



An Emerging Revolution: Clean Technology Research, Development and Innovation in China

China's policies to prioritize, fund and deploy clean technology R&D and innovation over the short and medium term stem from an ambition to emerge as a global power in science and technology through clean technology R&D and innovation.

MID-TO LONG-TERM CLEAN TECHNOLOGY DEVELOPMENT

In January 2006 China's government published the Medium-to-Long-Term Science and Technology National Plan (S&T National Plan). The plan establishes the government's front-and-center role in determining the direction, quality, and quantity of China's R&D and innovation efforts to 2020. The plan sets 4 quantitative targets and 5 strategic focuses, under which there are 11 key fields and 68 priority subjects. Of the 5 strategic focuses, top priority is given to technology related to energy, water resources and environmental protection.

SHORT-TERM CLEAN TECHNOLOGY DEVELOPMENT

Based on the S&T National Plan, the Ministry of Science and Technology (MOST) formulated the National 11th Five-year Development Plan of Science and Technology. This provided short-term targets and goals for China's R&D

and innovation activities from 2006 to 2010. Consistent with the S&T National Plan, the 11th Five Year S&T Plan lists energy and environmental protection as key areas to be targeted. Specifically, the plan highlights three key clean technologies: building key energy-saving technologies, 2-3 MW wind turbine commercialization, and high quality transmission technology and equipment.

FUNDING OF CLEAN TECHNOLOGY R&D AND INNOVATION

In the past five years government R&D appropriations have increased dramatically, from 70.3 billion yuan (\$11 bil) in 2001 to 168.9 billion yuan (\$26 bil) in 2006. As a result, the share of R&D in total government expenditure increased from 3.7% to 4.2% from 2001 - 2006 (MOST 2007). Among the various publicly-funded S&T programs (Table 3), the 863 & 973 programs provide the most direct funding sources for clean technologies.

Table 3 | Government Funded R&D in China

PROGRAM	SUBJECT	FUNDING, BILLION YUAN
863: National High-Tech R&D Program	IT, energy, resources and environment, advanced materials, biotechnology and agricultural technology, advanced manufacturing and automation, marine, space and laser technologies.	20
National Natural Science Fund	Basic and applied research in the natural sciences with most funding directed to life sciences and engineering.	10.5
Key Technologies R&D Program	R&D in agricultural processing and biotechnology, key manufacturing technologies, IT and high-tech industries, environment, traditional Chinese medicine, and social development.	6.3
973: National Basic Research Program	Basic and applied research in energy, agriculture, information, environment, population, and health, materials and synthesis.	4
Innovation Fund for Small, Technology-based Firms	Development support in the areas of electronics and IT, biotechnology, materials, automation, environment and energy for technology-based small to medium enterprises (SMEs).	2.6
Agricultural Science and Technology Transfer Fund	Development support for agricultural technology generation, transfer and application.	1.4
National New Products Program	Publication of annual list of new products that contain self-owned intellectual property rights (IPRs), have high export potential, replace import products, are made primarily with domestic parts or that adopt international standards for support through grants and other policies.	0.7
Torch	Development support in areas of new materials, biological and medical technology, electronic information, integrated light and electronics and their machinery, new and efficient energy.	0.3
Spark	Support of R&D and S&T education for rural economies, advanced technologies for township enterprises, the improvement of labor conditions and skills, and the creation of sustainable agricultural technologies.	0.5

*Funds were allocated during 2001-2005.

Data source: China Ministry of Science and Technology

863 Program:

Also known as the State High-Tech Development Plan, the 863 Program was created to stimulate the development of advanced technologies in a wide range of fields in order to render China independent of financial obligations for foreign technologies. The program has changing focuses and priorities, depending on the needs of national economic development. During the 11th Five Year Plan, the 863 program set up 10 focus areas, including energy technologies. Within the energy category there are four technology priorities: hydrogen and fuel cell, energy efficiency, clean coal and renewable energy. A total of 1.12 billion yuan (\$172 million) has been invested in these priorities, with hydrogen and efficiency technologies receiving the majority of funding (table 4).

Table 4 | 863 Program's Energy Focus - 11th Five Year Plan

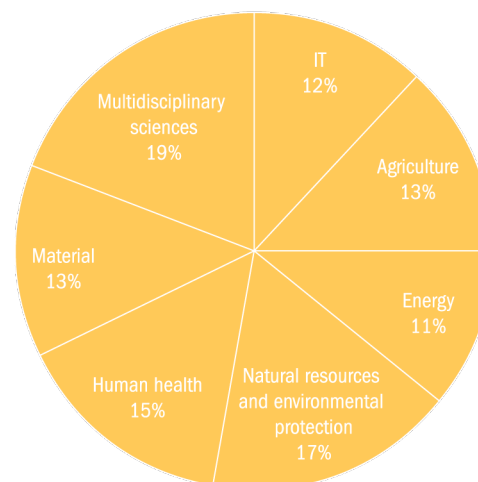
PRIORITY	FUNDING, MILLION YUAN
Hydrogen and fuel cell technologies	75/year
Energy efficiency technologies	75/year
Clean coal technologies	45/year
Renewable energy technologies	29/year

Data source: 2006 Application Guideline for 863 Program Energy Technology Field

973 Program:

Complementing the 863 Program, which focuses on specific technologies, is the National Basic Research Program, also called the "973 Program." Since its inception, core focuses of the 973 program have been energy, natural resources conservation, and environmental protection. From 1998 to 2008, the program supported 382 projects with a total funding level of 8.2 billion yuan (\$1.3 billion), of which 28% went to energy, natural resources conservation and environmental protection (Figure 2).¹

Figure 2 | 973 Program Funding by Strategic Focus



Data source: National Basic Science Research Data Base, 2004

During the 11th Five Year Plan period, the 973 Program's energy focus and financing targets the following topics:

- Basic research on the distribution and safe mining of deep coal resources and coal-bed methane.
- Basic research on efficient and environmentally sound usage of coal.
- New theories and methods on more efficient exploitation and utilization of oil and natural gas.
- Major scientific issues related to China's large grid system.
- Key scientific programs related to large-scale and pollution-free production, storage and transmission of hydrogen fuel.
- Exploration of utility-scale renewable energy and new energy development.
- Exploration of large-scale nuclear fission and fusion development.
- Key scientific issues related to energy efficiency improvement

Both the 863 & 973 programs are funded and managed by the MOST. At the local level, provincial and municipal governments are also actively involved in funding R&D. In the past 10 years local Chinese governments' S&T appropriation has steadily increased. In 2006, Shanghai topped the nation in R&D appropriation, with a total investment of 9.5 billion yuan (\$1.5 billion). This accounted for 5.2% of Shanghai's GDP in the same year.

PROMOTING INTERNATIONAL COLLABORATION ON CLEAN TECHNOLOGY

In November 2007, the MOST and National Development and Reform Commission (NDRC) jointly launched the International Science and Technology Cooperation Program on New and Renewable Energy. The program's goals are twofold: diversifying the sources of technology imports, and expediting technology transfer processes between China and other

countries. The program has identified five priority technologies for international collaboration (Table 5). The program has greatly enhanced China's efforts in international collaboration. Already, China has signed 103 cooperation agreements with 97 countries.ⁱⁱ A significant number of these agreements have a focus on new energy and renewable energy development. The EU, the US and Japan are the top three partners China seeks collaborative opportunities from. In July of 2009, US Secretary of Energy Steven Chu together with Chinese Minister of Science and Technology Wan Gang announced plans for a joint US-China Clean Energy Research Center.

Table 5 | Priority Fields for International Collaboration

Technology	Details
Integration of solar power generation and building integrated solar technology systems	Solar and PV power generation system, thin-film solar cells, building integrated solar, low-cost, low-pollution and high-purity silicon material production, solar thermal utilization for industrial applications.
Biomass fuels and biomass power generation	Non-food energy crops and ethanol from cellulosic materials, energy forestry, bio-diesel, biomass briquettes and biomass gasification, biogas power generation and more.
Wind power generation	Wind energy resources assessment, large high-efficiency wind turbines, offshore turbines and wind farms.
Hydrogen energy and fuel cell	Technologies for the production, storage and transportation of hydrogen, technologies for new types of fuel cells and fuel cell automobiles.
Natural gas hydrates	Technologies for the exploration, development, storage, transportation, and utilization of gas hydrates.
Source: International Science and Technology Cooperation Program on New and Renewable Energy, 2007	

CONCLUSIONS

China utilizes an array of complementary policy measures to spur domestic R&D and innovation in clean technology. These measures include:

- designing a national-level S&T strategy prioritizing clean energy;
- establishing direct funding programs to support clean energy R&D;
- capitalizing on public-private synergies to bring together multi-sector expertise;
- pursuing a “going-out” policy of global engagement on clean energy development; and
- incentivizing the involvement of the private sector in clean tech innovation.

In the decades ahead, most of the growth in global energy demand – 90% by 2030 – will come from emerging countries. If greenhouse gas emissions are to be constrained, large-scale clean technology deployment is therefore especially vital in the developing world. China’s comprehensive efforts to lay the groundwork both to achieve a domestic clean energy economy, and to assist other developing countries to do so, indicate its commitment to becoming a global player in the clean technology revolution.

This ChinaFAQs fact sheet was largely adapted from, “**An Emerging Revolution: Clean Technology Research, Development and Innovation in China**” by Xiaomei Tan (WRI) and Zhao Gang (CASTED), published December, 2009.

Box 1 | Policies to Stimulate Private Sector R&D Investment

Preferential tax treatments:
• Accelerated implementation of consumption VAT to allow for capital expenditure deduction
• Accelerated depreciation of R&D apparatus and facilities
• Increased deduction of R&D expenses from taxable income
• Favorable tax policies, including favorable taxation terms for venture capital to promote development of new products, technologies, and high-tech enterprises
• Preferential tax policies for R&D-focused small and medium enterprises
• Further support the establishment of overseas R&D centers
Favorable financing policies
• Provide loans to R&D-focused enterprises, and finance their imports and exports
• Encourage commercial banks to provide loans based on government guarantees and discounted interest rates
• Encourage venture capital investment with government funding and commercial loans
• Create a favorable environment for R&D enterprises to go public in overseas stock exchange
• Establish technology-oriented financing platforms
• Special funding for the absorption, digestion, and re-innovation of imported technologies
Government procurement policies
• Governments purchase domestically-innovated products and technologies
• Financial support to enterprises that purchase domestically-innovated products and technologies
• Establish technical standards through government purchases of domestically-innovated products and technologies
Protection of IPR and implementation of technology standards
• Further improve the national IPR system
• Create a legal system that respects IPR
• Prioritize the development of technology standards
• Actively participate in international standard-setting
Designation of high-tech development zones
• Build infrastructure for high-tech development zones
• Create a favorable policy environment for enterprises based in high-tech development zones
• Provide policy support to technology transfer center and other technology-focused intermediary service institutions
Data source: China S&T National Plan, 2006

This fact sheet is a product of ChinaFAQs, a joint project of the World Resources Institute and experts from leading American universities, think tanks and government laboratories. Find out more about the ChinaFAQs Project at: <http://www.ChinaFAQs.org/>.

Notes

ⁱ 973 Program News, 2008. “10th Anniversary of 973 Program Took Place in Beijing” October 7 2008. Available at: <http://www.973.gov.cn/ReadCont.aspx?aid=422>.

ⁱⁱ Wan Gang 2009. Relying Science and technology to tackle climate change. Available at <http://www.ccchina.gov.cn/cn/NewsInfo.asp?NewsId=12193>.

ChinaFAQs

World Resources Institute
10 G St NE
Washington, DC 20002
202-729-7600
www.ChinaFAQs.org