# China's Science, Technology and Innovation (STI) System and Policy

Embassy of the People's Republic of China in the Kingdom of Thailand July 2014

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S&T achievements in China
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#### China's top 10 science and technology progress in 2013



•<u>Chang'e-3 landed on the</u> moon's Sinus Iridum,or the Bay of Rainbows, on <u>14 December, making</u> China the third country in the world to carry out such a rover mission after the United States and <u>former Soviet Union. And</u> China's first moon rover, Yutu, or Jade Rabbit, separated from the lander several hours after the Chang'e-3 probe softlanded on the lunar surface.

#### China's top 10 science and technology progress in 2013

•<u>The Shenzhou-10 mission</u> has made China's manned spacecraft flights successful in a consecutive way, and put a satisfactory end to the first phase of the second step of China's manned space program.



#### China's top 10 science and technology progress in 2013



•Chinese scientists have made the first verv experimental observation of a phenomenon known as the quantum anomalous Hall (OAH) effect, a discovery that will help accelerate the IT revolution and in developing low-powerconsumption electronics

#### China's top 10 science and technology progress in 2013

•H7N9 avian influenza, which was first reported in humans in China this year, has a lower fatality risk than H5N1-type bird flu that emerged in 2003.



#### China's top 10 science and technology progress in 2013



•The supercomputer Tianhe-2, capable of operating as fast as 33.86 petaflops per second, was ranked on Monday as the world's fastest computing system, according to TOP500, a project ranking the 500 most powerful computer systems in the world.

China's top 10 science and technology progress in 2013

•<u>Ultra-light Aerogel Produced</u> at China. A research team have developed ultra-light aerogel – it breaks the record of the world's lightest material with surprising flexibility and oilabsorption. This progress is published in the "Research Highlights" column in Nature.



#### China's top 10 science and technology progress in 2013



• Chinese Academy of Sciences (CAS) has launched a deep ultraviolet (DUV) solid-state laser device, making the country first-ever in the world to possess such technology.

#### China's top 10 science and technology progress in 2013

• Chinese scholars reported a resolution of sub-nanometer (about 0.5nm) Raman spectral imaging technique that can distinguish between the internal structure and surface configuration of individual molecules. This technology not only makes chemical imaging on a single molecule level possible, but opened up a new way to study single molecules nonlinear optical processes and photochemical processes in the world.



#### China's top 10 science and technology progress in 2013



•<u>The world's largest nuclear</u> <u>power generatorunit</u> <u>capacity -- the Taishan</u> <u>nuclear power plant No. 1</u> <u>1750 megawattnuclear</u> <u>power generators by China</u> <u>Dongfang Electric Co.,</u> <u>Ltd.manufacturing, and</u> <u>from the Sichuan Deyang</u> <u>smooth shipment.</u>

#### China's top 10 science and technology progress in 2013

•Chinese scientists have put forward a new theory of mimicry computing and successfully developed the world's first dynamic variable structure mimicry computer based on bionics, cognitive science and information technology.



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✓ S&T Achievements in China

✓ <u>Updated Statistics (2013)</u>

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In 2013, Gross domestic R&D expenditure reached 11906 billion Yuan\*, annual growth rate over 20%.



Gross Domestic Expenditure on R&D2000-2011 (Vertical axis in 100 million yuan)

•\* 1USD=6.2855 CNY, exchange rate on 2012.12.31

Ratio of the nations' Gross domestic expenditure on R&D (GERD) to GDP reached from 1.84% in 2011 to 2.09% in 2013.



**GERD** in selected countries

#### ✤ GERD by type of activity in 2011(%).



GERD by type of activity

In 2013, <u>Central Government</u> science and technology appropriation reached 246.059 Billion Yuan.



#### **Total Government S&T appropriation from 2000-2011**

High-tech industry R&D expenditure continued to grow. Large (medium)-type high-tech industry enterprises R&D expenditure reached 123.78 billion Yuan (2011).



High-tech industry R&D expenditure and investment intensity distribution by sectors

In 2013, National R&D personnel reached 3.60 million person-years from 3.20 million person-years in 2012.

	2006	2007	2008	2009	2010	2011
R&D人员(万人年) R&D personnel(10,000 person-years)	150.3	173.6	196.5	229.1	255.4	288.3
每万就业人员中R&D人员(人年) R&D personnel per 10,000 total employment (person-year)	20.04	23.05	26.01	30.22	33.56	35.28

National R&D Personnel (2006-2011)

In 2013, patent licenses by SIPO reached 0.59 million cases, increased of 24% compared to 2012.



Patent applications field and patents granted by SIPO

From 2003 to Sept. 2013, Chinese scholars have published International scientific papers 114.3 Million, ranked 2nd in the world, cited 7.0988 Million times, ranked 5th in the world.

	2006	2007	2008	2009	2010	2011
科学引文索引 SCI	7.1	8.9	9.6	10.9	12.2	14.4
工程索引 EI	6.5	7.6	8.9	9.3	11.2	12.4
科学会议录引文索引 CPCI-S	3.6	4.3	6.5	5.2	3.8	5.2

万高 10,000 papers

Chinese S&T papers indexed by SCI, EI and CPCI-S (2006-2011)

In 2012, The Gross industrial output of high-tech industry is 10228.4 billion Yuan.

亿元 100 million yuan

	2007	2008	2009	2010	2011
总产值 Gross industrial output	50461	57087	60430	74709	88434
主营业务收入 Revenue from principal business	49714	55729	59567	74483	87527
利润 Profits	2396	2725	3279	4880	5245
利税 Taxes and profits	3353	4024	4660	6753	7814
出口交货值 Export	28423	31504	29500	37002	40600

Main economic indicators of high-tech industry in total

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#### Decision-Making and Stakeholders



#### Ministry of Science and Technology



#### 14 Departments and Offices

25Affiliated Agencies and 1 Newspaper Office (Science & Technology Daily)

Administrative Office, CPC Committee of MOST

Department of Policy, Regulations and Reform (Office for Building Innovation System) Department of Development Planning, Major Special Project Office Department of Facilities and Financial Support, Department of Basic Research Department of High and New Technology Development and Industrialization Department of Rural Science and Technology, Department of Social Development Department of International Cooperation (Office of Hong Kong, Macao & Taiwan Affairs) Department of Personnel, Bureau of Retired Staff, Bureau of Supervision

#### Missions of the Ministry of Science and Technology

- Takes the lead in drawing up S&T development plans and policies, drafting related laws, regulations, department rules, National S&T Programs.
- Compiles and implements plans on national laboratories, innovative bases, national S&T programs, and research conditions so as to promote infrastructure construction and resource sharing.
- Formulates and supervises S&T plans, and guides the national high-tech industrial development zones.
- Draws up policies and measures on enhancing rural and social progress with S&T to improve the livelihood of the people.
- Promote application and demonstration of scientific discovery and technological invention, and improve innovation capacity of enterprises.
- Budgeting, final accounting, and supervising of S&T funds.
- Appraise the National S&T Award, drawing plans on S&T talents team-building and making proposals.
- Drafts plans and policies on science popularization, technology market and S&T intermediaries.
- Draws up policies on bilateral and multilateral S&T cooperation and exchange, guiding relevant departments and local governments in international interaction, appointing and supervising S&T diplomats, and facilitating aid to and from China.

#### R&D forces in China

- Enterprises
  - State owned Enterprises
  - high-tech private enterprises (e.g. Lenovo, Huawei, ZTE, etc.)
  - technology-based SMEs
- Independent Research Institutes
  - ▶ Central govt.
  - Chinese Academy of Sciences (National team)
  - Research Institutes affiliated to Ministries, Bureaus, etc. (mainly focused on research for public interests/goods)

**Enterprises** 

Institutes Universities

- ► <u>Local Govt.</u>
- Research Universities (Project 211 and Project 985)
  - ➢ Ministry of Education
  - Local Govt.

- Outline of National Medium and Long-term S&T Development Program (2006-2020)
  - Priorities (11) and topics (68)





2. Water and mineral resources

- 3. Environment
- 4. Agriculture





5. Manufacturing



- Outline of National Medium and Long-term S&T Development Program (2006-2020)
  - Priorities (11) and topics (68)
    - 6. Transportation





- 7. Information industry and modern service industry
- 8. Population and health



9. Urbanization and city development

10. Public security







11. National defense

- Outline of National Medium and Long-term S&T Development Program (2006-2020)
  - Frontier technologies research(8 areas, 27 topics)
    - ➢ <u>Biotechnology</u>
    - Information technology
    - New material technology
    - Advanced manufacturing technology
    - Advanced energy technology
    - Marine technology
    - Laser technology
    - Space and aviation technology
  - <u>Basic Research (18 topics)</u>
    - Frontier research issues
    - Basic research to meet national strategic needs

- Outline of National Medium and Long-term S&T Development Program (2006-2020)
  - Matching Policy Package ("60 Theses")
    - Increase govt. R&D investment
    - ➤ <u>Tax incentive</u>
    - Supports from financial sector
    - Public procurement
    - Imports, digestion, absorption and re-innovation
    - Create and protect IPRs
    - Human resource development
    - Education and promote public understanding of science, Innovation base and platform
    - Planning and coordination

#### National 12th Five-Year Plan on Sci & Tech Development

 <u>Targets of the 12th five-year plan on scientific and technological</u> <u>development</u>

Targets	2010	2015	
R&D expenditure as percentage of GDP	1.75%	2.20%	
R&D personnel per 10,000 workers	33/man-year	43/man-year	
Ranking of citations in international science papers	8th	5th	
Invention patent ownership per 10,000 persons	1.7 pieces	3.3 pieces	
R&D personnel's invention patent	10 pieces/hundred man-	12 pieces/hundred	
applications	years	man-years	
Total contract deals in domestic technology market	RMB 390.6 billion yuan	RMB 800 billion yuan	
High-tech value added as percentage of manufacturing sector value added	13%	18%	
Percentage of civic scientific literacy in the population	3.27%	5%	



#### National R&D Programs





•Core electronic devices, high-end general chips and fundamental software



•Mega-scale integrated circuit manufacturing technologies



•Next generation of broadband wireless mobile networks



•Advanced digital control machines and fundamental manufacturing equipments



•Large-scale development of oil & gas fields and coal-bed gas





•Large-scale advanced •Waste water pressurized water control and reactor and high treatment temperature gas-cooled nuclear power plants



•Breeding of new variety for transgenic biology



•Key new drug innovation



•Prevention and treatment of key infectious diseases (e.g. HIV/AIDS, hepatitis)



•Mega-airplanes

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•High-resolution earth observation system



•Manned space flight and lunar exploration

- National Basic Research Program(973)-basic research with national goals:
  - ▶ 9 key areas
    - agriculture science
    - <u>energy science</u>
    - <u>information science</u>
    - <u>resources</u>
    - <u>environmental science</u>
    - <u>health sciences</u>
    - *materials science*
    - manufacturing and engineering sciences
    - *integrated interdisciplinary science*
    - major scientific frontier research

- 6 key major scientific research programs:
  - <u>nanotechnology research</u>
  - <u>protein research</u>
  - quantum control research
  - <u>developmental and</u> <u>reproductive research</u>
  - <u>global change research</u>
  - <u>stem cell research</u>

- National High-tech R&D Program(863) :
  - ► Information
  - ➢ Bio and medical
  - ➢ New materials
  - Advanced manufacturing
  - ►<u>Advanced energy</u>
  - Resource and environment
  - ≻ <u>Marine</u>
  - Modern agriculture
  - Modern transportation
  - Earth observation and navigation

- National Key Technologies R&D Program( joint application: research entity plus enterprise, and matching funds from enterprises)
  - Energy
  - <u>Resources</u>
  - *Environment*
  - ►<u>Agriculture</u>
  - <u>Materials</u>
  - Manufacturing
  - > Transportation
  - Information industry and modern service industry
  - Population and health
  - Urbanization and urban development
  - Public safety and other social undertakings

- International S&T Cooperation Program :
  - Initiated in year 2001
  - Budget: from 27million to 1.3 billion yuan
  - Support joint research projects and joint research centers/labs
  - integration of project, talents and int'l cooperation bases
  - In line with national R&D priorities and show complementarities in <u>collaboration</u>
  - Open competition, (scientific/int'l collaboration) merit-based peer review
  - Sharing of R&D results, protect IPRs and respect international practices

- Talents Pool and young scientists exchange programs:
  - Recruitment for Global Expert (1000 talents plan)
  - Chang Jiang (Cheung Kong) Scholars Program and Chunhui Program, Ministry of Education
  - Hundred Talents Program, Chinese Academy of Sciences
  - State Administration of Foreign Experts
  - National Science Fund for Distinguished Young Scholar, NSFC
  - Young scientists exchange programs with US, Australia, New Zealand, etc., MOST
  - CAS Foreign Young Scholar Fellowship
    - (http://english.bic.cas.cn/AF/Fe/200906/t20090615\_6347.html)
  - NSFC Research Fellowship for International Young Scientists
    - (http://www.sibs.ac.cn/international/tal\_05.asp)

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 Useful Information

- Open Innovation Strategy
- Establish intergovernmental STI dialogues and cooperation mechanisms
- Create cooperation platforms, i.e. joint labs, joint R&D
   centers, international technology transfer centers, international innovation parks
- Actively participants in international organization and multilateral mechanisms as well as international mega-science projects and research programs
- Support international STI projects
- Support STI multilateral organizations in China

- Establish intergovernmental STI dialogues and cooperation mechanisms
  - Established S&T cooperation ties with 154 countries and regions
  - Signed 106 bilateral and multilateral S&T cooperation agreements
  - Established Joint S&T cooperation Commission with foreign counterparts
  - Innovation Dialogue and Cooperation with US, EU, Germany, France, UK, etc

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China-U.S. Joint Commission Meeting on S&T Cooperation, Beijing, 2012



China-EU Innovation Cooperation Dialogue, Beijing, 201

- Establish intergovernmental STI dialogues and cooperation mechanisms
  - <u>144 accredited diplomats of science and technology in 47</u> countries(regions and international organizations), 70 embassies and consulates



Countries (regions) and international organizations with S&T diplomats

#### Create cooperation platforms

- <u>21 international innovation parks</u>
- 93 joint R&D centers
- <u>26 international tech. transfer centers</u>
- <u>301international cooperation bases</u>



Website of China-Italy Technology Transfer Centre, 2012

China-Finland Nano Innovation Center, 2012

- China actively participants in international organization and multilateral mechanisms as well as international mega-science projects and research programs
  - International organization and multilateral mechanisms
     OUNCSTD, UNESCO, UNU, UNDP, UNEP, WIPO, APEC, ASEM, BRICS, OECD, IEA, CEM, CSLF, IPHE, TWAS, COMSATS, ICGEB, etc.
  - International mega-science projects and research programs



Large Hadron Collider, by CERN



Experimental Advanced Superconducting Tokamak



General Meeting of the Third World Academy of Sciences

#### Support STI multilateral organizations in China

 <u>UNESCO International Research and Training Center for</u> <u>Science and Technology Strategy in Beijing</u>



Launch ceremony of UNESCO International Research and Training Center

#### China-Africa S&T Partnership Program

- ≻Webpages:
  - http://www.cistc.gov.cn/China\_Africa/index.asp?column=697&column3=301
- ► Areas of focus :
  - Capabilities of Science and technology policy and management
  - <u>Ability to promote the technology industry development</u>
  - Ability to improve people's livelihood via S&T



China-Africa Science and Technology Cooperation Forum, Beijing, Dec. 2011

#### China-ASEAN S&T Partnership Program

➤ Key areas of cooperation:

 policy advice and technical services, S&T human resource development, collaborative research, S&T cooperation platform, China - ASEAN technology transfer networks



Launch ceremony of China-ASEAN S&T Partnership Program, Nanning, 20 Bharing of satellite data with ASEAN

- China Latin America Technology Innovation Forum
- <u>Recruitment of Asian and African young scientists for short-</u> term working experience in China
  - *Who can apply:* 
    - <u>From Asian and African countries (excluding Japan, Singapore, Israel, Central Asian countries)</u>
    - under 45 years old
    - with 5 years experience in scientific research, or holding a doctorate degree
    - fluent in English or Chinese

≻ Funding :

• <u>MOST will provide each selected young scientist with a grant of RMB12,500 yuan per</u> <u>month (6-12 months)</u>

 $\succ$  How to apply :

• Application via the receiving research institutes

➤ For more Information:

• <u>http://www.cistc.gov.cn/introduction/Notice\_4.asp?column=375&id=81627</u>

Cooperation with other developing countries

- Funding scientists exchange programs identified by the Intergovernmental Joint Commissions of China and the developing countries.
- Equipment donation to researchers from developing countries
   For more information:
  - <u>http://www.cistc.gov.cn/China\_Africa/info.asp?column=699&id=72132</u>



Equipment donation

Implementation of Scientific and Technical Aid projects

Joint laboratory (Joint Research Center)

<u>Agricultural S&T parks.</u>

Joint S&T research and demonstration

Research on S&T policy and science park planning

Cooperation network for regional S&T integration

#### Implementation of Scientific and Technical Aid projects



China-Cambodia food industry lab (Phnom Penh, 2012)



China-ASEAN Technology Transfer Center (Nanning, 2013)



Thailand 1.2MW Rice husk gasification power plant,by GIEC, CA\$<sup>3</sup>



Tanganyika lake ecological environment monitoring and resource protection, by NIGLAS,CAS & UNEP,2008



Launching of China - Mongolia Natural focus of infection joint research lab,Ulan Bator,by CAIQ, AQSIQ,

#### International Training Program

> ITP of MOST started in1989, during 2001 to 2013, MOST sponsored :

- about 420 international technological workshops
- with nearly 8500 participants for courses on management and <u>technology</u>
- from more than 120 developing countries



11.5% of participants from Latin America and other continents

#### International Training Program

- ➤ 3 main categories of training workshops
  - Mature and applicable technologies
  - <u>High technologies</u>
  - <u>Science and technology policy and management</u>
- ► Fields:
  - <u>Agriculture and forestry, resources, environment, new and</u> <u>renewable energies, information, manufacturing, health care,</u> <u>science and technology policy and management</u>



Statistics of training workshops in accordance with the technical fields (2008-2013, 210 in

total)





Breeding techniques and rainwater harvesting

Satellite applications and medical device manufacturing





S&T park planning and technology transfer

#### International Training Program

- *▶ How to Apply:* 
  - Program guidance published on the web site of CISTC early in the year.
  - Applicants need to contact the organizors
  - <u>http://www.cistc.gov.cn/Training/English/details.asp?column=877&id=83</u> 588
- *For more information:* 
  - <u>http://www.cistc.gov.cn/Training/English/</u>





- Participants Apply
  - https://168.160.11.33/student\_ login.aspx
- News and Highlight Events
  <u>http://www.cistc.gov.cn/Tr</u> <u>aining/English/</u>



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Useful Information

#### **China-Thailand S&T Cooperation**

- Bilateral ST& agreement signed in 1978
- Joint Committee Meeting held every two years between Thailand Ministry of Foreign Affairs and Chinese Ministry of Science and Technology
  - 20 Joint Committee Meetings held in the past 35 years
  - 859 Joint R&D projects and Study Visit Projects covers agriculture, forestry, mechanics, electronic, biology, remote sensing, chemical industry, mineral resource, astronomy, meteorology, seismology, metrology, water resource, new energy, traditional medicine, satellite communications, textile, S&R management, urban planning, wildlife conservation, etc
- 4 MOUs signed between Chinese Ministry of Science and Technology and Thailand Ministry of Science and Technology in 2013
  - 1st Joint Committee Meeting held in march 2014
  - 4 priories: High-speed railway Joint Research Center, Remote Sensing Satellite Data Sharing and Service Platform, Thailand-China Technology Transfer Cooperation, Talented Young Scientist Visiting Program
- Other mechanisms: agriculture, marine, astronomy, CAS-MOST, NRCT, etc

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✓ <u>Other Information</u>

### Other Information

- Ministry of Science and Technology
  - http://www.most.gov.cn/
- International Science and Technology Cooperation in China
  - http://www.cistc.gov.cn/
- China Science and Technology Newsletter
  - <u>http://www.cistc.gov.cn/englishversion/newsletters.asp?column=123</u>
- International Technology Training Program for developing countries (ITP)
  - <u>http://www.cistc.gov.cn/Training/English/</u>
- China Science and Technology Exchange Center
  - http://www.cstec.org.cn

# Thank You

