the overall number of graduates rose by only 0.5% compared with the 2007 academic year; the number of graduates receiving Ph.D. degrees increased the most in the 2008 academic year, growing by 14.3% compared with the year before.

Table 9 Number of graduates of higher education in Taiwan during the most recent five years

Units: persons

Level	Program category	A.Y. 2004	A.Y. 2005	A.Y. 2006	A.Y. 2007	A.Y. 2008
Ph.D. students	Humanities	305	399	367	431	493
	Social sciences	348	397	443	552	604
	S&T	1,512	1,818	2,043	2,157	2,492
	Total persons	2,165	2,614	2,853	3,140	3,589
Master's students	Humanities	7,383	7,636	8,496	9,583	10,155
	Social sciences	12,299	13,652	14,636	16,637	17,977
	S&T	20,097	24,448	26,844	28,167	29,542
	Total persons	39,779	45,736	49,976	54,387	57,674
Undergraduates	Humanities	32,705	34,052	35,184	35,696	35,523
	Social sciences	80,136	83,999	87,096	86,806	88,337
	S&T	97,922	101,868	106,365	107,696	104,025
	Total persons	210,763	219,919	228,645	230,198	227,885
Total students		252,707	268,269	281,474	287,725	289,148

Source: MOE.

Notes: 1. The humanities include education, art, humanities, and other (including athletics).

2. The social sciences include economics, sociology, psychology, business management, law, tourist services, mass communications, and home economics (excluding food & nutrition).

3. S&T includes the natural sciences, mathematics, computer science, pharmaceuticals & health, industrial arts, engineering, architecture, urban planning, agriculture, forestry, fishing, animal husbandry, transportation, communications, and food and nutrition.

B. National R&D manpower

R&D manpower includes research personnel, technical personnel, and support personnel, and the number of personnel in all categories grew over the most recent five years. In particular, the number of research personnel group at the fastest rate, and accounted for approximately 59.6% of all R&D personnel in 2008. The percentage of support personnel has fallen in recent years (see Table 10).

The relative number of R&D personnel in the general population has grown steadily during the most recent five years, and reached 10.6 person-years FTE per 1,000 working persons in 2008. This surpassed the target 9.7 person-years FTE set for 2009. In addition, the relative number of research personnel in Taiwan is less than that in Finland, Japan, and Sweden, but higher than that of the US, South Korea, France, Canada, Germany, Russia, Britain, and China (see Fig. 6).

The number of female research personnel rose steadily from 14,683 person-years in 2004 to 20,746 person-years in 2008. However, there has been no significant change in the percentage of female research personnel among all research personnel (Table 10).

Table 10 R&D manpower in Taiwan during the most recent five years

Units: FTE

Item	2004	2005	2006	2007	2008
R&D manpower	138,604	149,154	161,314	175,741	184,633
Research personnel	81,209	88,859	95,176	103,455	110,089
Share of all R&D manpower	58.59%	59.58%	59.00%	58.87%	59.63%
Technical personnel	47,568	49,471	54,519	59,868	62,936
Share of all R&D manpower	34.32%	33.17%	33.80%	34.07%	34.09%
Support personnel	9,827	10,824	11,619	12,418	11,608
Share of all R&D manpower	7.09%	7.26%	7.20%	7.07%	6.29%
Research personnel per 1000 employment	8.3	8.9	9.4	10.0	10.6
Female research personnel	14,683	16,563	18,558	19,650	20,746
Share of all research personnel	18.08%	18.64%	19.50%	18.99%	18.84%

Source: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

Notes: R&D manpower is measured in terms of full-time equivalents (FTE), which refer to the number of persons engaging in R&D work converted to the number of persons performing that work on a full-time basis, and has units of person-years.

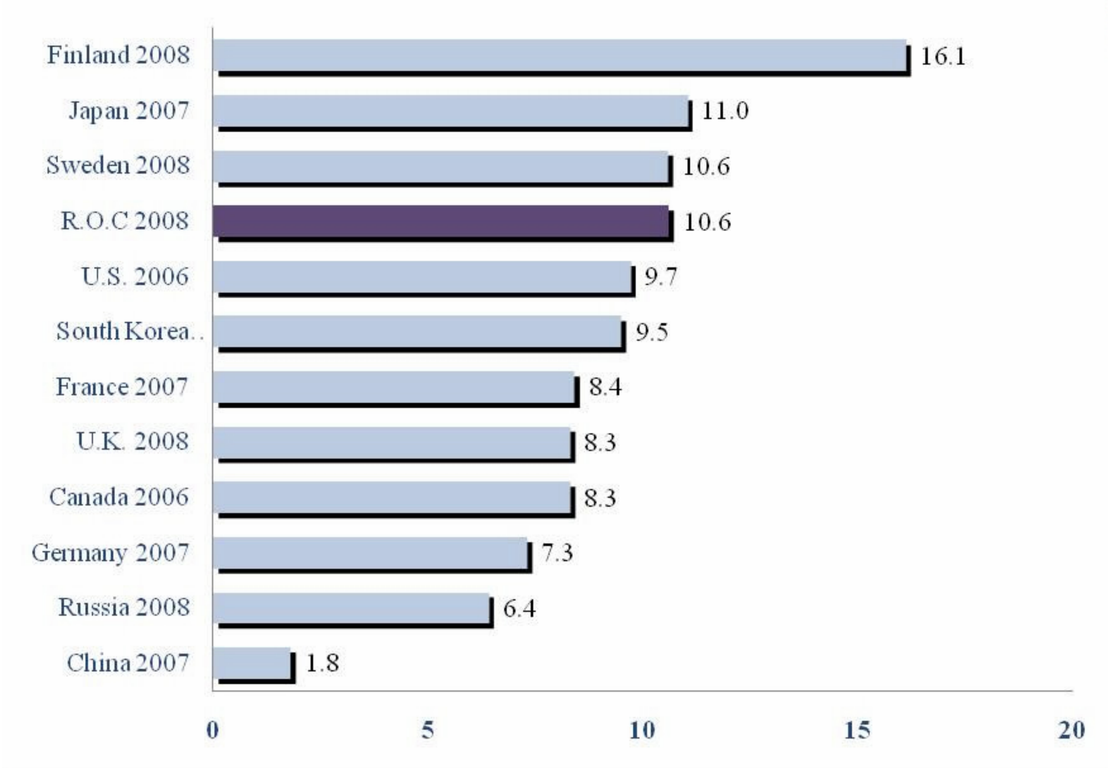

Figure 6　Number of research personnel per 1000 employment in various countries

Source: 1. ROC: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

2. Other countries: Main Science and Technology Indicators, 2009/2, OECD.

1. R&D manpower in different sectors: Research personnel have constituted the largest share of R&D manpower over recent years, followed by technical personnel, with support personnel last (Table 11). In 2008, research personnel accounted for 89.25% of higher education sector R&D manpower. Technical personnel constituted the largest share of R&D manpower in the corporate sector, where they accounted for 41.31% of all personnel. Support personnel accounted for less than 13% of all R&D personnel in all sectors.

Table 11 R&D manpower in Taiwan during the most recent five years (ratio by implementing sector)

Units: FTE, %

Implementing sector	Manpower type	2004	2005	2006	2007	2008
Corporate sector	Research personnel	51.89%	52.94%	52.81%	52.79%	52.99%
	Technical personnel	42.32%	41.01%	41.24%	41.46%	41.31%
	Support personnel	5.79%	6.04%	5.95%	5.75%	5.69%
	Total persons	89,882	96,714	106,262	118,005	128,036
Government	Research personnel	53.83%	53.71%	52.23%	52.19%	56.73%
	Technical personnel	31.63%	31.17%	32.22%	31.84%	30.86%
	Support personnel	14.54%	15.12%	15.55%	15.97%	12.40%
	Total persons	24,674	25,673	26,684	27,409	24,522
Higher education sector	Research personnel	89.55%	90.01%	89.41%	89.37%	89.25%
	Technical personnel	6.62%	6.16%	6.85%	6.74%	7.04%
	Support personnel	3.83%	3.83%	3.75%	3.89%	3.71%
	Total persons	23,017	25,752	27,439	29,351	31,118
Private nonprofit sector	Research personnel	65.57%	67.85%	63.51%	64.18%	57.99%
	Technical personnel	19.30%	21.30%	24.11%	24.16%	29.15%
	Support personnel	15.13%	10.95%	12.38%	11.67%	12.96%
	Total persons	1,031	1,014	929	977	957

Source: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

2. Educational qualifications of research personnel: The number of research personnel in Taiwan has increased steadily over the most recent five years, and the number of Master's degree holders has increased the most; Master's degree holders now account for more than half of all research personnel in Taiwan. PhD-holding personnel have grown at the next fastest rate, and the number of Bachelors degree holders has grown steadily with some small fluctuations (Table 12).

Table 12 Distribution of educational level among research personnel in Taiwan during the most recent five years

Units: FTE, %

Educational level	2004	2005	2006	2007	2008
Ph.D.	14,655	15,450	16,792	18,258	19,574
Share of all research personnel	18.0%	17.4%	17.6%	17.6%	17.8%
Master's degree	41,657	47,056	49,545	53,999	57,791
Share of all research personnel	51.3%	53.0%	52.1%	52.2%	52.5%
Bachelor's degree	24,898	26,353	28,839	31,197	32,725
Share of all research personnel	30.7%	29.7%	30.3%	30.2%	29.7%
Total research personnel	81,209	88,859	95,176	103,454	110,089

Source: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

III. Results

A. National competitiveness

According to the 2010 global competitiveness rankings announced by the World Economic Forum (WEF), had a rank of 13th worldwide, and its position was basically unchanged compared with 2009. The fact that Taiwan ranked 7th in the world in the "innovation" category and 11th in the world in the "higher education and training" category suggests that Taiwan's promotion of S&T development has paid off in the form of increased international competitive potential (Table 13).

According to the Lausanne International Institute for Management Development's (IMD) 2010 world competitiveness rankings, Taiwan had an overall rank of 8th, which was dramatically improved from its 15th place in 2009; among science and technology-related items, Taiwan ranked 5th worldwide in both the "technological development" and "scientific development" categories (Table 14).

Table 13 Taiwan's global competitiveness according to the World Economic Forum

Ranking item	Switzerland	Sweden	Singapore	USA	Germany	Japan	Finland	Netherlands	Denmark	Canada	Britain	**Taiwan**	Korea	Israel	China	Ireland
Global competitiveness index	1	2	3	4	5	6	7	8	9	10	12	**13**	22	24	27	29
1. Basic needs	1	3	2	32	6	26	4	9	7	11	18	**19**	23	39	30	35
(1) Institutions	7	2	1	40	13	25	4	12	5	11	17	**35**	62	33	49	24
(2) Infrastructure	6	10	5	15	2	11	17	7	13	9	8	**16**	18	34	50	38
(3) Macroeconomy	5	13	32	87	22	105	14	24	15	35	56	**20**	6	60	4	95
(4) Health and primary education	7	18	3	42	25	9	2	8	20	6	19	**11**	21	46	37	10
2. Efficiency improvement	4	5	1	3	13	11	14	8	9	6	7	**16**	22	23	29	25
(1) Higher education and training	4	2	5	9	19	20	1	10	3	8	18	**11**	15	33	60	23
(2) Good market efficiency	4	5	1	26	21	17	24	8	13	11	22	**15**	38	37	43	14
(3) Labor market efficiency	2	18	1	4	70	13	22	23	5	6	8	**34**	78	19	38	20
(4) Technological readiness	7	1	11	17	10	28	15	3	6	16	8	**20**	19	26	78	21
3. Innovation factors	2	3	10	4	5	1	6	8	9	14	12	**7**	18	11	31	21
(1) Business sophistication	4	2	15	8	3	1	10	5	7	16	9	**13**	24	26	41	20
(2) Innovation	2	5	9	1	8	4	3	13	10	11	14	**7**	12	6	26	22

Source: World Economic Forum (WEF), The Global Competitiveness Report 2010-2011.

Table 14 Taiwan's global competitiveness according to the IMD

Ranking item	Singapore	Hong Kong	USA	Switzerland	**Taiwan**	Denmark	China	Ireland	Korea	Thailand	Japan	India
Overall rank	1	2	3	4	**8**	13	18	21	23	26	27	31
1. Economy performance	5	4	1	10	**16**	30	3	22	21	6	39	20
2. Governmental effectiveness	2	1	22	3	**6**	11	25	19	26	18	37	30
3. Corporate efficiency	1	2	13	7	**3**	11	28	18	27	20	23	17
4. Infrastructure	11	23	1	3	**17**	5	31	24	20	46	13	54
(1) Basic development	17	25	11	6	**21**	7	12	39	20	26	18	53
(2) Technological development	2	3	1	14	**5**	6	22	27	18	48	23	38
(3) Scientific development	12	28	1	9	**5**	19	10	21	4	40	2	34
(4) Health and environment	18	23	20	3	**24**	5	54	13	27	51	11	58
(5) Education	13	30	21	4	**23**	3	46	16	35	47	29	58

Source: International Institute for Management Development (IMD), The World Competitiveness Yearbook 2010.

According to the Innovation for Development Report 2010-2011 published by the European Business School in 2010, Taiwan's ranked 9th out of 131 countries in the Innovation Capacity Index (ICI) category, and this position was an increase of four places compared with the previous year. Among the various categories compared, Taiwan ranked an outstanding 4th place in the "research and development" category, and within this category it ranked 4th in terms of "R&D infrastructure" and 5th in terms of "patents and trademarks." This shows that Taiwan has demonstrated excellent innovation ability and fine overall S&T performance on the international stage (Table 15).

Table 15 Taiwan's global innovation ability rank according to the European Business School

Item	USA	Switzerland	Singapore	Denmark	**Taiwan**	Japan	Hong Kong	Ireland	Korea	Thailand	China	India
Overall rank	5	2	3	6	**9**	16	13	18	11	45	64	88
I. Institutional environment	27	6	10	3	**29**	40	2	21	34	66	58	75
1. Good governance	19	4	8	1	**31**	18	16	14	35	71	70	65
2. National policy	97	7	13	9	**28**	125	2	106	47	52	24	93
II. Human capital, training, and social tolerance	15	8	31	4	**17**	34	51	12	35	62	78	97
1. Education	10	36	41	1	**9**	38	66	25	7	51	89	102
2. Social tolerance and equitable policies	18	6	25	7	**21**	33	40	13	47	72	72	85
III. Legal and regulatory framework	5	44	2	13	**45**	29	3	9	51	10	70	89
1. Convenience of doing business	5	44	2	13	**45**	29	3	9	51	10	70	89
IV. Research and development (R&D)	9	1	10	13	**4**	6	24	17	5	55	49	74
1. Basic R&D infrastructure	12	11	5	10	**4**	7	25	26	6	64	55	73
2. Patent rights and trademarks	7	1	10	24	**5**	3	22	11	4	55	40	89
V. Use of information & communications technology (ICT)	12	4	13	5	**15**	24	6	17	10	64	85	96
1. Telephone communications	12	1	21	16	**5**	31	4	14	17	73	118	76
2. Mobile phone communications	78	42	22	58	**73**	80	13	17	15	75	94	111
3. Internet, computers, and television	8	3	18	7	**12**	21	11	22	17	78	64	102
4. Government ICT use	2	18	11	7	**–**	17	–	21	1	66	63	89
5. Infrastructure quality	42	9	4	2	**–**	27	22	13	28	15	39	89

Source: European Business School (European Business School, EBS), Innovation for Development Report 2010-2011.

B. S&T development result indicators

S&T development result indicators include papers in academic periodicals, patents, value of technological trade, e-competitiveness, and value of high-tech products.

1. Papers in academic periodicals: The number of research papers by authors from Taiwan cited in *Science Citation Index* (*SCI*) and *Engineering Index* (*EI*) has grown rapidly, and the number of SCI–cited papers has increased the fastest. This indicates that scientific research in Taiwan is yielding very promising results.

2. Patents: In 2009 Taiwan was ranked 5th in terms of approved US patents (excluding new design patents). Although Taiwan's rank has changed little in recent years, the number of approved US patents received by applicants from Taiwan has grown steadily (see Tables 16 and 17). However, the fact that Taiwan's current impact index (CII) has been below average in recent years, and is falling, indicates that Taiwan's patents are relatively seldom cited (Table 18). Because of this, while continuing to emphasize quantitative growth, Taiwan must also increase attention to the quality of its patents.

3. Value of technological trade: In terms of value of technological trade, technological imports and technological exports both exhibited stable growth, and Taiwan's technological trade revenue to expense ratio also displayed a rising trend (Table 16).

Table 16 Taiwan's S&T development results during the most recent five years

Item	2004	2005	2006	2007	2008
Number of papers in academic periodicals					
SCI papers	13,621	16,721	17,846	18,571	22,509
EI papers	10,980	11,661	13,076	16,657	17,483
Number of patents (excluding new design patents)					
Number of approved US patents to Taiwan applicants (patents)	5,938	5,118	6,361	6,128	6,339
Percentage of total US patents	3.6%	3.6%	3.7%	3.9%	4.0%
Value of technological trade					
Technological exports (NT$1 m)	8,942	13,257	—	16,804	—
Technological imports (NT$1 m)	52,156	57,133	—	65,171	—
Revenue to expense ratio of technological trade	0.17	0.23	—	0.26	—

Source: Indicators of Science and Technology, ROC, 2009, National Science Council, Executive Yuan.

Notes: With regard to value of technological trade, the MOEA did not conduct its Factory Correction and Operation Survey in 2006, and 2008 data has not been announced.

Table 17 Taiwan's approved US patents during the most recent five years (excluding new design patents) and rank

	2005			2006			2007			2008			2009		
	Patents	Rank	%	Patents	Rank	%	Patents	Rank	%	Patents	Rank	%	Patents	Rank	%
USA	74,637	1	51.9%	89,823	1	51.7%	79,526	1	50.6%	77,501	1	49.1%	82,382	1	49.2%
Japan	30,341	2	21.1%	36,807	2	21.2%	33,354	2	21.2%	33,682	2	21.4%	35,501	2	21.2%
Germany	9,011	3	6.3%	10,005	3	5.8%	9,051	3	5.8%	8,915	3	5.7%	9,000	3	5.4%
South Korea	4,352	5	3.0%	5,908	5	3.4%	6,295	4	4.0%	7,549	4	4.8%	8,762	4	5.2%
Taiwan	**5,118**	**4**	**3.6%**	**6,361**	**4**	**3.7%**	**6,128**	**5**	**3.9%**	**6,339**	**5**	**4.0%**	**6,642**	**5**	**4.0%**
Canada	2,894	7	2.0%	3,572	7	2.1%	3,318	6	2.1%	3,393	6	2.2%	3,655	6	2.2%
Britain	3,148	6	2.2%	3,585	6	2.1%	3,292	7	2.1%	3,094	8	2.0%	3,175	7	1.9%
France	2,866	8	2.0%	3,431	8	2.0%	3,130	8	2.0%	3,163	7	2.0%	3,140	8	1.9%
China	402	18	0.3%	661	16	0.4%	773	16	0.5%	1,226	12	0.8%	1,655	9	1.0%
Israel	925	13	0.6%	1,220	13	0.7%	1,108	12	0.7%	1,167	13	0.7%	1,404	10	0.8%
Total approvals	143,806		100%	173,772		100%	157,282		100%	157,722		100%	167,349		100%

Source: U.S. Patent and Trademark Office.

Table 18 Current impact index (CII) of invention patents from major countries

Country	2005	2006	2007	2008	2009
Taiwan	**0.86**	**0.91**	**0.85**	**0.85**	**0.79**
USA	1.20	1.25	1.21	1.23	1.24
Japan	0.86	0.74	0.82	0.78	0.75
Germany	0.56	0.50	0.54	0.54	0.53
France	0.56	0.58	0.58	0.57	0.56
Britain	0.76	0.83	0.87	0.87	0.85
Italy	0.51	0.51	0.53	0.52	0.50
Canada	0.95	0.98	0.97	0.99	1.00
South Korea	0.91	1.05	0.82	0.83	0.81

Source: U.S. Patent and Trademark Office database, calculations by Taiwan Institute of Economic Research (TIER).

4. E-competitiveness: According to the ranking in the 2010 World Economic Forum's Global Information Technology Report, 2009-2010," Taiwan's Networked Readiness Index (NRI) rose from 13th in 2008 to 11th in 2010, showing that Taiwan's e-competitiveness is strong and improving (Table 19).

Table 19 Taiwan's Networked Readiness Index rank

Country	2008	2009	Change in rank
Sweden	2	1	1
Singapore	4	2	2
Denmark	1	3	-2
Switzerland	5	4	1
USA	3	5	-2
Finland	6	6	0
Canada	10	7	3
Hong Kong	12	8	4
Netherlands	9	9	0
Norway	8	10	-2
Taiwan	**13**	**11**	**2**
Iceland	7	12	-5
Britain	15	13	2
Germany	20	14	6
Korea	11	15	-4

Source: World Economic Forum, Global Information Technology Report, 2007-2008, 2008-2009, 2009-2010.

5. Value of technological products: In 2009, Taiwan was the world's leading producer of many information and communications products, showing Taiwan's important role in the development of the ICT industry. In addition, thanks to the government's support for the health care industry in recent years, such health industry products as electric scooters and green algae have been successfully marketed worldwide (see Table 20).

Table 20 Taiwan's major industries/products among the world's top three in 2009 (excluding overseas production)

Ranked 1st worldwide			Ranked 2nd worldwide			Ranked 3rd worldwide		
Item (7)	Value (US$1 m)/ volume	Global market share %	Item (13)	Value (US$1 m)/ volume	Global market share %	Item (7)	Value (US$1 m)/ volume	Global market share %
Wafers	12,091	65.20%	IC design	10,525	23.20%	Printed circuit boards	4,950	14.30%
Mask ROM	345	99.40%	DRAM	3,511	15.70%	Polyurethane (PU) synthetic leather	34,619 kiloyards	3.20%
IC packaging	6,048	45.70%	WLAN	117	5.50%	Polyester fiber	1.02 m tons	5.15%
IC testing	2,655	70.50%	PND	2,007	36.50%	Nylon fiber	287,000 tons	8.20%
CDs	1,426	57%	Large TFT LCD panels (>10”)	20,127	33.10%	PTA	3577	10.90%
	12,194 million	63%					4.41 m tons	11.30%
Green algae	873 Tons	50.50%	Medium/small TFT LCD panels (<10”)	4,120	23.80%	TPE	242,000 tons	13.90%
			OLED panels	225	29.50%	β-carotene	35 tons	4%
			IC substrate	1,420	20.00%			
			Glass fiber fabric	271	30.30%			
			Electric scooters and electric wheelchairs (mobility vehicles for the disabled)	167,000	23.20%			
			LED	1,292	18.60%			
			ABS	1.25 m tons	19.10%			

Source: ITIS Project, Department of Industrial Technology ITIS.

2. 3 Major S&T Achievements and Plans

The world's leading countries have universally made human safety and prosperity and the sustainability of the ecological environment the core values of their S&T development policies. The government of Taiwan is also actively encouraging innovative R&D and promoting numerous important S&T policies and plans. The major science and technology programs integrate Taiwan's academic and S&T achievements via mechanisms cooperation between industry, academia, and research organizations, and hope to use relevant research results to improve citizens' lives and stimulate the sprouting of the next generation of tech industries.

I. Major Government Actions and Plans

A. National Science and Technology Development Plans

The Fundamental Science and Technology Act states: "Taking into consideration the direction of national development, the needs of society, and the goal of balanced regional development, the government should draft a national science and technology development plan once every four years to serve as a basis for the formulation of scientific and technological policy." The Executive Yuan held the 8th National Science and Technology Conference in January 2009 order to study and discuss the state of S&T development in Taiwan, the overall objectives of S&T development, planning of strategies and resources, developmental goals for different sectors and fields, and other important matters concerning S&T development. The "National Science and Technology Development Plan, 2009-2012 and quote was subsequently drafted on the basis of the consensus and conclusions of this conference. This plan serves as the current blueprint for Taiwan's S&T policies and implementation of S&T research and development.

The six major goals of the current plan consist of: (1) strengthening the knowledge innovation system; (2) creating an industrial competitive and image; (3) improving all citizens' quality of life; (4) promoting sustainable national development; (5) enhancing national standards of science and technology; and (6) strengthening autonomous defense technology. The following six strategies have been formulated in order to achieve these goals: Strategy I: Linking science and technology with the humanities, raising the quality of life; Strategy II: Cultivating S&T manpower, using human resources in the most effective manner; Strategy III: Putting the legal system on a sound footing, integrating S&T resources; Strategy IV: Pursuing academic excellence, strengthening social concern; Strategy V: Strengthening S&T innovation, improving the industry environment; Strategy VI: Harnessing S&T capabilities to promote sustainable development. A total of 144 key measures have been established under these strategies. Following approval by the Executive Yuan, 23 agencies have embarked on implementation of these measures; the chief responsible agency for each measure drafts implementation plans, and proposes annual focal points and specific progress indicators.

B. The i-Taiwan 12 Project

The government approved the "i-Taiwan 12 Project" in 2009; this project promotes development in the four major areas of transportation, industrial innovation, urban-rural development, and environmental conservation, and seeks to increase domestic demand, improve the investment environment, strengthen the country's economic constitution, and enhance quality of life. The projects first priority is to implement 12 infrastructure undertakings between 2009 and 2016 for the purpose of improving national infrastructure, boosting competitiveness, expediting Taiwan's economic growth, and outdoing competitors. The competent authorities in charge of major projects are shown in Table 21.

The projects overall funding needs are estimated to be NT$3.99 trillion, of which roughly NT$2.79 will come from the government budget and NT$1.20 will take the form of private investment. The project is forecast to promote the development of industrial innovation, increase domestic investment, revitalize Taiwan's economy, improve life quality, and balance regional development.

Table 21 Competent authority in charge of major projects

Project	Competent authority	Integrating agency
Overall project	Council for Economic Planning and Development	Council for Economic Planning and Development
1. A convenient Island-Wide Transportation Network	MOTC, MOI, National Council on Physical Fitness and Sports	MOTC
2. Redevelopment of Kaohsiung harbor	MOTC, Council for Economic Planning and Development, MOEA	MOTC
3. Development of New High-Tech Industry Clusters in Central Taiwan	NSC, MOEA, Council for Economic Planning and Development, MOTC, MOE	NSC
4. Taoyuan International Air City	MOTC, MOEA, Taoyuan County government	MOTC
5. Intelligent Taiwan	MOE, MOEA, Council for Cultural Affairs, Government Information Office, Executive Yuan Science and Technology Advisory Group	Executive Yuan Science and Technology Advisory Group,
6. Industrial Innovation Corridor	MOEA, NSC, COA	MOEA
7. Renewal of Cities and Industrial Districts	MOI, MOEA, MOTC	MOI
8. Revitalization of Farming Villages	COA, MOI	COA
9. Coastal Renewal	COA, MOEA, MOTC, MOI, Council for Economic Planning and Development	COA
10 Green Reforestation	COA	COA
11. Flood Prevention	MOEA, COA, MOI, Council of Indigenous Peoples	MOEA Council of Indigenous Peoples
12. Sewer Construction	MOI	MOI

C. Four Major Emerging Intelligent Industries

In order to develop intelligent industries, harness innovative development capabilities, stimulate economic prosperity, and plant the seeds of long-term industrial development competitiveness, apart from the Six Major Emerging Industries, the government's S&T policy implementation units are also promoting the Four Major Emerging Intelligent Industries—Cloud Computing, Intelligent Electric Vehicles, Intelligent Green Architecture, and Industrialization of Invention Patents. The government pledges that he will commit funding of at least NT$15.0 billion to this program over the next six years; the program will take advantage of Taiwan's strengths and resources in the area of information and communications technology, dovetail with global energy conservation and carbon emission reduction trends and opportunities, and catalyze new opportunities for industrial growth in Taiwan.

"Cloud Computing Industry Development Program": This program seeks to (1) establish a cloud computing environment; (2) promote cloud system products featuring hardware and software integration; (3) encourage the development of intelligent terminal products and value-added application services; (4) urging industry investment in the use of cloud tools, accelerating transformative upgrading; and (5) promoting the ubiquity of cloud applications in five key aspects of industry and life. The Cloud Computing Program will involve total investment of NT$24.0 billion during the five-year period from 2010 to 2014.

The "Intelligent Electric Vehicle Development Strategy and Action Plan" seeks to make Taiwan globally synonymous with smart electric vehicles by 2016, and fulfill the policy objective of making Taiwan a "low-carbon island." This program has the following five developmental strategies: (1) establishment of a smart electric vehicle development environment on the basis of environmental, energy conservation, and carbon emission reduction considerations; (2) promotion of smart electric vehicle demonstration activities; (3) enhancement of electric vehicle purchase incentives for consumers; (4) creation of an environment encouraging smart electric vehicle use; (5) guidance of the industry's development. This program will have a planned investment of NT$9.7 billion during three stages; the program seeks to make Taiwan one of the world's five leading exporters of smart electric vehicles by 2020, and achieve the annual export of more than one million electric vehicles.

The "Smart Green Architecture Development Promotion Program" is promoting the integration of the construction, ICT, energy conservation, and technical service industries in order to stimulate the development of new industry chains and encourage the emergence of intelligent green architecture. This program has a planned investment of NT$3.22 billion over a six-year.

The "Invention Patent Industrialization Development Program" calls for (1) the establishment of a value-added patent consulting center; (2) the strengthening of TWTM service functions; (3) assistance for commercialization certification services; (4) integration of government resources in order to better assist commercialization of corporate patent; (5) assistance for individual patent-folder start-up incubation and development of new products; and (6) strengthening of the commercialization of the results of government technology development programs. This program as planned investment of NT$11.8 billion between 2010 and 2015.

D. Six Major Emerging Industries

At the February 21, 2009 "Conference on Contemporary Macroeconomic Trends and Response Measures," President Ma Ying-Jeou proposed: "Within three months, the government should submit tangible strategies for improving Taiwan's industrial development plans, including such aspects as diversification of export products, greater emphasis on brands, and acquisition of key technologies. In particular, the country must commit even greater resources to such key emerging industries as tourism and travel, healthcare, biotechnology, green energy, cultural creativity, and boutique agriculture. We must seek to expand the scale of these industries, boost their output value, and encourage and attract private investment. At the same time, we must increase our assistance for the development of conventional industries, and help them take advantage of new market opportunities." In line with these suggestions, the Executive Yuan entrusted six agencies (Executive Yuan Science and Technology Advisory Group, MOTC, MOEA, DOH, COA, and Council for Cultural Affairs) with the task of planning and implementing development programs for the Six Major Emerging Industries—"Taiwan Diamond Action Plan for Biotech Takeoff," "Project Vanguard for Excellence in Tourism," "Dawning Green Energy Industry Program," "Healthcare Upgrade Platinum Program," "Quality Agriculture and Health Excellence Program," and "Cultural & Creative Industries Development Plan."

The development strategy laid out by the "Taiwan Diamond Action Plan for Biotech Takeoff" calls for boosting of industrialization R&D capacities in order to strengthen the commercialization and transfer of upstream R&D results; promotion of biotechnology integration and incubation mechanisms providing needed services for budding industries; establishment of a biotechnology start-up fund encouraging private investment; and establishment of a food and drug management bureau and development of pharmaceutical legal environment in tune with international norms.

The development strategy for the "Project Vanguard for Excellence in Tourism" includes the establishment of seamless travel information and feeder services, and the transformation of tourist destinations with existing advantages into international attractions; training of international tourist manpower meeting the industry's needs, improving the business constitution of the tourism industry; and the expansion and deepening of emerging markets, and promotion of transaction security and oversight measures such as quality audits in the travel industry, enhancing the tourism industry's added value.

The "Dawning Green Energy Industry Program" focuses on the photovoltaic, LED lighting, wind power, hydrogen energy and fuel cell, biofuel, energy ICT, and electric vehicle industries, and seeks to establish a green energy industry development environment, expand domestic demand and promote exports, establish Taiwan as an energy technology and production power, and shape Taiwan's image as a force for energy conservation and emissions reduction through technological breakthroughs and investment in key areas.

The "Healthcare Upgrade Platinum Program" seeks to stimulate the development of relevant industries and core technologies, and polish Taiwan's health care service brand, by expanding the scope of current medical service systems into the areas of health promotion, long-term care, intelligent medical services, international health care, and biotech pharmaceuticals.

The "Quality Agriculture and Health Excellence Program" chiefly seeks to develop genetic seed selection and high-performance/high biosafety bio-production technologies, take advantage of tourism and cultural creativity to deepen recreational farming and other new business models, foster healthy, outstanding, LOHAS boutique agriculture, and reliance on natural living spaces to enhance citizens' quality of life and well-being.

The "Cultural & Creative Industries Development Plan" primarily seeks to promote the six major flagship industries of TV, film, popular music, digital content, design, and craftsmanship, targets Chinese-language markets, and relies on clustering effects in creative industries, the expansion of domestic and foreign consumer markets, the easing of legal restrictions, the flow of investment, industry-oriented R&D, and development of key human resources to create a sound development environment.

The government has completed planning of development strategies and subprojects for the Six Major Emerging Industries. It is preliminarily estimated that the government will provide more than NT$200 billion in funds to the six development programs between 2009 and 2012. The expected benefits of the development programs are shown in Table 22.

Table 22 Expected benefits of development strategies for the Six Major Emerging Industries

Units: NT$

	Output value/revenue (to 2013)	Increased employment (to 2013)	Investment attracted
Biotechnology	NT$260.0 billion	50,000 persons	At least NT$54 billion annually (private)
Tourism	NT$550.0 billion	400,000 persons	NT$200 billion (private)
Green energy	NT$475.2 billion	110,000 persons	NT$200 billion (private)
Health care	NT$356.4 billion	310,000 persons	—
Boutique agriculture	NT$158.9 billion	31,000 persons	NT$86.4 billion (government)
Cultural creativity	NT$1 trillion	200,000 person	NT$900 million (private)

Source: Executive Yuan Six Major Emerging Industries web site

E. Promotion of service industry development

Service industries are at the heart of the country's economic activity. Taiwan's service industries generated an overall output in excess of NT$8.6 trillion in 2009, which accounted for 68.7% of GDP. The service sector employed an average of 6.05 million persons during 2009, which accounted for 58.9% of total employment. In view of the fact that numerous competent authorities are in charge of service industries, the Executive Yuan established the "Executive Yuan Service Industry Promotion Task Force" in December 2009 in order to boost integration of relevant resources. The chairman of the Council for Economic Planning and Development (CEPD) is the convener of this interagency platform, which seeks to coordinate the easing of obstacles to service industry investment, and foster the establishment of a sound service industry develop environment.

In addition, the government has selected ten key service industry areas for focused development assistance; these areas are international health care, international logistics, music and digital content, exhibitions and trade shows, globalization of fine food, urban renewal, WiMAX, Chinese-language e-commerce, export of higher education, and high-tech and innovative enterprise fund-raising platforms. All relevant competent authorities have drafted relevant action plans, and the CEPD will regularly monitor the state of implementation in the ten key industries to ensure that the preset goals will be achieved on time and on quality. The government hopes that promoting the development of service industries will improve the public's standard of living.

F. Framework for Taiwan's Sustainable Energy Policy

Responding to the growing to national attention accorded to environmental and energy issues, the world's leading countries have been actively drafting carbon dioxide emission reduction strategies in the wake of the Kyoto Protocol. The Executive Yuan accordingly passed the Framework for Taiwan's Sustainable Energy Policy on June 5, 2008; this framework embodies a three-win vision for energy security, climate protection, and economic development achieved by promoting high-efficiency, high-value, low emissions, and low dependence.

The Sustainable Energy Policy Framework focuses on both the supply-side aspect of clean energy and demand-side aspect of conservation:

1. Clean energy initiatives will reform the country's energy structure and promote efficiency improvement.
2. Conservation initiatives will encourage substantial energy conservation improvements in all sectors and promote carbon emission reduction measures.
3. Establishment of a comprehensive legal and regulatory basis and relevant mechanisms.

In order to apply science and technology to the creation of an all-round energy conservation environment, the government will strive to promote the development of low-carbon energy, R&D efforts targeting emerging low-carbon technologies, and the establishment of a low-carbon city.

G. Strengthening disaster prevention and response S&T R&D and implementing development programs

In view of the importance of disaster prevention and response work and research, the government first implemented three stages of the five-year "Disaster Prevention Science and Technology Research Program" from 1982 to 1997, and then conducted the interagency "National Science and Technology Program for Hazards Mitigation" from 1999 to 2006. The latter program promoted systematic up-, mid-, and downstream scientific research and the transformation of R&D results into practical disaster prevention and response applications.

Following implementation of the National Science and Technology Program for Hazards Mitigation by various relevant government agencies, Taiwan's disaster mitigation science and technology R&D work has gradually acquired effective operating mechanisms. In addition, many outstanding results have been obtained in such areas as hazard potential and hazard magnitude analysis, scenario modeling, early warning and prediction technology, structural seismic design and assessment and reinforcing of seismic resistance, an earthquake damage assessment decision-making support system, a disaster prevention and relief database, a disaster management decision-making support system, and disaster prevention and relief system review and strategies. Furthermore, the application of R&D results has yielded numerous tangible benefits.

To build on the disaster prevention and relief technology R&D results and applications accumulated in the National Science and Technology Program for Hazards Mitigation, in 2006 the Executive Yuan approved the implementation of the four-year Program for Enhancing Innovation and Implementation of Disaster Reduction starting 2007. Under this program, the National Science and Technology Center for Disaster Reduction will assist participating agencies to continue implementation of disaster prevention and response technology R&D work meeting practical needs.

Following Typhoon Morakot in 2009, the NSC proposed the "Disaster Prevention and Response Applied Science and Technology Program" in order to assess the efficiency of the existing disaster prevention and relief system and rapidly apply scientific and technological results to support of disaster prevention and response needs. This program will continue from 2010 to 2014. The first stage of the program will focus on the investigation and application of technologies conceived in the wake of Typhoon Morakot; NT$450 million in funding has been budgeted for the integration of disaster prevention capabilities and provide reference information for land planning. The second stage of the program will focus on long-term disaster prevention science and technology research.

H. New Century National Development Plan, Stage Three

Responding to international trends and issues faced in Taiwan, the CEPD proposed the four-year "New Century National Development Plan, Stage Three" in 2009 with a vision of transforming Taiwan into a "highly innovative, socially just, sustainable, energy-thrifty advanced nation," and proposed six policy themes of (1) spatial reengineering, (2) industrial renovation, (3) global linkage, (4) innovative human resources, (5) a just society, and (6) a sustainable environment.

With regard to giving Taiwan a vital, innovative economy, the plan has the goals of establishing global innovation centers and transforming Taiwan into an intelligent nation serving as a trade and business hub. The establishment of a comprehensive social safety net, promotion of cultural diversity, and implementation of honest, competent, and efficient government administration will realize a just society with equal distribution of wealth. The three key elements of a convenient transportation network, urban and rural renewal, and low-carbon green lifestyles will build a sustainable, energy-thrifty environment. The National Development Plan is based on R&D, and seeks to steadily boost productivity and harness science and technology as a driving force for economic growth.

I. Statute for Industrial Innovation

In order to promote industry-academic innovation, boost industrial competitiveness, and support Taiwan's future industrial development trends, the government drafted the Statute for Industrial Innovation in order to provide tax credits for innovative R&D and subsidies to SMEs increasing their employment. After passage by the Legislative Yuan on April 16, 2010, the Statute for Industrial Innovation has been promoting industrial upgrading, technological innovation, and increased competitiveness by encouraging industry to invest in innovation and R&D.

In the wake of the passage of this Statute, special municipality, city, and county governments may draft local industrial development strategies, and the central competent authority may provide incentives or subsidies, and may also establish industrial parks. Apart from industrial districts, industrial parks may include medical, cultural, innovative, environmental, and science parks.

To accelerate the adding of value through industrial innovation and promote the nation's economic transformation, the Statute prescribes that the Executive Yuan shall establish a national development fund that can be used to fund S&T research and development activities, support national industrial development strategies, fund or finance major undertakings or programs boosting industrial benefits or improving the industry structure, and also assist the government's implementation of projects and promotion plans.

All central industry competent authorities may use subsidies or assistance to promote industrial innovation and R&D, provide industrial technology and upgrading assistance, encourage companies to establish innovation or R&D centers, help establish innovation and R&D organizations, promote cooperation between industry, schools, and research organizations, encourage companies to invest in human resource development at schools, boost industrial human resources, and help promote local industrial innovation. In addition, to encourage companies to engage in R&D activities and investment, the Statute for Industrial Innovation also gives tax credits to companies investing in R&D activities.

In addition, addressing subsidies for pollution control technology, energy efficiency improvement, and water-conserving equipment, the Statute prescribes that central industry competent authorities shall encourage government agencies and companies to prioritize energy and resource reuse, energy and water conservation, and the use of non-toxic, low pollution, low environmental load green products.

J. Biotech and New Pharmaceutical Development Statute

In order to encourage companies to invest in the development of high-value new pharmaceuticals and high-end medical equipment, the Legislative Yuan passed the Biotech and New Pharmaceutical Development Statute in July 2007. By easing restrictions on work at companies developing new biotech pharmaceuticals by research personnel affiliated with government research organizations, the Statute has encouraged the rapid development of companies primarily engaged in the R&D of new biotech pharmaceuticals, and directed funds to the new biotech pharmaceutical industry. By boosting the competitiveness of Taiwan's biotech pharmaceutical industry, the Statute is transforming the industry into a driver of the country's economic transformation.

The November 2007 Sixth National Industrial Development Conference proposed a "new biotech pharmaceutical industry development strategy" in connection with the content of the Biotech and New Pharmaceutical Development Statute; this strategy includes (1) the establishment of a legal and regulatory system and industrial development environment favoring the development of new biotech pharmaceuticals; (2) the establishment of a new biotech pharmaceutical development cooperation platform promoting participation in international new pharmaceutical development opportunities, strategic alliances, and international new biotech pharmaceutical industry value chains; (3) the inducement of international biotech pharmaceutical companies to authorize technologies or products to companies in Taiwan, along with the acquisition of professional international manpower; (4) the determination and selection of domestic niche products targeting late clinical trial products and accelerating the marketing of new biotech pharmaceuticals; and (5) filling of gaps in biotech industry value chains.

The revision to Article 3, Subparagraph 4 of the Biotech and New Pharmaceutical Development Statute passed by the Executive Yuan May 6, 2010 widens the scope of high-risk medical equipment eligible for subsidies under the Statute. The expansion of equipment eligible for subsidies from 96 items to 134 items better meets the actual needs of the domestic medical equivalent industry and encourages SMEs in the precision machinery industry possessing a competitive advantage but lacking incentives to enter the biotech industry, stimulating the development of high-risk medical equipment in Taiwan.

II. National Science and Technology Programs

After the government passed the National Science and Technology

Program Promotion Guidelines in 1998, programs in the areas of telecommunications and agricultural biotechnology were followed by a disaster mitigation program in 1999. A biotech pharmaceuticals program was added in 2000, followed by digital archives, genomic medicine, chip system, nanotechnology, and e-learning programs in 2002, resulting in nine national science and technology programs. These programs can be classified as economic (telecommunications, chip system, and nanotechnology programs), promoting industrial upgrading and the development of key, innovative technologies in Taiwan; biotech (agricultural biotechnology, biotech pharmaceuticals, and genomic medicine programs), promoting the development of the biotechnology industry and supporting forward-looking molecular biology research aimed at improving citizens' health; and consumer (disaster mitigation, digital archives, and e-learning), promoting residential safety, education, and sociocultural development. Among the programs, the National Science and Technology Program for Hazards Mitigation was completed at the end of 2006, and was followed by the Program for Enhancing Innovation and Implementation of Disaster Reduction, which seeks to assist the government in drafting appropriate disaster mitigation policies by planning and integrating nationwide disaster mitigation and relief science and technology R&D capabilities.

In order to build on the accumulated results of the first and second stages of the National Science and Technology Program for Telecommunications, the government implemented the Networked Communication Program in 2008. Similarly, after the National Science and Technology Program for Agricultural Biotechnology completed its mission in 2008, the industrialization of its R&D results was shifted to the successor Development Program of Industrialization for Agricultural Biotechnology. The five-year Taiwan e-Learning and Digital Archives Program initiated in 2008 integrated the digital archives and e-learning science and technology programs. The 2009 economic-oriented National Science Technology Program-Energy integrated domestic human and material resources connected with energy research, and is planning Taiwan's energy S&T development directions and research content. Taiwan is therefore currently implementing eight national science and technology programs, and plans to begin programs on biotech pharmaceuticals (a new program combining the content of the biotech pharmaceuticals and genomic medicine programs) and intelligent electronics (building on the results of the chip system program) in 2011. Table 23 contains the time frames, funding, and participating agencies for each program.

Table 23　Time frames, funding, and participating agencies of national science and technology programs

National science and technology program	Stages	Time frame	Total program funding (NT$1,000)	Managing agency	Participating agencies
Networked Communications (originally telecommunications)	Stage 1 Stage 2 Stage 3	1998 to 2003 2004 to 2008 2009 to 2013	10,672,934 13,350,160 11,068,000	NSC	MOEA, NSC, MOE, Department of Posts and Telecommunications (MOTC), National Communications Commission, DOH, Chunghwa Telecom Laboratories
Chip system	Stage 1 Stage 2	2003 to 2005 2006 to 2010	5,605,439 11,026,374	NSC	NSC, MOEA, MOE
Nanotechnology	Stage 1 Stage 2	2003 to 2008 2009 to 2014	22,307,075 22,075,172	NSC	NSC, MOEA, MOE, Atomic Energy Council, EPA, DOH, Council of Labor Affairs
Agricultural biotechnology	Stage 1 Stage 2 Stage 3	1998 to 2001 2002 to 2004 2005 to 2008	801,000 1,991,500 4,048,000	NSC	Academia Sinica, MOEA, COA, DOH, NSC
Biotech pharmaceuticals	Stage 1 Stage 2 Stage 3	2000 to 2002 2003 to 2006 2007 to 2010	1,688,587 5,993,643 3,214,717	NSC	NSC NSC, MOEA, DOH
Genomic medicine	Stage 1 Stage 2	2002 to 2005 2006 to 2010	6,876,965 9,604,164	NSC	NSC, DOH, MOEA
Digital archives and e-learning	Stage 1	2008 to 2012	8,905,530	NSC	MOE, MOEA (Industrial Development Bureau, Industrial Technology Department), Central Personnel Administration, Overseas Chinese Affairs Commission, Council of Labor Affairs, Council for Cultural Affairs, Council for Hakka Affairs, Council of Indigenous Peoples, NSC, National Palace Museum, Academia Historica (Taiwan Historica), National Library, National Museum of Natural Science, Chinese Taipei Film Archive, National Taiwan University, Academia Sinica, Taiwan Provincial Consultative Council, National Archives Administration
Energy	Stage 1	2009 to 2013	30,776,000	NSC	NSC, MOI, MOE, MOTC, EPA, Atomic Energy Council, COA, MOEA
Biotechnology pharmaceutical	Stage 1	2011 to 2016	16,683,142	NSC	MOEA, Atomic Energy Council, DOH, NSC
Intelligent electronics	Stage 1	2011 to 2015	12,435,000	NSC	MOEA, MOE, NSC

Source: National Science Council, Executive Yuan.

To ensure that the results of the national science and technology programs on biotech pharmaceuticals and genomic medicine are put to practical application, the National Research Program for Biopharmaceuticals will be implemented from 2011 to 2016; this program will shepherd initial R&D results into preclinical and stage I clinical trials, assist with the establishment of biotech pharmaceutical R&D mechanisms, and promote achievement of the goals of the government's "Diamond Action Plan for Biotech Takeoff." In addition, following the conclusion of the National Science and Technology Program for Systems-on-Chip in 2010, the government will implement the National Project for Intelligent Electronics from 2011 to 2015; this project will encourage the development of niche electronic technologies in the fields of medicine, green energy, and 4C, and will also focus on human resource development, forward-looking research, industrial promotion and development of key science and technology at research organizations under the Industrial Technology Department, MOEA.

The national science and technology programs have yielded many outstanding results. The seven programs that have been completed or are currently being implemented have delivered quantitative results including an average of more than 5,000 research papers published annually, more than 6,000 participating Master's and PhD students, more than 700 patents, and over 388 technology transfers cases (see table 24).

Table 24 Quantitative results of national science and technology programs

Program	Performance indicator	Units	2005	2006	2007	2008	2009
Telecommunications (Networked Communications)	Research papers	Papers	681	1,055	1,404	1,041	800
	Master's & Ph.D. students	Persons	335	539	488	480	366
	Patents received	Cases	98	118	144	115	95
	Technology transfers	Cases	54	58	42	69	83
		Contract value (NT$1,000)	114,857	117,705	138,441	213,058	142,572
	Corporate investment promoted	Investment (NT$1,000)	34,047,663	40,448,671	31,893,498	29,790,621	27,132,077
Chip system	Research papers	Papers	1,188	639	909	1,206	1,316
	Master's & Ph.D. students	Persons	750	2,784	2,966	2,993	3,060
	Patents received	Cases	95	88	73	69	79
	Technology transfers	Cases	27	76	33	45	61
		Contract value (NT$1,000)	87,970	108,751	71,567	94,461	61,982
	Corporate investment promoted	Investment (NT$1,000)	1,544,000	1,383,200	3,742,000	102,253,000	176,030,420
Nanotechnology	Research papers	Papers	1,165	1,514	1,997	1,856	1,674
	Master's & Ph.D. students	Persons	1,484	1,731	2,287	2,019	1,559
	Patents received	Cases	167	220	254	228	382
	Technology transfers	Cases	110	94	154	131	75
		Contract value (NT$1,000)	142,204	114,700	164,443	151,243	96,584
	Corporate investment promoted	Investment (NT$1,000)	1,210,830	1,357,050	2,174,933	2,849,781	2,718,826
Energy	Research papers	Papers	—	—	—	—	692
	Master's & Ph.D. students	Persons	—	—	—	—	391
	Patents received	Cases	—	—	—	—	144
	Technology transfers	Cases	—	—	—	—	142
		Contract value (NT$1,000)	—	—	—	—	131,649

	Corporate investment promoted	Investment (NT$1,000)	—	—	—	—	2,297,860
Biotech pharmaceuticals	Research papers	Papers	725	521	308	209	332
	Master's & Ph.D. students	Persons	220	181	740	172	674
	Patents received	Cases	57	36	28	14	19
	Technology transfers	Cases	35	14	3	6	3
		Contract value (NT$1,000)	25,946	19,242	70,000	112,744	40,774
	Corporate investment promoted	Investment (NT$1,000)	570,939	483,897	13,546	825,725	564,634
Genomic medicine	Research papers	Papers	531	679	403	323	331
	Master's & Ph.D. students	Persons	338	600	340	407	373
	Patents received	Cases	6	21	16	19	13
	Technology transfers	Cases	1	13	17	13	5
		Contract value (NT$1,000)	381	1,218	3,646	1,502	545
	Corporate investment promoted	Investment (NT$1,000)	6,302	5,280	12,870	13,365	12,716
Digital archives / e-learning	Research papers	Papers	341/ 381	263/ 456	218/ 771	482	635
	Master's & Ph.D. students	Persons	54/ 744	51/ 773	189/ 611	339	646
	Patents received	Cases	1/ 6	2/ 3	1/ 8	11	6
	Technology transfers	Cases	18/ 23	11/12	11/ 15	26	34
		Contract value (NT$1,000)	624/ 16,806	900/ 9,326	320/ 11,859	9,238	16,798
	Corporate investment promoted	Investment (NT$1,000)	22,726/ 468,690	15,000/ 348,907	23,015/ 640,939	151,715	456,001

Source: National Science Council, Executive Yuan.

Note 1: The National Science and Technology Program for Agricultural Biotechnology was completed in 2008; the National Science and Technology Program for Hazards Mitigation was completed in 2006; the National Science and Technology Program for e-Learning and National Digital Archives Program were combined as the Taiwan e-Learning and Digital Archives Program in 2008.

2: Starting in 2008, the quantitative results of the original digital archives and e-learning national science and technology programs (2005-2007) are combined as the results of a single program.

III. Results of Academic Research

In Taiwan's S&T development organizational system, basic and advanced applied research is chiefly implemented by the Academia Sinica and domestic universities, while applied research and technology development is chiefly implemented by research organizations and universities. Research funding is provided by the government and by state-run and private enterprises commissioning research. Government funding consists of two types: budgeted funding, such as that for the Academia Sinica, and funding determined by the government via review mechanisms.

A. Academia Sinica

The Academia Sinica has recently undergone organizational adjustments giving it 22 institutes, two institute preparatory offices, and seven research centers (see Table 25).

Academia Sinica mainly focuses on basic scientific research, and its institutes and research centers planned research focal points, hire appropriate manpower, select research topics, and autonomously perform research work aligned with mid-/long-term academic development directions. Furthermore, in order to strengthen integration and encourage interdisciplinary research, the institutes and research centers collaboratively implement three major types of subsidized projects arranged by the Academia Sinica: The first type consists of "team research projects" integrating different fields of study within the Academia Sinica, promoting cooperation with domestic and foreign schools and academic research organizations, and conforming to mid-/long-term academic development directions. The second type consists of "forward-looking projects" recruiting and promoting young researchers with excellent research results and great promise, focusing on forward-looking research topics with international competitiveness, and training world-class academic research manpower. The third type consists of "in-depth projects" encouraging research personnel to devote themselves to research work, conduct long-term, original research in important areas of knowledge, and fully realize their potential as researchers.

Table 26 shows funding and personnel in the Academia Sinica's Mathematics and Physical Sciences Division, Life Sciences Division, and Humanities and Social Sciences Division in recent years.

Table 25 Organizational structure of the Academia Sinica

	Physical Sciences Division	Life Sciences Division	Humanities and Social Sciences Division	Total
Institutes	8	5	9	22
Institute preparatory offices	0	0	2	2
Research centers	3	3	1	7

Source: Academia Sinica.

Table 26 Academia Sinica funding and manpower inputs

Item (NT$1 m/person-times)	2006		2007		2008	
	Funding	Persons	Funding	Persons	Funding	Persons
Natural science	1,952	296	2,137	304	2,452	307
Life science	3,150	298	3,137	312	3,143	312
Humanities and social sciences	1,380	330	1,483	326	1,502	322
Total	6,482	924	6,757	942	7,097	941

Source: NSC academic statistics database.

B. Major Academic Research Results at Universities

NSC chiefly employs subsidies for specific-topic research projects to encourage research personnel at universities and research organizations to engage in academic research. In addition, the NSC also promotes cooperation, sharing of resources, and interdisciplinary research, and industry-university cooperative research projects seeking to develop industrial applications and training personnel with corporate R&D potential. Various models are being used at different stages to harness industry resources, promote close cooperation between schools and industry, and training S&T manpower meeting industry needs. Table 27 shows numbers of NSC-approved specific-topic research projects and funding in recent years.

Table 27 Approval of NSC-funded specific-topic research projects in various disciplines

Amount: NT$1 m

Item	2006		2007		2008		2009	
	Projects	Amount	Projects	Amount	Projects	Amount	Projects	Amount
Natural science research	2,060	3,556.39	1,632	3,134.79	1,731	2,850.19	1,756	3,182.51
Engineering and applied science	7,098	5,491.57	5,833	4,587.27	4,980	4,244.11	5,563	5,246.37
Life sciences	3,792	4,637.15	2,980	4,099.81	2,337	3,368.10	2,305	3,630.96
Humanities and social sciences	3,637	2,045.83	3,526	2,239.92	3,107	1,814.83	3,529	2,109.10
Science education	658	587.34	498	495.45	518	442.34	485	469.60
Academic cooperation in applied technology	221	187.89	203	165.58	143	121.84	–	–
Sustainable development research	314	230.29	284	223.27	–	–	–	–
Total	17,780	16,736	14,956	14,946	12,816	12,841	13,638	14,639

Source: NSC specific-topic research project database (April 1, 2010).

Notes: 1. Projects subsidized by the Applied Research Office were combined with the Department of Engineering's projects in 2009.

2. The Council for Sustainable Development was merged with the Department of Natural Sciences in 2008.

C. Academic Excellence

The MOE is implementing the Development Plan for World Class Universities and Research Centers of Excellence in order to develop first-rate, world-class universities and establish top-notch research centers in distinctive fields through competitiveness funding and establishing an academic competition environment. This project looks forward to the establishment at least ten top-notch research centers or research areas in which Taiwan is an Asian leader within five years, and expects that at least one university will be a first-rate international university within ten years. This project encompasses two subprojects:

1. Project to develop first-rate international universities

The MOE is using competitiveness funding to assist the creation of research universities with large size and development potential, boost the efficiency of overall university instruction and research, integrate human resources, improve university management strategies, and establish a sound organizational operation system. This project seeks to enable universities to develop to certain size and boost educational funding per student to at least US$10,000 per year.

2. Project to develop top-notch research centers (research fields)

The MOE is encouraging research universities to establish interscholastic (international) research teams or cooperate with research organizations in specialized areas in order to focus human resources and equipment investments, developing key national research areas, assisting the creation of new opportunities for integration of R&D and innovation, rewarding the establishment of distinctive areas only instruction, establishing instructional ability and results assessment indicators, and making adjustments at the school and department level and establishing new curricula in order to promote key areas of study.

The MOE's Development Plan for World Class Universities and Research Centers of Excellence is providing subsidies in two-year phases, and two phases have been completed thus far. The second phase providing subsidies to 15 first-rate universities and top-notch research centers. Table 28 shows the schools receiving subsidies and amounts received.

Table 28 Subsidies provided under the MOE's Development Plan for World Class Universities and Research Centers of Excellence

Units: NT$100 m

Type	Schools	Phase 1		Phase 2		
		2006	2007	2008	2009	2010
First-rate universities	National Taiwan University	30	30	30	30	30
	National Cheng Kung University	17	17	17	17	17
	National Tsinghua University	10	10	12	12	12
	National Chiao Tung University	8	8	9	9	9
	National Central University	6	6	7	7	7
	National Sun Yat-sen University	6	6	6	6	6
	National Yang Ming University	5	5	5	5	5
	National Chungshing University	4	4	4.5	4.5	4.5
	National Taiwan University of Science and Technology	3	3	2	2	2.2
	National Chengchi University	2.05	3	2	2	2
	Chang Gung University	3	3	2	2	2
	Yuan Ze University	2.32	3			
Key research areas	Chung Yuan Christian University's Film Technology Center	1	0.4	0.7	0.7	0.8
	National Taiwan Ocean University's Fisheries Biotechnology Research Center	1	0.4	0.9	0.9	0.9
	Taipei Medical University's Stroke Research Center	0.6	0.4			
	National Taiwan Normal University's Educational Assessment and Development Center	0.515	0.2			
	National Chung Cheng University's Taiwan Humanities Research Center	0.515	0.1			
	Yuan Ze University's Fuel Cell Research Center			0.9	0.9	0.9
	Kaohsiung Medical University's Environmental Medicine Research Center			0.9	0.9	0.9
Total		100	99.5	99.9	99.9	100.2

D. Development of Science Parks

Taiwan's current Science Park system encompasses three major industry clusters in different parts of Taiwan: In Northern Taiwan, six parks (Hsinchu, Jhunan, Tongluo, Longtan, Yilan and Hsinchu Biomedical Park) are centered on the Hsinchu Science Park; in central Taiwan, five parks (Taichung, Huwei, Houli, Erlin, and Zhongxing Advanced Research Park) are centered on the Central Taiwan Science Park; in southern Taiwan, two parks (Tainan and Kaohsiung) are centered on the Southern Taiwan Science Park. Table 29 and Fig. 7 provide background information and growth trends for the various parks. The government hopes that the parks located throughout western Taiwan will form a "technology corridor" in the future.

In the World Economic Forum's "2008-2009 Global Competitiveness Report," Taiwan scored 5.6 out of 7 points in the industry cluster development indicator ("state of cluster development"), and ranked first in the world for three consecutive years. Furthermore, according to the Lausanne International Institute for Management Development's (IMD) 2010 world competitiveness rankings, Taiwan advanced from 23rd during the previous year to 8th, sprinting ahead 15 places in one year and displaying the best performance of any country ever. Taiwan made big jumps in the four areas of economic performance, governmental effectiveness, corporate effectiveness, and infrastructure, and its progress in these areas was the greatest of any of the 58 assessed countries.

The total revenues of science park firms grew by a factor of five from 1997 to 2007. Due to the global financial crisis that began during the fourth quarter of 2008, however, total park revenues declined throughout 2009. Nevertheless, the numbers of patents obtained by science park firms continue to display a slight growth trend, rising from 2,489 in 2008 to 2,539 in 2009.

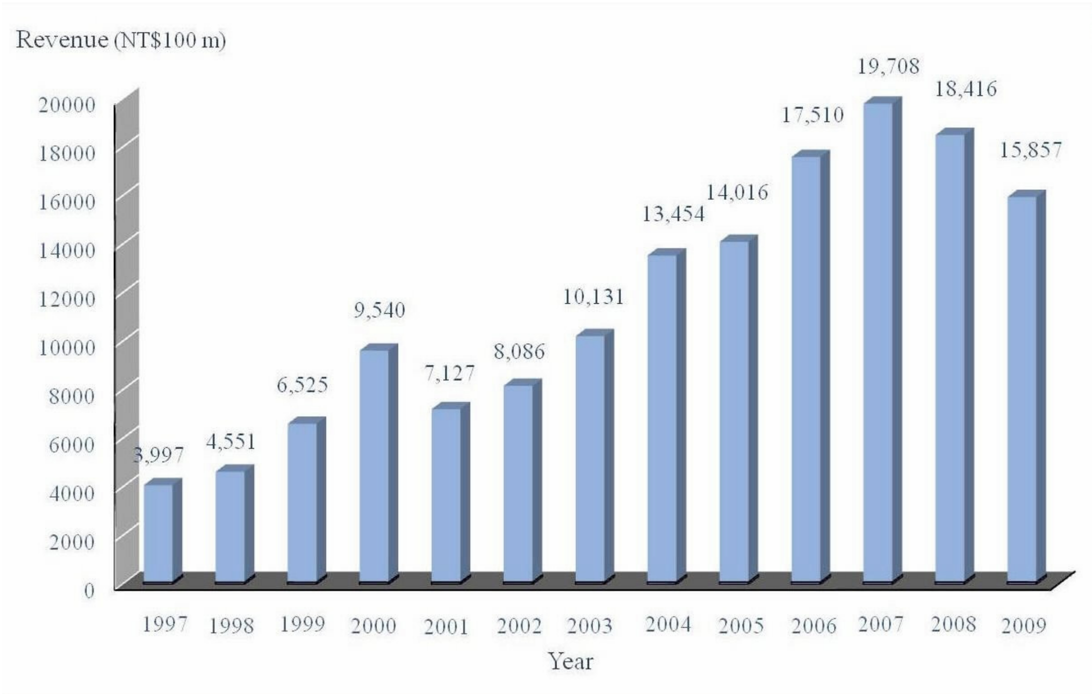

Figure 7 Total revenues of three major science parks

Source: Hsinchu Science Park (http://www.sipa.gov.tw/); Central Taiwan Science Park (http://www.ctsp.gov.tw); Southern Taiwan Science Park (http://www.stsipa.gov.tw/).

Table 29 Overview of the Hsinchu, Central Taiwan, and Tainan Science Parks

	Science Park Administration	Central Taiwan Science Park Administration	Southern Taiwan Science Park Administration
Subordinate parks	Hsinchu, Jhunan, Tongluo, Longtan, Hsinchu Biomedical, Yilan (six parks)	Taichung, Huwei, Houli, Erlin, and Zhongxing Advanced Research Park Project (five parks)	Tainan, Kaohsiung (two parks)
Area	1,342 hectares	1,662 hectares	1,613 hectares
Industry clusters	Semiconductors, optoelectronics, biotechnology	Optoelectronics, precision machinery, integrated circuits, biotechnology, computers and peripherals, communications	Optoelectronics, integrated circuits, green energy and energy conservation, precision machinery, biotechnology
Number of firms	441 firms, including: Integrated circuits (194), computer & peripherals (53), communications (46), optoelectronics (88), precision machinery (27), biotechnology (30), and other (3)	104 firms, including: Optoelectronics (31), precision machinery (34), biotechnology (16), integrated circuits (8), computer & peripherals (5), communications (1), and other (9)	164 firms, including: Precision machinery (45), optoelectronics (44), biotechnology (41), integrated circuits (11), communications (12), computer & peripherals (3), other (8)
Number of employees	136,661 persons Including 2,417 Ph.D.-holders and 32,441 Master's degree holders unting for 25.51% of all employees	21,785 persons Including 96 Ph.D.-holders and 3,301 Master's degree holders ounting for 15.59% of all employees	53,290 persons Including 448 Ph.D.-holders and 8,510 Master's degree holders ounting for 16.81% of all employees
Developmental goals and focal points	Developmental goals: Upholding core values of "convenience, efficiency, loyalty, competence, and honesty" and maintaining a vision of "establishing a superior park investment environment	1. Acquiring high-tech firms, investing in advanced industrial technologies, establishing high added value industry clusters, boosting global competitiveness of park firms. 2. Acquiring firms in new energy,	Developmental goals: To become a high-tech industry and manpower center in Asia, ensuring that firms have no regrets, and letting citizens have hope in their homeland. Development focal points:

	and contributing to the national economy." Key points of development strategy: 1. Perfecting the park's investment environment, providing convenient efficient service. 2. Promoting high-tech industrial upgrading, enhancing companies' competitive ability. 3. Establishing low-carbon green energy parks, creating sustainable development environment. 4. Strengthening cooperation between industry, government, academia, and the research community cooperation, and boosting industry's R&D capabilities.	biotechnology, and other promising emerging industries in response to industrial development trends and energy conservation, carbon reduction, and environmental protection policies, and building green technology parks. 3. Promoting forward-looking, core technology R&D and innovation, implementing the "High-tech Equipment Future Technology Development Plan," developing high-tech human resources, and strengthening industrial/academic collaboration mechanisms. 4. Establishing the National CTSP Experimental High School, meeting the everyday living needs of company personnel, realizing single-window service, and establishing a superior science park.	1. Development of a complete optoelectronics industry cluster. 2. Formation of a complete integrated circuit industry supply chain encompassing up- and downstream industries, including IC design, wafer fab, packaging & testing, and semiconductor equipment industries. 3. Reliance on the park's comprehensive industry structure encompassing integrated circuits, optoelectronics, and solar power, etc. to attract even more precision machinery industry investment, and make industry chains within the park even more complete. 4. Promotion of the Kaohsiung park as a biotech medical equipment industry cluster. 5. Active establishment of the Kaohsiung park as a green energy, low-carbon industry cluster.
Publications	Science Park text message	CTSP text message, CTSP Review, CTSP Bulletin	Tainan Science park text message, Work Safety e-Bulletin, Tainan Science Park Review, Park History Public, Tainan Science park Landscaping Vegetation

Source: Hsinchu Science Park (http://www.sipa.gov.tw/); Central Taiwan Science Park (http://www.ctsp.gov.tw); Southern Taiwan Science Park (http://www.stsipa.gov.tw/). Data date for July 31, 2010.

In order to maintain competitiveness of the science park system and support the i-Taiwan 12 Project, the Executive Yuan approved the Zhongxing Advanced Research Park Establishment Project on November 19, 2009. This project calls for the establishment of an R&D platform encouraging cooperation between research organizations, schools, and companies. The Zhongxing Advanced Research Park will take advantage of central Taiwan's existing geographical advantages, convenient transportation, information network technology, and peripheral high-tech industry chains to acquire innovative R&D capabilities and establish a high-tech industry cluster in central Taiwan. By increasing the added value of industries in central Taiwan, this project will expedite the formation of an "industrial innovation corridor" spanning western Taiwan.

Furthermore, responding to the global financial crisis, the NSC initiated the Science Park Local Industry Advancement Research Project in 2009 in order to encourage high-tech science park firms to continue to invest in R&D and take advantage of academic research capabilities, and thereby improve industrial technologies. Under this project, the science parks approved subsidies totaling NT$287.3 million in 61 cases; a total of 868 R&D personnel benefited from these subsidies. A results sharing conference was held for the first stage of the project on July 14, 2010, and a mid-term on-site review of the second stage of the project was completed in May 2010.

To encourage employment growth in line with "Employment Promotion Year" and maintain its focus on innovation, the NSC integrated existing industrial-academic program resources by merging the existing Program of Science Park Innovation Technology and Industrial-Academic Collaboration and Science Park Local Industry Advance Research Project as the Piloting Cooperation Projects between Industries and Academia at Science Parks starting in 2010. The NSC hopes that an industrial-academic collaboration model will foster more joint research integrating heterogeneous industries and key technologies, while simultaneously training the superior R&D needed by industry. The science parks are projected to have provided roughly NT$150 million in subsidies to around 30 industrial-academic collaborative projects in 2010, and announced acceptance of new applications starting in July 2010.

IV. Promotion of Collaboration Among Industry, Academia, and Research Organizations

The government relies on science and technology programs to promote joint industrial-academic research, which boost Taiwan's technology R&D capacity, industrial innovation, startup incubation capability, and human resources training. The knowledge innovation fostered by collaboration between industry, academia, and research organizations in these programs is the key to their success. To better promote joint research involving industry, academia, and research organizations, in recent years the MOE, MOEA, and NSC have drafted strategies addressing up-, mid-, and downstream scientific and technological development aimed at enhancing Taiwan's innovative capacity.

A. Academia Sinica

After the Legislative Yuan approved the *Fundamental Science and Technology Act* in 1999, the Academia Sinica immediately established a dedicated department (Office of Public Affairs) to bear responsibility for encouraging patent applications, technology licensing, and industrial cooperation. By smoothly transferring R&D results to society, this mechanism is boosting national competitiveness and encouraging social development.

The Academia Sinica had received 296 patents as of April 2010, including an especially significant number of new biotech pharmaceutical patents. According to statistics from the United States Patent and Trademark Office, Taiwan is ranked around 13th-17th worldwide in terms of biotech pharmaceutical patents, putting it on the same level as Australia. It should also be noted that the Academia Sinica's new biotech pharmaceutical patents account for at least one-fourth of all new biotech pharmaceutical patents obtained in Taiwan. The Academia Sinica has signed at least 471 technology licensing contracts valued at more than NT$1.49 billion with industry thus far, and 80% of these technology transfer cases are in the field of biotechnology. Furthermore, there have been more than 270 collaborative R&D projects involving Academia Sinica research personnel and industrial firms, and funding for these projects has exceeded NT$460 million. Because biotech pharmaceutical products usually have a development period spanning more than a decade, most licensing cases are still at the R&D stage. Last year the Academia Sinica obtained product royalty income of NT$6.43 million, and this revenue is still growing rapidly.

The Academia Sinica does not rule out technology licensing to foreign firms, but assigns priority to licensing to domestic companies. In the very short period of only one decade, the Academia Sinica's technology transfer work has catalyzed the establishment of more than 20 startup companies. In addition, after obtaining the Office of the President's consent, the Academia Sinica established a biotechnology incubation center at the Genomics Research Center in 2003. This center employs technical consulting and core facilities to assist resident firms to research the Academia Sinica's major discoveries in hope of developing innovative new products including new drugs, high-end therapeutic equipment, and precision instruments. The Academia Sinica is therefore actively applying R&D results to industry, which is boosting industrial development and upgrading.

The establishment of an Office of Public Affairs and incubation center has enabled the Academia Sinica to promote the development of a cutting-edge biotech industry through technology transfer and incubation, and thereby contribute to society. Firms currently occupying the incubation center in currently employ over 300 highly-skilled biotech personnel, including many domestic and foreign holders of Master's and Ph.D. degrees and returning scholars. These firms also spent over NT$700 million on R&D in 2008. Firms at the incubation center have included winners of the Taipei Biotechnology Award and other biotechnology honors for several consecutive years. The MOEA has provided NT$179 million in subsidies for R&D projects conducted by these firms, which have also received NT$5.6 billion from investment firms and private investors. The support these firms have attracted from the government, industry, and financial institutions reflects the high degree of confidence in their successful development of new products.

Companies at the incubation center have been highly effective at developing products. They are working on 44 types of new products, five of which are already on the market, and the remainder are at different stages of the research and product development process, ranging from early research to stage 3 human trials. Eight products have entered clinical trials in Taiwan, and five have entered clinical trial in the United States; these products include cancer drugs, flu vaccines, and immunological drugs. Three products constituting "testing reagents for adverse drug reactions" and resulting from licensed Academia Sinica technology have been marketed in Taiwan and the European Union.

B. Ministry of Education

The MOE announced the *Regulations Governing University Industrial-Academic Collaboration* in 2006 to provide basic guidelines for university involvement in industrial-academic collaboration, and began performing "University Industrial-Academic Collaboration Performance Assessment" on an annual basis starting in 2007. Apart from the MOE's efforts to persuade universities to take industrial-academic collaboration as an important part of their administrative scope, performance assessment results have served as a key quantitative basis for MOE subsidies to universities implementing relevant projects. The MOE has consequently been implementing the University Industrial-Academic Collaboration Performance Stimulus Program, which is aimed at the general university system, from 2008 to 2011, and has provided subsidies to 11 schools under this program. In addition, aiming at the technical university and college system, starting in 2002 the MOE provided subsidies for the establishment of six "MOE Regional Industrial-Academic Collaboration Centers" located throughout northern, central, and southern Taiwan to provide a channel for industrial-academic interchange and matching of potential R&D partners. Beyond the regional industrial-academic collaboration centers, since 2003 the MOE has additionally provided subsidies to technical schools establishing technology R&D centers, which are an important means of increasing the closeness of industrial-academic ties, deepening technological R&D results, and accumulating industrial-academic collaboration methods and experience.

With regard to the MOE's success at promoting industrial-academic collaboration in 2009, technology licensing cases involving subsidized schools and companies and resulting from industrial-academic collaboration were worth roughly NT$453 million, and this figure represented growth of 43% compared with the equivalent figure of NT$317 million in 2008. Furthermore, companies attributed to NT$2.55 billion in revenue to the results of joint industrial-academic research, which was 15% higher than the equivalent figure of NT$2.23 billion in 2008. A total of 310 firms occupied incubation centers, and 73 new firms took up occupancy; these figures represented growth of 21% and 24% respectively compared with 2008. In order to further promote interchange and research cooperation between technical schools and industry, the MOE announced the Implementation Guidelines for the Ministry of Education Promotion's Promotion of Industrial-Academic Collaboration between Technical Colleges and Universities and Industry Parks in 2005. Furthermore, since 2010 the MOE has provided subsidies to 12 technical schools for the establishment of "joint technology development centers" in specific industry-related areas; these technology development centers will integrate the resources of existing R&D units, boost the technological standards of relevant industries, and add value to existing R&D results.

C. Ministry of Economic Affairs

The MOEA has striven to expand the breadth of industrial technology R&D through Academic Development Industrial Technology Research Projects, Industrial Development Industrial Technology Projects, and innovation incubation centers. And in order to induce domestic industry to embrace "Taiwan innovation," the government has directed its S&T project resources toward the goal of "stimulating industrial innovation and creating industrial value," and provided NT$884 in funding to academic development industrial technology research projects, which accounted for roughly 4.84% of all funding for technology development projects aimed at forward-looking innovative industrial technologies in 2008. From the start of the MOEA's industrial technology development projects in 2001, these projects have taken advantage of academic researchers' cumulative basic R&D capabilities and facilities to establish focused, innovative industrial technology R&D centers and laboratories, strengthening academic participation in industrial technology R&D, and better integrating the up-, mid-, and downstream industrial technology development systems. As of the end of 2008, 21 schools had established innovative, forward-looking industrial technology R&D centers focusing on key aspects. In addition, academic development technology development projects had made 1,633 patent applications and received 382 patents.

D. National Science Council

The NSC has drafted industrial-academic collaboration strategies since 1991, and has issued the Subsidy Operating Guidelines for Industrial-Academic Collaborative Research Projects (for "major industrial-academic projects"), Project on Upgrading Industrial Technology and Enhancement of Human Resources (for "minor industry-academic projects"), and the National Science Council, Executive Yuan Subsidy Operating Guidelines for Digital Content Industrial-Academic Collaborative Research Projects (for "digital industrial-academic projects"). Afterwards, responding to changes in international R&D trends, the NSC has adopted and even more forward-looking subsidy strategy to integrate the subsidy guidelines for major, minor, and digital industrial-academic projects. Accordingly, the NSC approved the National Science Council, Executive Yuan Subsidy Operating Guidelines for Industrial-Academic Collaborative Research Projects in December 2007, and drafted subsidy models for pioneering, developmental, technological, and knowledge application industrial-academic collaborative projects. The NSC further revised the foregoing Guidelines in 2009 and 2010 in order to strengthen the industrial-academic collaboration support system by providing more flexible legal and promotional mechanisms. Table 2 shows numbers of industrial-academic collaborative projects and their results from 2005 to 2009.

Table 30 Industry-university cooperative research projects and performance, 2005-2009

Item	2005	2006	2007	2008	2009
Number of projects	1,040	1,046	1,084	588*	1,103
Subsidy funding (NT$1 m)	512.95	532.14	495.46	431.48	1,096.00
Participating firms	1,060	1,048	1,090	584	1,130
Firm contributions (NT$1 m)	245.18	251.11	226.45	174.35	324.77
Human resource development (Master's and Ph.D. students) (persons)	1,750	1,811	1,848	1,248	2,718
Approved patents	30	44	30	21	46
Technology licensing (cases)	1,249	996	1,013	588*	—
Royalty income (NT$1 m)	84	74	78	50.4	—

Source: 2009 Annual Report, National Science Council, Executive Yuan.

Notes: *In the 2008 revision of the *Subsidy Operating Guidelines for Industrial-Academic Collaborative Research Projects*," the application acceptance periods for applications-type industrial-academic collaborative projects were changed from two periods per year to one period per year, which resulted in a reduction in applications. Two acceptance periods per year were restored this years, and the number of subsidized projects grew.

E. Council of Agriculture, Executive Yuan

The COA has promoted the Agricultural Technology Development Program, Agricultural Biotechnology Industrialization Development Program, industrial-academic collaborative projects, and the Agricultural Biotechnology Industrialization Assistance Program, all of which have yielded good results.

1. Agricultural Technology Development Program

The COA has developed and implemented an agricultural technology development program system consisting of the Juristic Person Organization Industrial Research Program (Juristic Person Technology Development Program), Assistance Program to Promote R&D at Agribusiness Organizations, and Academic Participation in Agricultural Technology Project Program. This system is integrating the agricultural R&D capacities of industry, government, academia, and the research community, boosting competitiveness of agricultural industries.

To propel Taiwan's agricultural industries toward sustainability, since 2007 the COA has striven to achieve the effective utilization of agricultural technology R&D manpower and financial resources and bring about the integration of the up-, mid-, and downstream agricultural R&D systems, creating industrial value and enhancing industrial competitiveness. The COA had provided NT$415 million in funding for agricultural industrial R&D. As of the end of 2009, 126 technical publications had been issued, 124 brands established, 119 products and 26 testing methods developed, assistance provided to help 25 agricultural products to pass testing, nine patent applications made, eight product standards issued, four technical certification systems developed, two variety rights obtained, two certification marks developed, and one spin-off company established.

2. Agricultural Biotechnology Industrialization Development Program

In accordance with the Executive Yuan's Action Plan for Strengthening the Biotechnology Industry, the COA, MOEA, DOH, NSC, and Academia Sinica shall jointly compile budgets and fund projects under the National Science and Technology Program for Agricultural Biotechnology and Agricultural Biotechnology Industrialization Development Program. This system has established important bridges for interchange between industry and academia, established an environment promoting the development of an agricultural biotechnology industry, made up-, mid-, and downstream R&D cooperation smoother, and realized the industrialization of biotechnology R&D results.

From 2006 to 2010, the COA provided a subsidies totaling NT$85.8 million to industrial-academic collaborative projects under the National Science and Technology Program for Agricultural Biotechnology and Agricultural Biotechnology Industrialization Development Program, and firms made contributions totaling NT$12.7 million. These projects resulted in the approval of two patents and the implementation of two technology licensing cases yielded a total of NT$2.5 million in royalties.

3. Agricultural Biotechnology Industrialization Assistance Program

The Agricultural Biotechnology R&D Results Industrialization Assistance Regulations, issued by the COA on May 22, 2009 employs subsidies to induce companies to establish key technologies and develop products with local industrial development niches and potential. These Regulations are important supporting regulations to the Quality Agriculture and Health Excellence Program. As of the end of 2009, the COA had provided more than NT$2.19 million in subsidies to firms, the industry had contributed NT$3.33 million to industrialization projects, and the COA had assisted the five firms to develop industrial technology. The COA began assisting firms to adopt and utilize relevant R&D results in 2010. This work is achieving the industrialization of agricultural biotechnology R&D results, enhancing the international competitiveness of the agricultural biotechnology R&D system.

4. COA implementation of industrial-academic collaboration

In order to promote the industrialization of agricultural biotechnology R&D results, encourage industry to engage in technology R&D, and boost the industry's sustainable competitiveness, the *Council of Agriculture, Executive Yuan Implementation Guidelines for Industrial-Academic Collaboration in Agricultural Technology* were approved in August 1998, and the COA began promoting industrial-academic collaborative projects in agricultural technology in 1999 in order to increase the industry's competitiveness.

A total of 105 industrial-academic collaborative projects were implemented in 2009, and stimulated the input of NT$13 million in R&D investment by companies. The COA signed 170 technology licensing contracts worth more than NT$71 million in 2009; these technology results derived from 130 R&D projects, of which 41 were industrial-academic collaborative projects (accounting for 31.5% of technology licensing cases). Furthermore, among the patents obtained by the COA, eight were derived from industrial-academic collaborative projects. To promote the upgrading of agricultural businesses as agricultural technology enterprises, and enable them to better respond to global competition, the COA encourages firms that have completed agricultural industrial-academic collaborative projects and industrialized R&D results to occupy agricultural innovation incubation centers, where they can obtain integrated R&D, marketing, operation, and management services. Three agricultural innovation incubation centers were established and began operation in 2009; 14 firms currently occupy these centers. In addition, in order to boost the business constitution of agricultural firms across the board, the COA has organized a management assistance consulting team. This team has performed on-site visits to 200 firms and providing consulting services concerning the six major aspects of production, sales, personnel, inventions, finance, and capital. Afterwards, 62 firms were selected to receive advanced diagnosis and business improvement recommendations, and improvement assistance projects were implemented for 43 firms. The beneficiaries of this business assistance extension program numbered over 1,000 (person-times).

Chapter 3 S&T Development Vision and Strategies

In keeping with today's knowledge economy and globalization trends, S&T development trends in many countries place increasing emphasis on the R&D of innovative technology, the maintenance of a green, sustainable environment, promotion of industrial and economic development, and advancement of citizens' welfare. Taiwan has similarly taken academic excellence in research, innovation in industrial technology, citizens' welfare and safety, and a superior, sustainable environment as its objectives, and, beyond continuing to rely on the strengths of the information and communications industry, has also taken active steps to develop green energy and smart living technology, strengthen biotech medicine and disaster mitigation and response R&D, promote emerging service industries, promote dialog between technology and the humanities, provide citizens with a superior quality of life and environment, and transform Taiwan into a global leader in green energy technology and intelligent living.

3.1 Vision, Goals, and Indicators

Vision: Taiwan will become a global leader in green energy technology and intelligent living by 2020

Goals:

I. Academic Excellence in Research

1. Pursuit of world-class research quality, creation of a superior research environment, effective manpower "selection, use, cultivation, and retention" strategies.

2. Development of forward-looking academic research areas, establishment of world-class research communities.

3. Consolidation of key superior R&D fields able to contribute to national prestige and conform to international environmental trends.

4. Integration of industry-academic research results, activation of knowledge value, promotion of industrial development, enhancement of citizens' welfare, contribution to the world.

II. Innovation in Industrial Technology

1. Effective use of cultural creativity and scientific and technological advantages, pursuit of innovative breakthroughs, transformation of Taiwan into a global innovation center.

2. Development of high-value low-carbon industries, leveraging of industry clusters with distinctive features, establishment of high-tech innovation corridors.

3. Integration of interdisciplinary emerging industries, provision of safe and healthy living technology, responding to future social changes.

4. Encouragement of creative R&D and design, establishment of company brand, global deployment and trade without restrictions.

III. Citizens' Welfare and Safety

1. Establishment of a ubiquitous network environment, supply of knowledge

creation services, establishment of Taiwan as a pioneering global intelligent island.

2. Marketing Taiwan using art and creativity drawing on local cultural features, stimulating a national aesthetic economy.

3. Responding to global climate change, enhancing disaster mitigation technology R&D capabilities, protecting citizens' lives and safety.

4. Stimulating the utilization of intellectual property, development of emerging knowledge service industries, enhancing intelligent soft power.

IV. A Superior, Sustainable Environment

1. Promotion of forward-looking technological planning, encouragement of interagency integration and sharing of tasks, effective deployment of government resources, development of focused national strategies.

2. Adjustment of organizational and legal systems, establishment of a performance evaluation system, enhancement of government operating performance.

3. Extension of energy conservation and carbon emission reduction technology, establishment of a low-carbon LOHAS environment, pursuit of ecologically-sustainable development.

4. Effective utilization of domestic natural marine and terrestrial resources, development of distinctively Taiwanese research, and thereby make contributions to humanity.

Indicators:

The following input and output indicators have been determined in order to achieve this vision and goals connected with academic research, the economy, citizens' welfare, and the environment. These indicators can be used to assess the effectiveness of science and technology policy implementation in Taiwan.

Input indicators

- The steady growth in government R&D funding will induce the private sector to increase R&D investment, hopefully causing Taiwan's nationwide R&D funding to rise to 3% of GDP in 2012.

- With regard to private sector funding of R&D, the manufacturing industry's R&D funding as a share of operating revenue will reach 1.7% by 2012 and 2.5% by 2020.

- The percentage of R&D funding in the higher education sector deriving from companies will rise to 9.1% in 2014.

- The number of research personnel per 1,000 employment will rise to 12 FTE by 2020.

Output indicators

- Patent quality indicator

  A current impact index (CII) for patent applied for in the United States of 1.

- Top-flight academic research

  1. At least ten research centers or fields in Taiwan will become world leaders by 2015.
  2. The number of papers with high citation rates (HiCi) during the most recent decade will grow 50% by 2015.

- Service innovation indicators

  After strengthening service innovation R&D, service exports will have a global share of 1.2% by 2012.

- Quality of life indicators

  Quality of life indicators will rise to the standard of a developed country by 2015.

- Energy conservation and carbon emission reduction indicators

  1. Energy conservation: Energy efficiency will increase by at least 2% annually, causing energy intensity to fall by more than 20% compared with 2005 by 2015, and fall by more than 50% by 2025 relying on technological breakthroughs and supporting measures.
  2. Carbon reduction: National carbon dioxide emissions will fall to the 2005 level by 2020, and fall to the 2000 level by 2025.

3.2 Strategies

In order to realize Taiwan's S&T development vision and goals, the government has put forward eight major development strategies addressing academic, economic, public welfare, and environmental aspects. In the area of academic research, strategies will include the training of outstanding manpower in order to link Taiwan with global innovation networks and achieve world-class research quality. In the area of economic development, strategies will include strengthening of design and innovation, establishment of ties to emerging knowledge industries, meeting citizens' living needs, and reinforcing the nation's economic strength. In the area of citizens' welfare, strategies will include enhancement of disaster mitigation technologies and technologies for living, boosting citizens' safety, and improving quality of life by combining S&T development with the humanities to establish an aesthetic economy. In the area of environmental development, strategies will include the establishment of an environment promoting the synergy in the application of scientific research results, the revitalization of local resources, sufficient attention to environmental conservation, and fulfillment of Taiwan's responsibilities as a global citizen.

Strategy I. Making best use of S&T manpower resources, developing limitless knowledge value

Strategy II. Emphasizing the quality of academic research, promoting cooperation between research and industry

Strategy III. Establishing global innovation centers, strengthening distinctive industry clusters

Strategy IV. Innovating technologies for healthy living, establishing emerging smart industries

Strategy V. Integrating disaster prevention and response technologies, enhancing the public welfare and safety

Strategy VI. Combining S&T development with the humanities, enhancing smart soft power

Strategy VII. Easing legal restrictions & improving systems, strengthening forward-looking policy planning

Strategy VIII. Developing innovative sustainable energy technologies, building a green low-carbon environment

I. Making best use of S&T manpower resources, developing limitless knowledge value

A. Training, recruiting, and utilizing S&T manpower

1. Actively promoting interdisciplinary collaborative projects involving alliances of universities, nurturing world-class research teams.
2. Implementation of a long-term plan for higher education.
3. Use of interagency technology decision-making support mechanisms, drafting of multifaceted S&T manpower development strategies.
4. Easing of hiring restrictions, improvement of the research and living environment, establishment of an environment facilitating recruiting of outstanding overseas human resources.
5. Assessment of scientific research manpower needs in light of the trend toward fewer children in Taiwan, determine more active human resources acquisition strategies.

B. Respond to changes in the demographic structure by balancing S&T manpower supply and demand in key areas.

1. Active promotion of an employment market supply and demand forecasting mechanism and notification system, establishing mechanisms for adjusting supply and demand of human resources.
2. Integration of training resources in industry, government, academia, and the research community, promotion of programs to shorten the gap between education and industry demand, achieving a diversified balance between industry manpower supply and demand.
3. Promotion of a multifaceted interdisciplinary system integration manpower project training personnel with forward-looking R&D leadership ability.
4. Use of online learning channels to share education resources, provide in-service training and second specialization training, and implement a lifelong learning program in conjunction with the professional skills certification system.

C. Training interdisciplinary collaboration and international systems innovation manpower with a global perspective.

1. Strengthening scholarship programs for overseas students studying in Taiwan, boosting the international vision of education in Taiwan via international exchange programs.

2. Actively funding the overseas travel expenses of outstanding research personnel participating in international academic interchange activities and projects, cultivating manpower accustomed to international and interdisciplinary collaboration.
3. Establishment of an internationally-recognized academic research grant program for foreigners, expanding the pool of partners in international research cooperation collaboration.

D. Promotion of international S&T and manpower interchange, connection of global S&T communities and industrial innovation networks.

1. Holding of international activities, establishment of global manpower networks and international technology R&D community linking programs, actively promoting international manpower interchange.
2. Active participation in international collaborative R&D plans, reliance on advanced technology interchange and transfer to quickly achieve harmony with international norms.
3. Implementation of incentive programs inducing domestic research organizations and prominent international research units to establish alliances, boosting Taiwan's S&T competitiveness.

II. Valuing the quality of academic research, promoting cooperation between research and industry.

A. Establishing a superior academic research environment, boosting S&T research service performance.

1. Promotion of frontier research and high added-value projects, and strengthening of national-level research programs, in order to effectively integrate research resources and enhance research synergy through specialization and division of labor.
2. Boosting research service performance, strengthening interagency S&T R&D integration and effective management of research equipment.
3. Promotion of boundary-spanning applications-type research projects or new field of application development projects, promoting consumer economic development.

B. Establishment and activation of top-flight research communities, pursuit of top-flight world-class research quality.

1. Promotion of research projects in key areas in order to integrate the resources of industry, government, academia, and the research

community research, and ensure that resources are used effectively and yield the greatest possible returns.

2. Encouragement of academic excellence, promotion of excellence projects, encouragement of research in forward-looking, distinctive fields.
3. Promotion of research projects seeking to achieve the conservation and sustainable utilization of unique or special Taiwanese resources, consolidating R&D capabilities and making Taiwan a academic research stronghold in the Asia-Pacific region.
4. Placing emphasis on research quality, changing existing indicators stressing short-term quantitative performance, forecasting on long-term results and impacts.

C. Promoting of close cooperation between industry, academia, and research organizations, forming intensive interactive knowledge innovation systems.

1. Establishment of a regional innovation system program, linking local economic and service potential with universities' R&D specialties, implementation of incentive programs encouraging academic researchers to license their R&D results, generating new high-tech spin-off companies.
2. Strengthening R&D incentives, rewarding instructors who engage in industrial-academic collaboration, fostering entrepreneurial spirit on university campuses, putting the technology trading system, intellectual property management system, and interchange platforms on a sound basis, activating industry-academic R&D mechanisms.
3. Encouraging manpower in companies, universities, and research organizations to participate in multinational R&D projects and establish overseas R&D centers, encouraging overseas personnel to return to establish start-ups in Taiwan.

D. Emphasizing assessment of academic research results and extension of applications.

1. Promotion of incentive measures encouraging the application of university research to industrial development, cultivating outstanding manpower possessing entrepreneurial spirit.
2. Formulation of clear indicators for assessing results and implementation of an assessment system to provide a basis for the rational allocation and utilization of research resources.

3. Establishment of an S&T risk assessment and governance system, realizing a channel of communication between the academic community and society at large. Deliberative, democratic methods should be used to deal with the extension of controversial research results to social applications, promoting public participation, better understanding, and a higher degree of social acceptance.

III. Establishing global innovation centers, strengthening distinctive industry clusters

A. Systematic analysis of global market opportunities and S&T trends, facilitating access to global resources and an effective R&D deployment.

1. Promotion of research projects focusing on systematic analysis of market trends, guiding industrial R&D, expanding market scope, using the Internet to facilitate connections between localized resources and domestic technological innovation capabilities, and implementing a global R&D deployment.
2. Promotion of international networking plans, enlarging emerging markets, consolidating the export competitiveness of domestic products, promoting freedom from trade boundaries.
3. Development of original models matching technological capabilities with commerce, breaking through existing industrial development models, boosting industrial level and creating competitive advantages.
4. Promotion of service performance improvement plans, using information applications as platforms and taking software knowledge as the focus of economy value-adding activities, enhancing Taiwan's qualifications as a global innovation center.

B. Encouraging companies to commit themselves to green R&D, design, and production, boosting their brands and global marketing capabilities.

1. Establishment of a strategic specialized division of labor model plan, working together with trade partners, using the advantages of R&D creativity and flexible production to enter global industry value chains.
2. Development of technological innovation and knowledge service integration plans, promotion of multinational firms' R&D centers, establishment of company brands.
3. Formulation of plans for the development of green environmentally-friendly products meeting international standards in

keeping with the global green environmental trend, strengthening product design capabilities, enhancing industrial innovation value and added value chains.

C. Development of distinctive high added-value industry clusters, establishment of high-tech industrial innovation corridors.

1. Promotion of plans and measures relying on science parks to stimulate regional economic development, accelerating the upgrading of conventional industries.
2. Establishment of next-generation intelligent, innovation parks drawing on successful science park development experiences and linked with peripheral hardware and software facilities and urban development trends.
3. Promotion of high added-value industry cluster development plans, establishment of a basic industrial innovation environment, transformation of clusters into innovative R&D-oriented science parks.
4. Promotion of high-tech industrial innovation corridor plans drawing on local culture, economic features, and resources, leveraging the strengths of different clusters.

D. Making best use of the strengths of the information and communications industry, drawing on Taiwan's cultural creativity to become a global innovation center.

1. Promotion of intelligent information development plans shortening the gap between urban and rural areas, balancing regional development, and transforming Taiwan into an innovative intelligent island.
2. Implementation of industrial innovation and knowledge service platform integration plans, use of existing information and communications strengths to transform Taiwan into a global innovation center.
3. Making best use of the cross-Strait division of labor and globalization trends, creating an open, diversified environment, participating in East Asian regional economic integration, and making Taiwan a trade and operations hub.

E. Activating the use of intellectual property, establishing an innovative entrepreneurial environment.

1. Perfecting the intellectual property rights management and appraisal system, putting trading environment laws on a sound footing,

establishing an intellectual property rights protection, management, and bridging system that will promote the active use of research results.

2. Establishment of various mechanisms promoting technological transactions, integrating intellectual property information interchange and service platforms, providing companies with intellectual property services, promoting the development of a technological service industry.
3. Establishment of a professional licensing system for patent personnel, boosting the standards of the intellectual property industry, actively participating in the drafting of international intellectual property rights standards.

IV. Innovating technologies for healthy living, founding emerging smart industries

A. Promoting key emerging industries, fostering lean, diversified industrial development.

1. Integrating biotech pharmaceuticals, medicine, agriculture, and environmental protection R&D and industrialization capacities, boosting industrial development.
2. Implementation of low-carbon energy industry development programs, use of domestic strengths in photovoltaic power and LEDs to transform Taiwan into a green energy technology and production powerhouse,.
3. Implementation of development programs for industries with local features, shaping local styles of living and stimulating tourist industries; conducting cultural diplomacy.
4. Establishment of agricultural product refinement and environmentally-friendliness programs, encouragement of farming product development, biotechnology application assistance, and simultaneous strengthening of the land's agricultural production, living, and ecological functions.

B. Promotion of emerging intelligent industries, enhancement of the value of industrial innovation.

1. Implementation of a program to transform Taiwan into an "intelligent kingdom," promotion of cloud industry opportunities conforming to international trends and taking advantage of existing information hardware strengths.
2. Implementation of an integrated program on information,

communications, and green energy R&D capacity, reliance on an advanced, intelligent grid to expand the electron vehicle market, making life more convenient and realizing sustainable transportation.

3. Establishment of a smart green architecture development plan facilitating linkage between the construction, information and communications, and energy conservation industries, promoting healthy living, and encouraging environmental sustainability.
4. Development of an intellectual property industry and enhancement of high-tech innovation added-value, strengthening the international competitiveness and defensive/offensive ability of emerging industries.

C. Connecting biotechnology industry value chains, boosting the economic output of biotechnology, promoting citizens' health and welfare.

1. Refining the legal and regulatory environment, enhancing review performance and putting the intellectual property management system on a sound footing, accelerating development of the biotechnology industry.
2. Strengthening collaboration and alliances with global industry chains to make optimal use of international resources and enlist international manpower and funds.
3. Promotion of a preventive medicine and translational technology program benefiting both industrial development and citizens' health and welfare, and responding to expected future social change and development trends.

D. Development of an interdisciplinary applied living industry closely linked with the public's needs.

1. Establishment of a health information grid combining biotechnology, information, and health management technology, enhancing citizens' health and welfare.
2. Promotion of a program to develop consumer applications products and combining emerging biotechnology, materials, and information technologies in order to improve quality of life.
3. Establishment of a pioneering R&D results demonstration mechanism fostering linkage between applications concepts, everyday living needs, and cultural features.

V. Integrating disaster prevention and response technologies, enhancing citizens' welfare and safety.

A. Assessing the impact of global climate change, developing a natural disaster management system.

1. Implementation of a climate change monitoring capability improvement plan, reducing natural disaster losses and incidence through a typhoon, flooding, and drought early warning system.
2. Establishment of environmental change indicators, improvement of automatic disaster early warning and notification system.
3. Establishment of localized climate change trend and impact analysis and response measures.
4. Disaster risk assessment addressing infrastructure, proposal of safety management mechanisms.

B. Strengthening of disaster prevention and response technology R&D, improvement of overall social disaster mitigation and relief capabilities.

1. Promotion of various types of natural disaster early warning system plans, use of satellite observation data and information/communications technology, integration of meteorological, sea state, and geological observation data, establishment of a natural disaster early warning system at an early date.
2. Formulation of a more accurate debris flow forecasting system, use of remote sensing technology to establish a landslide and debris flow forecasting mechanism.
3. Promotion of a residential safety technology program, enhancement of urban and building disaster prevention and relief capabilities, safeguarding the safety of the living environment.
4. Promotion of research projects on the social and economic aspects of disaster mitigation, including risk control, insurance systems, emergency settlement, and medical assistance.

C. Putting environmental monitoring and risk assessment management on a solid footing, development of climate change adaptation strategies

1. Establishment of environmental monitoring systems; collection, management, and analysis of environmental data.
2. Establishment of a localized environmental database, promotion of international environmental information interchange.
3. Development of climate change adaptation strategies, planning of strategies in the eight major areas of natural disasters, water resources, life support infrastructure, energy and industrial economy, coasts,

agricultural production and biodiversity, health, and land use.

4. Development of a public facility monitoring, safety management, and operating assessment decision-making support system.

D. Activation of disaster prevention and response system notification, communication, and coordination, boosting post-disaster recovery and reconstruction performance.

1. Establishment of a competent authority notification and emergency response mechanism linking different communication system levels.
2. Establishment of an interdepartmental disaster mitigation database and disaster prevention and response information network integrating disaster prevention and response information.
3. Establishment of a post-disaster sanitation and health support system ensuring public environmental sanitation and health management of affecting residents.
4. Implementation of various types of disaster prevention and response manpower training plans, providing universal awareness of disaster prevention and mitigation concepts.

VI. Combining S&T development with the humanities, enhancing smart soft power.

A. Drawing on S&T innovation, cultural creativity, and local life to promote cultural art industries and boost quality of life.

1. Boosting citizens' aesthetics endowment, employing S&T and humanities education to cultivate manpower with creative design skills.
2. Employing boutique agriculture, healthcare, and cultural creativity to expand the content of tourism and promote the development of soft power.
3. Integration and active utilization of digital archives content to enrich culture, society, and the economy; use of mobile communications and the digital living industry to boost citizens' e-learning qualifications and develop knowledge economy power.

B. Development of humane technologies and emerging service industries in response to social changes.

1. Establishment of effective healthcare and living assistance systems, and expansion to underprivileged groups, enhancing dignity of life and

highlighting the spirit of humane concern.

2. Promotion of health information S&T development, strengthening of health care service and disease prevention measures, and application to everyday medicine, creating an emerging medical service industry.
3. Making best use of elderly and retired manpower, promotion of automation S&T development in response to labor shortages in the wake of Taiwan's declining birth rate.

C. Creation of an intelligent living environment, shaping of a superior, happy social atmosphere.

1. Construction of intelligent transportation and living systems meeting local needs, implementation of urban and rural renewal, building a superior, convenient living environment.
2. Promotion of a LOHAS organic agriculture plan, establishing a superior living environment and transforming Taiwan into a non-toxic LOHAS island.
3. Making active use of science and technology to develop smart green architecture, building a contented safe, environmentally-friendly, energy-conserving, low-carbon society.

VII. Easing legal restrictions & improving systems, strengthening forward-looking policy planning.

A. Promoting forward-looking technological research, establishing a consensus among citizens concerning the long-term development of S&T and society.

1. Promoting routine forward-looking S&T research responding to social and economic needs, drafting an S&T development blueprint for Taiwan.
2. Selecting key, forward-looking areas of technology for development assistance, effectively allocating government's R&D resources, performing strategic planning for key technologies and drafting developmental timetables.
3. Steering S&T innovation and industrial development via development of key fields, establishing core technological capabilities, integrating R&D resources, focusing on the development of niche industries, achieving leading international status in specific areas.

B. Emphasizing the long-term planning of S&T development and performance assessment.

1. Establishment of a domestic S&T development and industrial needs performance evaluation systems in line with international public management trends.
2. Refinement of the S&T budget review system, implementation of interagency integration and division of labor functions, strengthening of synergy in the scientific research system.
3. Strengthening of national science and technology program results management and evaluation, improvement of academic research project assessment and subsidy mechanisms, and establishment of a project exit mechanism.

C. Loosening of legal and regulatory restrictions and reform of institutional systems in order to create an environment promoting the development of science and technology.

1. Loosening restrictions on residence by foreign professionals, enabling skilled personnel to enjoy long-term residence and contribute their talents to Taiwan.
2. Establishment of a flexible S&T personnel affairs system and concurrently position regulations governing personnel at government research organizations, creating a superior research environment by activating human resource interchange mechanisms spanning industry, government, academia, and the research community.
3. Drafting a review mechanism allowing application for promotion on the basis of technological results, encouraging possesses instructors possessing practical experience to take part in industry-academic research.
4. Adjusting the S&T organizational and legal systems to keep up with the changing times and international trends, creating an environment facilitating scientific and technological R&D innovation.

D. Putting the legal and regulatory system on a sound footing, promoting synergy in the utilization of the R&D results of industry, academia, and research organizations.

1. Making the legal and regulatory system more comprehensive, establishing rational R&D results ownership, protection, and technology transfer mechanisms, encouraging joint industry-academic R&D.

2. In order to strengthen Taiwan's S&T competitiveness, encouraging an entrepreneurial culture on university campuses, and promoting the incubation of spin-off companies based on R&D and innovation.
3. Establishment of interdisciplinary R&D centers implementing market-oriented innovative product R&D.
4. Liberalizing the teacher salary system and easing restrictions on transfer to companies or research organizations.

VIII. Developing innovative sustainable energy technologies, building a green low-carbon environment.

A. Promoting clean and green energy technologies, creating green employment opportunities, building a low-carbon economy.

1. Promotion of regeneration, energy conservation, alternative and clean energy programs, and power generation and energy use efficiency programs, upgrading Taiwan's energy structure, establishing an energy information and communications infrastructure, developing an energy conservation service industry.
2. Design of a marine energy development program, development of marine algae biofuel technology to increase alternative energy output and promoting the absorption of greenhouse gases.

B. Increasing the value and reducing the carbon emissions of conventional industries, establishing a green energy industry environment.

1. Promotion of resource recycling and reuse, reduction of waste, shaping a recycling society.
2. Provision of resource conserving and environmentally-friendly technologies, establishment of a cyclic economy development model.
3. Develop of domestic energy, stimulating the development of the new energy industry, creation of green jobs.
4. Development of energy conservation and carbon emission reduction technologies, promotion of home, auto, and building applications, boosting the green energy economy.

C. Promotion of national land restoration and environmental protection, pursuit of sustainable development.

1. Promotion of national land development and environmental coexistence research, implementation of a comprehensive program on

national land planning and ecological engineering, development of ecological working methods meeting local needs for use in land restoration.

2. Strengthening ecological conservation and biodiversity research, establishment of cyclic ecological system observation and implementation capabilities, and development of terrestrial resource conservation and management technologies for use in biological restoration work.
3. Implementation of water resource management plans, development of water reuse, water source conservation, and reservoir renewal technologies.

D. Development of marine science and technology, placing balanced emphasis on marine/terrestrial resource conservation and utilization.

1. Implementing marine resource exploration projects, performing marine resource conservation and restoration work.
2. Strengthening marine S&T research, establishing national marine databases.
3. Implementing innovative emerging marine industry plans, making good use of marine resources as new sources of pharmaceuticals, food, and biofuels.